

**Date and Time:** Monday 9 September 2024 17:03:00 CEST

**Job Number:** 233030105

**Documents (100)**

1. [*Register of Commission documents: Written answer : Holding Member States accountable for meeting Farm to Fork Strategy targets P9\_RE(2020)003396 / FULL / EN04/08/2020*](https://advance.lexis.com/api/document?id=urn:contentItem:60RR-7JC1-F0YC-N3NS-00000-00&idtype=PID&context=1516831)

**Client/Matter:** -None-

**Search Terms:** statistics and data or statistics and eurostat or statistics and nutrients or statistics and collections or data and eurostat or data and nutrients or data and collections or eurostat and nutrients or eurostat and collections or nutrients and collections

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2. [*Agency Information Collection Activities; Proposals, Submissions, and Approvals (ID: USDA\_FRDOC\_0001-2173)*](https://advance.lexis.com/api/document?id=urn:contentItem:5Y7X-WMM1-F0YC-N408-00000-00&idtype=PID&context=1516831)

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3. [*Register of Commission documents:Written answer : Statistics on horses Document date: 2020-02-04 P9\_RE(2019)003538 Answers to written questions*](https://advance.lexis.com/api/document?id=urn:contentItem:5Y4Y-T661-F0YC-N3FK-00000-00&idtype=PID&context=1516831)

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4. [*Council of the European Union:REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the implementation of Regulation (EU) No 691/2011 on European environmental economic accounts PDF document ST 6102 2020 INIT17-02-2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5Y7X-WMV1-F0YC-N048-00000-00&idtype=PID&context=1516831)

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5. [*Federal Register: Submission for OMB Review; Comment Request Pages - 19423 [FR DOC #2020-07220]*](https://advance.lexis.com/api/document?id=urn:contentItem:5YM5-NWC1-F0YC-N4VD-00000-00&idtype=PID&context=1516831)

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6. [*No upturn in sales of fertilisers despite increased crop production*](https://advance.lexis.com/api/document?id=urn:contentItem:5YVF-50Y1-JDG9-Y219-00000-00&idtype=PID&context=1516831)

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7. [*API – Index of the purchase prices of the means of agricultural production – statistics notice (data to May 2020) accessible format*](https://advance.lexis.com/api/document?id=urn:contentItem:60FV-NTJ1-F0YC-N1NY-00000-00&idtype=PID&context=1516831)

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8. [*Monthly UK statistics on cattle, sheep and pig slaughter and meat production– statistics notice (data to June 2020)*](https://advance.lexis.com/api/document?id=urn:contentItem:60FV-NTJ1-F0YC-N1PH-00000-00&idtype=PID&context=1516831)

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9. [*Statistics Finland : Corona situation review of 15 May 2020: effects of the exceptional situation are reflected in the figures for the economy in March*](https://advance.lexis.com/api/document?id=urn:contentItem:5YY0-VBF1-JDG9-Y1W7-00000-00&idtype=PID&context=1516831)

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10. [*The association between carbohydrate quality and nutrient adequacy in Australian adults*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2C1-JCWX-C1J6-00000-00&idtype=PID&context=1516831)

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11. [*Register of Commission documents: Report from the Commission to the European Parliament and the Council on the implementation of Regulation (EU) No 691/2011 on European environmental economic accounts Document date: 2020-02-17 COM\_COM(2020)0056 COM documents*](https://advance.lexis.com/api/document?id=urn:contentItem:5Y7P-VP61-JDG9-Y3R3-00000-00&idtype=PID&context=1516831)

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12. [*UNO Official Document System (ODS): IMPLEMENTATION OF THE UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE STATISTICAL PROGRAMME 2020 - ADDENDUM - REPORT OF THE JOINT ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT / UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE SEMINAR ON THE IMPLEMENTA*](https://advance.lexis.com/api/document?id=urn:contentItem:601P-88J1-F0YC-N1X0-00000-00&idtype=PID&context=1516831)

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13. [*Register of Commission documents: DRAFT OPINION on Impacts of EU rules on the free movements of workers and services: intra-EU labour mobility as a tool to match labour market needs and skills AGRI\_PA(2020)648630 / FULL / EN01/04/2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5YKS-KN91-F0YC-N4FB-00000-00&idtype=PID&context=1516831)

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14. [*What constitutes healthiness of Washoku or Japanese diet?*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2C1-JCWX-C1YJ-00000-00&idtype=PID&context=1516831)

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15. [*Register of Commission documents: Annex to the communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A Farm to Fork Strategy For a fair, healthy and environmentally-friendly food system COM\_COM(2020)0381 / ANN01 / EN20/05/2020*](https://advance.lexis.com/api/document?id=urn:contentItem:6002-RCN1-JDG9-Y4GK-00000-00&idtype=PID&context=1516831)

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16. [*Association Between Nutrient Patterns and Hypertension Among Adults in the United States : A Population-Based Survey*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2V1-F0C0-314P-00000-00&idtype=PID&context=1516831)

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17. [*Register of Commission documents:Digital culture − Access issues EPRS\_BRI(2020)651942 / FULL / EN04/06/2020*](https://advance.lexis.com/api/document?id=urn:contentItem:6037-DMT1-JDG9-Y19K-00000-00&idtype=PID&context=1516831)

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18. [*Cover Crops, Sensors, and Food Security*](https://advance.lexis.com/api/document?id=urn:contentItem:61VV-NT61-JDG9-Y45V-00000-00&idtype=PID&context=1516831)

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19. [*Sustainability analysis of French dietary guidelines using multiple criteria*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2M1-JCWX-C25X-00000-00&idtype=PID&context=1516831)

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20. [*ExpoKids: An R-based tool for characterizing aggregate chemical exposure during childhood*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2N1-F0C0-3510-00000-00&idtype=PID&context=1516831)

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21. [*Impact of Broadband Penetration on U.S Farm Productivity*](https://advance.lexis.com/api/document?id=urn:contentItem:61J4-7FB1-JDG9-Y00P-00000-00&idtype=PID&context=1516831)

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22. [*Environmental Accounts – Emissions to air Q4 2019: Greenhouse gas emissions intensity for Sweden ’s economy decreased in 2019*](https://advance.lexis.com/api/document?id=urn:contentItem:5YX2-8JM1-F0YC-N211-00000-00&idtype=PID&context=1516831)

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23. [*Western Kenyan Anopheles gambiae showing intense permethrin resistance harbour distinct microbiota*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H841-F129-P27D-00000-00&idtype=PID&context=1516831)

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24. [*Woody litter protects peat carbon stocks during drought*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2B1-JCWX-C2C1-00000-00&idtype=PID&context=1516831)

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25. [*Council of the European Union: COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A new Circular Economy Action Plan "For a cleaner and more competitive Europe" PDF document ST 6766 2020 INIT11-03-2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5YDF-TJP1-JDG9-Y15M-00000-00&idtype=PID&context=1516831)

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26. [*Discrepancy between perceived diet quality and actual diet quality among US adult cancer survivors*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2C1-JCWX-C1J5-00000-00&idtype=PID&context=1516831)

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27. [*The Food Systems Dashboard is a new tool to inform better food policy*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H841-F129-P4KG-00000-00&idtype=PID&context=1516831)

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28. [*dpa WEEKLY PLANNER for OCTOBER 19-25, 2020*](https://advance.lexis.com/api/document?id=urn:contentItem:613H-PCK1-JB0G-F4XD-00000-00&idtype=PID&context=1516831)

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29. [*Request for Information and Comments on Consumption of Certain Uncommon Produce Commodities in the United States ; Establishment of a Public Docket*](https://advance.lexis.com/api/document?id=urn:contentItem:60KR-6FC1-F0YC-N4B4-00000-00&idtype=PID&context=1516831)

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30. [*NEWS BULLETIN NO. 11077*](https://advance.lexis.com/api/document?id=urn:contentItem:5Y87-76V1-JDKJ-13WP-00000-00&idtype=PID&context=1516831)

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31. [*UK Intellectual Property Office grants trade mark " Working Dog Food Co. " to Jordan Szyndra*](https://advance.lexis.com/api/document?id=urn:contentItem:6073-8Y21-F0YC-N3CN-00000-00&idtype=PID&context=1516831)

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32. [*Uniting remote sensing, crop modelling and economics for agricultural risk management*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H851-F129-P0CV-00000-00&idtype=PID&context=1516831)

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33. [*A longitudinal association between the traditional Japanese diet score and incidence and mortality of breast cancer—an ecological study*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2C1-JCWX-C1V9-00000-00&idtype=PID&context=1516831)

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34. [*High adherence to a mediterranean diet at age 4 reduces overweight, obesity and abdominal obesity incidence in children at the age of 8*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2N1-F0C0-33W1-00000-00&idtype=PID&context=1516831)

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35. [*Significant stream chemistry response to temperature variations in a high-elevation mountain watershed*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2K1-JCWX-C0J3-00000-00&idtype=PID&context=1516831)

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36. [*Review panel appointed as Overseer improvements continue*](https://advance.lexis.com/api/document?id=urn:contentItem:5YDD-9G31-F0YC-N4S3-00000-00&idtype=PID&context=1516831)

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| News | Timeline: 02 feb 2020 tot 02 feb 2021; Locatie: International; Plaats van publicatie: Europe; Taal: English |

37. [*The association of skipping breakfast with cancer-related and all-cause mortality in a national cohort of United States adults*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H7S1-JDK8-01CS-00000-00&idtype=PID&context=1516831)

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| News | Timeline: 02 feb 2020 tot 02 feb 2021; Locatie: International; Plaats van publicatie: Europe; Taal: English |

38. [*Forecasting the red lentils commodity market price using SARIMA models*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2K1-JCWX-C1B2-00000-00&idtype=PID&context=1516831)

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39. [*Covid-19 Demands Innovative Ideas for Financing the SDGs*](https://advance.lexis.com/api/document?id=urn:contentItem:5YVS-SHV1-JDG9-Y0W3-00000-00&idtype=PID&context=1516831)

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40. [*Dietary patterns are associated with obesity in Mexican schoolchildren*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2C1-JCWX-C1HD-00000-00&idtype=PID&context=1516831)

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41. [*Executive summary for the final impact assessment of the UK-Japan Comprehensive Economic Partnership (CEPA)*](https://advance.lexis.com/api/document?id=urn:contentItem:6157-1B21-JDG9-Y3TR-00000-00&idtype=PID&context=1516831)

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42. [*Association between the 10-year predicted risk of atherosclerotic cardiovascular disease and dietary patterns among Canadian adults 40–79 years*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2C1-JCWX-C1R9-00000-00&idtype=PID&context=1516831)

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43. [*Federal Register: National Primary Drinking Water Regulations: Lead and Copper Rule Revisions Pages 4198 - 4312 [FR DOC #2020-28691]*](https://advance.lexis.com/api/document?id=urn:contentItem:61SY-21B1-JDG9-Y0X7-00000-00&idtype=PID&context=1516831)

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44. [*Identification of bacterial endospores and targeted detection of foodborne viruses in industrially reared insects for food*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H841-F129-P4D4-00000-00&idtype=PID&context=1516831)

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45. [*UK inflation rises to 0.6%; London average house price exceeds £500,000 – business live*](https://advance.lexis.com/api/document?id=urn:contentItem:61TC-9RS1-DY4H-K1KK-00000-00&idtype=PID&context=1516831)

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46. [*We need reliable statistics on forestry*](https://advance.lexis.com/api/document?id=urn:contentItem:61HF-JP21-DYS1-00J2-00000-00&idtype=PID&context=1516831)

**Client/Matter:** -None-

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47. [*Why has Japan become the world’s most long-lived country: insights from a food and nutrition perspective*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2C1-JCWX-C1M7-00000-00&idtype=PID&context=1516831)

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48. [*Oviposition of Aedes japonicus japonicus (Diptera: Culicidae) and associated native species in relation to season, temperature and land use in western Germany*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H7S1-F129-P35X-00000-00&idtype=PID&context=1516831)

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49. [*Decoupling livestock and crop production at the household level in China*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2M1-JCWX-C29H-00000-00&idtype=PID&context=1516831)

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50. [*TOPIC PAGE: Construction - impact on chemicals*](https://advance.lexis.com/api/document?id=urn:contentItem:60CG-4SM1-JCN4-H1Y8-00000-00&idtype=PID&context=1516831)

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51. [*UK Intellectual Property Office grants trade mark "FoodArt Direct" to EMRAH SAHBAZ*](https://advance.lexis.com/api/document?id=urn:contentItem:5YXS-CHK1-F0YC-N006-00000-00&idtype=PID&context=1516831)

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| News | Timeline: 02 feb 2020 tot 02 feb 2021; Locatie: International; Plaats van publicatie: Europe; Taal: English |

52. [*HUMAN RIGHTS COUNCIL HOLDS DIALOGUE ON THE RIGHTS OF PERSONS WITH ALBINISM AND BEGINS DIALOGUE ON THE RIGHT TO FOOD*](https://advance.lexis.com/api/document?id=urn:contentItem:5YC5-6D61-F0YC-N4BY-00000-00&idtype=PID&context=1516831)

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53. [*Federal Register: Establishment of a Domestic Hemp Production Program Pages 5596 - 5691 [FR DOC #2021-00967]*](https://advance.lexis.com/api/document?id=urn:contentItem:61TB-W411-F0YC-N3D2-00000-00&idtype=PID&context=1516831)

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| News | Timeline: 02 feb 2020 tot 02 feb 2021; Locatie: International; Plaats van publicatie: Europe; Taal: English |

54. [*Council of the European Union: COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A Union of Equality: Gender Equality Strategy 2020-2025 PDF document ST 6678 2020 INIT09-03-2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5YD8-5JY1-JDG9-Y4T3-00000-00&idtype=PID&context=1516831)

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55. [*Association Between Fasting Blood Glucose and All-Cause Mortality in a Rural Chinese Population: 15-Year Follow-Up Cohort Study*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P311-F0C0-33FS-00000-00&idtype=PID&context=1516831)

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56. [*The association of fluoride in drinking water with serum calcium, vitamin D and parathyroid hormone in pregnant women and newborn infants*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2C1-JCWX-C1N9-00000-00&idtype=PID&context=1516831)

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57. [*A global perspective on sustainable intensification research*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2M1-JCWX-C26B-00000-00&idtype=PID&context=1516831)

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58. [*Quantifying flight aptitude variation in wild Anopheles gambiae in order to identify long-distance migrants*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H841-F129-P1WR-00000-00&idtype=PID&context=1516831)

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59. [*Council of the European Union: Draft Joint Conclusions of the Economic and Financial Dialogue between the EU and the Western Balkans and Turkey PDF document ST 7853 2020 INIT08-05-2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5YW6-N4P1-F0YC-N1JR-00000-00&idtype=PID&context=1516831)

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60. [*Adjusting GDP for ecological deficit: the Index of Debt to the Future (IDF)*](https://advance.lexis.com/api/document?id=urn:contentItem:673K-JYX1-JCWX-C4SS-00000-00&idtype=PID&context=1516831)

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61. [*Sugar-sweetened beverages increases the risk of hypertension among children and adolescence: a systematic review and dose–response meta-analysis*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H821-F129-P1M4-00000-00&idtype=PID&context=1516831)

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62. [*Hungary Consumer Outlook*](https://advance.lexis.com/api/document?id=urn:contentItem:614G-6GN1-JD33-J0VD-00000-00&idtype=PID&context=1516831)

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63. [*NEWS BULLETIN NO. 11357*](https://advance.lexis.com/api/document?id=urn:contentItem:61CY-3MW1-F12K-R1T5-00000-00&idtype=PID&context=1516831)

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64. [*Global maps of twenty-first century forest carbon fluxes*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2B1-JCWX-C2NX-00000-00&idtype=PID&context=1516831)

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65. [*TOPIC PAGE: Construction - impact on chemicals*](https://advance.lexis.com/api/document?id=urn:contentItem:60N5-3BY1-JCN4-H0M0-00000-00&idtype=PID&context=1516831)

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66. [*NEWS BULLETIN NO. 11306*](https://advance.lexis.com/api/document?id=urn:contentItem:6112-FBC1-JDKJ-10V9-00000-00&idtype=PID&context=1516831)

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67. [*Chinese whispers: COVID-19, global supply chains in essential goods, and public policy*](https://advance.lexis.com/api/document?id=urn:contentItem:67FK-J9R1-JCWX-C3FR-00000-00&idtype=PID&context=1516831)

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68. [*Is carbon sequestration on farms actually working to fight climate change?*](https://advance.lexis.com/api/document?id=urn:contentItem:5YP2-Y7D1-JDG9-Y0J1-00000-00&idtype=PID&context=1516831)

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69. [*Federal Register: National Organic Program; Proposed Amendments to the National List of Allowed and Prohibited Substances per April 2019 NOSB Recommendations (Livestock and Handling) Pages 34651 - 34655 [FR DOC #2020-11840]*](https://advance.lexis.com/api/document?id=urn:contentItem:603C-NCP1-JDG9-Y0JV-00000-00&idtype=PID&context=1516831)

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70. [*Blue bioeconomy localities at the margins: Reconnecting Norwegian seaweed farming and Finnish small-scale lake fisheries with blue policies*](https://advance.lexis.com/api/document?id=urn:contentItem:6BGY-HK51-JBMY-H420-00000-00&idtype=PID&context=1516831)

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71. [*Nitrogen emissions along global livestock supply chains*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H841-F129-P4CW-00000-00&idtype=PID&context=1516831)

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72. [*Bank of England not ruling out negative interest rates as inflation drops to 0.8% - as it happened Rolling coverage of the latest economic and financial news, as UK central bank tells MPs it is keeping its 'lower bound' under reviewLatest: BoE governor Andrew Bailey says tools are under reviewInvestors pay to lend to BritainUK annual inflation almost halved last monthCoronavirus - latest updatesSee all our coronavirus coverage*](https://advance.lexis.com/api/document?id=urn:contentItem:5YY4-98X1-JCJY-G476-00000-00&idtype=PID&context=1516831)

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73. [*NEWS BULLETIN NO. 11120*](https://advance.lexis.com/api/document?id=urn:contentItem:5YR7-9WD1-F12K-R0YC-00000-00&idtype=PID&context=1516831)

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74. [*Agroecology, Information and Communications Technology, and Smallholders’ Food Security in Sub-Saharan Africa*](https://advance.lexis.com/api/document?id=urn:contentItem:6BH2-VXY1-JBMY-H498-00000-00&idtype=PID&context=1516831)

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75. [*A scoping review of interventions for crop postharvest loss reduction in sub-Saharan Africa and South Asia*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2M1-JCWX-C2BF-00000-00&idtype=PID&context=1516831)

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76. [*Council of the European Union: REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS AND THE EUROPEAN INVESTMENT BANK on the implementation of the Commission Communication on a stronger and renewed strategic partnership with the EU's outermost regions PDF documentST 7091 2020 INIT31-03-2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5YK3-JHF1-F0YC-N1F0-00000-00&idtype=PID&context=1516831)

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77. [*What’s the talk in Brussels? Leveraging daily news coverage to measure issue attention in the European Union*](https://advance.lexis.com/api/document?id=urn:contentItem:6123-8R91-JBMY-H50V-00000-00&idtype=PID&context=1516831)

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78. [*Register of Commission documents:Framework for National Roma Integration Strategies up to 2020: European Implementation Assessment EPRS\_STU(2020)642827 / FULL / EN23/04/2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5YSM-59R1-JDG9-Y2X7-00000-00&idtype=PID&context=1516831)

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79. [*Flagellin of Bacillus amyloliquefaciens works as a resistance inducer against groundnut bud necrosis virus in chilli (Capsicum annuum L.)*](https://advance.lexis.com/api/document?id=urn:contentItem:693N-XPG1-JDK8-021G-00000-00&idtype=PID&context=1516831)

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80. [*Industrial dynamics in the context of a region’s international competitiveness*](https://advance.lexis.com/api/document?id=urn:contentItem:6BNK-C111-DY41-73V4-00000-00&idtype=PID&context=1516831)

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81. [*Genome-Wide Identification of Copper Stress-Regulated and Novel MicroRNAs in Mulberry Leaf*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H7S1-JDK8-000P-00000-00&idtype=PID&context=1516831)

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82. [*Public sector organizations and agricultural catch-up dilemma in emerging markets: The orchestrating role of Embrapa in Brazil*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2V1-F0C0-33S6-00000-00&idtype=PID&context=1516831)

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83. [*UK Intellectual Property Office grants trade mark "TOKYO 2021" to Comité International Olympique*](https://advance.lexis.com/api/document?id=urn:contentItem:61DR-DM11-F0YC-N1PJ-00000-00&idtype=PID&context=1516831)

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84. [*Crop cover is more important than rotational diversity for soil multifunctionality and cereal yields in European cropping systems*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H841-F129-P4HB-00000-00&idtype=PID&context=1516831)

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85. [*Being different matters! A closer look into product differentiation in specialty coffee family farms in Central America*](https://advance.lexis.com/api/document?id=urn:contentItem:6084-J4H1-JBN9-R0KV-00000-00&idtype=PID&context=1516831)

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86. [*TOPIC PAGE: Construction - impact on chemicals*](https://advance.lexis.com/api/document?id=urn:contentItem:614K-7YW1-F046-717T-00000-00&idtype=PID&context=1516831)

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87. [*Council of the European Union: JOINT STAFF WORKING DOCUMENT The EU Special Incentive Arrangement for Sustainable Development and Good Governance ('GSP+') assessment of Armenia covering the period 2018 - 2019 Accompanying the document Joint Report to the European Parliament and the Council Report on the Generalised Scheme of Preferences covering the period 2018-2019 PDF document ST 5949 2020 ADD 211-02-2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5Y6F-P9W1-F0YC-N24P-00000-00&idtype=PID&context=1516831)

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88. [*TOPIC PAGE: Construction - impact on chemicals*](https://advance.lexis.com/api/document?id=urn:contentItem:61CV-DS01-JCN4-H2D1-00000-00&idtype=PID&context=1516831)

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89. [*Inland fish and fisheries integral to achieving the Sustainable Development Goals*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2M1-JCWX-C26P-00000-00&idtype=PID&context=1516831)

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90. [*NEWS BULLETIN NO. 11084*](https://advance.lexis.com/api/document?id=urn:contentItem:5Y9V-2421-F12K-R4D3-00000-00&idtype=PID&context=1516831)

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91. [*NEWS BULLETIN NO. 11342*](https://advance.lexis.com/api/document?id=urn:contentItem:618R-FNS1-F12K-R32D-00000-00&idtype=PID&context=1516831)

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92. [*NEWS BULLETIN NO. 11368*](https://advance.lexis.com/api/document?id=urn:contentItem:61G8-T6F1-JDKJ-11T6-00000-00&idtype=PID&context=1516831)

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93. [*Influence of land tenure interventions on human well-being and environmental outcomes*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2M1-JCWX-C2CC-00000-00&idtype=PID&context=1516831)

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94. [*NEWS BULLETIN NO. 11116*](https://advance.lexis.com/api/document?id=urn:contentItem:5YJH-YWX1-F12K-R0KP-00000-00&idtype=PID&context=1516831)

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95. [*European Court of Human Rights Judgment: HUDOROVIC AND OTHERS v. SLOVENIA - 24816/14 (Judgment : Preliminary objection joined to merits : Second Section) [2020] ECHR 211 (10 March 2020)*](https://advance.lexis.com/api/document?id=urn:contentItem:5YF8-R5G1-F0YC-N3RM-00000-00&idtype=PID&context=1516831)

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96. [*NEWS BULLETIN NO. 11175*](https://advance.lexis.com/api/document?id=urn:contentItem:6017-WRG1-F12K-R39S-00000-00&idtype=PID&context=1516831)

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97. [*Register of Commission documents: REPORT on competition policy – annual report 2019 P9\_A(2020)0022 / FULL / EN26/02/2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5YB9-KY41-JDG9-Y05C-00000-00&idtype=PID&context=1516831)

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98. [*Council of the European Union: ADDENDUM TO THE COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS concerning the European Union Strategy for the Adriatic and Ionian Region PDF document ST 7363 2020 INIT16-04-2020*](https://advance.lexis.com/api/document?id=urn:contentItem:5YPB-55D1-F0YC-N15G-00000-00&idtype=PID&context=1516831)

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| News | Timeline: 02 feb 2020 tot 02 feb 2021; Locatie: International; Plaats van publicatie: Europe; Taal: English |

99. [*POLITICAS DE CIENCIA, TECNOLOGIA E INNOVACION HACIA ATRAS, HACIA ADELANTE Y MAS ALLA: RETOS Y OPORTUNIDADES DE DESARROLLO PARA IBEROAMERICA EN LA ERA DE COVID-19.*](https://advance.lexis.com/api/document?id=urn:contentItem:6360-HF41-DYTM-91TW-00000-00&idtype=PID&context=1516831)

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100. [*Food production in China requires intensified measures to be consistent with national and provincial environmental boundaries*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H841-F129-P4DY-00000-00&idtype=PID&context=1516831)

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# [***Register of Commission documents: Written answer : Holding Member States accountable for meeting Farm to Fork Strategy targets P9\_RE(2020)003396 / FULL / EN04/08/2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60RR-7JC1-F0YC-N3NS-00000-00&context=1516831)

Impact News Service

September 2, 2020 Wednesday

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**Length:** 469 words

**Body**

Brussels: Public Register European Parliament has issued the following document:

(English version)Question for written answer E-003396/20to the CommissionMick Wallace (GUE/NGL)(5 June 2020)Subject: Holding Member States accountable for meeting Farm to Fork Strategy targetsExperience with the current common ***agricultural*** policy (CAP) shows that Member States have large ***data*** gaps for assessing impacts on the environment, namely on water quality, soil organic matter and farmland. In some Member States, basic ***statistics*** are missing (e.g ***nutrient*** loss, antimicrobial sales).Will the Commission ensure that the CAP Strategic Plans are approved on the condition that updated baselines and monitoring systems are set up, including at regional level?How will the Commission ensure that the most up-to-date and robust baselines are used?Answer given by Mr Wojciechowski on behalf of the European Commission(4 August 2020)The Commission’s proposal for the common ***agricultural*** policy (CAP) Strategic Plan Regulation (1) requires Member States to draft their Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis based on up-to-date information (2) and a set of context indicators established in its Annex I, including for environment, climate and societal objectives.The proposal also includes provisions to make sure that Member States provide the Commission with the necessary information for CAP monitoring and evaluation (3). Finally, it specifies the conditions for approving the CAP Strategic Plans (4).The Commission is aware of ***data*** gaps for assessing the impact of the CAP on the environment and health, and is working to fill them in various ways. A new regulation for ***statistics*** on ***agricultural*** inputs and outputs is planned, with the aim to improving ***data*** ***collection***, including for Gross ***Nutrient*** Balances and the sales and use of plant protection products. ***Data*** on soil organic matter will again be ***collected*** through the Land Use and Cover Area frame Survey (LUCAS) (5) in 2022.From 2022, Member States will be required to deliver detailed ***data*** on sales and use of antimicrobials. Information on farmland is being updated in the ***agricultural*** census 2020. Indicators availability depends largely on the cooperation of Member States in developing the necessary legal basis and in ***collecting*** the ***data***. The Commission regularly updates the CAP indicators and makes these updates available to Member States.⋅1∙Proposal for a regulation of the European Parliament and of the Council establishing rules on support for strategic plans to be drawn up by Member States under the Common ***agricultural*** policy (CAP Strategic Plans), COM(2018) 392 final.⋅2∙Article 103.2⋅3∙Article 129⋅4∙Article 106⋅5∙[*https://ec.europa.eu/****eurostat****/****statistics****-explained/index.php/LUCAS\_-\_Land\_use\_and\_land\_cover\_survey*](https://ec.europa.eu/eurostat/statistics-explained/index.php/LUCAS_-_Land_use_and_land_cover_survey) ((((()) ) ) )

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February 19, 2020 Wednesday

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**Body**

Washington, DC: This Notice document was issued by the Department of ***Agriculture*** (USDA)

The Department of ***Agriculture*** will submit the following information ***collection*** requirement(s) to OMB for review and clearance under the Paperwork Reduction Act of 1995, Public Law 104-13 on or after the date of publication of this notice. Comments are requested regarding: Whether the ***collection*** of information is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility; the accuracy of the agency's estimate of burden including the validity of the methodology and assumptions used; ways to enhance the quality, utility and clarity of the information to be ***collected***; and ways to minimize the burden of the ***collection*** of information on those who are to respond, including through the use of appropriate automated, electronic, mechanical, or other technological ***collection*** techniques or other forms of information technology should be addressed to: Desk Officer for ***Agriculture***, Office of Information and Regulatory Affairs, Office of Management and Budget (OMB), New Executive Office Building, Washington, DC; New Executive Office Building, 725 17th Street NW, Washington, DC 20503. Commenters are encouraged to submit their comments to OMB via email to: [*OIRA\_Submission@omb.eop.gov*](mailto:OIRA_Submission@omb.eop.gov) or fax (202) 395-5806 and to Departmental Clearance Office, USDA, OCIO, Mail Stop 7602, Washington, DC 20250-7602.

Comments regarding these information ***collections*** are best assured of having their full effect if received by March 19, 2020. Copies of the submission(s) may be obtained by calling (202) 720-8681.

An agency may not conduct or sponsor a ***collection*** of information unless the ***collection*** of information displays a currently valid OMB control number and the agency informs potential persons who are to respond to the ***collection*** of information that such persons are not required to respond to the ***collection*** of information unless it displays a currently valid OMB control number.National ***Agricultural*** ***Statistics*** Service

Title: Poultry Litter ***Nutrient*** Distribution Producer Survey.

OMB Control Number: 0535-0264.

Summary of ***Collection***: The primary objectives of the National ***Agricultural*** ***Statistics*** Service (NASS) are to prepare and issue official State and national estimates of crop and livestock production, disposition and prices, economic ***statistics***, and environmental ***statistics*** related to ***agriculture*** and to conduct the Census of ***Agriculture*** and its follow-on surveys. NASS will conduct a survey of select ***agricultural*** operations in Delaware, Maryland, Pennsylvania, and Virginia. Each selected farmer or rancher will be asked to provide ***data*** on (1) Basic crop and tillage practices in 2019, (2) Preferred sources of ***nutrients*** and actual sources of ***nutrients*** used, (3) Where the operator gets information and recommendations on ***nutrients***, and (4) Farmer perception between poultry litter co-products and other sources of ***nutrients***. General authority for these ***data*** ***collection*** activities is granted under U.S.C Title 7, Section 2204.

Need and Use of the Information: A comprehensive evaluation of farmer preferences for using fresh poultry litter or poultry litter ash co-products has not been previously conducted in the Chesapeake Bay area.

***Data*** may be used for market development, policy, and/or budgeting for cost-share/poultry transport programs. Stakeholders would be farmers (poultry growers and crop producers), policy makers, technology vendors, fertilizer manufacturers, and manure brokers/haulers.

Information from the survey could be used by commercial fertilizer dealers, poultry growers, technology vendors, or state agencies to make investment decisions regarding fresh poultry litter and poultry litter ash co-products. For example, policy makers could base changes to the state cost share program for manure transport on the results, or a fertilizer company/technology vendor could invest in a new fertilizer product based on the results.

The survey will also complement on-going efforts in Chesapeake Bay states to achieve water quality goals via promoting on-farm and regional phosphorus balance. Several states (Maryland and Delaware for example) offer funding to transport poultry litter from farms where it is produced to fields where it is needed. Despite cost share incentives to use poultry litter, many farmers choose not to use poultry litter. This survey will identify barriers to expanded use of poultry litter on farms in the region.

Description of Respondents: A sample of all active ***agricultural*** operations in Delaware, Maryland, Pennsylvania, and Virginia that produce:

200 or more acres of row crops (corn, soybeans, wheat, peanuts, cotton), 25 or more acres of specialty crops (vegetables, fruit, flowers), and/or at least $10,000 of floriculture sales.

Number of Respondents: 1,000.

Frequency of Responses: Reporting: Once a year.

Total Burden Hours: 483.Ruth Brown,Departmental Information ***Collection*** Clearance Officer.[FR Doc. 2020-03067 Filed 2-14-20; 8:45 am]BILLING CODE 3410-20-P

**Load-Date:** February 20, 2020

**End of Document**



[***Register of Commission documents:Written answer : Statistics on horses Document date: 2020-02-04 P9\_RE(2019)003538 Answers to written questions***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5Y4Y-T661-F0YC-N3FK-00000-00&context=1516831)

Impact News Service

February 5, 2020 Wednesday

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**Length:** 470 words

**Body**

Brussels: Public Register European Parliament has issued the following document:

ENE-003538/2019Answer given by Mr Gentilonion behalf of the European Commission(4.2.2020)***Eurostat*** does not ***collect*** statistical ***data*** on the total number of horses per use.The aggregated number of horses, donkeys, mules and hinnies kept on ***agricultural*** holdings isavailable in the Farm Structure Survey for 2013 and 2016 in ***Eurostat***’s database1. Theseequidae are kept on the farm for meat production, as draught animals or as a leisure activity ofthe farm family. In the 2020-2026 Integrated Farm Statistics2 horses will be reported underthe class “other animals” as their economic importance for farms is very small.***Data*** on animals in ***Eurostat*** ***statistics*** applies to livestock as part of ***agricultural*** activities. Dueto the vast majority of horses used under other economic activities than ***agriculture***, attemptsto cover the number of equidae within ***agricultural*** ***statistics*** can easily lead to falseconclusions as the ***data*** can be interpreted as representing the total equidae population.***Eurostat*** is not planning any study to ***collect*** ***data*** on overall number of horses.Administrative ***data*** on numbers of horses should exist at national level3. At present, there is alegal requirement to identify equidae, but not to register them. In accordance with Regulation(EU) 2016/4294 and Delegated Regulation (EU) 2019/20355, the identification andregistration of equidae, the registration of establishments keeping equidae and theestablishment of a database in each Member State will be mandatory. This will allowgenerating substantiated ***data*** on the equine population in the Union for animal healthpurposes.1 [*https://appsso.****eurostat****.ec.europa.eu/nui/show.do?dataset=ef\_lsk\_main&lang=en*](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ef_lsk_main&lang=en), last update: 2 May 2019.2 Regulation (EU) 2018/1091 of the European Parliament and of the Council of 18 July 2018 on integrated farmstatistics and repealing Regulations (EC) No 1166/2008 and (EU) No 1337/2011, OJ L 200, 7.8.2018, p. 1–29.3 Commission Implementing Regulation (EU) 2015/262 of 17 February 2015 laying down rules pursuant toCouncil Directives 90/427/EEC and 2009/156/EC as regards the methods for the identification of equidae(Equine Passport Regulation), OJ L 59, 3.3.2015, p. 1–53.4 Regulation (EU) 2016/429 of the European Parliament and of the Council of 9 March 2016 on transmissibleanimal diseases and amending and repealing certain acts in the area of animal health (‘Animal Health Law’),OJ L 84, 31.3.2016, p. 1–208.5 Commission Delegated Regulation (EU) 2019/2035 of 28 June 2019 supplementing Regulation (EU) 2016/429of the European Parliament and of the Council as regards rules for establishments keeping terrestrial animals andhatcheries, and the traceability of certain kept terrestrial animals and hatching eggs, OJ L 314, 5.12.2019,p. 115–169.

**Load-Date:** February 6, 2020

**End of Document**



[***Council of the European Union:REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the implementation of Regulation (EU) No 691/2011 on European environmental economic accounts PDF document ST 6102 2020 INIT17-02-2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5Y7X-WMV1-F0YC-N048-00000-00&context=1516831)

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February 19, 2020 Wednesday

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**Length:** 5822 words

**Body**

Brussels: Council of the European Union has issued the following document:

6102/20 JV/mbTREE.1.A ENCouncil of theEuropean UnionBrussels, 17 February 2020(OR. en)6102/20ENV 82STATIS 11ECO 10FIN 94COVER NOTEFrom: Secretary-General of the European Commission,signed by Mr Jordi AYET PUIGARNAU, Directordate of receipt: 14 February 2020To: Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council ofthe European UnionNo. Cion doc.: COM(2020) 56 finalSubject: REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENTAND THE COUNCIL on the implementation of Regulation (EU)No 691/2011 on European environmental economic accountsDelegations will find attached document COM(2020) 56 final.Encl.: COM(2020) 56 finalEN ENEUROPEANCOMMISSIONBrussels, 14.2.2020COM(2020) 56 finalREPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT ANDTHE COUNCILon the implementation of Regulation (EU) No 691/2011 on European environmentaleconomic accounts1REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT ANDTHE COUNCILon the implementation of Regulation (EU) No 691/2011 on European environmentaleconomic accounts(1) INTRODUCTIONRegulation (EU) No 691/2011 on European environmental economic accounts1 (theRegulation) introduced a common framework for ***collecting***, compiling, transmitting andevaluating European environmental economic accounts. Article 10 of the Regulationstipulates the following:By 31 December 2013 and every 3 years thereafter, the Commission shall submit areport on the implementation of this Regulation to the European Parliament and theCouncil. That report shall evaluate in particular the quality of the ***data*** transmitted,the ***data*** ***collection*** methods, the administrative burden on the Member States and onthe respondent units, as well as the feasibility and effectiveness of those ***statistics***.This is the third report fulfilling this obligation. The previous reports were published in 20162and 20133. This implementation report covers 2016 to 2018.(2) ENVIRONMENTAL ECONOMIC ACCOUNTSThe European Green Deal resets the Commission commitment to tackling climate andenvironmental-related challenges4. The Commission commits to put the EU firmly on a newpath of sustainable and inclusive growth, while protecting and strengthening the EU’s naturalcapital. Under the Green Deal, the EU aims to:• increase the EU’s climate ambition to achieve climate neutrality by 2050;• supply clean energy;• bring about a circular economy;• build in an energy and resource-efficient way;• achieve zero pollution and a toxic-free environment;• preserve and restore ecosystems and biodiversity;• ensure a sustainable and healthy food system;• promote sustainable and smart mobility.1 [*http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02011R0691-201406162*](http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02011R0691-201406162)   [*https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1478531808092&uri=CELEX:52016DC06633*](https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1478531808092&uri=CELEX:52016DC06633)   [*http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013DC08644*](http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013DC08644)   [*https://ec.europa.eu/info/sites/info/files/european-green-deal-communication\_en.pdf2Ensuring*](https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf2Ensuring) a ‘just transition’ towards climate neutrality and financing the transition are keyelements to be mainstreamed in all policies. The European Green Deal is an integral part ofthe Commission’s strategy to implement the 2030 Agenda and the UN SustainableDevelopment Goals.Environmental economic accounts, or environmental accounts for short, are a powerful,multipurpose information framework addressing the sustainability aspects of our economicbehaviour. Mainstream economic ***statistics***, such as the national accounts, which underpinGDP, do not take account of environmental aspects in production, consumption, investment orfinancing. The environmental accounts enable the integration of economic and environmentalaspects to complete this picture.The key feature of environmental accounts is integration. This concerns both the integrationof environmental and economic aspects, and the integration into a consistent economicaccounting system of a range of key thematic environmental aspects such as i) energy,taxation and air emissions; ii) material extractions and waste; and iii) government andbusiness expenditure and investment. This integration allows developing coherent indicatorsets, and helps identifying possible synergies and trade-offs between sectoral policies. Theenvironmental accounts facilitate this due to the reasons set out below.• They generate coherent sets of indicators that are linked to one another in acomprehensive and consistent economic and environmental context.Correspondingly, the accounts are well placed for assessment frameworks relating tothe key components of natural capital (air, water, land and biodiversity) and to servemultidimensional, cross-cutting topics such as progress towards achieving theSustainable Development Goals or the circular economy;• They provide structure and enhance possibilities for analysis. Information isorganised to exploit synergies across individual thematic areas. This enables costeffectivenessanalyses, scenario modelling and forecasts. The accounts enable theallocation of emissions or resource use to imports, exports, consumption andinvestment and the calculation of footprint-type indicators using input-outputtechniques. Other applications include measuring the contribution of naturalresources and energy to economic growth (growth accounting, decompositionanalysis).The accounting approach is useful because it enables high quality information to be produced(i.e by integrating source ***data*** and combining them into robust estimates) and available datato be reused so as to limit the administrative burden on businesses and citizens.At European level, the European environmental accounts underpin the supranationaldimension of the environmental issues and provide a systematic approach and coverage acrossMember States and environmental topics that enable policy assessment and comparisonsacross Member States.3The European environmental accounts are based on the international standard System ofEnvironmental-Economic Accounting 2012 – Central Framework (SEEA CF)5. This standardwas produced and released under the auspices of the United Nations, the EuropeanCommission (***Eurostat***), the Food and ***Agriculture*** Organisation of the UN, the Organisationfor Economic Co-operation and Development (OECD), the International Monetary Fund andthe World Bank group.The Regulation establishes the European environmental economic accounts. The Regulationhas EEA relevance6. It structures the accounts in modules, originally creating three modules(Annexes I to III to the Regulation), as follows:• Air emissions accounts: the emissions into the atmosphere of six greenhouse gases(including CO2 and CO2 from biomass used as a fuel) and seven air pollutants(including ammonia and fine dust particles), with a breakdown covering 64 emittingindustries plus households.• Environmentally related taxes by economic activity: environmental taxes for fourbroad groups: energy, transport, pollution and resources, with a breakdown covering64 paying industries plus households and non-residents.• Economy-wide material flow accounts: the amounts of physical inputs into theeconomy, material accumulation in the economy, and outputs to other economies orback to the environment.Since 2013, there has been an obligation to submit ***data*** to the Commission (***Eurostat***) underAnnexes I to III.Three additional modules were added in 2014 (Annexes IV to VI)7, as follows:• Environmental protection expenditure accounts: expenditure undertaken byeconomic units for environmental protection purposes.• Environmental goods and services sector accounts: output, value added andexports of goods and services that have been specifically designed and produced toprotect the environment or manage resources. The employment associated with theseactivities is also reported.• Physical energy flow accounts: flows of energy from the environment into theeconomy (extraction of natural inputs), within the economy (manufacture and use ofenergy products) and from the economy to the environment (discharge of energyresiduals).Since 2017, there has been an obligation to submit ***data*** to the Commission (***Eurostat***) underAnnexes IV to VI.5   [*http://unstats.un.org/unsd/envaccounting/seea.asp6*](http://unstats.un.org/unsd/envaccounting/seea.asp6) It covers Norway and Iceland. Liechtenstein has a complete derogation. The bilateral StatisticalAgreement of Switzerland with the European Union, includes the Regulation since December 20197 Regulation (EU) No 538/2014 of the European Parliament and of the Council of 16 April 2014amending Regulation (EU) 691/2011 on European environmental accounts4In October 2019, the European Court of Auditors published the Special Report No 16/2019 onEuropean Environmental Economic Accounts8. The Court checked whether the Commissionset up, managed and used the environmental accounts well. The Court concluded that theenvironmental accounts are an important source of ***data*** for monitoring and evaluatingenvironmental policies, such as the 7th environment action programme, and progress towardsachieving the United Nations’ Sustainable Development Goals. The Court made threerecommendations regarding i) the strategic framework for environmental accounts, ii)relevance for policymaking and iii) timeliness of ***data***. While some of the recommendationsconcur with ongoing activities by the Commission (***Eurostat***) and the Member States, theCourt’s Report will require additional work.(3) ACTIVITIES SINCE THE LAST REPORTLEGAL FRAMEWORKThere have been no new legal acts related to the Regulation since the last implementationreport in 2016.***DATA*** ***COLLECTION*** METHODS AND ADMINISTRATIVE BURDENEnvironmental economic accounts do not generally require new ***data*** to be ***collected***. Insteadthey mostly make use of existing ***data*** already held by national authorities, complementedwith additional estimates where needed. This is because they collate ***data*** from a wide rangeof sources, e.g underlying ***statistics*** on energy, transport, ***agriculture***, government expenditureand taxation, as well as some non-statistical sources, in addition to the national accounts ***data***.To fulfil the ***data*** requirements set out in the Regulation, Member States can adjust existingdata to bring it into line with the concepts in the SEEA CF. This may require specific workfrom Member State national statistical offices. The fact that environmental economic accountsreuse existing ***data*** means that the additional response burden placed on businesses andhouseholds is very small, as long as ***data*** sources exist and are maintained. Countries can alsochoose to set up specific ***data*** ***collection*** processes for the purposes of the environmentaleconomic accounts, which will help to improve ***data*** quality. One example of where this hasbeen undertaken is the environmental goods and services sector accounts (Annex V to theRegulation), which involved some countries setting up dedicated surveys to complement theirother sources of ***data***. These surveys have annual or multiannual periodicity and the burdenplaced on businesses is often low.National authorities (typically the national statistical institutes) carry out most of the workrequired to produce the accounts, which involves processing existing ***data*** and improving theiranalytical potential. The average number of staff required to compile the accounts in eachnational authority is estimated at between four and six full-time equivalents for the sixAnnexes to the Regulation. There are differences across Member States because of theircircumstances, existence/extent of ***data*** sources, etc. The accounts add considerable value tothe basic ***data*** and increases the potential to analyse mutual interactions between the topics in8   [*https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=512145the*](https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=512145the) Annexes e.g air emissions and energy use. Several national authorities used pilot studies(co-financed by the Commission) to set up the methods for processing and analysing the ***data***.FEASIBILITY AND EFFECTIVENESSThe modules laid down in the Regulation were tested and piloted before the Commissionproposed a legal framework, thus ensuring their feasibility (see below). The testing is carriedout in cooperation with the Member States so as to benefit from their expertise and ensurethere is a common understanding about the modules’ feasibility. Pilot studies of further,potential new modules are currently ongoing.The effectiveness of the environmental economic accounts depends on two factors: first, howexisting information can be reorganised into a common framework; and second, how and towhat extent the accounts are used.As regards the first point, the air emissions accounts (Annex I to the Regulation) provide oneexample of how existing information has been reorganised. The air emission accounts useinformation already gathered for the air emission inventories that are required for reportingunder the United Nations Framework Convention on Climate Change (UNFCCC) and underthe United Nations Economic Commission for Europe Convention on Long-rangeTransboundary Air Pollution (CLRTAP). Further information is then added to the ***data*** tobring them into line with the classifications and concepts used in the national accounts. Thenthe air emissions accounts can be combined with input-output tables to produceenvironmental footprints; they can be used with national accounts to calculate how much theenvironment contributes to economic growth (decomposition analysis).The air emission accounts can also be used together with environmental accounts for otherareas such as energy or environmental taxes. This information can be used in causalframeworks for describing and analysing the interactions between society and theenvironment, like the framework 'Driving forces, Pressures, State, Impact and Responses'adopted by the European Environment Agency.As regards the second point, the environmental accounts underpin the 7th EU environmentalaction programme to 2020, ‘Living well, within the limits of our planet’9. The environmentaleconomic accounts are used to monitor the progress towards the Sustainable DevelopmentGoals in an EU context10. The environmental accounts are also used to measure progressmade in the EU’s policies on the circular economy, as indicators based on environmentalaccounts are part of the EU monitoring framework for the circular economy11. Environmentaltaxes (Annex II to the Regulation) are used in environmental fiscal reform studies12.QUALITY OF THE ***DATA*** TRANSMITTED SINCE THE LAST REPORT9   [*http://ec.europa.eu/environment/action-programme/10*](http://ec.europa.eu/environment/action-programme/10)   [*https://ec.europa.eu/****eurostat****/web/products-statistical-books/-/KS-01-18-656*](https://ec.europa.eu/eurostat/web/products-statistical-books/-/KS-01-18-656). Example indicators based onenvironmental accounts are: ‘resource productivity’, ‘circular material use rate’ and ’shares of environmental taxesin total tax revenues’.11   [*https://ec.europa.eu/****eurostat****/web/circular-economy/indicators/monitoring-framework*](https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework) . One example indicatorbased on environmental accounts is ‘circular material use rate’.12   [*https://ec.europa.eu/environment/integration/green\_semester/index\_en.htm6The*](https://ec.europa.eu/environment/integration/green_semester/index_en.htm6The) Regulation requires Member States, as well as EEA countries, to report ***data*** to ***Eurostat***.13Switzerland along with a number of candidate countries and potential candidate countries forEU membership also report some ***data*** on a voluntary basis. This implementation reportfocuses on the first group of countries (EU/EEA countries). ***Eurostat*** validates the datareceived and makes them publicly available on its website14, together with technicalexplanations (metadata) and a dedicated section15 with background information.The vast majority of Member States consistently report complete ***data*** sets according to thedeadlines set in the Regulation. A small number of Member States reported a delay, usually afew days; only one Member State reported a longer delay. Those delays had no practicalimpact on the processing or dissemination of the ***data***.A number of areas and specific items have been identified for which countries struggle toensure that ***data*** are of good quality. The Commission (***Eurostat***) continues to work with theMember States to resolve issues at a technical level. Until these areas are fully resolved, inorder to minimise the information loss for users from such incomplete reporting, theCommission (***Eurostat***) filled gaps in the ***data*** submitted by Member States and calculated EUaggregates.The activities carried out between 2016 and 2018 to improve the quality of the ***data*** includethe following.As regards the accounts which are reported since 2013, and for which there is moreexperience, the previous implementation report already identified specific areas and items forwhich countries struggle to ensure that ***data*** are of good quality. The issues stated in theprevious implementation report that are now solved or are being solved, are described below.• The issues solved are, for Annex I (air emissions accounts): coverage of emissions offluorinated gases. For Annex III (economy-wide material flow accounts): i) estimatesfor crop residues, fodder crops and grazed biomass, sand and gravel extraction (withguidance and proposed solutions in a new ***Eurostat*** handbook16 published in 2018and newly available ***Eurostat*** crop production ***statistics***); ii) the adjustment to theresidence principle for the whole EU.• The issues being solved are, for Annex I: the reconciliation with the estimates for theUNFCCC and CLRTAP reporting obligations (solution in preparation using13 For the three new modules, Spain, France, Italy and Cyprus benefited from derogations under CommissionImplementing Decision (EU) 2016/335 of 7 March 2016 granting derogations from Regulation (EU) No 691/2011on European environmental economic accounts with regard to Spain, France, Italy and Cyprus (   [*http://eurlex.europa.eu/legal-content/EN/ALL/?uri=uriserv:OJ.L\_.2016.062.01.0018.01.ENG).In*](http://eurlex.europa.eu/legal-content/EN/ALL/?uri=uriserv:OJ.L_.2016.062.01.0018.01.ENG).In) addition, Regulation (EU) 691/2011, Annex IV, section 5.1 grants a derogation for those NACE codes, whichMember States are not obliged to ***collect*** under Regulation (EC) 295/2008 on structural business ***statistics***.Iceland has a temporary derogation to report the ***data*** in Annexes IV to VI until 2019, as specified in an EFTASurveillance Authority Decision of 20 October 2015. Liechtenstein has a complete derogation from 691/2011, asspecified in Decision of the EEA Joint Committee No 98/2012 of 30 April 2012 amending Annex XXI (***Statistics***)to the EEA Agreement (   [*https://www.efta.int/sites/default/files/documents/legal-texts/eea/other-legaldocuments/adopted-joint-committee-decisions/2012%20-%20English/098-2012.pdf)14*](https://www.efta.int/sites/default/files/documents/legal-texts/eea/other-legaldocuments/adopted-joint-committee-decisions/2012%20-%20English/098-2012.pdf)14)   [*https://ec.europa.eu/****eurostat****/web/environment/****data****/database15*](https://ec.europa.eu/eurostat/web/environment/data/database15)   [*http://ec.europa.eu/****eurostat****/web/environment/overview16*](http://ec.europa.eu/eurostat/web/environment/overview16)   [*https://ec.europa.eu/****eurostat****/web/products-manuals-and-guidelines/-/KS-GQ-18-0067international*](https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-18-0067international) databases of passenger air transport and truck road transport). ForAnnex II (environmentally related taxes by economic activity): i) the allocation oftax revenue to non-residents has significantly improved as almost 70% of countriesare now reporting on this aspect fully; ii) cases of non-suitable administrative sourcedata are now limited following revisions of macroeconomic ***statistics***.Besides addressing those issues, the quality of ***data*** for Annexes I to III has been consolidatedsince the 2016 implementation report by means of i) producing longer time series; ii) closingdata gaps; iii) improving consistency; iv) improving validation and dissemination procedures;and v) increasing the voluntary reporting of supplementary variables and breakdowns beyondthe Regulation’s requirements. Furthermore, the ***data*** are disseminated faster thanks to special,model-based early estimates by ***Eurostat*** and a faster delivery by Member States.As regards Annexes IV to VI (respectively: environmental protection expenditure accounts,environmental goods and services sector accounts, and physical energy flow accounts), theactivities over 2016-2017 running up to the first reporting deadline late in 2017 includedpreparatory work for the first mandatory ***data*** ***collection***, including i) annual voluntary datacollections; ii) Commission (***Eurostat***) guidance; iii) producing handbooks; and iv) providingcompilation tools and training. Since 2018, training has continued and work has focused onproviding feedback to Member States on the quality of the ***data*** submitted. Expert groups(‘task forces’) have been developing solutions for two methodological issues: i) the allocationof road transport emissions to the NACE classification (concerning mainly Annexes I and VI)and ii) the update of the classification of environmental economic activities (concerningAnnexes IV and V).Overall, for all Annexes I to VI, the ***data*** quality improved over 2016-2018. The statisticaldata for Annexes I to III submitted by Member States under the Regulation is of high quality.The ***data*** for Annexes IV to VI show a lower level of maturity because obligatory reportingonly started in 2017, i.e until then there had been only two ***collection*** rounds. In addition,Annexes IV and V are more complex than the other Annexes and require other categories ofsource ***data***. The Commission expects the quality of the ***data*** for Annexes IV to VI to improvein the next few years. There are still areas where improvement is needed. The Commission(***Eurostat***) continues to work with the Member States to resolve issues at a technical level. Anumber of measures are either being implemented or are planned in order to improve quality,see next section.(4) IMPROVEMENT MEASURESThis section discusses proposals for introducing new environmental economic accountsmodules and the measures being taken to improve ***data*** quality and ***data*** ***collection*** methods, asrequired under Article 10 of the Regulation.The initiatives presented in this section are the result of two main strategies. The first is theimplementation strategy17 for the SEEA CF, which is the international statistical standard thatthe European environmental economic accounts adhere to. This worldwide implementation17   [*http://unstats.un.org/unsd/statcom/doc13/BG-SEEA-Implementation.pdf8strategy*](http://unstats.un.org/unsd/statcom/doc13/BG-SEEA-Implementation.pdf8strategy) recommends a flexible and modular approach, in order to accommodate differentpolicy needs and the availability of different levels of ***data***.The second is the European strategy for environmental accounts for 2019 to 202318. This is aprogramme of further work agreed by the Commission (***Eurostat***) and the Member States andadopted by the European Statistical System Committee. This strategy coordinates Europeanefforts and paves the way for possible new modules. The objectives for 2019 to 2023 are to:• continue to improve the quality of the current European environmental accounts,including long time series and timeliness;• better communicate the relevance and content of the European environmentalaccounts, including communicating the environmental modules as a whole system;• serve user needs by offering further extensions, applications and indicators, includingfootprints, based on the current European environmental accounts;• assess the need to adjust the European environmental accounts to new priorities andareas;• support those who produce the accounts in the Member States with financialresources, training, handbooks and compilation tools;• contribute to the further development of global standards of the UN SEEA and globalinitiatives such as monitoring the Sustainable Development Goals.The European strategy for environmental accounts does not prevent individual Member Statesfrom also developing other streams of work, according to their national circumstances, policyneeds and available resources.PROPOSALS FOR NEW MODULESArticle 10 of the Regulation states that this implementation report, where appropriate andtaking into account the findings of pilot studies, must be accompanied by proposals for newmodules in a number of named areas19.Several new accounts continue to be developed, including those listed in Article 10 of theRegulation, and the programme for pilot studies, established under Article 4(2) of theRegulation, continues to be used. Over 2016-2018, Member States piloted studies onecosystem accounts, environmental subsidies and similar transfers, water accounts as well asresource management expenditure accounts.Besides those pilots, there was other development work, as described below.• On environmental subsidies and similar transfers, ***Eurostat*** has been running avoluntary ***data*** ***collection*** since 2015. Some 13 Member States have participated sofar but a critical mass of Member States has yet to be reached. More recently, workon fossil fuels subsidies is under way in the context of Sustainable Development18   [*https://ec.europa.eu/****eurostat****/documents/1798247/6191525/European+Strategy+for+Environmental+Accounts/19*](https://ec.europa.eu/eurostat/documents/1798247/6191525/European+Strategy+for+Environmental+Accounts/19) Three of the new areas listed in Article 10 eventually became Regulation Annexes IV to VI, andtherefore are not candidates for future areas.9Goals indicators. Environmental subsidies is an area more demanding thanenvironmental taxes because their recording in public finance ***statistics*** is morecomplex.• On ecosystem accounts, there has been substantial development driven by theCommission INCA project20 (phase 1 completed and phase 2 advancing), which isscheduled to end in 2020. Member States are not required to join at this stage butthey are kept informed and will be able to join if the project is successful. BesidesINCA, the Commission (***Eurostat***) contributed to the release of the TechnicalRecommendations in support of the SEEA Experimental Ecosystem Accounting21 inDecember 2017and to the revision of the SEEA Experimental Ecosystem Accountingscheduled to end by 202022.• On water accounts, the Commission (***Eurostat***) did conceptual work on physicalwater flow accounts, which was documented in a draft manual. No ***data*** collectionhas been launched. The Commission (***Eurostat***) follows the activities of the EuropeanEnvironmental Agency in order to produce water accounts.• On forest accounts, the Commission (***Eurostat***) has streamlined and simplified avoluntary ***data*** ***collection*** process. The experience in some participating MemberStates is that past pilots did not meet the users’ expectations and work wasdiscontinued at national level, but in other Member States demand is high.Member States would support the development of new modules but at a slower pace as theyhave concerns regarding the resources needed for regular production. The modules that areseen to produce the most benefits at the lowest cost are those already introduced in theRegulation. The remaining potential new modules are considered to have proportionally lessbenefits and are more costly.Priorities about relevance may shift in the future. There is a lot of technical progress ongoing,e.g big ***data***, satellite images (Copernicus), etc. Demand for information in order createpolicies making is rising in areas such as those related to the Sustainable Development Goals,the circular economy, natural capital, etc. The annual sustainable growth strategy23 has astronger focus on environmental sustainability, including climate change, as one of itsstrategic objectives alongside productivity, fairness and macroeconomic stability24.TheCommission will continue to monitor the implementation of this Regulation.QUALITY IMPROVEMENTS: RECENT ACTIVITIESImproving the quality of the accounts will continue to be a focus for the following years.Improving the quality has been a focus of the European strategy for environmental accounts20 Integrated system of Natural Capital and ecosystem services Accounting, see the project description(   [*http://ec.europa.eu/environment/nature/capital\_accounting/pdf/KIP-INCA-ScopingPaper.pdf*](http://ec.europa.eu/environment/nature/capital_accounting/pdf/KIP-INCA-ScopingPaper.pdf) ) and the final reportfor phase 1 (   [*http://ec.europa.eu/environment/nature/capital\_accounting/pdf/KIP\_INCA\_final\_report\_phase-1.pdf).21https://seea.un.org/sites/seea.un.org/files/technical\_recommendations\_in\_support\_of\_the\_seea\_eea\_final\_white\_cover.pdf22*](http://ec.europa.eu/environment/nature/capital_accounting/pdf/KIP_INCA_final_report_phase-1.pdf).21https://seea.un.org/sites/seea.un.org/files/technical_recommendations_in_support_of_the_seea_eea_final_white_cover.pdf22)   [*https://seea.un.org/content/seea-experimental-ecosystem-accounting-revision23*](https://seea.un.org/content/seea-experimental-ecosystem-accounting-revision23)   [*https://eur-lex.europa.eu/legalcontent/EN/TXT/?qid=1578392227719&uri=CELEX%3A52019DC065024*](https://eur-lex.europa.eu/legalcontent/EN/TXT/?qid=1578392227719&uri=CELEX%3A52019DC065024)   [*https://ec.europa.eu/info/sites/info/files/2020-european-semester-annual-sustainable-growth-strategy\_en.pdf10as*](https://ec.europa.eu/info/sites/info/files/2020-european-semester-annual-sustainable-growth-strategy_en.pdf10as) well. Quality improvements also increase relevance and make efficiency gains possible,which in turn decrease administrative burden. The following are the current and upcomingactivities.(a) Providing grants for pilot studies and quality improvements. Article 4 of theRegulation calls on the Commission to draw up a programme of pilot studies to becarried out by Member States on a voluntary basis. The aim of the studies is to: i)develop reporting methods and improve ***data*** quality; ii) establish long time series;iii) develop the methods used for processing the ***data*** and iv) test the feasibility ofintroducing new modules for environmental economic accounts. The Commission(***Eurostat***) has co-financed pilot studies every year (now up to 90% of the costs) andpublished the results in the public online site ‘Communication and InformationResource Centre for Administrations, Businesses and Citizens (CIRCABC)’25. Thesefindings are taken into account when planning quality improvements and introducingnew modules for environmental economic accounts.(b) Producing early estimates to reduce the time delay in the availability of ***data***.The environmental accounts have originally been regarded as fairly detailed,structural ***data***, which becomes available with long delays. The Commission(***Eurostat***) and the Member States are assessing whether environmental accountscould be compiled and submitted earlier and are also examining ways of producingearly estimates for some of the main indicators. These early estimates may have ahigher margin of error and may be less detailed than the ***data*** required under theRegulation, but appear to offer valuable early information to users. Early estimatesenable ***statistics*** to be produced several months earlier, without increasing the burdenon Member States. Considerable progress has been made to have more and betterearly estimates. As a result, the Commission (***Eurostat***) now produces and publishesearly estimates of economy-wide material flow accounts (Annex III to theRegulation) 6 months after the end of the reference year, which is 18 months earlierthan the deadline in the Regulation. Similarly, the Commission (***Eurostat***) compilesestimates for air emission accounts (Annex I) 12 months after the end of thereference period, which is one year earlier than required in the Regulation. Work isalso ongoing to streamline the ***data*** ***collected*** on environmental taxes (Annex II) withdata on national tax lists compiled under the National Accounts ESA2010transmission programme26. The Commission (***Eurostat***) is exploring the feasibilityand quality of early estimates for the other modules.(c) Publishing handbooks and providing methodological guidance. This referencematerial enables the production of ***statistics*** and helps statisticians both within andoutside the EU. Since the last implementation report in 2016, the Commission(***Eurostat***) has published the following manuals and guidelines: i) the Handbook onenvironmental goods and services sector27 (2016); ii) the Practical guide on25   [*https://circabc.europa.eu/ui/group/b01d2930-990e-44fb-9121-a9a6b00a1283/library/bfd9a826-38e7-4a02-b7d6-89064f903e51?p=1&n=10&sort=modified\_DESC26*](https://circabc.europa.eu/ui/group/b01d2930-990e-44fb-9121-a9a6b00a1283/library/bfd9a826-38e7-4a02-b7d6-89064f903e51?p=1&n=10&sort=modified_DESC26)   [*http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013R054927*](http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013R054927)   [*https://ec.europa.eu/****eurostat****/web/products-manuals-and-guidelines/-/KS-GQ-16-00811environmental*](https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-16-00811environmental) goods and services sector28 (2016); iii) the Handbook onenvironmental protection expenditure accounts29 (2017); and iv) the Handbook oneconomy-wide material flow accounts30 (2018).(d) Setting standards for transmissions of ***data*** and quality reports. Seeking betterefficiency and robustness, standards for ***data*** transmission were agreed between theMember States and the Commission (***Eurostat***). They are in turn aligned to globalstandards by the UN, the OECD and the Commission (***Eurostat***), enabling globaldatabases of environmental information to be created. Quality reports based onMicrosoft Word and Excel are also being gradually discontinued in favour of reportsindependent of proprietary software.(e) Maintaining classifications. The Commission (***Eurostat***) and the Member Statesmaintain and improve two classifications used for Annexes IV and V: theClassification of Environmental Protection Activities and the Classification ofResource Management Activities. These classifications are also used outside Europe.(f) Providing compilation tools. The Commission (***Eurostat***) creates tools forcompiling accounts available to Member States and other countries. For example, itprovides an IT tool, called PEFA-Builder, that compiles physical energy flowaccounts (Annex VI to the Regulation) on the basis of energy ***statistics***. TheCommission (***Eurostat***) also maintains up-to-date lists (classifications) of theproducts and activities needed to compile the accounts. The Commission (***Eurostat***)provides tools for calculating footprints, which measure the global impact ofeconomic actors (businesses, families, government) in the environment when theyuse natural resources. Footprints are derived from combining environmentaleconomic accounts with other ***statistics*** like input-output tables.(g) Facilitating training courses under the European statistical training programme.The Commission organises around five courses a year on environmental economicaccounts. The material used in past courses is published on the CIRCABC site.31(h) Promoting the exchange of experience between countries. The Commission(***Eurostat***) organises two working groups32 that meet every year to share experiences,identify best practices and coordinate improvements. There are also task forces thatstudy specific methodological issues and propose recommendations. TheCommission (***Eurostat***) participates in the international initiatives organised by theOECD, the United Nations Economic Commission for Europe and the UN.(5) CONCLUSIONSThe Commission and the Member States continue to improve the European environmentalaccounts under Regulation (EU) No. 691/2011, in particular by means of:28   [*https://ec.europa.eu/****eurostat****/web/products-manuals-and-guidelines/-/KS-GQ-16-01129*](https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-16-01129)   [*https://ec.europa.eu/****eurostat****/web/products-manuals-and-guidelines/-/KS-GQ-17-00430*](https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-17-00430)   [*https://ec.europa.eu/****eurostat****/web/products-manuals-and-guidelines/-/KS-GQ-18-00631*](https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-18-00631)   [*https://circabc.europa.eu/w/browse/6ade1ca8-6a06-44bd-bff0-498217d0ec0532*](https://circabc.europa.eu/w/browse/6ade1ca8-6a06-44bd-bff0-498217d0ec0532) Working group environmental accounts and working group monetary environmental ***statistics*** andaccounts12• strengthening ***data*** quality and effectiveness;• better communication;• developing further indicators to meet users’ needs; and• assessing the need to adjust the European environmental accounts to new prioritiesand areas.

**Load-Date:** February 20, 2020

**End of Document**



[***Federal Register: Submission for OMB Review; Comment Request Pages - 19423 [FR DOC #2020-07220]***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YM5-NWC1-F0YC-N4VD-00000-00&context=1516831)

Impact News Service

April 7, 2020 Tuesday

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**Length:** 834 words

**Body**

Washington: Office of the Federal Register has issued the following notice:

DEPARTMENT OF AGRICULTURESubmission for OMB Review; Comment RequestApril 1, 2020. The Department of ***Agriculture*** will submit the following information ***collection*** requirement(s) to OMB for review and clearance under the Paperwork Reduction Act of 1995, Public Law 104-13 on or after the date of publication of this notice. Comments are requested regarding: (1) Whether the ***collection*** of information is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility; (2) the accuracy of the agency's estimate of burden including the validity of the methodology and assumptions used; (3) ways to enhance the quality, utility and clarity of the information to be ***collected***; and (4) ways to minimize the burden of the ***collection*** of information on those who are to respond, including through the use of appropriate automated, electronic, mechanical, or other technological ***collection*** techniques or other forms of information technology. Comments regarding these information ***collections*** are best assured of having their full effect if received by[[Page 19423]]May 7, 2020. Written comments and recommendations for the proposed information ***collection*** should be submitted within 30 days of the publication of this notice on the following website [*www.reginfo.gov/public/do/PRAMain*](http://www.reginfo.gov/public/do/PRAMain). Find this particular information ***collection*** by selecting ``Currently under 30-day Review--Open for Public Comments'' or by using the search function. An agency may not conduct or sponsor a ***collection*** of information unless the ***collection*** of information displays a currently valid OMB control number and the agency informs potential persons who are to respond to the ***collection*** of information that such persons are not required to respond to the ***collection*** of information unless it displays a currently valid OMB control number.National ***Agricultural*** ***Statistics*** Service (NASS) Title: ***Agricultural*** Resource Management and Chemical Use Surveys--Substantive Change. OMB Control Number: 0535-0218. Summary of ***Collection***: General authority for these ***data*** ***collection*** activities is granted under U.S Code Title 7, Section 2204 which specifies that ``The Secretary of ***Agriculture*** shall procure and preserve all information concerning ***agriculture*** which he can obtain . . . by the ***collection*** of ***statistics*** . . .''. The primary objective of the National ***Agricultural*** ***Statistics*** Service (NASS) is to provide ***data*** users with timely and reliable ***agricultural*** production and economic ***statistics***, as well as environmental and specialty ***agricultural*** related ***statistics***. To accomplish this objective, NASS relies on the use of diverse surveys that show changes within the farming industry over time. Using the ***Agricultural*** Resource Management Survey (ARMS) and the Vegetable Chemical Use Survey, NASS ***collects*** environmental ***data*** which includes cropping practices, fertilizer applications, pesticide usage for weeds, insects, fungus, mold, etc., and the use of various pest management practices. Through cooperative agreements with the Economic Research Service and the Office of Pest Management Policy NASS ***collects*** additional ***data*** to aid in there research. The additional questions that will be added to the questionnaires that were not in the original approval will address topics such as seed treatments, GPS enabled equipment, ***nutrient*** management, crop insurance, environmental regulations, organic production practices, etc. Complete listings of the questions added and deleted have been added as supplemental documents to this submission. This substantive change will not change the sample sizes of any of the surveys only the content of the ARMS II surveys for rice, corn and soybeans, the Vegetable Chemical Use Survey and the Cropping Practices Survey (done under a cooperative agreement with Mississippi State University). A detailed listing of the changes are attached to the docket submission. Based on the ARMS II and the Fruit Chemical Use surveys conducted in 2019, in which the field enumerators were asked to record beginning and ending times for personal interviews the changes in average burden per questionnaire a 10 to 15 minute increase was added to the questionnaires. This resulted in a net increase in respondent burden of 442 hours above the currently approved annual average total. Need and Use of the Information: The Office of Pest Management Policy (OPMP), the Economic Research Service (ERS), and the Mississippi State University Extension Service (MSUES) will be able to better address changes in the farming practices and chemicals used on these crops that have occurred since the original approval of this docket. Description of Respondents: Farms. Number of Respondents: 16,815. Frequency of Responses: Reporting: Once. Total Burden Hours: 13,610.Ruth Brown,Departmental Information ***Collection*** Clearance Officer.[FR Doc. 2020-07220 Filed 4-6-20; 8:45 am]BILLING CODE 3410-20-P

**Load-Date:** April 8, 2020

**End of Document**



[***No upturn in sales of fertilisers despite increased crop production***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YVF-50Y1-JDG9-Y219-00000-00&context=1516831)

Impact Financial News

May 6, 2020 Wednesday

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**Length:** 312 words

**Body**

Stockholm, Sweden: ***Statistics*** Office of Sweden has issued the following press release:

Sales of nitrogen in mineral fertilisers from July 2018 to June 2019 were at the same level as a year ago and amounted to 182 700 tonnes. Sales of phosphorus were 10 percent lower than a year ago and amounted to 12 800 tonnes.

Sales of potassium were 8 percent lower than a year ago and amounted to 27 000 tonnes. Sulphur sales amounted to 26 900 tonnes, down 11 percent compared to a year ago.

The phosphorus fertilisers contained about 97 kg of cadmium, which corresponds to 7.6 g per tonne phosphorus.

The ***statistics*** on sales of fertilisers include fertilisers for ***agricultural*** and horticultural purposes. This ***data*** is ***collected*** from manufacturers, importers and trading companies of fertilisers.

Results can vary between years, depending on stock changes at the farms, expected price changes, and changes in taxes and charges. In such cases, the results do not reflect actual use. Normally, high price levels on crop outputs increase the optimal nitrogen fertilisation level.

The cultivation of winter crops, sown in autumn 2018, reached record highs in 2019. The dry summer in 2018 led to lower yields than expected and lowered the crop requirements of plant ***nutrients***. The fertilisers that remained in stock from 2018 were probably used in 2019 instead, since there was a significant increase in crop production between the years, although sales of fertilisers in 2019 were at the same level or even lower than in 2018.

Farmers’ fertiliser application rates vary according to soil type, season, crop variety, farm policy, and more. More detailed information on the use and handling of fertilisers, based on interviews with farmers, is published intermittently. ***Data*** for 2015/16 is available in the report “Use of fertilisers and animal manure in ***agriculture*** in 2015/16” (MI 30 SM 1702).

**Load-Date:** May 8, 2020

**End of Document**



[***API – Index of the purchase prices of the means of agricultural production – statistics notice (data to May 2020) accessible format***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60FV-NTJ1-F0YC-N1NY-00000-00&context=1516831)

Impact News Service

July 25, 2020 Saturday

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**Length:** 1792 words

**Body**

London: UK Government has issued the following news release:

16 July 2020Agricultural Price Index – May 2020The ***Agricultural*** Price Index (API) is an index of the price of ***agricultural*** outputs and inputs for the UK used to track change over time. More details on the index, including how it is produced, are in the Background section at the end of this document.Key points at May 2020Outputs• The price index for total outputs is 2.1 points higher compared with May 2019. This is driven by increases for crop products (+4.7 points) and, to a lesser extent, animals and animal products (+0.4 points). However, the picture is once again mixed within these product groups, with lower prices for cereals (notably oats) and animal products, and higher prices for fresh fruit and animals (notably pigs, and sheep and lambs). The decrease for animal products was driven by lower prices for milk, partially offset by higher prices for eggs. The largest annual price index change was for fresh fruit (+81.2 points).• The price index for total outputs increased by 1.1 points from April 2020. Overall, this was driven by a price increase of 2.1 points for animals (most significantly sheep and lambs), partially offset by price decreases of 1.1 points for crop products and 2.4 points for animal products. The largest monthly price index change was for fresh fruit (-46.4 points).Inputs• The price index for total inputs is 2.9 points lower compared with May 2019. This is driven by significant decreases in the price for energy and lubricants, and fertilisers and soil improvers, and is only partially offset by price increases for plant protection products and vehicle maintenance. The largest annual price index change was for energy and lubricants (-24.7 points).• The price index for total inputs was once again little changed from April 2020 (-0.6 points), with all product groupings showing little to no change except for energy and lubricants (-3.7 points).ContentsAgricultural Price Index – May 2020........................................................................... 1Key points at May 2020........................................................................................... 1Outputs ................................................................................................................... 1Inputs ...................................................................................................................... 1Contents..................................................................................................................... 2What you need to know about this release................................................................. 3Section 1 – Summary charts for prices indices .......................................................... 4Section 2 – Details of selected outputs and inputs..................................................... 5Section 3 – Summary table of price indices ............................................................... 6Section 4 – About these ***statistics*** .............................................................................. 8Background ......................................................................................................... 8Data uses ............................................................................................................ 8Methodology ........................................................................................................ 8Weights................................................................................................................ 8What you need to know about this releaseContact detailsResponsible statistician: Simon Maxwell, Room 202, Foss House, Kings Pool, 1-2 Peasholme Green, York, YO1 7PX.Tel: 0208 026 4098Email: [*prices@defra.gov.ukNational*](mailto:prices@defra.gov.ukNational) ***Statistics*** StatusNational ***Statistics*** status means that our ***statistics*** meet the highest standards of trustworthiness, quality and public value, and it is our responsibility to maintain compliance with these standards.These ***statistics*** last underwent a full assessment [Assessment Report 271 ***Statistics*** on ***Agriculture***] against the Code of Practice for ***Statistics*** in 2014.Since the latest review by the Office for ***Statistics*** Regulation, we have continued to comply with the Code of Practice for ***Statistics***. We have also made improvements to enhance the quality of this publication as part of our regular 5-year rebasing, which has included updating the range of prices ***collected*** based on availability and quality, and improving weighting methodology in line with ***Eurostat*** guidance.For general enquiries about National ***Statistics***, contact the National ***Statistics*** Public Enquiry Service:Tel: 0845 601 3034Email: [*info@****statistics****.gov.uk*](mailto:info@statistics.gov.uk) You can find more information about National ***Statistics*** at ***statistics***.gov.uk Section 1 – Summary charts for prices indicesFigure 1: Monthly indices for Total Outputs and Total Inputs to May 2020 (2015 = 100)Figure 2: Annual average indices for Total Inputs and Total Outputs to May 2020 (2015 = 100)Figure 3: Milk price index to May 2020 (2015 = 100). For more information visit the monthly UK farm-gate milk price publication.8090100110120130140201520162017201820192020Total OutputsTotal Inputs708090100110120130140201520162017201820192020 (todate)Total InputsTotal Outputs708090100110120130140150201520162017201820192020MilkSection 2 – Details of selected outputs and inputsFigure 4: Change in annual and monthly price indices for selected outputs for May 2020 (2015 = 100)Figure 5: Change in annual and monthly price indices for selected inputs for May 2020 (2015 = 100)-60.0-40.0-20.00.0+20.0+40.0+60.0+80.0+100.0Total OutputsWheatBarleyOatsPotatoesOilseed RapeSugar BeetForage plantsFresh VegetablesFresh FruitCattle and calvesPigsSheep and lambsAll PoultryMilkEggsAnnual changeMonthly change-25.0-20.0-15.0-10.0-5.00.0+5.0+10.0+15.0Total InputsSeedsEnergy and lubricantsFertilisers and soil improversPlant protection productsVeterinary servicesStraight feedingstuffsCompound feedingstuffsVehicle maintenanceBuilding maintenanceOther goods and servicesMaterialsBuildingsAnnual changeMonthly changeSection 3 – Summary table of price indicesTable 1: Index of prices of ***agricultural*** outputs and inputs to May 2020 (2015 = 100), with annual change calculated as the difference from May 2019 and monthly change calculated as the difference from April 2020May 2019Apr 2020May 2020Annual changeMonthly changeTotal Outputs115.8116.7117.9+2.1+1.1Crop products127.1132.8131.8+4.7-1.1Cereals137.2128.6128.5-8.7-0.1Wheat137.7131.5131.4-6.3-0.1Barley130.4117.2115.8-14.6-1.5Oats159.8117.7123.5-36.3+5.8Potatoes146.8144.6144.3-2.5-0.3Industrial Crops118.5120.5119.7+1.2-0.8Oilseed Rape120.2126.3122.8+2.7-3.5Sugar Beet (1)100.4100.4100.40.00.0Forage plants139.7151.3151.4+11.8+0.1Fresh Vegetables122.7136.0125.6+2.9-10.4Fresh Fruit145.4273.0226.6+81.2-46.4Animals and animal products108.6108.7109.0+0.4+0.3Animals108.1108.9111.0+2.9+2.1Cattle and calves100.7100.0102.5+1.7+2.4Pigs111.3126.1125.0+13.7-1.1Sheep and lambs123.5121.2132.2+8.7+11.0All Poultry107.9105.3104.6-3.4-0.8Animal products109.3108.5106.1-3.2-2.4Milk113.7111.7108.9-4.7-2.7Eggs81.987.787.7+5.80.0Total Inputs112.8110.5109.9-2.9-0.6All goods and services currently consumed113.7110.8110.0-3.7-0.8Seeds107.1104.2104.2-3.00.0Energy and lubricants127.8106.8103.2-24.7-3.7Fertilisers and soil improvers104.895.493.4-11.4-2.0Plant protection products114.5128.0127.8+13.3-0.2Veterinary services115.1114.4114.4-0.8+0.0Animal feedingstuffs116.6113.8113.2-3.4-0.6Straight feedingstuffs123.7126.8124.7+1.0-2.1Compound feedingstuffs113.3107.9107.9-5.4+0.0Vehicle maintenance108.6112.4112.1+3.5-0.3Building maintenance112.9111.1111.5-1.4+0.4Other goods and services109.8110.4110.4+0.6+0.0Goods and services contributing to investment (2)108.7109.2109.5+0.8+0.3Materials107.2108.5108.5+1.3+0.0Buildings112.1110.8111.7-0.4+0.9(1) Sugar beet prices are provided annually and with a delay of upwards of a year. Lack of change in this index, monthly or yearly, is not necessarily representative of the price changes within this market.(2) Provisional.Section 4 – About these statisticsBackgroundThe output series reflects the price farmers receive for their products, also referred to as farm gate price. Information is ***collected*** for all major crops (for example wheat and potatoes) and on livestock and livestock products (for example sheep, milk and eggs).The input series reflects the price farmers pay for goods and services. The series is in two groups: goods and services currently consumed; and goods and services contributing to investment. Goods and services currently consumed refer to items that are used up in the production process, for example fertiliser or seed. Goods and services contributing to investment relate to items that are required but not consumed in the production process, such as tractors or buildings.***Data*** usesFarmers use the ***agricultural*** price index to help set prices for their output and monitor the price paid for inputs. Analysts in Government, industry and academia use the ***data*** to assess the impact that price changes have on industry and consumers.The Office of National ***Statistics*** (ONS) uses API ***data*** in the production of the Producer Price Index (PPI), which is one of the key measures of inflation.MethodologyDefra ***collect*** prices from a wide variety sources to produce the monthly API. This includes ***data*** from our own surveys, information from the ***Agricultural***, Horticultural Development Board (AHDB), and the ONS. For some items we only receive quarterly or annual ***data***, for example, electricity prices. When no new ***data*** are available estimates are made based on previous values until new ***data*** becomes available.The methodology used is described in the Handbook for EU ***Agricultural*** Prices and is standard across the EU.WeightsEach price point is assigned a weight which reflects its contribution to the overall index. The weights for each item represent their annual monetary value from the ***Agricultural*** Accounts. For example, if the annual value of animal feed purchased is three times more than fertilisers then the annual weight for animal feed will also be three times more than for fertiliser. Where monthly ***data*** is available, monthly and quarterly weights for outputs reflect the pattern of sales volumes across the year. For example, if the volume of sales for apples in October is double that in June, then the October weight for apples is double the weight for June. Monthly and quarterly weights for input items do not vary within the year. The weights are recalculatedevery five years to reflect more recent ***data***. The April 2018 index was the first to be produced using weights based on 2015, replacing weights based on 2010.

**Load-Date:** July 28, 2020

**End of Document**



[***Monthly UK statistics on cattle, sheep and pig slaughter and meat production– statistics notice (data to June 2020)***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60FV-NTJ1-F0YC-N1PH-00000-00&context=1516831)

Impact News Service

July 25, 2020 Saturday

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**Length:** 2444 words

**Body**

London: UK Government has issued the following news release:

Enquiries on this publication to: Julie Rumsey, Department for Environment, Food and Rural Affairs,Room 201, Foss House, Kings Pool, 1 - 2 Peasholme Green, York, YO1 7PX.Tel: ++ 44 (0)2080 266306, [*email:julie.rumsey@defra.gov.ukA*](mailto:email:julie.rumsey@defra.gov.ukA) National ***Statistics*** publication. National ***Statistics*** are produced to high professional standards. Theyundergo regular quality assurance reviews to ensure that they meet customer needs. They are producedfree from any political interference. For general enquiries about National ***Statistics***, contact the NationalStatistics Public Enquiry Service: tel. 0845 601 3034 email [*info@****statistics****.gov.uk*](mailto:info@statistics.gov.uk) You can also findNational ***Statistics*** on the internet at [*http://www.****statistics****.gov.uk/.16th*](http://www.statistics.gov.uk/.16th) July 2020United Kingdom Slaughter ***Statistics*** – June 2020Due to the increased strain Covid-19 is having on the Livestock industry, our survey response were lower than usual at 90%. To compensate we have made greater use of the Food Standards Agency throughput ***data*** to maintain coverage. This may impact on how within species numbers are split amongst their classifications; such as how sheep numbers are split amongst clean sheep and ewe & rams.ContentsSection 1 Monthly numbers of home killed livestock slaughtered page 2Section 2 Average dressed carcase weights page 2Section 3 Monthly volumes of home killed meat production page 3Section 4 Average weekly numbers of livestock slaughtered page 3Section 5 Monthly numbers of livestock slaughtered by country page 5Section 6 Methodology, notes and revisions policy page 6Key pointsThe key results for June 2020 compared to June 2019 are:• Cattle: UK prime cattle (steers, heifers and young bulls) slaughterings in June 2020 were up 11% on June 2019 at 175,000 head. Beef and veal production was 80,000 tonnes, 12% higher than in June 2019.• Sheep: UK clean sheep slaughterings were up 8.9% on June 2019 at 988,000 head. Mutton and lamb production was 23,000 tonnes, 6.2% higher than in June 2019.• Pigs: UK clean pig slaughterings were 3.0% higher than in June 2019 at 834,000 head. Pigmeat production was 74,000 tonnes, 4.8% higher than in June 2019.This notice will be updated at 09:30 on Thursday 13th August 2020. Additional time series which include weekly slaughter averages, production and trade ***data*** can be found at[*https://www.gov.uk/government/****statistics****/cattle-sheep-and-pig-slaughter2Section*](https://www.gov.uk/government/statistics/cattle-sheep-and-pig-slaughter2Section) 1: Monthly numbers of home killed livestock slaughteredTable 1 shows monthly estimates of the number of home killed cattle, sheep and pigs, slaughtered as meat for human consumption in UK abattoirs.Table 1: United Kingdom monthly numbers of livestock slaughteredthousand headJune 2019April 2020May 2020June 2020yr on yr30 days30 days31 days30 days% change Steers7877758610%Heifers6065656915%Young Bulls211516210.1%Cows and Adult Bulls5045456019%Calves7754-42%Clean Sheep9078437689888.9%Ewes and Rams11114884110-0.5%Clean Pigs8099137978343.0%Sows and Boars182315195.2%(1) The definition of calves from May 2014 is “Bovines less than 1 year”. Please see methodology for full details.Section 2: Average dressed carcase weights (2)Table 2 shows the monthly average dressed carcase weight (DCW) of livestock slaughtered for meat for human consumption in the United Kingdom. The large increase in carcase weight for calves is due to a larger reduction in the number of light calves seen at the slaughterhouse.Table 2: United Kingdom average dressed carcase weights (2)kilogrammeJune 2019April 2020May 2020June 2020Steers365.6364.8361.5361.8Heifers327.0328.3328.0327.3Young Bulls352.8342.7346.7350.2Cows and Adult Bulls315.1312.6307.3316.0Calves83.874.186.797.4Clean Sheep19.920.520.319.8Ewes and Rams28.525.928.427.6Clean Pigs84.186.186.085.6Sows and Boars147.8142.6142.6145.03Section 3: Monthly volumes of home killed meat productionTable 3 shows the monthly volumes of meat produced in UK abattoirs.Table 3: United Kingdom monthly volumes of meat productionthousand tonnesJune 2019April 2020May 2020June 202030 days30 days31 days30 daysBeef7269688011%Mutton and Lamb212118236.2%Pigmeat718271744.8%yr on yr % changeSection 4: Average weekly numbers of home killed livestock slaughteredTable 4 shows the average weekly slaughter figures for the last thirteen months. The monthly slaughter figures in section one are affected by the number of days in the survey period. To get a clearer measure of trends weekly averages are calculated using the number of livestock slaughtered and the number of days in each period.Longer term trends can be seen in Figures 4:1, 4:2 and 4:3, following this table.Table 4: United Kingdom average weekly numbers of livestock slaughteredthousand head2019201920192019201920192019202020202020202020202020JunJulAugSepOctNovDecJanFebMarAprMayJunSteers18181821222218202021181720Heifrs14141416171714161717151516Young Bulls5544332333445Cows and Adult Bulls12121214171613141313101014Calves2223322223211Clean Sheep212246283278294289269235202209197174230Ewes and Rams26343933353232292930351926Clean Pigs189205212210226224211217208214213180195Sows and Boars44455545555344Figure 4:1 United Kingdom average weekly numbers of cattle slaughteredSteersHeifersYoung BullsCows and adult bullsCalves0510152025Jun 19Jul 19Aug 19Sep 19Oct 19Nov 19Dec 19Jan 20Feb 20Mar 20Apr 20May 20Jun 20Thousand HeadFigure 4:2 United Kingdom average weekly numbers of sheep slaughteredClean SheepEwes and Rams050100150200250300350Jun 19Jul 19Aug 19Sep 19Oct 19Nov 19Dec 19Jan 20Feb 20Mar 20Apr 20May 20Jun 20Thousand headFigure 4:3 United Kingdom average weekly numbers of pigs slaughteredClean PigsSows and Boars050100150200250Jun 19Jul 19Aug 19Sep 19Oct 19Nov 19Dec 19Jan 20Feb 20Mar 20Apr 20May 20Jun 20Thousand head5Section 5: Monthly numbers of home killed livestock slaughtered by countryTable 5 shows monthly estimates of the number of cattle, sheep and pigs slaughtered for meat in England and Wales, Scotland, Great Britain and Northern Ireland.Table 5: United Kingdom monthly numbers of livestock slaughtered by countrythousand headApril 2020May 2020June 202030 days31 days30 daysEngland & WalesSteers484656Heifers424246Young Bulls111013Cows and Adult Bulls353344Calves754Clean Sheep747673861Ewes and Rams14680107Clean Pigs734620652Sows and Boars221417ScotlandSteers161717Heifers121312Young Bulls234Cows and Adult Bulls455Calves000Clean Sheep796683Ewes and Rams111Clean Pigs272830Sows and Boars112Great BritainSteers646472Heifers545558Young Bulls121417Cows and Adult Bulls393850Calves754Clean Sheep825739944Ewes and Rams14882108Clean Pigs761648681Sows and Boars231519Northern IrelandSteers131113Heifers111011Young Bulls334Cows and Adult Bulls6710Calves010Clean Sheep183044Ewes and Rams122Clean Pigs152148152Sows and Boars0006Section 6: ***Data*** users, methodology, Definitions and revisions policyData users1. Users of the ***data*** include the EU Commission where these slaughtering ***statistics*** are required monthly under Regulation no. EC.1165/2008. Detailed information on this legislation is available by selecting “Animal Production” at [*http://epp.****eurostat****.ec.europa.eu/portal/page/portal/****agriculture****/legislation*](http://epp.eurostat.ec.europa.eu/portal/page/portal/agriculture/legislation). European level ***statistics*** on meat products (which includes ***data*** tables showing results at EU Member State level) are available at [*http://epp.****eurostat****.ec.europa.eu/****statistics****\_explained/index.php/****Agricultural****\_products#Meat\_and\_milk2*](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Agricultural_products#Meat_and_milk2). The livestock industry is also a major user of the ***data***, including divisions of the ***Agriculture*** and Horticulture Development Board (AHDB). AHDB Pork (formally known as BPEX, representing the English pig industry) and AHDB Beef and Lamb (formerly EBLEX, representing the English beef and sheep industry). Industry users rely heavily on the numbers of slaughterings and meat production to assess the current state of the industry and predict the available supplies of meat for the coming year. This, in turn, can affect meat prices and trade decisions on levels of imports and exports to maintain supply. Users have always been very keen for the slaughtering ***statistics*** to be produced as quickly as possible so that the ***data*** is still relevant. For this reason, we ***collect*** and publish these ***statistics*** to a very tight timetable, publishing within three weeks of the survey date. The “Market Intelligence” and “Market Outlook” Reports on the AHDB Beef and Lamb website refer consistently to our ***statistics*** at [*http://beefandlamb.ahdb.org.uk/markets*](http://beefandlamb.ahdb.org.uk/markets)/ The AHDB Pork site provides more in-depth analysis of pigmeat production ***statistics*** at [*http://pork.ahdb.org.uk/prices-stats/3*](http://pork.ahdb.org.uk/prices-stats/3). Contact details are available on the front page of this notice, for you to send feedback or ask questions about the information provided.Methodology4. Defra runs a monthly survey of registered England and Wales slaughterhouses. It is a statutory survey (approximately 85) that ***collects*** information on livestock slaughter numbers and weight of meat produced. All major slaughterhouses participate in the survey and the response rate is typically 100%. Similar surveys are run by RERAD in Scotland and by DAERA in Northern Ireland. Scottish ***statistics*** on livestock slaughterings are available in the Economic Report on Scottish ***Agriculture*** at [*http://www.scotland.gov.uk/Topics/****Statistics****/Browse/****Agriculture****-Fisheries/PubEconomicReport*](http://www.scotland.gov.uk/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport) (Tables A5 and A6). This website also contains contact details and more information. Northern Ireland results are available at [*https://www.daera-ni.gov.uk/articles/slaughtering-cattle-and-sheep*](https://www.daera-ni.gov.uk/articles/slaughtering-cattle-and-sheep) and [*https://www.daera-ni.gov.uk/articles/slaughtering-pigs-20035*](https://www.daera-ni.gov.uk/articles/slaughtering-pigs-20035). The England and Wales slaughter survey accounts for around 90% of the E&W slaughterhouse throughput for each livestock type. These ***data*** are supplemented by administrative ***data*** from the Food Standards Agency (FSA) for smaller slaughterhouses to give complete monthly coverage of livestock slaughterings.76. Information on the weight of meat produced from a sample of animals weighed at slaughterhouses is obtained from survey respondents, around 55 slaughterhouse respondents. From the information provided average dressed carcase weights for each animal type are primarily calculated by adding up the total weight of the meat produced and dividing by the number of animals weighed. Cold dressed carcase weights are recorded.7. The volume of meat production is estimated from the number of all livestock slaughtered and average dressed carcase weight information ***collected***. This total ‘Home killed’ production includes livestock imported into the United Kingdom for slaughter.8. The ***data*** are subject to a variety of validation checks which identify inconsistencies in the ***data***. All ***data*** are cleaned prior to publication in discussion with the survey respondents.9. With effect from February 2016 the ***statistics*** published in this notice are based on calendar rather than statistical months. This change simplifies our survey processes and brings our slaughter survey in line with our milk surveys which are already run on a calendar month basis; it also removes the need for the 53 week year (which would have to be 2016). Since the end of weekly slaughter survey several years ago, there is no legislative requirement for weekly ***data***, so since then we have derived the average weekly throughput from the monthly survey ***data***.10.The January 2016 ***data*** will include the last week of December 2015 and therefore be classed as a 5 week month. From 1st February 2016 onwards the ***statistics*** are based on calendar months.11.We have carried out a review of the methodology for calculating the dressed carcase weights in order to align with UK specifications. Some slaughterhouses provide Cattle Dressed Carcase Weights (DCW) including Kidney Knob and Channel Fat (KKCF); some slaughterhouses provide pig weights at EC specification. From September 2019 cattle DCWs are calculated to UK specification which excludes KKCF; Pigs are dressed to UK specification.12.To calculate the DCW of animals by category:a. If the slaughterhouse includes KKCF in the total weight, a deduction of 3.9% occurs. This aligns to the UK DCW specification.[*https://www.gov.uk/guidance/the-beef-carcase-classification-scheme-classify-carcasesb*](https://www.gov.uk/guidance/the-beef-carcase-classification-scheme-classify-carcasesb). If pigs are dressed to EC specification then an increase of 1.6% to the DCW occurs to align with UK specification.[*https://www.gov.uk/guidance/the-pig-carcase-grading-scheme-dress-and-grade-carcases13.Some*](https://www.gov.uk/guidance/the-pig-carcase-grading-scheme-dress-and-grade-carcases13.Some) slaughterhouses specialise for niche markets. These slaughterhouses are treated separately so their DCW are not used to raise the ***data*** for those slaughterhouses who do not provide DCW ***data***.14.***Data*** have been revised to January 2018 using the new methodology. If you have any questions or comments we are happy to discuss. Please contact us at [*DEFRA.FISU@defra.gov.uk8Definitions15.Steers*](mailto:DEFRA.FISU@defra.gov.uk8Definitions15.Steers) (or Bullocks): Castrated males over 1 year old, raised for beef.Heifers: Female animals that have not calved. Over 1 year old, raised for beef.Young bulls: Non-castrated young males, raised for beef, generally slaughtered around 13 months old.Prime cattle: All those raised specifically for beef production. Total of Steers + Heifers + Young Bulls.Breeding bulls: Older cull males, previously used for breedingCows: Older cull females, previously used for breedingCalves: All bovine animals aged 1 year old or younger. Prior to May 2014, the definition was “animals weighing less than 165kg”.Revisions policy16.Figures in this notice are provisional and subject to revision. We will provide information about any revisions we make to previously published information in this ***statistics*** notice and the associated datasets. Revisions could occur for various reasons, including:a. if we have not received survey ***data*** from respondents we make an estimate based on their previous returns. These estimates will be replaced with actual survey ***data*** when it is received.b. survey respondents occasionally supply amended figures for previous periods.c. if we have not received administrative ***data*** for the smaller slaughterhouses we make an estimate based on previous ***data*** received. These estimates will be replaced with actual ***data*** when it is received.National ***Statistics*** status17.National ***Statistics*** status means that our ***statistics*** meet the highest standards of trustworthiness, quality and public value, and it is our responsibility to maintain compliance with these standards.18.The ***statistics*** last underwent a full assessment [Assessment Report 271 ***Statistics*** on ***Agriculture***] against the Code of Practice for ***Statistics*** in 2014.19.Since the latest review by the Office for ***Statistics*** Regulation, we have continued to comply with the Code of Practice for ***Statistics*** and have enhanced ***data*** quality by reviewing methodologies and ***data*** sources.

**Load-Date:** July 28, 2020

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[***Statistics Finland: Corona situation review of 15 May 2020: effects of the exceptional situation are reflected in the figures for the economy in March***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YY0-VBF1-JDG9-Y1W7-00000-00&context=1516831)

Nordic Daily

May 19, 2020 Tuesday

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**Length:** 718 words

**Body**

Helsinki: ***Statistics*** Finland has issued the following media release:

Due to the corona situation we have accelerated the production of ***data*** describing the exceptional circumstances. We publish ***statistics*** deviating from ordinary ***statistics*** production once a week for the time being and compile ***data*** on them and other topical ***statistics*** into this news item.Selections of ***statistics*** and articles describing the corona situation

15 May The Trend Indicator of Output shows that the output of the national economy adjusted for working days fell by 2.7 per cent in March from twelve months back. 15 May According to the index of turnover of service industries, turnover and output in services fell in March. 15 May The turnover in industry decreased by 5.1 per cent in March. 15 May According to the index of producer prices of ***agricultural*** products, the corona epidemic has not yet influenced the producer prices for ***agriculture***, the purchase prices of the means of ***agricultural*** production fell in the first quarter (in Finnish). 15 May The turnover and sales volume of construction enterprises continued growing in March. Building costs rose by 0.3 per cent in April year-on-year. 15 May Timo Ruuskanen writes in his blog how corona has restricted young people's physical exercise hobbies most (in Finnish). 14 May 2020 Iiro Halonen analyses the occupancy rate in his article Quarantine reveals the occupancy rate – many families with underage children live in overcrowded conditions (in Finnish). 14 May 2020 Preliminary ***statistics*** on the number of deaths per week indicate the number of deaths until 3 May. The ***data*** of the ***statistics*** will be supplemented, up-to-date information can be found in the experimental ***statistics*** database. 14 May The turnover of trade shows that the growth in turnover in trade has halted in March. 14 May According to the Consumer Price Index, inflation was -0.3 per cent in April. 13 May According to the ***statistics*** on balance of payments and international investment position, the current account was in deficit in March and the financial account was in balance. 13 May The ***data*** for the first quarter of 2020 on the ***statistics*** on international trade in goods and services were published as instant preliminary ***data*** in the database tables of the ***statistics***. The figures will be revised in the June release on 22 June 2020.

Coming this week

18 May The ***statistics*** on manufacturing and trade inventories describe the current priced value of inventories by industry in the first quarter (in Finnish). 19 May ***Data*** for April on road traffic accidents resulting in personal injury are published in the ***statistics*** on road traffic accidents. 19 May Hanna Sutela's blog about the breakthrough of remote work in Finland boosted by the corona crisis (in Finnish). 19 May The Job Vacancy Survey describes the number of open job vacancies in the first quarter. 20 May In the ***statistics*** on bankruptcies, ***data*** on bankruptcy petitions are released for April and preliminary ***data*** on the number of bankruptcy petitions on the weekly level are released in the rapid estimate of the ***statistics*** on bankruptcies for the first time on 22 May. 20 May Preliminary ***statistics*** on the number of deaths per week until 10 May. 20 May The experimental early estimate of output is published for April. 22 May The ***statistics*** on local government finances describe quarterly the development of the finances of municipalities and joint municipal authorities in Mainland Finland. 22 May Ilkka Lehtinen's article on the impact of the economic crisis on the housing market from the recession of the 1990s to the corona crisis (in Finnish).

We ***collect*** ***statistics*** describing the corona situation on the corona pages of ***Statistics*** Finland's web pages. ***Eurostat*** has also opened the Covid-19 page where you can find much information and ***data*** describing the situation on the EU level. In addition, we provide information in our weekly news on ***statistics*** describing the corona situation and on the effects of emergency conditions on ***statistics*** production.

***Statistics*** Finland’s ***statistics*** and services can be found on the [*www.stat.fi*](http://www.stat.fi) pages. The Information Services help in finding statistical information by telephone at +358 29 551 2220 or by email at [*info@stat.fi*](mailto:info@stat.fi) You can also inquire about ***statistics*** with the Ask about ***statistics*** form.

**Load-Date:** May 19, 2020

**End of Document**



[***The association between carbohydrate quality and nutrient adequacy in Australian adults***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2C1-JCWX-C1J6-00000-00&context=1516831)

European Journal of Clinical Nutrition

April 2020

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**Section:** Pg. 1594-1602; Vol. 74; No. 11; ISSN: 0954-3007,1476-5640

**Length:** 4864 words

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**Body**

Introduction

In recent years, there is growing research interest in the role of glycemic index (GI) and glycemic load (GL). The GI is a measure for the quality of dietary carbohydrates, where foods with a low-GI cause a smaller increase in postprandial blood glucose due to slower digestion and absorption []. Since the GI only compares equal quantities of carbohydrate for the measurement of carbohydrate quality, the concept of GL was introduced, which quantifies the overall glycemic effect in a serving of food by taking into account the actual amount of carbohydrates consumed [].

Most studies have reported that chronic high GI and GL diets were related to increased risks of chronic diseases, such as type 2 diabetes, cardiovascular diseases, and cancers []. It is believed that such association is related to the regular sharp rises in postprandial blood glucose levels which may lead to hyperinsulinemia and promote the development of insulin resistance []. However, there is another concern that chronic high GI and GL diets could also be associated with decreased ***nutrient*** adequacy, which may be another causative factor of these chronic diseases []. High-GI foods such as refined grains (e.g., white bread, cornflakes) and foods with high added sugars (e.g., soft drinks) are commonly micronutrient poor [, ]. In contrast, low-GI foods such as unrefined grains (e.g., whole-meal breads, brown rice, bran flakes, oatmeal), most fruits, and dairy products are usually rich in micronutrients, thus it is believed that following a low-GI diet may make it easier for individuals to meet their ***nutrient*** requirement [].

A previous study by our group had examined the association between dietary GI (dGI) and ***nutrient*** adequacy in Australian children and adolescents []. Since Australian adults tend to consume close to 45% of their energy from carbohydrates in their usual diets [], and the contributors to their dietary GI and GL are different from those of Australia children and adolescents [, ], it is interesting to investigate whether carbohydrate quality also impacts on their ***nutrient*** adequacy. This study therefore aims to investigate the association between dGI, dietary GL (dGL) and ***nutrient*** adequacy among a nationally representative sample of Australian adults. We additionally investigated how nutritional adequacy is linked to carbohydrate intake from high-(CHOhighGI) or low-GI (CHOlowGI) foods respectively. We hypothesize that among Australian adults, carbohydrate quality is positively associated with ***nutrient*** adequacy.

Subjects and methods

***Data*** source

The 2011–2012 Australian Healthy Survey (AHS) is the latest national health survey conducted in Australia by the Australian Bureau of ***Statistics*** (ABS). This secondary analysis used ***data*** from the National Nutrition and Physical Activity Survey (NNPAS) component of the 2011–2012 AHS. The methodology of the NNPAS was previously described in details []. In brief, the survey measured the dietary intakes of foods, drinks and supplements using a 24 h recall method on two non-consecutive days (1 face-to-face and 1 over the phone), which is based on the US Department of ***Agriculture*** Automated Multiple Pass Method [, ]. These ***data*** were ***collected*** between 29 May and 9 June 2012 from 12,153 participants, of which 9341 were adults aged 19 years or above. Dietary intake ***data*** were then translated into ***nutrient*** intake using the AUSNUT2011–13 food composition database []. Free sugars intake was estimated as previously described [, ].

***Data*** cleaning and estimation of usual intake

Adults who completed only one 24 h recall (n = 3288) or with missing ***data*** for covariates (n = 8) were excluded from the analyses. The final dataset included 6045 participants who provided two plausible 24 h recalls (Fig. ). The Multiple Source Method (MSM) was used to account for day-to-day variations in dietary intakes based on ***data*** from the two 24 h recalls in order to obtain an estimation of habitual ***nutrient*** intakes, especially for ***nutrients*** and foods (e.g., seafood) that are episodically consumed []. In brief, the MSM uses ***data*** from at least two repeated short-term dietary assessments to statistically model the probability of consumption and usual intake of foods and ***nutrients*** on consumption days based on covariates such as age and sex []. Therefore, the MSM allows better estimation of the usual intake even if a true consumer reported zero intake on both 24 h recalls. In the current study, the MSM transformation was performed with age, sex, and their interaction term as covariates.

Flow of participants.

Flow of study participants for the main and sensitivity analyses.

Calculation of dietary GL, GI, and intakes of low- and high-GI carbohydrates

The method used to assign GI values to the food items in the AUSNUT2011–2013 database was previously described [, ]. The GL of each food item was calculated as the GI of that food item (%) × amount (g) of available carbohydrate in a serving of that food, while the daily dGL of each participant was calculated as ∑ GL from all foods. The dGI was obtained by (dGL/total available carbohydrate intake in the day) × 100%. Carbohydrates from foods with a GI less than 55 were considered CHOlowGI, whereas those from foods with GI ≥ 55 were considered CHOhighGI [].

Comparison against the ***Nutrient*** Reference Values for Australia and New Zealand (NRVs)

The usual ***nutrient*** intakes calculated by MSM were compared against the NRVs []. Intake of calcium, iron, iodine, magnesium, zinc, vitamin A (as retinol equivalents), thiamin, riboflavin, vitamin C, and dietary folate equivalents below the estimated average requirement; intake of potassium, linoleic acid (LA), α-linolenic acid (ALA), long-chain omega-3 fatty acid (LCn3PUFA), dietary fiber, and vitamin E below the adequate intake (AI); intake of sodium above the upper level (UL) and more than 10% of total energy consumed as saturated fat (%ESFA) were all regarded as not meeting the NRV. While technically not an NRV, intakes above 10% of total energy from free sugars (%EFS) was presented as not meeting the NRV for simplicity in presentation. Dietary vitamin D intake was not assessed in the 2011–2012 AHS []. ***Data*** for phosphorus were not shown because all the participants met its NRV [].

Assessment of covariates

Age, sex, smoking status, whether on diet, remoteness of living area, equivalised household income, socioeconomic indexes for areas (SEIFA), and country of birth were obtained during the face-to-face interview of the NNPAS []. Weight and height of the participants were also measured during the interview and were used to calculate the body mass index. Some of these were recoded into binary variables as follows: whether on diet for health reasons (e.g., low salt diet, diabetic diet) or weight loss (on diet vs. normal diet), remoteness of living area (major cities vs. rural areas), and country of birth (English speaking countries vs. non-English speaking countries).

Food group intakes

Foods included in the AUSNUT2011–2013 were categorized into core and discretionary foods as defined by the ABS [] (See Online Supplementary Table for classification), as described previously []. Core foods were defined as those foods and beverages within the Five Food Groups (“Vegetables”, “Fruit”, “Grain (cereals)”, “Lean meat, poultry, fish, eggs, tofu, nuts and seeds, legumes”, and “Milk, cheese, yogurt and alternatives”) and plain water, while all other foods were considered as discretionary []. Similar to ***nutrient*** intake, the food group intake ***data*** were transformed using MSM []. Results of the food group intakes are presented in Online Supplementary Tables –.

Statistical analysis

***Data*** were weighted to account for over- or under-sampling of the Australian population aged ≥19 years in terms of age group, sex and region, and the weighted sample is representative of the general Australian population. Adjustment were made to the weighting factor to consider the removal of participants with only 1-day ***data***. Age-, sex-, and energy-adjusted residuals of dGI, dGL, CHOhighGI, and CHOlowGI were created by linear regression, with total energy intake, age, and sex as covariates. Participants’ characteristics were examined for statistically significant differences across quartiles of dGI, dGL, CHOhighGI, and CHOlowGI residuals using Pearson χ2 test for categorical variables, and one-way ANOVA for continuous variables. ANCOVA was used to calculate the estimated marginal means (EMM) ± SEM of ***nutrient*** intakes across quartiles of dGI, dGL, CHOhighGI, and CHOlowGI. Logistic regression was used to calculate the odds ratios (ORs) of not meeting the NRVs by quartiles of dGI, dGL, CHOhighGI, and CHOlowGI. Trend analyses across quartiles were performed by linear and logistic regression for continuous and binary outcomes respectively. The analyses were adjusted for age, sex, SEIFA, equivalized household income, remoteness of living area, and country of birth. Further adjustment for total energy intake was not performed, in order to reflect the real-life association between carbohydrate quality and ***nutrient*** adequacy in the population. A two-sided p < 0.001 was considered statistically significant for ANOVA, ANCOVA and linear regression to reduce the chance of type I error, whereas a two-sided p < 0.05 was considered statistically significant for Pearson’s χ2 test and individual odds ratio [, ]. All statistical analyses were performed by using Statistical Packages for Social Science, version 25.0 (IBM Corporation, New York, USA).

Sensitivity analyses

We performed sensitivity analyses which exclude energy mis-reporters to examine the effect of misreporting on our results. Participants whose energy intake:basal metabolic rate ratio not between 0.96 and 2.49 were excluded. This range was used per the advice of the Australian Bureau of ***Statistics*** [], and is similar to that used in previous studies [–]. We excluded 1093 extreme mis-reporters based on this method. We also excluded 688 participants as they did not have their weight recorded which disallowed the computation of the EI:BMR ratio. Another six participants were excluded due to missing ***data*** for covariates, leaving a final sample size of 4266 (weighted n = 4362). Results of the sensitivity analyses were presented in Online Supplementary Tables –. Results and conclusions were not materially different from the main analyses, and hence we presented results without excluding energy mis-reporters to increase the sample size.

Results

Demographic characteristics of the included participants (weighted n = 6150) by quartiles CHOhighGI are presented in Table . Participants with higher intake of CHOhighGI were more likely to have lower socioeconomic statuses (as indicated by lower SEIFA and household income quantiles), less likely to be on diet and born in English speaking country and have ever smoked (all p < 0.001). They also tended to have lower intakes of fiber and CHOlowGI, while having higher dGI and dGL (all p < 0.001). Demographic characteristics of the participants for dGI, dGL and CHOlowGI quartiles are presented in Online Supplementary Tables and .

Characteristics of the 2011–2012 AHS participants (n = 6150) according to quartile of age-, sex- and energy-adjusted CHOhighGI residuals.

|  | **Q1** | **Q2** | **Q3** | **Q4** | ***p* valuea** |
| --- | --- | --- | --- | --- | --- |
| Weighted *n* | 1587 | 1468 | 1509 | 1585 | ? |
| Age (year) | 45.3 ± 16.9 | 48.5 ± 17.8 | 48.9 ± 17.8 | 45.4 ± 17.7 | 0.273 |
| BMI (kg/m2) | 27.3 ± 5.2 | 27.3 ± 5.4 | 27.5 ± 5.5 | 27.2 ± 5.8 | 0.014 |
| Male (%) | 54.2 | 46.6 | 40.8 | 57.0 | <0.001 |
| SEIFA (%) |  |  |  |  |  |
| ?1st quintile | 15.4 | 15.1 | 20.5 | 19.9 | <0.001 |
| ?2nd quintile | 14.3 | 20.5 | 18.0 | 24.7 |  |
| ?3rd quintile | 19.2 | 20.6 | 18.8 | 19.9 |  |
| ?4th quintile | 20.6 | 21.2 | 18.9 | 16.7 |  |
| ?5th quintile | 30.6 | 22.7 | 23.8 | 18.7 |  |
| Household income (%) |  |  |  |  |  |
| ?1st decile | 6.4 | 8.4 | 8.8 | 10.8 | <0.001 |
| ?2nd decile | 5.2 | 6.3 | 9.7 | 7.9 |  |
| ?3rd decile | 6.4 | 8.0 | 7.1 | 9.0 |  |
| ?4th decile | 7.5 | 7.4 | 8.9 | 6.6 |  |
| ?5th decile | 9.8 | 10.5 | 10.5 | 10.7 |  |
| ?6th decile | 7.4 | 7.4 | 7.2 | 8.7 |  |
| ?7th decile | 11.5 | 12.1 | 9.3 | 10.5 |  |
| ?8th decile | 9.1 | 8.6 | 8.7 | 8.3 |  |
| ?9th decile | 10.5 | 9.5 | 8.5 | 8.0 |  |
| ?10th decile | 14.9 | 11.8 | 8.3 | 9.4 |  |
| ?Not stated/unknown | 11.4 | 10.2 | 12.7 | 10.0 |  |
| On diet (%) | 18.0 | 13.8 | 13.1 | 9.3 | <0.001 |
| Living in urban area (%) | 72.5 | 71.0 | 72.2 | 76.7 | 0.002 |
| Born in English speaking countries (%) | 88.0 | 84.3 | 81.9 | 68.7 | <0.001 |
| Never smoked (%) | 50.7 | 50.1 | 47.9 | 43.2 | <0.001 |
| Total energy intake (kJ/day) | 8884 ± 2305 | 8219 ± 2153 | 7863 ± 2163 | 8723 ± 2275 | 0.006 |
| Fiber (g/day) | 23.9 ± 8.3 | 22.3 ± 7.2 | 21.9 ± 7.4 | 23.0 ± 7.5 | <0.001 |
| dGI | 50.6 ± 3.5 | 53.2 ± 2.7 | 55.1 ± 2.5 | 57.4 ± 2.4 | <0.001 |
| dGL | 101.5 ± 33.8 | 104.6 ± 32.3 | 111.1 ± 31.8 | 139.3 ± 37.3 | <0.001 |
| CHOhighGI | 69.8 ± 28.6 | 90.1 ± 27.7 | 106.7 ± 28.6 | 150.4 ± 40.1 | <0.001 |
| CHOlowGI | 118.0 ± 48.6 | 107.3 ± 35.9 | 96.8 ± 33.3 | 88.9 ± 33.3 | <0.001 |

Values were presented as mean ± SD for continuous variables and percentages for categorical variables. ***Data*** were weighed to represent the Australian general adult population.

BMI body mass index, CHOhighGI high glycaemic index carbohydrates, CHOlowGI low glycaemic index carbohydrates, dGI dietary glycaemic index, dGL dietary glycaemic load, SEIFA socioeconomic index for areas.

aDifferences between quartiles were tested using one-way ANOVA for continuous variables, and Pearson’s χ2 for categorical variables.

Table shows the EMM ± SEM usual intake of micronutrients across the quartiles of CHOhighGI. Participants with higher intakes of CHOhighGI had lower intakes of the majority of ***nutrients*** examined, except iodine, sodium, and %EFS where increase trends across quartiles were observed (all ptrend < 0.001). Notably, compared with participants in the first quartile of CHOhighGI, those who had the highest CHOhighGI intake had 24%, 17%, 14%, and 8% lower intakes of LCn3PUFA, vitamin C, vitamin A, and calcium, respectively, while having close to 3%points higher %EFS.

Estimated marginal mean (EMM)a ± SE usual intakeb of micronutrient according to quartile of age-, sex-, and energy-adjusted CHOhighGI intake residuals.

|  | **Q1** | **Q2** | **Q3** | **Q4** | ***p*trendc** |
| --- | --- | --- | --- | --- | --- |
| Weighted *n* | 1587 | 1468 | 1509 | 1585 | ? |
| Fiber (g) | 23.9 ± 0.3 | 22.3 ± 0.2 | 22.1 ± 0.3 | 22.7 ± 0.3 | 0.108 |
| Vitamin A RE (µg) | 874.4 ± 11.9 | 815.1 ± 10.2 | 783.3 ± 11.1 | 754.2 ± 11.0 | <0.001 |
| Thiamin (mg) | 1.47 ± 0.02 | 1.48 ± 0.02 | 1.52 ± 0.02 | 1.63 ± 0.02 | 0.108 |
| Riboflavin (mg) | 1.94 ± 0.02 | 1.84 ± 0.02 | 1.80 ± 0.02 | 1.85 ± 0.03 | <0.001 |
| DFE (µg) | 584.0 ± 6.4 | 585.1 ± 6.9 | 607.0 ± 6.9 | 652.0 ± 8.7 | 0.062 |
| Vitamin C (mg) | 112.0 ± 1.9 | 101.9 ± 1.9 | 96.1 ± 1.9 | 92.9 ± 1.9 | <0.001 |
| Vitamin E (mg) | 11.4 ± 0.1 | 10.1 ± 0.1 | 9.6 ± 0.1 | 9.4 ± 0.1 | <0.001 |
| Calcium (mg) | 842.0 ± 9.9 | 775.6 ± 9.3 | 764.8 ± 9.6 | 772.2 ± 9.5 | <0.001 |
| Iodine (µg) | 168.5 ± 1.8 | 165.8 ± 1.7 | 167.2 ± 1.8 | 172.6 ± 1.7 | <0.001 |
| Iron (mg) | 11.5 ± 0.1 | 10.8 ± 0.1 | 10.7 ± 0.1 | 11.1 ± 0.1 | <0.001 |
| Magnesium (mg) | 365.6 ± 3.5 | 328.7 ± 3.1 | 315.9 ± 3.3 | 316.6 ± 3.3 | <0.001 |
| Phosphorus (mg) | 1543.9 ± 12.6 | 1427.3 ± 11.6 | 1394.5 ± 12.5 | 1403.8 ± 12.3 | <0.001 |
| Potassium (mg) | 3134.2 ± 25.2 | 2885.1 ± 24.8 | 2789.5 ± 25.6 | 2764.2 ± 26.4 | <0.001 |
| Zinc (mg) | 11.4 ± 0.1 | 10.6 ± 0.1 | 10.4 ± 0.1 | 10.6 ± 0.1 | <0.001 |
| Linoleic acid (g) | 9.88 ± 0.13 | 8.87 ± 0.12 | 8.56 ± 0.11 | 8.61 ± 0.11 | <0.001 |
| ?-linolenic acid (g) | 1.49 ± 0.02 | 1.36 ± 0.02 | 1.27 ± 0.02 | 1.28 ± 0.02 | <0.001 |
| LCn3PUFA (mg) | 266.1 ± 5.7 | 237.0 ± 6.0 | 206.3 ± 4.3 | 201.8 ± 4.4 | <0.001 |
| Sodium (mg) | 2324.8 ± 23.5 | 2296.0 ± 23.0 | 2334.8 ± 22.9 | 2399.4 ± 23.9 | <0.001 |
| %ESFA (%) | 11.7 ± 0.1 | 11.8 ± 0.1 | 11.5 ± 0.1 | 11.0 ± 0.1 | <0.001 |
| %EFS (%) | 9.2 ± 0.2 | 10.0 ± 0.2 | 10.7 ± 0.2 | 12.1 ± 0.2 | <0.001 |

%EFS %energy from free sugars, %ESFA %energy from saturated fatty acid, CHOhighGI high glycaemic index carbohydrates, DFE dietary folate equivalents, LCn3PUFA long-chain omega-3 polyunsaturated fatty acid, SE standard error, RE retinol equivalents.

aEMM ± SE and p values were calculated by ANCOVA with age, sex, socioeconomic indexes for areas, equivalised household income, country of birth, remoteness of living area, and whether on diet as covariates.

bUsual intakes were calculated using the Multiple Source Method [].

cp for trend assessed by linear regression with median of each cut-off as the independent variable, and adjustments for the same covariates as in the ANCOVA.

Participants with higher intakes of CHOhighGI were found to be less likely to meet the NRVs for most of the examined ***nutrients*** as presented in Table , with strong dose-dependent patterns observed. When compared with participants with the lowest CHOhighGI intake, those with the highest CHOhighGI intake had more than 100% increase in odds of not meeting NRVs were observe for vitamin A (2.19, 95% CI 1.89, 2.84), vitamin C (3.93, 95% CI: 1.61, 9.60), vitamin E (2.63, 95% CI: 2.08, 3.31), iron (2.27, 95% CI: 1.48, 3.49), magnesium (2.50, 95% CI: 2.01, 3.12), potassium (2.25, 95% CI: 1.79, 2.83), %EFS (2.74, 95% CI: 2.22, 3.38), and LCn3PUFA (2.35, 95% CI: 1.76, 3.16). They were also more than 100% more likely to have ≥4, 7, or 10 ***nutrients*** not meeting NRVs. Overall there were stronger and more consistent trends in ***nutrient*** intakes and odds of not meeting NRVs across quartiles of CHOhighGI. Results by dGI and dGL quartiles were similar in pattern, while those by CHOlowGI quartiles were in general in opposite direction. These results are presented in Online Supplementary Tables –.

Odds ratios (95% CI)a of not meeting NRVb according to quartile of age-, sex-, and energy-adjusted CHOhighGI intake residuals.

|  | **Q1 (ref.)** | | **Q2** | | **Q3** | | **Q4** | | ***p*trend** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cases (%)** | **OR** | **Cases (%)** | **OR (95% CI)** | **Cases (%)** | **OR (95% CI)** | **Cases (%)** | **OR (95% CI)** |
| Fiber | 72.5 | 1.00 | 78.9 | 1.51 (1.21, 1.89) | 78.8 | 1.53 (1.22, 1.92) | 77.8 | 1.39 (1.10, 1.76) | 0.007 |
| Vitamin A RE | 16.1 | 1.00 | 17.5 | 1.18 (0.90, 1.55) | 22.6 | 1.71 (1.33, 2.21) | 30.2 | 2.19 (1.89, 2.84) | <0.001 |
| Thiamin | 11.8 | 1.00 | 13.1 | 1.06 (0.79, 1.42) | 12.7 | 0.95 (0.70, 1.27) | 10.3 | 0.73 (0.53, 1.02) | 0.048 |
| Riboflavin | 4.6 | 1.00 | 7.4 | 1.47 (0.94, 2.31) | 9.1 | 1.78 (1.18, 2.69) | 10.6 | 1.87 (1.24, 2.80) | 0.002 |
| DFE | 4.5 | 1.00 | 6.2 | 1.35 (0.86, 2.14) | 4.8 | 0.94 (0.60, 1.49) | 5.1 | 1.05 (0.62, 1.78) | 0.764 |
| Vitamin C | 1.0 | 1.00 | 2.2 | 2.23 (0.90, 5.56) | 3.6 | 3.59 (1.48, 8.74) | 3.5 | 3.93 (1.61, 9.60) | <0.001 |
| Vitamin E | 24.6 | 1.00 | 32.4 | 1.62 (1.29, 2.03) | 37.6 | 2.26 (1.81, 2.82) | 44.3 | 2.63 (2.08, 3.31) | <0.001 |
| Calcium | 57.9 | 1.00 | 71.3 | 1.56 (1.25, 1.95) | 74.1 | 1.66 (1.32, 2.08) | 71.2 | 1.75 (1.38, 2.21) | <0.001 |
| Iodine | 5.5 | 1.00 | 6.5 | 1.12 (0.73, 1.70) | 8.1 | 1.27 (0.86, 1.89) | 5.3 | 0.82 (0.54, 1.25) | 0.519 |
| Iron | 5.2 | 1.00 | 9.1 | 1.89 (1.27, 2.80) | 11.9 | 2.37 (1.60, 3.51) | 9.8 | 2.27 (1.48, 3.49) | <0.001 |
| Magnesium | 26.4 | 1.00 | 40.3 | 1.90 (1.53, 2.36) | 48.1 | 2.69 (2.17, 3.32) | 49.2 | 2.50 (2.01, 3.12) | <0.001 |
| Potassium | 61.2 | 1.00 | 69.4 | 1.57 (1.27, 1.94) | 75.0 | 2.21 (1.78, 2.74) | 78.7 | 2.25 (1.79, 2.83) | <0.001 |
| Zinc | 28.1 | 1.00 | 29.9 | 1.30 (1.02, 1.66) | 29.3 | 1.46 (1.15, 1.85) | 35.4 | 1.31 (1.02, 1.68) | 0.023 |
| Linoleic acid | 60.3 | 1.00 | 68.2 | 1.62 (1.30. 2.01) | 70.7 | 2.03 (1.62, 2.54) | 74.4 | 1.96 (1.55, 2.48) | <0.001 |
| ?-linolenic acid | 24.7 | 1.00 | 27.9 | 1.33 (1.05, 1.68) | 31.9 | 1.78 (1.42, 2.23) | 36.4 | 1.74 (1.38, 2.19) | <0.001 |
| LCn3PUFA | 13.6 | 1.00 | 15.3 | 1.34 (1.00, 1.80) | 18.0 | 1.93 (1.43, 2.59) | 26.8 | 2.35 (1.76, 3.16) | <0.001 |
| Sodium | 49.6 | 1.00 | 40.9 | 0.82 (0.66, 1.01) | 43.0 | 1.01 (0.82, 1.25) | 51.5 | 1.15 (0.93, 1.44) | 0.078 |
| %ESFA | 77.6 | 1.00 | 77.8 | 1.07 (0.85, 1.35) | 73.0 | 0.84 (0.67, 1.06) | 65.4 | 0.60 (0.47, 0.75) | <0.001 |
| %EFS | 37.5 | 1.00 | 44.0 | 1.43 (1.16, 1.76) | 49.5 | 1.86 (1.52, 2.27) | 58.2 | 2.74 (2.22, 3.38) | <0.001 |
| ?4 ***nutrients*** not meeting NRV | 74.6 | 1.00 | 84.8 | 2.19 (1.70, 2.82) | 85.0 | 2.41 (1.86, 3.12) | 88.2 | 2.58 (1.97, 3.38) | <0.001 |
| ?7 ***nutrients*** not meeting NRV | 38.7 | 1.00 | 46.9 | 1.56 (1.26, 1.92) | 54.0 | 2.26 (1.84, 2.79) | 57.6 | 2.16 (1.74, 2.69) | <0.001 |
| ?10 ***nutrients*** not meeting NRV | 11.8 | 1.00 | 18.5 | 1.85 (1.39, 2.47) | 22.7 | 2.57 (1.95, 3.39) | 29.1 | 2.97 (2.24, 3.95) | <0.001 |

95% CI 95% confidence intervals, %EFS %energy from free sugars, %ESFA %energy from saturated fatty acid, CHOhighGI high glycaemic index carbohydrates, DFE dietary folate equivalents, LCn3PUFA long-chain omega-3 polyunsaturated fatty acid, NRV ***Nutrient*** Reference Values for Australia and New Zealand, OR odds ratio, RE retinol equivalents.

aOdds ratios and 95% CI calculated using binary logistic regression, adjusted for age, sex, socioeconomic indexes for areas, equivalised household income, country of birth, remoteness of living area, and whether on diet.

bTo be considered not meeting NRV, the following criteria were used: for vitamin A, thiamin, riboflavin, dietary folate equivalents, vitamin C, calcium, iodine, iron, magnesium, phosphorus and zinc, intakes less than their respective estimated average requirement (EAR); for fiber, vitamin E, potassium, linoleic acid, α-linolenic acid and long-chain omega-3 polyunsaturated fatty acids, intakes below their respective average intake (AI); for sodium, intakes above the upper level (UL); and for %E from saturated fat and free sugars intakes above 10% total energy intake.

Discussion

This study shows that among a nationally representative sample of Australian adults, carbohydrate quality, as measured by GI, is a strong predictor of ***nutrient*** adequacy. In particular, CHOhighGI was a stronger predictor than the other carbohydrate quality indicators. That means Australian adults whose diet is lower in CHOhighGI tend to have a more nutritionally adequate diet. The present findings enabled us to better understand the potential etiology regarding the association between dGI, dGL and the risks of chronic diseases []. In the past, some dietitians challenged that following a low-GI diet may restrict food choices, which could result in a poorer dietary quality []. Our finding showed the exact opposite.

The results of this study agree with that of a previous study by our group which examined a similar research question among Australian children and adolescents []. Two European studies [, ] also similarly concluded that carbohydrate quality is more important than quantity when determining the micronutrient adequacy of a diet, where individuals who had better quality carbohydrates tend to have higher micronutrient intakes. Since a major determinant of the GI of foods is the degree of processing of the grains used (where highly processed refined grains have high GIs usually), it does not come as a surprise that those with a high CHOhighGI/dGI/dGL had poorer ***nutrient*** intakes in general. In fact, many of these highly processed grain-based foods are ***nutrient*** poor unless fortified [], and the range of ***nutrients*** that could be fortified is limited by the relevant food standards. A notable exception is thiamin, where fortification in bread flour is mandatory in Australia []. Higher intakes of cereal grains and products amongst participants in higher quartiles of the carbohydrate quality indicators therefore reduced their likelihood of not meeting the thiamin NRV.

Our results suggest that these fortified high-GI foods were not the major source of CHOhighGI in the study population. On the other hand, low-GI foods usually tend to be micronutrient-rich (e.g., dairy products, fruits and vegetables), which allowed individuals with lower dGI/dGL and higher intakes of CHOlowGI to easily meet the NRVs. Food group intake analyses (Online Supplementary Tables –) revealed that those who had higher dGI tend to have lower intakes of ***nutrient***-dense foods such as fruit and vegetables, dairy products, legumes as well as nuts and seeds, while having higher intakes of energy-dense ***nutrient*** poor foods such as sugar-sweetened beverages, savory snacks, sugars and cereal grains and products. In contrast, the pattern across dGL quartiles is less clear cut between ***nutrient***-dense and energy-dense ***nutrient*** poor foods. This could be a result of an overall higher dietary food and carbohydrate intake among those with higher dGL, rather than solely an increase in high-GI foods consumption, as evident by the concurrent increase in dGL and CHOlowGI. It is therefore important to consider the overall intake when linking dGL to chronic diseases risks, as dGL could be increased by both quality and quantity of carbohydrates consumed. Using CHOhighGI may therefore be a better indicator of poor carbohydrate quality than dGL.

Similar to our previous study in Australian children and adolescents [], we found that Australian adults who had higher dGL and/or CHOhighGI tended to have poorer intake of polyunsaturated fatty acids (PUFAs). Those who had higher dGI and dGL, and those who consume more CHOhighGI tend to include less sources of PUFAs such as fish and seafood products in their diet. They were however more likely to meet the NRV for %ESFA, possibly because they had higher energy intake from total carbohydrates which lowered the %ESFA, rather than lower intakes of saturated fat per se. Our findings suggest that dietary advice should be given with the consideration of quality of both carbohydrates and fats, because having a low-GI diet does not guarantee sufficient intake of PUFAs [].

In contrast, higher likelihood of having more than 10%EFS were observed uniformly across all four carbohydrate quality indicators. Although the most common form of free sugar in Australia, sucrose [], has a medium GI of 65 [], our calculation of dGI/dGL and classification of CHOlowGI vs. CHOhighGI were performed at the food level. Therefore, both low or high-GI mixed foods can contribute to the overall free sugar intake, and this may have been exacerbated by not adjusting for total energy intake, although it should better reflect the real-life association between carbohydrate quality and ***nutrient*** adequacy.

Our results suggest that simple nutrition education messages focusing on reducing the intakes of CHOhighGI may indeed lead to significant improvements in ***nutrient*** adequacy, especially when the CHOhighGI is replaced by CHOlowGI. In fact, it may be easier for a lay person to focus on reducing the intakes the top CHOhighGI contributors in the diet, than choosing low-GI options for most if not all foods consumed in order to achieve a low dGI/dGL. The top CHOhighGI contributors in Australia were breads and bread rolls, cereal-based mixed dishes, flour and grains, and breakfast cereals (***data*** not shown). A simple message to encourage their replacement with lower GI alternatives, together with a list of high vs. low-GI items in these food groups, should be easy to follow for most individuals. This message could complement the current dietary guidelines.

The strengths of our study include the use of a published method [] to assign GI values to the food items in the 2011–2012 AHS, which increased the reliability of the GI values assigned and allowed comparisons to be made across different studies. Another strength is the use of a nationally representative sample, which allowed our results to be generalized to the Australian adult population. Furthermore, the use of the MSM [] allowed us to account for the day-to-day variation of dietary intake to get a better estimation of usual food and ***nutrient*** intake. Although we only modeled the usual intake using age and sex and their interaction term as covariates, our post hoc analysis showed including additional socioeconomic status covariates in the transformation model did not result in material difference in the conclusion (***data*** not shown). Thus we used the ***data*** from the simple model in the current study in congruence with our previous analyses [, ].

This study is however limited in several ways. First, any association between CHOhighGI, dGI, dGL, CHOlowGI, and ***nutrient*** adequacy cannot be confirmed with cause-and-effect relationship, due to the cross-sectional nature of the analysis. Second, while the 2011–2012 AHS is the most recent published national nutrition survey in Australia at the time the analysis was conducted, it is already 7 years old. As the food supply is constantly changing, with new food products emerging from the market regularly, some of which may be enriched with a variety of micronutrients, our results may not be fully translatable to the current situation. Our results should be confirmed when a newer national dataset becomes available. Third, the 24 h recall method relies heavily on the participants to accurately recall the foods and drinks they have consumed in the past 24 h, which may be affected by memory bias, particularly for elderly participants [, ]. Ideally, the findings of the present study should be confirmed using datasets that are based on a minimum of 3-day weighed food records, which is usually considered as the criterion reference method. This however would result in high respondent burden, and may result in a lower response rate which renders the ***collected*** ***data*** nonrepresentative []. Fourth, the study only focused on ***nutrient*** intake without considering the bioavailability of ***nutrients*** by measuring the biomarkers [], as this method is financially and logistically impractical for a national nutrition survey that includes thousands of participants. For example, absorption of some ***nutrients*** such as calcium or other divalent ions may be interfered by phytate that is mostly present in carbohydrate-related foods []. The true ***nutrient*** adequacy may therefore be worse than that reported in the present study.

Conclusions

Australian adults who had a high dGI and/or dGL were more likely to be at risk of inadequate intake of several key ***nutrients*** due to high intake of CHOhighGI. The findings in this study reinforced that the health benefits of a low-GI diet were not only due to the reduction in postprandial glycaemia, but possibly also the improvement in ***nutrient*** adequacy.

**Acknowledgements**

The authors would like to acknowledge The Glycemic Index Foundation for providing the special edition of AUSNUT2011–2013 database for use in this study. The original ***data*** of the Australian Health Survey 2011–2012 were ***collected*** by the Australian Bureau of ***Statistics***. The authors declare that those who carried out the original analysis and ***collection*** of the ***data*** bear no responsibility for further analysis or interpretation included in the paper.

**Funding**

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

**Notes**

Supplementary informationThe online version of this article ([*https://doi.org/10.1038/s41430-020-0620-9*](https://doi.org/10.1038/s41430-020-0620-9)) contains supplementary material, which is available to authorized users.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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[***Register of Commission documents: Report from the Commission to the European Parliament and the Council on the implementation of Regulation (EU) No 691/2011 on European environmental economic accounts Document date: 2020-02-17 COM\_COM(2020)0056 COM documents***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5Y7P-VP61-JDG9-Y3R3-00000-00&context=1516831)

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February 18, 2020 Tuesday

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**Length:** 985 words

**Body**

Brussels: Public Register European Parliament has issued the following document:

COMMISSIONBrussels, 14.2.2020COM(2020) 56 finalREPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT ANDTHE COUNCILon the implementation of Regulation (EU) No 691/2011 on European environmentaleconomic accounts1REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCILon the implementation of Regulation (EU) No 691/2011 on European environmental economic accounts(1) INTRODUCTIONRegulation (EU) No 691/2011 on European environmental economic accounts1 (the Regulation) introduced a common framework for ***collecting***, compiling, transmitting and evaluating European environmental economic accounts. Article 10 of the Regulation stipulates the following:By 31 December 2013 and every 3 years thereafter, the Commission shall submit a report on the implementation of this Regulation to the European Parliament and the Council. That report shall evaluate in particular the quality of the ***data*** transmitted, the ***data*** ***collection*** methods, the administrative burden on the Member States and on the respondent units, as well as the feasibility and effectiveness of those ***statistics***.This is the third report fulfilling this obligation. The previous reports were published in 20162 and 20133. This implementation report covers 2016 to 2018.(2) ENVIRONMENTAL ECONOMIC ACCOUNTSThe European Green Deal resets the Commission commitment to tackling climate and environmental-related challenges4. The Commission commits to put the EU firmly on a new path of sustainable and inclusive growth, while protecting and strengthening the EU’s natural capital. Under the Green Deal, the EU aims to: increase the EU’s climate ambition to achieve climate neutrality by 2050; supply clean energy; bring about a circular economy; build in an energy and resource-efficient way; achieve zero pollution and a toxic-free environment; preserve and restore ecosystems and biodiversity; ensure a sustainable and healthy food system; promote sustainable and smart mobility.1 [*http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02011R0691-201406162*](http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02011R0691-201406162)   [*https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1478531808092&uri=CELEX:52016DC06633*](https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1478531808092&uri=CELEX:52016DC06633)   [*http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013DC08644*](http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013DC08644)   [*https://ec.europa.eu/info/sites/info/files/european-green-deal-communication\_en.pdf2Ensuring*](https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf2Ensuring) a ‘just transition’ towards climate neutrality and financing the transition are key elements to be mainstreamed in all policies. The European Green Deal is an integral part of the Commission’s strategy to implement the 2030 Agenda and the UN Sustainable Development Goals.Environmental economic accounts, or environmental accounts for short, are a powerful, multipurpose information framework addressing the sustainability aspects of our economic behaviour. Mainstream economic ***statistics***, such as the national accounts, which underpin GDP, do not take account of environmental aspects in production, consumption, investment or financing. The environmental accounts enable the integration of economic and environmental aspects to complete this picture.The key feature of environmental accounts is integration. This concerns both the integration of environmental and economic aspects, and the integration into a consistent economic accounting system of a range of key thematic environmental aspects such as i) energy, taxation and air emissions; ii) material extractions and waste; and iii) government and business expenditure and investment. This integration allows developing coherent indicator sets, and helps identifying possible synergies and trade-offs between sectoral policies. The environmental accounts facilitate this due to the reasons set out below. They generate coherent sets of indicators that are linked to one another in a comprehensive and consistent economic and environmental context. Correspondingly, the accounts are well placed for assessment frameworks relating to the key components of natural capital (air, water, land and biodiversity) and to serve multidimensional, cross-cutting topics such as progress towards achieving the Sustainable Development Goals or the circular economy; They provide structure and enhance possibilities for analysis. Information is organised to exploit synergies across individual thematic areas. This enables cost-effectiveness analyses, scenario modelling and forecasts. The accounts enable the allocation of emissions or resource use to imports, exports, consumption and investment and the calculation of footprint-type indicators using input-output techniques. Other applications include measuring the contribution of natural resources and energy to economic growth (growth accounting, decomposition analysis).The accounting approach is useful because it enables high quality information to be produced (i.e by integrating source ***data*** and combining them into robust estimates) and available ***data*** to be reused so as to limit the administrative burden on businesses and citizens. At European level, the European environmental accounts underpin the supranational dimension of the environmental issues and provide a systematic approach and coverage across Member States and environmental topics that enable policy assessment and comparisons across Member States.3The European environmental accounts are based on the international standard System of Environmental-Economic Accounting 2012 – Central Framework (SEEA CF)5. This standard was produced and released under the auspices of the United Nations, the European Commission (***Eurostat***), the Food and ***Agriculture*** Organisation of the UN, the Organisation for Economic Co-operation and Development (OECD), the International Monetary Fund and the World Bank group.The Regulation establishes the European environmental economic accounts. The Regulation has EEA relevance6. It structures the accounts in modules

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[***UNO Official Document System (ODS): IMPLEMENTATION OF THE UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE STATISTICAL PROGRAMME 2020 - ADDENDUM - REPORT OF THE JOINT ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT /UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE SEMINAR ON THE IMPLEMENTA***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:601P-88J1-F0YC-N1X0-00000-00&context=1516831)

Impact News Service

May 30, 2020 Saturday

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**Length:** 1848 words

**Body**

New York: Office of The United Nation has issued the following Document:

Implementation of the United Nations Economic Commission for EuropeStatistical Programme 2020AddendumReport of the Joint Organisation for Economic Cooperation and Development /United Nations Economic Commission for EuropeSeminar on the Implementation of the System of Environmental-Economic Accounting (SEEA)Note by the secretariatSummaryThe present report presents the key outcomes of the fifth Joint OECE-UNECE Seminar on the implementation of the System of Environmental-Economic Accounting (SEEA) which was held on 13-14 February 2020 in Geneva, Switzerland.The seminarwas organized following a decision of the Conference of European Statisticians in June 2019 (ECE/CES/2019/13). The report is submitted to the Conference of European Statisticians for information.United NationsECE/CES/2020/14/Add.15Economic and Social CouncilDistr.: General20May2020EnglishonlyECE/CES/2020/14/Add.152I.Introduction1.The fifth Joint OECD/UNECE Seminar on the Implementation of the System of Environmental-Economic Accounting (SEEA) was held in Geneva from 13-14 February 2020. It was jointly organized with the Organisation for Economic Cooperation and Development (OECD) and an organising committee with members from Argentina, Australia, Belarus, Canada, Kazakhstan, Kyrgyzstan, New Zealand, the Netherlands, the Statistical Office of the European Union (***Eurostat***) and the United Nations ***Statistics*** Division (UNSD).2.Experts from the following countries attended the meeting: Albania, Armenia, Armenia, Azerbaijan, Belarus, Canada, Colombia, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Ireland, Kazakhstan, Kyrgyzstan, Lithuania, Luxembourg, Malta, Mexico, Republic of Moldova, the Netherlands, Portugal, Russian Federation, Slovenia, Sweden, Switzerland, Tajikistan, Turkmenistan, Ukraine, United Kingdom and Uzbekistan.3.Representatives of the United Nations Environment Programme (UNEP), International Labour Organization (ILO), European Commission –***Eurostat***, European Environment Agency (EEA)and theOrganisation for Economic Cooperation and Development (OECD)also attended the meeting. 4.The non-governmental organization Cadaster Institutewasalso represented at the meeting.5.Academia and research were represented by École Normale Supérieure de Lyon, the Leibniz Institute of Ecological Urban and Regional Development, the Technical University of Civil Engineering of Bucharest, the University of Lausanneand the World Resources Institute.6.The Federal Planning Bureau (Belgium) also attended the meeting.II.Organization of the seminar7.The seminar was chaired by Mr. Gerard J. Eding (***Statistics*** Netherlands).8.The participants adopted the agenda of the seminar.9.The seminar was structured in form of 5 sessions:(a)Session 1: Opening and introduction;(b)Session 2: Measuring circular economy with SEEA;(c)Session 3: Measuring the environmental goods and services sector (EGSS);(d)Session 4: SEEA Experimental Ecosystem Accounting (SEEA EEA);(e)Session 5: Conclusions and recommendations for further work.10.Session Chairs were Mr. Gerard Eding(***Statistics*** Netherlands, sessions1and 5), Mr.Arturo de la Fuente(***Eurostat***, session 2), Mr. Michael Wright(***Statistics*** Canada, session 3)andMs. Baktygul Ysabekova(National Statistical Committee of Kyrgyzstan, session 4).11.The two panel discussions in session 2 were moderated by Ms. Ekaterina Poleshchuk (National Statistical Committee of the Republic of Belarus) and Mr. Michael Nagy (UNECE). A panel discussion in session 3 wasmoderated by Mr. Asset Nakipbekov (Committee on ***Statistics*** of the Republic of Kazakhstan).12.A poster session was launched at the lunch break on 13 February. Posters were presented by Armenia, Belarus, Russian Federation, École Normale Supérieure de Lyonand the World Resources Institute.13.All documents of the meeting are available at [*http://www.unece.org/index.php?id=52557*](http://www.unece.org/index.php?id=52557).

ECE/CES/2020/14/Add.153III.Summary of the discussion and main conclusions reached at the meetingA.Session 1: Opening and introduction14.The objectives of this session, in addition to introducing and adopting the agenda, were to give an overview on recent and planned SEEA-related activities of international organisations and to present the ongoing work of the United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA). Furthermore, the main outcomes of the 24thmeeting of the London Group on Environmental Accounting and progress made with the SEEA research agenda were presented in this session.15.UNECE gave a presentation about SEEA-related activities of international organisations in the UNECE region, which was jointly prepared by EEA, ***Eurostat***, the Food and ***Agriculture*** Organization of the United Nations (FAO), ILO, OECD, UNECE, UNEP, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), United Nations Statistical Division (UNSD) and the World Bank. These international organisations are active in the region in multiple ways, including capacity development, methodological work, analytical work as well as the ***collection*** and dissemination of SEEA-related ***data***. The main objective of the information was to inform seminar participants about these activities and to contribute to their coordination.16.OECD presented their work on developing global SEEA databases under the umbrella of UNCEEA (working area D of the UNCEEA work programme). OECD is leading this working area in which several other international organisations are also involved. The main objective is the development of worldwide databases for a number of high priority SEEA-accounts(energy, air emissions, land, material flows, water), to be disseminated via a common platform, to provide a one-stop-shop for SEEA-related ***data*** at the global level. The SEEA databases will be available via the SEEA website1. A set of principles for the creation and maintenance of these databases was presented at the meeting.17.UNSD prepared a presentation on other work of UNCEEA with relevance for the region, which was presented by the seminar Chair. UNSD was not able to attend the meeting. A short overview was given on the state of work in the main working areas “coordination” (area A), “methodology” (including research agenda items, area B), “capacity building” (area D) and communication (area E). UNSD also informed that the UNCEEA membership is currently under review by its Bureau.18.The representative of ***Statistics*** Sweden, who is also the Chair of the London Group on Environmental Accounting, presented the current objectives of this city group and the main outcomes of its latest meeting, which was held from 7-10 October 2019 in Melbourne (Australia). The current focus of work is on supporting methodological development of SEEA Central Framework (SEEA-CF), supporting the promotion and implementation of SEEA-CF and contributing to the further development of SEEA Experimental Ecosystem Accounting (SEEA-EEA). An important additional objective is to provide a forum for sharing of national and international expertise and experience.B.Session2: Measuring circular economy with System of Environmental-Economic Accounting (SEEA)19.The session provided an introduction into the concept of the circular economy and its various definitions and discussed related policy questions and how they could be informed with SEEA.20.Furthermore, it discussed with the use of examples from countries and international organisations how selected SEEA accounts can contribute to measuring a transition towards a circular economy.1SEEA website: [*https://seea.un.org/ECE/CES/2020/14/Add.15421.****Eurostat***](https://seea.un.org/ECE/CES/2020/14/Add.15421.Eurostat) opened the session with a presentation of the main concepts and definitions of circular economy. The presentation also discussed the relevance of SEEA for measuring the circular economy and listed several relevant SEEA thematic accounts that are relevant for this policy application.22.OECD informed about their various activities related to circular economy policy making and measuring circular economy. OECD’s presentation discussed detailed information needs for the transition towards a circular economy.23.EEA presented how circular economy is measured and monitored in Europe and how this is used in several of their reports, including the most recent “European environment –state and outlook 2020”. EEA also presented their circular economy concept, which provides the conceptual basis for their work.24.Colombia presented the rationale for their national circular economy strategy and the lessons learned from drafting the first national circular economy report in 2019. Missing information includes consumption systems and the social dimension. Their efforts to strengthen SEEA implementation is expected to address some of the biggest information gaps.25.Finland in its presentation discussed the role of official ***statistics*** in producing circular economy indicators. A big challenge mentioned is to define the scope of circular economy. Therefore, ***Statistics*** Finland carried out a conceptual analysis based on a stakeholder survey and academic research.26.Netherlands recommended in its presentation the use of Sankey diagrams to illustrate material flows within the economy and to derive indicators. One example for an important indicator derived from it is the circular material use rate. Individual SEEA modules (such as Economy-wide Material Flow Accounts) provide useful inputs for this work.27.Canada presented their work on measuring plastics waste within the framework of circular economy. Challenges included the choice of the most appropriate methodology (e.g SEEA), the development of coefficients to convert financial estimates into physical quantities, figuring out how many years certain plastic goods stay in the economy and survey ***data*** not being granular enough.28.Mexico made a quick assessment about its available information sources for producing the ten indicators of the European Commission’s monitoring framework on the circular economy. In their presentation it was shown that at least six of these indicators can be produced from their national SEEA ***data***.29.The session included two panels where the following issues were discussed with the audience:(a)How to measure the transition towards a circular economy and the possible role of SEEA-CF (panellists from Canada, Colombia, EEA and UNECE/FAO);(b)What indicators are needed, how they can be communicated and how can SEEA used to its maximum potential for measuring circular economy (panellists from Finland, Mexico, Netherlands and OECD).Conclusions30.The discussions of the panellists and the audience were concluded by the session chair as follows:(a)Different definitionsof circular economy exist, but all seem to go into the same direction;(b)SEEA-CFhas an important role in measuring circular economy, although it is not the only ***data*** source;(c)One needsto get better at the interlinkages between topics e.g materials, energy use, carbon emissions, pollution, expenditure, employment, etc.and SEEA is particularly useful for enabling these linkages;

**Load-Date:** June 1, 2020

**End of Document**



[***Register of Commission documents: DRAFT OPINION on Impacts of EU rules on the free movements of workers and services: intra-EU labour mobility as a tool to match labour market needs and skills AGRI\_PA(2020)648630 / FULL / EN01/04/2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YKS-KN91-F0YC-N4FB-00000-00&context=1516831)

Impact News Service

April 4, 2020 Saturday

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**Length:** 544 words

**Body**

Brussels: Public Register European Parliament has issued the following document:

PA\1202015EN.docx PE648.630v01-00EN United in diversity ENEuropean Parliament2019-2024Committee on ***Agriculture*** and Rural Development2020/2007(INI)1.4.2020DRAFT OPINIONof the Committee on ***Agriculture*** and Rural Developmentfor the Committee on Employment and Social Affairson impacts of EU rules on the free movements of workers and services: intra-EU labour mobility as a tool to match labour market needs and skills(2020/2007(INI))Rapporteur for opinion: Ruža TomašićPE648.630v01-00 2/4 PA\1202015EN.docxENPA\_NonLegPA\1202015EN.docx 3/4 PE648.630v01-00ENSUGGESTIONSThe Committee on ***Agriculture*** and Rural Development calls on the Committee onEmployment and Social Affairs, as the committee responsible, to incorporate the followingsuggestions into its motion for a resolution:– having regard to the Commission’s 2018 Annual Report on Intra-EU Labour Mobility,– having regard to the study entitled ‘The EU farming employment: current challengesand future prospects’, published by its Directorate-General for Internal Policies inOctober 20191,A. whereas the principle of the free movement of workers is enshrined in Article 45 of theTreaty on the Functioning of the European Union;B. whereas according to ***Eurostat*** population ***statistics***, there were 17 million EU-28movers in the EU in 2017, of which 12.4 million were of working age (employed orlooking for work);1. Welcomes the Commission’s legislative proposal of March 2018 for establishing aEuropean Labour Authority to ensure that EU rules on labour mobility are enforced in afair, simple and effective way;2. Considers that better legal frameworks and a greater focus on the implementation andenforcement of labour law are urgently needed, including with regard to employmentrights and social security coverage, especially for atypical work and exploited labour;3. Points out that better targeting of EU funds would support worker mobility, enablingbetter use of the information available and improving the ***collection*** and use of ***data*** onthe patterns of labour mobility flows and imbalances within the labour market;4. Considers that family workers still represent the vast majority of ***agricultural*** labour inEurope, and that insufficient generational renewal is one of the major challenges facedby the farming sector across the EU, resulting in fewer farmers in the sector year afteryear;5. Points out that technological innovation is a driver of structural change within farms andagricultural labour markets, and that many holdings across Europe are not sufficientlyprepared for taking up technological innovation owing to the low level of agriculturaltraining of their farm managers, a level which differs significantly among MemberStates;6. Recalls that maintaining farming employment plays a key role in keeping ruraleconomies alive and is therefore of significant importance;7. Believes that the EU should not make legislation on EU minimum wages as this is a1 Study – ‘The EU farming employment: current challenges and future prospects’, European Parliament,Directorate-General for Internal Policies, Policy Department for Structural and Cohesion Policies, October 2019.PE648.630v01-00 4/4 PA\1202015EN.docxENnational competence.

**Load-Date:** April 6, 2020

**End of Document**



[***What constitutes healthiness of Washoku or Japanese diet?***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2C1-JCWX-C1YJ-00000-00&context=1516831)

European Journal of Clinical Nutrition

February 2021

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**Section:** Pg. 863-864; Vol. 75; No. 6; ISSN: 0954-3007,1476-5640

**Length:** 568 words

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**Body**

Japan is a small country geographically located far east of Eurasian continent but has ~126 million people, which was the 11th largest population in the world. Japanese people are proud of their traditional cuisine Washoku, which has been an intangible cultural heritage certified by the United Nations Educational, Scientific, and Cultural Organization in 2013. Before the Covid-19 pandemic in 2020, Japan’s tourism industry thrived for the last decade, as the number of tourists increased from about 10 million in 2013 to over 30 million in 2019 []. Together with these enthusiastic visitors excited by Washoku tourism, Japanese government has also been putting a lot of effort into advertising Washoku, emphasizing its healthiness as one of its merits [, ]. Authentic Washoku requires Japan’s mild climate with four seasons, quality water originated from mountainous land, and availability of a large variety of fishes and seaweed from the surrounding sea [].

In this special issue of European Journal of Clinical Nutrition, we listed the health benefits of Japanese diet, first by providing an overview that explained how Japan achieved the world’s highest life expectancy from dietary perspective []. Then, we provided four review articles focusing on the health effects of fish and omega-3 polyunsaturated fatty acid [], seaweed [], soy [] and green tea [], foods, drinks and ***nutrients*** that characterize Japanese diet. Interesting findings of three prospective studies followed the reviews. Intake of fermented soy foods such as natto was inversely associated with cardiovascular disease incidence but only in women in the Japan Public Health Center-based prospective Study []. Another intriguing new finding is possible enhancement of resistance against influenza by frequent green tea intake [], which need to be confirmed by future randomized trials. Dietary, i.e., ingredient diversity, which also characterizes Japanese diet [], was associated with slower hippocampal atrophy, and might give you protection against Alzheimer’s disease in a 2-year follow-up study of the National Institute for Longevity Sciences-Longitudinal Study of Aging []. Results of one cross-sectional and one ecological study are also discussed in the present issue. The Japan Multi-Institutional Collaborative Cohort study suggested a SNP related to preference for a Japanese dietary pattern []. An ecological study, which utilized Food and ***Agriculture*** Organization of the United Nations ***Statistics*** Division database, explored intercountry comparisons of traditional Japanese diet score and incidence and mortality of breast cancer [].

Finally, from social epidemiological perspective, a benefit of school lunch program, which is also considered as an important measure to preserve Washoku culture for future generations [], was introduced to reduce socioeconomic disparities in diet quality using National Health and Nutrition Survey ***data*** [].

We believe that the ***collection*** of these articles focusing on Japanese diet is of interest to our readership as the components are employed in food guidelines of various countries [, ]. Also, the benefits of Washoku that consists of a diversity of plant-based ingredients and low amounts of foods from animal sources would not only include human health but a key to environmental sustainability. It is our current responsibility to envision and seek ways to achieve planetary health [].

**Notes**

Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** February 6, 2023

**End of Document**



[***Register of Commission documents: Annex to the communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A Farm to Fork Strategy For a fair, healthy and environmentally-friendly food system COM\_COM(2020)0381 / ANN01 / EN20/05/2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6002-RCN1-JDG9-Y4GK-00000-00&context=1516831)

Impact News Service

May 22, 2020 Friday

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**Length:** 773 words

**Body**

Brussels: Public Register European Parliament has issued the following document:

EN ENEUROPEANCOMMISSIONBrussels, 20.5.2020COM(2020) 381 finalANNEXANNEXto theCOMMUNICATION FROM THE COMMISSION TO THE EUROPEANPARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIALCOMMITTEE AND THE COMMITTEE OF THE REGIONSA Farm to Fork StrategyFor a fair, healthy and environmentally-friendly food systemEN ENFARM TO FORK STRATEGYDRAFT ACTION PLANThe measures presented in this action plan will all need to be taken forward in line with the better regulation principles, including evaluations and impact assessments as appropriateACTIONS Indicative time-table N° - Proposal for a legislative framework for sustainable food systems 20231. - Develop a contingency plan for ensuring food supply and food security Q4 20212.Ensure sustainable food production- Adopt recommendations to each Member State addressing the nine specific objectives of the Common ***Agricultural*** Policy (CAP), before the draft CAP Strategic Plans are formally submittedQ420203.- Proposal for a revision of the Sustainable Use of Pesticides Directive to significantly reduce use and risk and dependency on pesticides and enhance Integrated Pest ManagementQ120224.- Revision of the relevant implementing Regulations under the Plant Protection Products framework to facilitate placing on the market of plant protection products containing biological active substancesQ420215.- Proposal for a revision of the pesticides ***statistics*** Regulation to overcome ***data*** gaps and reinforce evidence-based policy making20236.- Evaluation and revision of the existing animal welfare legislation, including on animal transport and slaughter of animalsQ420237.- Proposal for a revision of the feed additives Regulation to reduce the environmental impact of livestock farmingQ420218.- Proposal for a revision of the Farm Accountancy ***Data*** Network Regulation to transform it into a Farm Sustainability ***Data*** Network with a view to contribute to a wide uptake of sustainable farming practicesQ220229.- Clarification of the scope of competition rules in the TFEU with regard to sustainability in ***collective*** actions.Q3202210.- Legislative initiatives to enhance cooperation of primary producers to support their position in the food chain and non-legislative initiatives to improve transparency2021-202211.- EU carbon farming initiativeQ3202112.Stimulate sustainable food processing, wholesale, retail, hospitality and food services’ practices - Initiative to improve the corporate governance framework, including a requirement for the food industry to integrate sustainability into corporate strategies Q1 202113. - Develop an EU code and monitoring framework for responsible business and marketing conduct in the food supply chain Q2 202114. - Launch initiatives to stimulate reformulation of processed food, including the setting of maximum levels for certain ***nutrients*** Q4 202115. - Set ***nutrient*** profiles to restrict promotion of food high in salt, sugars and/or fat Q4 202216.- Proposal for a revision of EU legislation on Food Contact Materials to improve food safety, ensure citizens’ health and reduce the environmentalQ4 202217.EN ENfootprint of the sector- Proposal for a revision of EU marketing standards for ***agricultural***, fishery and aquaculture products to ensure the uptake and supply of sustainable products2021-202218.- Enhance coordination to enforce single market rules and tackle Food Fraud, including by considering a reinforced use of OLAF’s investigative capacities2021-202219.Promote sustainable food consumption, facilitating the shift towards healthy, sustainable diets- Proposal for a harmonised mandatory front-of-pack nutrition labelling to enable consumers to make health conscious food choicesQ4202220.- Proposal to require origin indication for certain productsQ4202221. - Determine the best modalities for setting minimum mandatory criteria for sustainable food procurement to promote healthy and sustainable diets, including organic products, in schools and public institutions Q3 202122. - Proposal for a sustainable food labelling framework to empower consumers to make sustainable food choices 202423. - Review of the EU promotion programme for ***agricultural*** and food products with a view to enhancing its contribution to sustainable production and consumption Q4 202024. - Review of the EU school scheme legal framework with a view to refocus the scheme on healthy and sustainable food 202325.Reduce food loss and waste- Proposal for EU-level targets for food waste reduction202326.- Proposal for a revision of EU rules on date marking (‘use by’ and ‘best before’ dates)Q4202227.

**Load-Date:** May 24, 2020

**End of Document**



[***Association Between Nutrient Patterns and Hypertension Among Adults in the United States: A Population-Based Survey***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2V1-F0C0-314P-00000-00&context=1516831)

High Blood Pressure & Cardiovascular Prevention

March 2020

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**Section:** Pg. 133-138; Vol. 27; No. 2; ISSN: 1120-9879,1179-1985

**Length:** 2914 words

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**Body**

Introduction

Hypertension (HTN) is an established major risk factor for cardiovascular disease (CVD). CVD is also the leading cause of death in the United States (US) []. Thus, controlling HTN could lead to a significant decrease in the risk of CVD morbidity and mortality []. Epidemiological studies have revealed that diet plays a crucial role in the pathology, prevention, and management of HTN []. The risk of HTN can be decreased with a diet high in fruits and vegetables, as reported in the Dietary Approaches to Stop Hypertension (DASH) intervention study []. The Mediterranean Diet, which is a also a plant-based dietary pattern but features higher proportions of monounsaturated fats (MUFA) has been reported to have beneficial effects in the management of HTN []. Such association can be partly explained by antioxidants (e.g., vitamins C and E) found in fruits and vegetables. Antioxidants have a major role in preventing oxidative stress which is a leading cause of chronic diseases [, ]. ***Nutrients*** such as potassium, niacin, thiamine, riboflavin, vitamin-B12, iron, and magnesium have also been found to decrease blood pressure [–].

Dietary intake can be evaluated by determining the consumption of individual ***nutrients*** and foods; however, it is becoming increasingly obvious that a mixture of these dietary exposures might affect chronic diseases []. Additionally, as individuals consume meals consisting of a variety of food items and complex combinations of ***nutrients***, using a traditional approach such as focusing on the intake of a single micronutrient and/or macronutrient does not necessarily take into account the cumulative inter-correlations and interactions between foods and ***nutrients*** []. ***Nutrient*** pattern (NP) analysis has therefore been recognized as a suitable method in nutritional epidemiology to investigating diet-disease relationships []. It has been suggested that NP may offer a better and more generalizable insight into diet-disease association [] and might be more prognostic of chronic disease risk compared with the consumption of individual ***nutrients*** []. Principal component analysis (PCA) is known as the most commonly used NP analytical approach []. In PCA, statistical approaches are applied to examine the pattern of intake of multiple ***nutrients*** to derive NPs [].

Despite the growing interest in dietary patterns and the risk of HTN, findings from studies remain inconsistent [–]. The current evidence has been carried out across a range of countries and indicates that dietary patterns and ***nutrients*** may be associated with the likelihood of HTN []. The present study will be, to our knowledge, the largest study conducted to date assessing HTN, dietary patterns, and ***nutrients*** in both males and females in the US population.

The main aim of this study was to identify the major NPs in a population-based sample of US adults and to investigate the associations of these NPs with the prevalence of HTN while accounting for the most prominent confounding factors.

Methods

Study Population

We used ***data*** from the National Health and Nutrition Examination Survey (NHANES), a national survey series by the US National Center for Health ***Statistics*** (NCHS) with the goal of assessing the health and nutritional status of the US population []. The detailed information regarding the NHANES sampling design, questionnaires, clinical measures, and individual-level ***data***, has been reported elsewhere []. All adult participants provided informed consent. The NCHS ethics review board approved the survey protocol []. For this study, we combined ***data*** from six 2-year NHANES survey cycles: 2005–2012. The questionnaires in the NHANES survey contain sociodemographic characteristics (age, sex, education, and race/Hispanic origin) and ***data*** on previously diagnosed medical conditions. ***Data*** on blood pressure were ***collected*** from NHANES, and details are provided in the NHANES Anthropometry Procedures Manual []. To obtain the participants’ blood pressure levels, the average of all available measures after a total of 4 attempted readings were used. Hypertension was diagnosed in individuals with systolic blood pressure at or above 140 mmHg. Also, diastolic blood pressure at or above 90 mmHg in persons who were on anti-hypertension medications was considered as HTN [].

Dietary Assessment

In the dietary recall component of the survey, the amount of all foods and beverages that participants had consumed from midnight to midnight on the day before the interview was recorded. The in-person dietary recall used guidelines, designed to assist the participant in reporting the amount, volume, and size of the food/beverage items consumed in the last 24 hours with accuracy. Following the dietary assessment, the energy and ***nutrient*** contents of each reported food and beverage items were coded using the US Department of ***Agriculture***’s Food and ***Nutrient*** Database for Dietary Studies (FNDDS, [*www.ars.usda.gov*](http://www.ars.usda.gov)).

Statistical Analysis

We conducted the study according to the guidelines set by Centres for Disease Control for analysis of complex NHANES dataset accounting for the masked variance and using the proposed weighting methodology []. To determine the NPs, we applied PCA with orthogonal transformation (Varimax procedure). Factors were retained for further analysis based on their natural interpretation and eigenvalues on the Screen test []. PCA provided a factor loading for each NPs. Next, we computed the factor score for each NP by summing up intakes of ***nutrients*** weighted by their factor loadings []. A factor score was donated to each participant for the identified pattern. All the necessary prerequisites of PC analysis, including linearity, Kaiser–Meyer–Olkin measure of 0.88, and the test of sphericity (Bartlett’s test, p < 0.001) were met. Factors were retained for further analysis based on their natural interpretation and eigenvalues on the Screen test [, ]. Simple linear dose-response relationships are unlikely to be found in nutritional epidemiology. Continuous and categorical demographic variables were compared across quartiles of ***nutrient*** pattern scores using analysis of variance (ANOVA) and Chi-square tests, respectively. We computed age-, sex- and race-adjusted mean intakes of ***nutrients*** using analysis of covariance (ANCOVA) with Bonferroni correction. We used multivariate logistic regression to evaluate the association between risk of HTN with each NP adjusting for age, sex, race, education, energy intake and antihypertensive treatment. Following the guidelines, we applied the sample weights to account for unequal probabilities of selection, nonresponse bias and oversampling. All tests were two-sided, and a p value of < 0.05 was used to characterize statistically significant results unless otherwise stated. All ***data*** were analyzed using SPSS complex sample module version 22.0 (IBM Corp, Armonk, NY).

Results

Description of the Study Participants

The baseline demographics stratified according to HTN status is presented in Table . From a total sample of 22,184 individuals, 4002 and 18,182 were hypertensive and normotensive, respectively (Table ). A significant association between sex and HTN (p = 0.004) was found. Overall, individuals with HTN were older compared to those without HTN (mean age 58.9 vs. 43.7 years; p < 0.001). The prevalence of HTN was also significantly different by race with those in the non-Hispanic white race category being more likely to have HTN whereas Mexican Americans were less likely to have HTN (p < 0.001, Table ).

Distribution of demographics of participants by status of hypertension

| **Variables** | **Hypertensive** | **Normotensive** | **p value** |
| --- | --- | --- | --- |
| Unweighted (n) | 4002 | 18,182 |  |
| Age [mean (95% CI)] | 58.9 (58.0?59.88) | 43.7 (43.0?44.4) | < 0.001 |
| Sex (%) |  |  |  |
| Male | 52.1% | 48.5% | < 0.001 |
| Female | 47.9% | 51.5% |  |
| Race (%) |  |  |  |
| Non-Hispanic White | 69.1% | 68.9% | < 0.001 |
| Mexican American | 6.0% | 8.7% |  |
| Non-Hispanic Black | 15.7% | 10.6% |  |
| Other Hispanic | 3.8% | 5.2% |  |
| Others | 5.4% | 6.6% |  |

Value expressed as a mean and 95% confidence interval or presentHTN hypertension, CI confidence interval

Principal Components Analysis

Using PCA method, we reduced the dietary variables from 63 to three major NPs, which together explained 50.8% of the variance of the dietary ***nutrient*** consumption (first 24.1%, second 16.3%, and third 10.4%). The first MUFA rich NP was mainly representative of high MUFA and low saturated fatty acids (SFA). The second micronutrient dense NP was rich in vitamins and minerals (Vitamin A, Riboflavin, Vitamin E, Magnesium, Potassium), and the third PUFA rich NP was mainly representative of high dietary PUFA and low dietary cholesterol. For the ***nutrients*** that are constituent elements of each NP, there was a statistically significant increase in trends of the ***nutrient*** intake by quartiles of the corresponding NP (all p < 0.001). For the ***nutrients*** that are not constituent elements of the other NPs, the trends were either weakened or reversed. For example, in the high MUFA NP MUFA intake increased between each quartile (from 17.4 g in the first quartile to 42.9 g in the 4th quartile, p < 0.001). In the micronutrient dense NP, intake of vitamin E and potassium rose from 4.5 mg and 1763 mg in the 1st quartile to 11.4 mg and 3688 mg in the 4th quartile respectively (both p < 0.001).

Adjusted (age, race, sex, education, energy intake and antihypertensive treatment) multiple logistic regression was applied to examine the strength of the association between HTN and the NPs (Table ). There was a graded decrease in the odds of an association with HTN by quartiles in the high MUFA NP with the 4th quartile being associated with a 28% (0.72, 95% CI 0.62–0.81; p < 0.001) lower odds of HTN compared to the 1st quartile. Therefore, with increasing dietary intake of MUFA, a reduced likelihood of HTN was observed. The same trend was observed for the NP “***Nutrient*** dense” which is highly loaded with vitamins and minerals (i.e., the 4th quartile had a 20% [0.80, 95% CI 0.62–0.96; p < 0.001] lower odds of HTN compared to first quartile) (Table ). We found no association with odds of HTN regarding the high PUFA NP. No significant interactions were found between NPs (p > 0.234).

Odds ratio (95% CI) for hypertension according to quartile (Q) of ***nutrient*** patterns

| **Variable** | **First NP (high in MUFA low SFA)** | **Second NP (high intake of micronutrients and vitamins)** | **Third NP (high dietary PUFA and low cholesterol)** |
| --- | --- | --- | --- |
| Partially adjusteda |  |  |  |
| Q1 | 1.0 [reference] | 1.0 [reference] | 1.0 [reference] |
| Q2 | 1.06 (0.92?1.11) | 0.98 (0.93?1.02) | 0.99 (0.96?1.02) |
| Q3 | 0.73 (0.64?0.84) | 0.76 (0.72?0.81) | 1.01 (0.99?1.02) |
| Q4 | 0.66 (0.48?0.92) | 0.60 (0.40?0.81) | 0.96 (0.94?0.98) |
| p trend | < 0.001 | < 0.001 | 0.011 |
| Fully adjustedb |  |  |  |
| Q1 | 1.0 [reference] | 1.0 [reference] | 1.0 [reference] |
| Q2 | 0.97 (0.62?1.32) | 0.92 (0.62?1.22) | 0.98 (0.85?1.11) |
| Q3 | 0.75 (0.63?0.88) | 0.82 (0.71?0.94) | 0.86 (0.63?1.09) |
| Q4 | 0.72 (0.62?0.81) | 0.80 (0.62?0.96) | 0.85 (0.42?1.29) |
| p trend | < 0.001 | < 0.001 | 0.763 |

aPartially adjusted model: adjusted for age, race, sex.

bFully adjusted model: adjusted for age, race, sex, education, calories intake and antihypertensive. Adjusted logistic regression performed.

Discussion

In the current study, we determined the association between different NPs and HTN by applying PCA among US adults. The first NP was mainly represented by a diet low in SFA and high in MUFAs. The second NP was characterized by high intake of micronutrients including vitamins and minerals, and the third NP was representative of high dietary PUFA and low dietary cholesterol. In combination, the three NPs explained 50.8% of the variance of dietary consumption.

Our results indicated a graded reduction in the odds of HTN across the quartiles of an increasing MUFA rich NP among men. A similar trend was observed in women. The 4th quartile was associated with 28% lower odds of HTN compared to the 1st quartile. The second NP, which was representative of a diet rich in micronutrients and vitamins was associated with a reduced trend for HTN through the quartiles of the NP score.

A blood pressure (BP) lowering the effect of MUFA has been suggested in some epidemiologic studies among populations with a high intake of MUFA []. Among hypertensive women, a diet rich in MUFA from olive oil showed beneficial effects on BP []. The protective effect of a Mediterranean diet promoting higher intake of MUFA was also shown in the seminal PREDIMED study where Mediterranean diet and low-fat diet were equally favourable for overall BP management although superior effects for diastolic BP were seen in the Mediterranean diet only []. Such association has not been reported in other trials exclusively among normotensive subjects []. It is hypothesised that in hypertensive individuals, due to their knowledge of their HTN some adherence to dietary recommendations that enhance BP may be followed and as such there is a degree of homogeneity for the emerging dietary patterns. Thus they can not be compared to normotensive individuals. In another study, replacing dietary PUFA with MUFA lowered both systolic and diastolic BP in 16 type 2 diabetes patients [], whereas only a minor drop in diastolic BP was detected in healthy subjects []. In addition, a diet rich in olive oil lowered the systolic BP and diastolic BP by 4–5 and 3 mm Hg, respectively, when compared to a carbohydrate-rich diet among a group of normotensive participants with type 2 diabetes. On the contrary, such an effect was not detected in a small group of insulin-treated type 2 diabetic patients with microalbuminuria []. The olive oil phenolics, as powerful antioxidants, may explain the BP lowering effect [].

The discrepancies between the studies investigating similar dietary changes may be due to differences in populations. Furthermore, differences in measurement methods may explain some discrepancies. The ambulatory BP monitoring with repeated measurements over 24 hours more accurately detects small changes in BP compared with clinical BP measurements. It is notable that among type 2 diabetes patients, in a study by Storm et al. blood pressure was not influenced by the type of SFAs ( stearic vs. palmitic acids) []. Further studies with proper sample sizes among different population groups are needed to explain the potential role of diets with a high amount of MUFA in lowering blood pressure.

In line with our findings, several investigations proposed the role of vitamin consumption in regulating BP [, , ]. It has been suggested that the dietary patterns rich in fruits, vegetables, and antioxidants could decrease the risk of HTN [, , ]. Dietary patterns such as DASH and the Mediterranean diet, which are rich in fruits and vegetables have been associated with reduced risk of hypertension []. This effect can be explained by the antioxidant effects of vitamin C and E [, ] as well as other ***nutrients*** such as niacin, thiamine, riboflavin, vitamin-B12, Iron, potassium, and magnesium found in vegetables and fruits [–]. Furthermore, it recently been reported that Vitamin C deificiency is associated with an increased risk of HTN []. Fruits and vegetables are also high in potassium, which is protective against cardiovascular risk factors. Potassium, in particular, assists in negating the effects of sodium in the diet through enhancing urinary excretion and also through relaxing the blood vessels [].

Magnesium, is a cofactor for enzymes in signal transduction pathways involved in vascular contraction. Magnesium can inhibit the vasoconstriction induced by cytosolic accumulation of calcium concentrations []. High levels of extracellular magnesium are reported to correlate with improvements in hemodynamic status including blood flow, vascular resistance, and capacitance function of vessels all of which are implicated in the pathophysiology of HTN []. Additionally, magnesium has been shown to be beneficial in the prevention of HTN through attenuating the damage of vasculature from oxidative stress in antioxidant pathways and preventing vascular injury [].

This study has several strengths. To the best of our knowledge, it is the largest study evaluating the association of dietary patterns with HTN. The current study was sufficiently powered to evaluate the associations. The selection of the participants was based on random sampling of the US general population. Hence, the results are interpretable at the population level. The NHANES ***data*** ***collection*** was performed on all days of the week throughout the year, hence, the potential for selection bias is very low [, ]. Furthermore, the use of PCA is advantageous as the method can group correlated food groups into uncorrelated factors assessing dietary patterns. Moreover, factors can be assessed as continuous variables within regression models. PCA has also been deemed most reliable in large sample sizes such as the sample in this paper []. This study also has important limitations. Although a large body of evidence from prior experiments and randomized controlled clinical trials have established causality on a number of reported ***nutrients***, the cross-sectional nature of this observation does not allow inferring causality. The use of one day of 24-hour dietary recall may not accurately capture dietary behaviours, thus, studies with two or more days are needed. Moreover, based on our study design we cannot exclude the possibility that our findings may be influenced by unmeasured or residual confounding.

In conclusion, our findings provide further evidence on the inverse association between high intake of micronutrients and MUFA and the risk of HTN. Randomized control trials are still needed to confirm causality.

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June 6, 2020 Saturday

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**Length:** 6818 words

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Brussels: Public Register European Parliament has issued the following document:

BRIEFINGEPRS European Parliamentary Research ServiceAuthor: Magdalena Pasikowska-SchnassMembers' Research ServicePE 651.942 – June 2020 ENDigital culture − Access issuesSUMMARYThe digital shift has touched all aspects of human activity, and culture is no exception. Cultural assetsand works have been digitised and digital technology has become a tool for novel creations. Digitalbornworks have enriched the resources available to those interested in culture. Technology hashuge potential to facilitate and democratise access to cultural resources.However, certain technical conditions are required to allow access to these cultural resources, forexample webpages devoted to digitised cultural heritage and its hidden treasures as well as thosedevoted to novel creations. These conditions include an internet infrastructure, computers, tablets,or, more frequently, a smartphone − all of which has a price tag. Moreover, the deployment of suchinfrastructure needs to be evenly distributed so as to provide equal and democratic access tocultural resources − which is not yet the case.Access to costly technology is not sufficient. The technology used must go hand in hand with digitalskills that are not evenly acquired by all ages and social groups. Persons with disabilities are in aparticularly difficult situation, since ICT equipment often does not suit their specific needs.Moreover, cultural resources are often not available in suitable formats for them.European Union policies and strategies in many areas take all these challenges and access barriersinto consideration. EU funds finance connectivity infrastructure in areas in need, training, andeducational initiatives across policy areas going from culture and education to innovation andtechnology. The relationship between technology, science, the arts, and culture is becomingincreasingly close in the digital era.In this Briefing• Culture as a right and cross-area policy• Culture and digital technologies• Use of the internet for cultural purposes• European Union actions supporting access todigital cultureEPRS European Parliamentary Research Service2Culture as a right and cross-area policyThe European Union has very limited powers in the policy area of culture. The Treaty on the Functioning of the European Union (TFEU) sets it the role of coordinating Member States' efforts in this field (Article 6), promoting and preserving Europe's cultural heritage, cultural and linguistic diversity (Article 167), and providing support, including financial. The Treaty also states that cultural aspects shall be taken into account in actions under other provisions of the Treaty. This is important given the presence of cultural aspects in many human activities.The right to participate freely in cultural life was recognised by Unesco's 1948 Universal Declaration of Human Rights and confirmed by the United Nations General Assembly in the 1966 International Covenant on Economic, Social, and Cultural Rights, in force since 1976. The signatory states need to ensure conditions allow for such participation, bringing down barriers which hinder its application, and to take the necessary steps for the conservation, development, and diffusion of science and culture, as well as to respect the freedom necessary for creative activity.The European Convention on Human Rights, adopted by the Council of Europe in November 1950, guarantees the freedom of expression in its Article 10. The European Court of Human Rights considers its impact in the context of cultural rights. It interprets different articles of the Convention and has 'gradually recognised substantive rights which may fall under the notion of cultural rights in a broad sense,' covering issues such as artistic expression, access to culture, cultural identity, and linguistic rights, among other issues. The Court devoted special attention to access to culture through the internet and television, recognising their potential for promoting access to culture, and focusing also on self-expression, freedom of expression and potential copyright infringement in a digital environment.The Charter of Fundamental Rights of the European Union – of equivalent legal value to the EU Treaties since December 2009 – also contains provisions related to cultural rights. Article 13 focuses on artistic and academic freedom, Article 22 focuses on the respect of cultural, religious, and linguistic diversity, and Article 25 recognises the right of the elderly to participate in social and cultural life.Culture and digital technologiesAs information technology and digitalisation started to expand swiftly in the 1990s, their relationship with culture has become increasingly closer in the following areas:• digitisation of cultural content, such as cultural heritage (digitised content),• creation of digital content (digital-born content),• digital participation in culture for the empowerment of citizens:- amateur production of content (prosumers, i.e consumers of digital culture expressing their relationship to it via content of their own making),- sharing opinions and information (citizens' engagement).Thus, the framework for the analysis of the EU's policy approach to culture and the digital environment can be split into the following issues related to cultural rights:• digital access to cultural goods and services,• freedom of expression,• digital cultural participation (content providers),• digital cultural engagement,• cultural and linguistic diversity in the digital environment (identity and linguistic rights, diversity of digital culture consumption),• digital cultural content in education.All these cultural rights issues can be applied to cultural heritage and current cultural creation as both commercial and non-commercial goods and services.Digital culture − Access issues3Access to digital culture, an important aspect of access to culture, implies technical issues, such as:• internet infrastructure and connection,• ICT equipment,• digital platforms providing cultural content,• digital skills for content provision and access.There is no access to digital culture without internet infrastructure and equipment that allows digital technologies to operate. The structure of cultural expenses can cast some light on issues of access to digital culture.An analysis of household expenditure on cultural goods and services is important in the context of access to culture. A 2016 French publication pointed to a rise in cultural expenses from 4.4 % in 1980 to 6 % in 2000, but showed that the purchase of equipment, payment of TV and internet subscription fees, and the purchase of cultural goods and services proper are not evenly distributed.1 Figure 1 supports this analysis − 46 % of cultural expenses are devoted to equipment and fees; 37 % to books, periodicals, newspapers, and cinema, theatre, and concert tickets; and 17 % to photographic and cinematographic equipment and accessories, repairs of such equipment, photographic services, musical instruments, stationary, and drawing materials. All of these expenses go to support users' self-expression and content production. The ***data*** cast new light on the growth of expenditure on cultural goods and services. Almost half of it goes to equipment and various access fees that do not necessarily or directly contribute to cultural production or to artists/creators' revenues. Moreover, often customers are not ready to pay for the content in addition.This trend is further highlighted by the 2016 Flash Eurobarometer 437 on internet users' preferences for accessing content online, according to which the majority of EU citizens favours free online content. 71 % of online users prefer to listen to free music (33 % prefer free music without ads), 77 % favour free-of-charge news services (42 % favour those without ads), and 64 % choose free film and TV services (42 % choose those without ads).Digital access and the digital gapIt is widely accepted that digital technology is key to democratic access to cultural goods and services, since it potentially facilitates access to culture for inhabitants of remote, rural, or peninsular areas devoid of cultural infrastructure and activities, and for people with disabilities and the elderly.A 2001 Council of Europe project − Vital Links for a Knowledge Culture – considers public access2 to information and content a prerequisite to a democratic information society. Public access must beFigure 1 − Households' expenditure on cultural goods and services by consumption purpose (in purchasing power standard)***Data*** source: ***Eurostat***, 2015 (not including ***data*** from France and Denmark).0,0500,01.000,01.500,02.000,02.500,03.000,03.500,04.000,0Repair of AV, photographic and ICT equipmentMuseums, libraries, zoosMusical instruments incl. rental and leasingPhotographic servicesPhot and vide cameras and accessoriesRecording mediaStationery and drawing materialsReception, recording and reproduction equipmentCinemas, theatres, concertsBooksNewspapers and periodicalsInformation processing equipmentTV and radio licence fees, subscriptions, hire of equipmentEPRS European Parliamentary Research Service4'affordable, available, and usable' to 'a literate user having access to meaningful content and services'. Thus, the lack of internet access is a factor of exclusion. Differences in access to the internet based on revenue, location, level of digital skills (digital literacy), and availability of equipment and services adapted to the needs of people with disabilities are measures of thedigital gap/divide.Digital gap according to location and revenueIn the EU, there are significant differences among Member States with regard to access to the internet in rural areas, cities, towns, and suburbs (see Figure 2). In most cases, people living in rural areas do not have the same level of access to the internet as those living in cities. This difference is especially significant in Bulgaria, Ireland, Greece, Spain, Croatia, Cyprus, Latvia, Lithuania, Hungary, Portugal, Romania, and Slovakia − countries that have a significant rural population.The biggest difference in digital access by revenue can be found in Bulgaria (see Figure 3). In general, the difference in internet access by people with the highest revenue is very small across Member States, while the difference in internet access by people with the lowest revenue approaches 60 % − Bulgaria and the Netherlands.ICT devices according to age and sexEurostat ***data*** show that the device used to access the internet varies according to age (see Figures 4 and 5). In the case of mobile phones, the difference in the number of users aged 16-24, on the one hand, and 55-74, on the other hand, is almost 50 %.The largest difference in the use of desktop computers is only 16 % among the different age groups, probably due to the fact that the overall rate of use of this equipment is much lower than that of mobile devices. ***Data*** show that in 2018 the use of mobile phones and smartphones to access the internet increased by 9 % as a whole and by 12 % among people aged 55-74. The situation varies considerably among Member States. In Sweden and Denmark, for example, there are no significant differences across age categories. In Bulgaria, Greece, and Latvia, on the other hand, internet access from mobile/smart phones is four times more frequent among 16-34 year-olds than it is among 55-74 year-olds. It is often argued that women have more restricted access to new technologies than men. However, this also varies according to age, geographical origin, and educational level.Figure 4 − Use of the internet on a desktop computer by age group (%)***Data*** source: ***Eurostat***, 2018.010203040506070EUIEBGMTROPLELPTLTESITSKHRSLHUFIBELVATFRUKLUEECZDKSENLDEIndividuals 25 to 34 years oldIndividuals 16 to 24 years oldIndividuals 55 to 74 years oldAll individualsFigure 2 − Household internet access by location (%)***Data*** source: ***Eurostat***, 2018.020406080100EUBGELPTLTROSKHRLVESCYHUIENLtotalcitiestowns and suburbsrural areasFigure 3 − Household access to the internet by revenue (%)***Data*** source: ***Eurostat***, 2018.020406080100EUBGHUROLVLTPTELCZPLSKCYSLBEESHRIEEEFRATDEDKLUFISENLfirst quartilefourth quartileDigital culture − Access issues5Figure 6 illustrates these differences. The use of computers or phones to access the internet in the EU does not differ a lot between males and females in the 16-24 and 25-34 age groups. In 11 Member States, for the 16-24 age group, men are more likely than women to use computers and smart/mobile phones to access the internet, with a 9 % difference in Ireland and a mere 1 % difference in Greece. In 12 Member States, the percentage is higher for women, with the biggest difference in Sweden (7 %). In Latvia, the percentage of women is higher for all age groups, with a 5 % difference in the 16-24 age group and a 2 % difference in the 55-74 age group, at 21 %. Poland shows almost identical percentages for men and women of all age groups. The biggest difference between men and women, where men are a higher percentage of users than women, can be found in the 55-74 age group, with the highest differences in Luxembourg (14 %), Spain (12 %), Belgium (11 %), and Germany (10 )%. However, in some Member States, women in this age group are slightly more likely than men to use such technologies.Skills gapAnother factor that affects access to digital culture is the level of digital skills − the ability to use ICT equipment as a passive consumer or to create one's own content. On average, 1 % of EU citizens have no digital skills, 26 % have a low level, 26 % have a basic level, and 31 % have a level that is above basic (see Figure 7). The percentage of citizens with a low overall level of digital skills is highest in Romania (35 %) and lowest in Luxembourg (12 %). The percentage of citizensFigure 6 − Use of computers or phones to access the internet by sex and age group (%)***Data*** source: ***Eurostat***, 2018.0102030405060708090EUROBGLVPLSKELIEHRLTCZITCYHUPTSLMTEEFRESBEATFIDELUSEDKNLMales 25-54Females 25-54Males 55-74Females 55-74Figure 7 − Digital skills (%)***Data*** source: ***Eurostat***, 2017.0102030405060EUROBGIELVFRCYESPLBEEEHUDKHRCZSLELMTPTDELTSKATFINLLow overall digital skillsBasic overall digital skillsAbove basic overall digital skillsNo digital skillsFigure 5 − Use of the internet on a mobile phone or smart phone by age group (%)***Data*** source: ***Eurostat***, 2018.020406080100EUBGELLVPLCZSKHULTROHRPTMTSLIEEEITFRBECYATESFIDEUKLUNLDKSEIndividuals 16 to 24 years oldIndividuals 25 to 34 years oldIndividuals 55 to 74 years oldAll individualsEPRS European Parliamentary Research Service6with an above-average level of digital skills is, this time around, highest in Luxembourg (55 %) and lowest in Romania (10 %).Figure 8 gives some insights into the digital gap between men and women. The ***data*** confirm a significant difference in basic and above-basic digital skills among men and women in the 55-74 age group, which lags significantly behind the younger generations. However, the ***data*** for 16-24 year-olds in many countries show that young women are more likely to master basic and above-basic digital skills. 24-54 year-old women in many cases have equal or even better scores than men. Since there is no prevalence of poor digital skills of girls and women in general, it seems the issue is rather a local problem of Member States and girls should not be stigmatised as performing poorly in digital environment.However, ***Eurostat*** ***data*** for 2019 (see Figure 9) show that the digital skills of inhabitants of cities are better than such skills among inhabitants of rural areas, towns and suburbs. The digital gap shows on average 14 % difference in the EU between cities and rural areas. The gap exceeds 20 % in Ireland, Lithuania, and Hungary, reaching 23 % in Bulgaria, Greece, Croatia, and Portugal. It is a reflection of the differences in educational level and type of education between urban and rural populations.Availability of cultural content for persons with disabilitiesDigital technologies have the potential to facilitate access to digital cultural content for persons with disabilities. Access to the internet, proper equipment, and IT skills can solve problems of physical barriers for people with disabilities, as well as help to overcome distance barriers. According to the European Union of the Deaf, 'upcoming technology promises a future where many of the challenges that people with disabilities currently face in society could be tackled with creative solutions'. The websites of museums, libraries, and archives, as well as films and performances must contain audio descriptions or other enhancements that make them accessible to the visually impaired. Only 5 % of all books published in developed countries are offered in a format accessible to the visually impaired and the print disabled.Likewise, upcoming technology can also improve the lives of the deaf and the hard of hearing, for example by creating special gadgets for sign language interpretation of museum visits and exhibitions and by subtitling non-dialogue audio − accompanying noises and music in films and theatre performances. People with a cognitive disorder would also benefit from such gadgets.Figure 9 − People with basic and above-basic skills by location (%)Source: ***Eurostat***, 2019.Figure 8 − Basic and above-basic digital skills by sex and age (%)***Data*** source: ***Eurostat***, 2017.0102030405060708090100EUROELHRBGPLPTMTCYHUESSLSKLTLVCZIEATEEBEDEDKFISENLLUfemales 16-24 basic and above basic skillsfemales 25-54 basic and above basic skillsmales 16-24 basic and above basic skillsmales 25-54 basic and above basic skillsmales 55-74 basic and above basic skillsfemales 55-74 basic and above basic skillDigital culture − Access issues7Use of the internet for cultural purposesAmong other possible uses, the internet is a tool for accessing cultural content, such as films, books, the press, information on and tickets for cultural events and services, learning platforms, and knowledge-sharing platforms for cultural heritage and current cultural trends. Figure 10 shows that most EU consumers use the internet to purchase films or music. Only in the Netherlands, Spain, Poland, Portugal, and Slovakia does the number of people who purchase e-books exceed the number of people who purchase films or music. This does not mean that people in these Member States read more than they watch films or listen to music. It simply shows that for them, in 2017, buying e-books was more popular than buying films or music online. Finding out what percentage of films watched online were heritage films would be an excellent input for film literacy actions and film education.Digital access to and availability of cultural heritageFigure 11 is based on a special Eurobarometer survey carried out at the end of 2017 in preparation for the 2018 European Year of Cultural Heritage. It shows uses of the internet for purposes related to cultural heritage. The survey enquired about habits such as looking up information, checking the accessibility of facilities, checking the main features of a heritage site or event, buying an entrance ticket, deepening knowledge after a visit, giving an opinion about a site, and sharing self-created content related to a visit.Overall, more than half of the respondents used the internet for purposes related to cultural heritage. More than 30 % looked for information about a cultural heritage site or event. Slightly less than 25 % bought tickets online and less than 20 % looked for further information after the visit. Only very few shared their experience by posting an opinion or by sharing content related to the site visited or event attended.Figure 11 − Use of the internet for purposes related to cultural heritage (%)Source: Special Eurobarometer 466 on Cultural heritage, European Commission, 2017.051015202530354045None of these activitiesLook up general information on cultural heritageBuying or booking services for events or activitiesView content related to site/artwork during a visitRead on the cultural event after a visitCreated/shared event related content, picture/videoGive opinion of a cultural heritage site or activityFigure 10 − Online purchases of online cultural services as a percentage of individuals who used the internet within the previous year.***Data*** source: ***Eurostat***, 2017.0510152025303540EUCRELCYHUPTROPLLVSLCZLTSKESBEEEFRNLIEMTATDEFIDKLUSEe-books downloaded or accessed from websites or appse-magazines, e-newspapers downloaded or accessedfrom websites or appsFilms/music, delivered or upgraded onlineEPRS European Parliamentary Research Service8Figure 12, also based on Special Eurobarometer 466, shows the main reasons why people do not visit cultural heritage sites − lack of interest, time, information, choice, or money, and the poor quality or remote location of the sites (or events). Interestingly, people who use the internet daily are the most likely to mention lack of information as a reason for not attending cultural heritage events or visiting cultural heritage sites. They are by far the most likely to mention lack of time to visit sites or attend events. It seems that access to the internet and its use on a daily basis is no guarantee of access to information on museums, archaeological sites, cultural heritage events and festivals, although this information is widely available online.The Eurobarometer 466 confirms that in the era of hyper-choice in the area of online cultural content, heritage sites, works of art, heritage films, festivals, and traditions compete for attention with all other online content. One expert in the field of cultural content has claimed that the quantity of online cultural content is overwhelming, which may constitute an access barrier in itself. For this reason, he stresses the need for a sort of 'knowledgeable librarian' to guide the public through the content jungle and to attract the attention of those who are not aware that such content is available online.3Digitised cultural heritage and its availabilityFollowing the 2005 Commission communication on digital libraries, the 2010 communication on European cinema in the digital era, and the successive 2014 communication on European film in the digital era, cultural institutions in the Member States launched digitisation projects of their libraries, archives, art ***collections***, museums, films, and music ***collections***. In 2008, the digital platform 'Europeana' was launched as a single entrance point for access to European cultural heritage material online. At present, it contains more than 58 million artworks, books, manuscripts, photographs, films, and music tracks. Images account for 58 % of the digital ***collection***, text 39 %, and video and sound recordings 3 %.According to the site's own ***statistics***, the United States and the Netherlands are the countries with the most visits, followed by eight other European countries − Spain, Germany, Italy, France, the United Kingdom, Sweden, Denmark, and Poland (see Figure 13).Following digitisation initiatives at EU level, cultural institutions in all Member States launched projects to digitise their ***collections***, thereby contributing to Europeana. Since 2008, a survey by ENUMERATE has been following the progress of these projects, especially the accessibility and availability of digital objects.Figure 12 − Internet use as a factor in accessing cultural heritage sitesSource: Special Eurobarometer 466 on Cultural heritage, European Commission, 2017051015202530354045Lack ofinterestLack oftimeCostLack ofinformationLack orlimitedchoicePoorquality ofsites oractivitiesSites tooremote ordifficult toaccessEUIndividuals using internet every dayUsing internet often/sometimesNever using internetFigure 13 − Top 10 countries by number of generated visits on Europeana (in thousands, 2018)Source: Europeana pro, Usage ***statistics***, 2018.Digital culture − Access issues9According to ENUMERATE's 2017report, as much as 74 % of all digitalised library objects are available online, 59 % of all archive objects, and 48 % of museums' objects. The report also shows that 83 % of online users access digital ***collections*** via the website of the institution to which the ***collection*** belongs, 40 % of users go through Europeana, and 20 % go through other aggregators or social media platforms. It is expected that the number of users that go through social media platforms will increase to 25 %.The digitisation of cultural heritage and its availablility and accessibility are just some of the possibilities offered by digital culture and an example of a priority area in EU cultural policy that is enshrined in the Treaties.European Union actions supporting access to digital cultureThe EU has various tools to shape and implement its policies. Digital culture is a horizontal policy area that cuts across other policy areas, such as technology, culture, infrastructure, and research.Aspects of access to digital culture in the Digital Single MarketThe Digital Single Market (DSM) is at the core of the Digital Single Market Strategy, which aims at providing better access to digital content and covers, among other issues, connectivity and access, digital infrastructure, media, and digital culture. The digital society, another element of the DSM, aims at creating an inclusive digital society through the promotion of digital skills, which are key for an inclusive culture.Supporting media and digital culture in the framework of the DSM means providing coherent media policies, legislation on audiovisual media services, and the preservation of cultural heritage through digital technologies. The objective is to offer European citizens a variety of interactive content from across Europe and to ensure EU citizens access to European audiovisual works. Access to cultural content from the EU entails issues such as copyright, rules on advertising, media freedom, and the fight against illegal content, among others. The digitisation of cultural heritage from European libraries, archives, museums, and audiovisual archives is part of this strategy.The Commission plans to propose legislation on the Digital Single Market of Content to enhance digital distribution of creative content. Creative content is delivered and used in various ways, such as e-books, music streaming sites, video-sharing platforms, and gaming applications, to name just a few. Such content needs to be available in a borderless interoperable internet environment, which the DSM is meant to provide.The Commission's priorities for 2019-2024 − Europe Fit for the Digital Age − include new rules on e-commerce intended to break down barriers to full access to all goods and services offered online and to promote cross-border access to online content. A modern framework for copyright should include simpler licensing for online transmissions.Since April 2018, the cross-border portability of digital content allows subscribers to online content services to access the services they paid for during a stay in another EU Member State for a limited period of time. This measure is also part of the Digital Single Market Strategy.In its contribution to the informal EU-27 leaders' meeting in Sibiu in May 2019, the Commission highlighted the benefits of digitisation. However, it also pointed to the risk that digitalisation might widen digital skills gaps and deepen regional and social divides across the European Union. Figures 2 and 3 illustrate such gaps in internet access by location (urban and rural areas), Member State, and revenue. Figures 7, 8, and 9 show digital skills gaps by location (rural and urban areas), Member State, and age. Skills gaps also reflect differences in educational levels, which in turn are related to socio-economic status. This shows that the potential of digital technologies to benefit all citizens has not yet been realised.The 2010 Commission report on the implementation of the European Agenda for Culture, which strongly focused on access to culture and digitisation, stated that digitisation has contributed to progress in access to culture. However, with digitised resources still lacking visibility, especiallyEPRS European Parliamentary Research Service10across national boundaries, and, for example, only around 10 % of Europe's cultural heritage digitised onEuropeana, more digitised resources of relevance should be made available online and their cross-border use enhanced.Language is a barrier in access to content in the DSM. €200 million was already allocated to computer-assisted translation, semantic technologies, multilingual publishing in previous research and competitiveness funding programmes.Digital infrastructureIn an effort to bridge the gap in broadband access between urban and rural areas, the Commission invested €100 million of the Connecting Europe Facility to create the Connecting Europe Broadband Fund and to further mobilise some €3 billion of investment in broadband infrastructure projects in rural areas The Commission's investment contributed to the financing of a cross-border broadband network between Slovenia and Croatia for more than 4 000 villages. It also allocated €6 billion of EU structural funds to broadband needed for the smart rural economy.The European ***Agricultural*** Fund for Rural Development (EAFRD) brought an optic fibre network to the Arctic Circle – a region with a population density of two inhabitants per 10 km2, who strongly need to stay connected. The EAFRD is part of the European structural and investment funds, which also contributes to improving access to digital content thanks to the development of cloud computing infrastructure and services that reduce the need for heavy investments in ***data*** centres, hardware, and software required for the promotion of digital technologies in relatively poor rural areas.The digital scoreboard measures, across the EU, digital performance defined according to indicators, such as the consumption of audiovisual and media content; reading and downloading online newspapers and news magazines; playing and downloading games, images, films, and music; household subscription to video-on-demand (VoD) services; or watching VoD from commercial services platforms. The ***data*** provided via the scoreboard are key to the development of a policy for facilitating access to digital culture.The Web Accessibility Directive, in force since September 2018, addresses the issue of digital exclusion and the digital gap resulting from disability, a phenomenon still to be assessed as regards its scope. Digital inclusion is addressed in research projects such as WAI-dev, which focuses on the creation of an ecosystem for inclusive design and development that provides better accessibility for everyone. The Accessibility Directive is accompanied by the European Accessibility Act, which covers products and services promoting digital inclusion in various areas, including audiovisual media services, e-books, and ICT equipment. These measures have an impact on access to digital culture for persons with disability.Cultural and educational policy aspects of access to digital cultureAccording to research quoted in the Commission's New European Agenda for Culture, 'cultural access is the second most important determinant of psychological well-being'. The document also points to the fact that both urban and rural communities which want to attract employers, students and tourists need to consider the importance of their cultural offer. The EU’s Digital4Culture strategy reflects the benefits of the digital revolution for a broader, more democratic access to culture and heritage as well as new ways to access cultural content.Audience development, referred to in the 2017 Council conclusions on promoting access to culture via digital means, is to attract new audiences and engage existing ones in an effort to increase cohesion within communities. The document points to links between education and culture, concluding that, to achieve its objective, the audience needs to acquire new skills, such as digital skills. One of the proposed actions aimed at achieving cohesion and well-being is the understanding of digital audiences, particularly as concerns ***data*** ***collection***, since ***data*** is the key to understanding audience's needs, thus addressing people's access to the content that they like or might like. However, this raises questions about the creation of a 'cultural consumption bubble' through the customisation of content based on ***data*** on audience preference, which would, as a result, lead to less exposure to cultural novelty and bewilderment, so important in the arts and culture.Digital culture − Access issues11The Council resolution on education and training of February 2020 draws attention to the digital skills gap, which still needs to be addressed in the light of the Annual Sustainable Growth Strategy 2020.The promotion of the skills needed to access cultural content cuts across education policy and the digital strategy. Digital literacy equips people with the skills needed to thrive in the digital environment. These skills are covered by the Connectivity in schools action, which is part of the Digital Education Action Plan, under the supervision of the Commissioner for Internal Market, Thierry Breton. With 18 % of EU schools lacking a reliable broadband connection, they cannot help in the development of students' digital skills. Schools have a role to play in developing audiences, showing them the way to rich cultural online content, acquainting them with Europeana and other online cultural resources for educational needs, via video streaming, cloud computing, and virtual and augmented reality as educational tools for cultural awareness and creative usage. The action plan on connectivity at schools aims at informing interested parties about funding possibilities for connectivity projects, namely funds from the European Regional and Development Fund (ERDF), the EAFRD, and the Connecting Europe Facility.The current Creative Europe programme set as its objectives audience development and access to cultural and creative works, particularly for under-represented groups, such as people with disability. However, it does not specifically mention digital technologies and digital access. The development of digital skills is only mentioned in relation to professionals. The next programme (2021-2027) aims at enhancing online distribution and providing wider cross-border access to European audiovisual works and content. It contemplates film education schemes as a way of enhancing access to digital culture. Online educational catalogues of recent and heritage films will help educate students. Media literacy − a factor in access to culture – will be a part of policy cooperation among Member States in this areaWith a view to provide better access to digital cultural content, the 2019 work programme for the Creative Europe Programme lists among its actions support for the development of European video games. It includes an award for games that encourage 'accessibility for gamers with disabilities and other impairments'.The Europe-wide provision of subtitles for European television programmes with cultural content in the framework of the Creative Europe Programme aims at promoting access to cultural content for audiences all over Europe.European Parliament on access to digital cultureIn its resolutions, the European Parliament has often addressed the issue of access to culture and digitisation of cultural works, paying particular attention to the digital divide and striving to turn the potential of digital technology as a facilitator of universal and democratic access to culture into reality. The 2017 resolution on the new skills agenda recognised the role of culture for personal development and described media literacy as the ability to critically understand different forms of media, which enhances the benefits of digital literacy. It called upon Member States to set up national strategies for digital skills that involve education and culture professionals who work with both young people and the elderly in order to bridge the digital divide. The 2016 resolution on the Implementation of the UN Convention on the Rights of Persons with Disabilities pointed to a disproportionate number of people with disabilities left out of digital developments and unable to access important services. It also calledPilot projects supported by the European ParliamentSince 2014, following the success of Parliament’s pilot projects and preparatory actions supporting the subtitling of non-fiction cultural content programmes with a view to facilitating cross-border access, the Creative Europe programme has been providing stable funding for the subtitling in English, Spanish, Polish, and Italian of a selection of ARTE programmes originally available only in French and German. These programmes are available online and in the mother tongue of almost 70 % of Europe's citizens.Source: 2019 Annual Work Programme for the Implementation of the Creative Europe Programme, European Commission, 2018.EPRS European Parliamentary Research Service12for measures that support the rights of people with disability to access online cultural content, such as training programmes at national and EU levels, the mainstreaming of digital content, and the mandatory suspension of copyright for materials used for non-commercial purposes.In June 2017, a resolution on the Commission communication on digitising European industry highlighted the need to provide funds for the digitisation of cultural works and for facilitating access to culture for people with disability and for people in remote areas. The issue was raised again in a 2019 legislative resolution on the proposal for the ERDF and Cohesion Fund for 2021-2027.In the June 2018 resolution Structural and financial barriers in the access to culture, Parliament drew attention to digital barriers that need to be addressed via a digital strategy for cultural infrastructures and activities, including audience development. The resolution focused on the digital skills and competences required by those in charge of cultural and education institutions and on the promotion of public access to digital cultural heritage resources and services.In its legislative resolution of April 2019 on the proposal for a regulation establishing the Digital Europe programme (2021-2027), under discussion with the Commission and the Council, the European Parliament highlighted that digitisation can facilitate and improve access to digital services − including multilingual ones − for everyone, regardless of age, disability, and distance from urban centres.Digital preservation and subtitling were also described as an issue of access in the 2015 resolution on European film in the digital era. The digitisation of cultural heritage as an issue of access for people with disability and those living in rural areas was highlighted in the resolution on an integrated approach to cultural heritage for Europe. Finally, the 2016 resolution on a coherent EU policy for cultural and creative industries called for support to the digitisation of cultural content and recognised online platforms as a means to provide wider access to cultural and creative works.ENDNOTES1 K. Berger, M. Alduy and C. Le Moing, La culture sans état − de Modiano à Google, 2016.2 A.-M. Ronchi, eCulture − Cultural Content in the Digital Age, 2009.3 E. Durand, La diversité culturelle à l’ère de l’hyperchoix, 2016.DISCLAIMER AND COPYRIGHTThis document is prepared for, and addressed to, the Members and staff of the European Parliament as background material to assist them in their parliamentary work. The content of the document is the sole responsibility of its author(s) and any opinions expressed herein should not be taken to represent an official position of the Parliament.Reproduction and translation for non-commercial purposes are authorised, provided the source is acknowledged and the European Parliament is given prior notice and sent a copy.© European Union, 2020.Photo credits: © spr / Adobe [*Stock.eprs@ep.europa.eu*](mailto:Stock.eprs@ep.europa.eu) (contact)[*www.eprs.ep.parl.union.eu*](http://www.eprs.ep.parl.union.eu) (intranet)   [*www.europarl.europa.eu/thinktank*](http://www.europarl.europa.eu/thinktank) (internet)   [*http://epthinktank.eu*](http://epthinktank.eu) (blog)Digital culture during coronavirus lockdownThe lockdown introduced due to the pandemic resulted in more demand for cultural content online. Due to intense film watching and online activity, major film screening platforms were asked to drop the high definition standard during office hours. Individual artists shared their content for free and cultural institutions enhanced their online presence providing and attracting audiences with new content. Musicians streamed their concerts live in empty halls to provide their supporters at least with an online performance.

**Load-Date:** June 9, 2020

**End of Document**



[***Cover Crops, Sensors, and Food Security***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61VV-NT61-JDG9-Y45V-00000-00&context=1516831)

Impact News Service

January 26, 2021 Tuesday

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**Length:** 2991 words

**Body**

Washington, D.C: American Geophysical Union has issued the following press release:

Marty McFly and Doc Brown stand at the end of an unfinished bridge, dangling out over a ravine. The two had planned to use the bridge as a runway for a time-traveling DeLorean, accelerating them back to the future.

“Oh well, guess we’ll have to wait a year until it’s finished,” Marty says.

“Marty, you’re just not thinking fourth dimensionally!” Doc Brown says.

“Right, right, I have a real problem with that,” Marty replies.

Of course, in the future, the DeLorean won’t jet off the end of the bridge—the bridge will be finished!

It was “fourth-dimensional” ideas that Elizabeth Stulberg sought when leading a task force of 12 ***agricultural*** stakeholders to think about the biggest problems confronting farmers in the United States.

Stulberg is the science policy manager for the American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA). From the Science Policy Office where she works in Washington, D.C , Stulberg put together a group of experts, guiding them through brainstorming sessions and compiling their comments. The task force formally submitted comments in August 2020.

The mission of the ***Agriculture*** Innovation Agenda (AIA) of the U.S Department of ***Agriculture*** (USDA) is to “align USDA’s resources, programs, and research to provide farmers with the tools they need. ” By using measurable outcomes, the USDA’s goal is to increase ***agricultural*** production by 40% while halving its environmental impact by 2050.Dig DeeperInterested in food security? The podcast of ASA, CSSA, and SSSA—Field, Lab, Earth—recently released a series of episodes relating to this topic. You can find the podcast online or through your favorite podcast provider.

These are lofty goals. In 2019, the National Academies of Sciences, Engineering, and Medicine published Science Breakthroughs 2030: A Strategy for Food and ***Agricultural*** Research, which outlines the immediate “how” of increasing production and decreasing the environmental impacts of ***agriculture***. But the AIA will serve as a mission statement and vision for those goals—the “fourth-dimensional” view of ***agriculture***.

Here we take a deep dive into two of the technologies put forward by the AIA task force: cover crops and biodegradable, ubiquitous sensors. In both cases, the advances researchers can make in the next 30 years—by 2050—will help us maintain our food supply, grow food more efficiently, and care for our climate and environment. All of which contributes to greater food security.Cover Crops

“It’s not debatable, at this point: Cover crops provide a whole range of agroecosystem services,” Steven Mirsky says. “But there are lots of things we don’t know. To what degree do they provide those services? How do we enhance them? How do services change based on your climate, your soil, your management?”

Mirsky is a research ecologist at the Sustainable ***Agricultural*** Systems Laboratory, a USDA ***Agricultural*** Research Service (ARS) site in Maryland. Mirsky coleads a Coordinated ***Agricultural*** Project that includes over 100 researchers in more than 29 states, all focused on documenting cover crop use, management, and breeding.

By definition, cover crops cover soil during gaps in the crop rotation where the field might otherwise lie fallow. They’re often worked into rotations in the winter (between cash crops) in high-yielding systems.

Aside from the aesthetic benefit of keeping the landscape green for a larger chunk of the year, cover crops are a boon to soil health and water conservation.Aside from the aesthetic benefit of keeping the landscape green for a larger chunk of the year, cover crops are a boon to soil health and water conservation. They help capture nitrogen, preventing it from leaching into waterways. They increase soil organic matter, recycle ***nutrients***, and suppress pesky weeds. They prevent erosion, increase soil aggregation, build soil biology, and increase water infiltration.

“Cover crops don’t take land out of production, but they reduce our environmental footprint,” says ASA Fellow Rob Malone, a task force member and USDA-ARS ***agricultural*** engineer. “It’s exactly the kind of thing the AIA is looking for. ”

Typical cover crops fall into four broad categories: grasses, brassicas, legumes, and mixes.

Farmers use grasses like winter rye, oats, annual ryegrass, and sudangrass to prevent erosion, build soil aggregation, and retain ***nutrients***, which reduces leaching. Many grass cover crops can also be used as forage for livestock—an immediate economic benefit. Some grass species die off over the winter, making it easier for farmers to manage them before planting their cash crops in the spring.

Legumes, with their nitrogen-fixing capabilities, are suited for summer, winter, or even perennial or biennial cover. However, farmers must remember to inoculate legumes with nitrogen-fixing bacteria, and bacterial species are crop specific.

Producers are increasingly incorporating brassicas like mustard, rapeseed, forage radish, and canola into their rotations, particularly in specialty crop production.

Finally, there are the mixtures, in which farmers combine two or more cover crop species for specific outcomes. A mixture provides much the same advantage as a diverse ecosystem: If one species struggles, there are others present to fill the gap. Each species in a mix brings different benefits to the soil, but mixtures can be difficult to seed and manage.

Those are just some of the choices a farmer faces in selecting a species of cover crop. There are unique management questions for each, too. But with these challenges comes great opportunity.Benefits and Breeding

As Mirsky pointed out, researchers don’t have a complete grasp on the degree of benefits provided by cover crops. Often, cover crops are tested in two- or three-year-long studies, and information is swayed by the weather.

“You could have one year that’s wet, and one that’s dry, and you just won’t be able to detect any differences even if you have a bunch of treatments,” Mirsky says.

“Cover crops are messy—they don’t always behave like you want them to. ”Mirsky’s team, coled by Chris Reberg-Horton at North Carolina State University, is piloting ***collection*** methodologies and wrangling ***data*** from longer-term, on-farm studies across the United States. They’re trying to quantify the benefits cover crops can offer, learning from farmers versed in their management. The team was awarded a five-year grant from USDA National Institute of Food and ***Agriculture*** in 2019.

At the same time, researchers are confronting gaps in knowledge about cover crop breeding. From locally adapting certain varieties to designing blends of seeds for a farmer’s specific needs, the field is wide open for further research.

“Cover crops are messy—they don’t always behave like you want them to,” Mirsky admits. “They’re very responsive to their environment, and there’s been little improvement to their genetics. We can make big strides in very little time, just because there’s been so little focus on them. ”Cover Crop Adoption

The National Cover Crop Survey has been ***collecting*** ***data*** about cover crop use and management since 2012. The number of acres planted with cover crops of all kinds increased 50% between 2012 and 2017.

Even with that year-over-year increase, it’s still only a tiny fraction of America’s farmland. In 2017, cover crops were planted on only 15.4 million of the 395 million acres farmed in the United States—a mere 3.9%.

What’s keeping farmers from using them?

“You don’t just wake up one day and say, ‘I’m going to grow cover crops!’” says Eileen Kladivko, an ASA and SSSA Fellow. Kladivko, a professor of agronomy at Purdue University, is a founding member of the Midwest Cover Crops Council. “There’s site-specific selection, there’s getting the right crop, there’s managing it, and there’s the economic aspect, too. ”

Economic benefits to farmers aren’t immediate, and they aren’t always found in increased yield. After a farmer shells out for seeds, spends time and energy planting in the fall, and either terminates or plants into the crop in the spring, the costs can be daunting.

But Kladivko cites potential benefits in reduced herbicide use and decreased inputs as ways to offset those initial costs.

“Cutting back on inputs isn’t something that happens in a single year, either,” Kladivko says. “I remind farmers that for every 10 or 20 pounds of nitrate they keep from going into a tile drain, that’s building organic matter. ”

Like a certificate of deposit, farmers can’t cash in on soil ***nutrient*** benefits right away. Over time, the inputs begin to recycle as soil microorganisms release them in forms that plants can use.

The reason a farmer turns to cover crops is usually not the same reason a farmer keeps planting them. At first, a farmer might be looking for an immediate fix for soil erosion or a solution for earlier cash crop planting in the spring, but long-term benefits have surprised early adopters.

“I’ve heard a lot of farmers talking about how cover crops have added to their enjoyment of farming,” says Rob Myers. “They like figuring out how to use them in different fields; they like keeping their farms greener. ”

Myers, the director of USDA’s North Central Sustainable ***Agriculture*** Research and Education (SARE) program, says that farmers are innovating faster than some researchers can keep up. Myers encourages researchers to keep track of the latest innovations farmers are using—something SARE keeps abreast of by asking questions about management in their National Cover Crop Survey.

All this to say that the key to unlocking the benefits that cover crops offer is communication and coordination across stakeholder groups.Biodegradable SensorsIllustration of biodegrading crop sensorsThis schematic displays a biodegradable sensor network (left) and a sensor node (right). The node degrades over time as is shown clockwise in the four blocks on the right. Credit: Raj Khosla

Picture an object about the size of a dollar coin. It’s made of beeswax or wood or biodegradable plastic—it’s not built to last. You have a pile of these little gadgets, and you’re going to scatter them across your field.

Over the course of a growing season, these sensors will send you ***data*** every 30 minutes, hour, or day. They’ll document soil moisture and ***nutrient*** levels like nitrate and record if pests or weeds threaten your plants. You can precisely manage inputs, applying them just to parts of the field you know need them.

You check your sensor ***data***, looking at a map that visualizes moisture levels across your fields. You start watering, and as your center pivot irrigation makes its way across the field, the map changes. Over a day or so, you see soil moisture increasing and pivot, applying a little less water to the areas of your fields that retain more water. You do the same for nitrogen inputs as the ***data*** integrate with technology already installed on your precision-input tractor.

At the end of the season, there’s no need to go on a scavenger hunt for sensors—they degrade in the soil. With the money you save on fertilizer, herbicide, pesticides, and water, you buy another set for the next year.

This is the vision of Raj Khosla, a task force member and professor of precision ***agriculture*** at Colorado State University in Fort Collins. His team is developing sensor technology specifically aimed at measuring moisture and ***nutrient*** levels in the soil.

“You can’t manage what you can’t measure. ”“You can’t manage what you can’t measure,” Khosla says. “We have the tractors, the applicators, and the sprinklers to apply the right inputs at the right time, in the right place, in the right amount, in the right manner, down to a square foot level. But we have to ***collect*** ***data*** in high density from the field to take advantage of what precision technology offers. ”

Like Back to the Future’s Doc Brown, Khosla sees past the unfinished business of the present. The sensors of today are expensive, bulky, metal-made, and battery-operated machines.

“It’s a major limitation,” admits Subash Dahal, a postdoctoral researcher in Khosla’s lab. “We can’t put them at a spatially dependent scale to capture all the variability in the field. ”

Other means of monitoring, from GPS technology to drone-based images, do not give direct measures of in-field variables.

“It’s an indicator, not a measurement,” Khosla explains. “If you go to the doctor, they don’t take a blood test and say, ‘Maybe you’re diabetic.’ No! They diagnose you, given their measurements of your blood. Right now, we can’t measure nitrogen, phosphorus, or potassium with sensors. We’re always using surrogate measures. ”

With only indicators to go on, farmers cannot manage fields in real time, and they definitely can’t catch signs that sensors could. For example, precision technology of the future could measure pest infection before physical indicators of infection appear and spread. With this kind of forewarning, farmers could prevent yield losses or disease spread long before they could even see it happening.

If cover crops get at the heart of environmental challenges facing ***agricultural*** systems in the United States, precision technology addresses issues of efficiency.

“We have to use our resources efficiently because those resources are limited,” Dahal says.Challenges for Sensor Technology

There’s one drawback: Sensor technology is a high-risk, high-reward area of research.A student holds a pot of maize to check damage to biodegradable sensorsWub Yilma assesses the damage to the biodegradable sensor candidate after 90 days of maize growth as Huma Tariq looks on. Yilma and Tariq are Ph.D students in the Khosla Lab at Colorado State University. Credit: Raj Khosla

“I’ve been involved with smart ***agriculture*** since its inception,” Khosla says. “The first 20, 25 years were an uphill battle. It created challenges and issues and conundrums for farmers because we didn’t have the answers. It’s slowly but surely gaining attention because we’ve advanced the technology, and we have the ***data*** to show it can make a difference. ”

For example, a farmer applying fertilizer at an average rate for a given field may over- or underapply ***nutrients*** more than 90% of the time, according to Khosla. With a net of sensors scattered in a field, farmers can apply fertilizer more precisely—just the right amount to meet the needs of an individual section of a field.

For now, the team is trying to find ways to create biodegradable sensors that supply accurate measurements for the course of one growing season but still break down.

“They’re not encased in metal—they go in the soil where there are microbes and herbicides and fertilizers; they can be trampled by tractors or penetrated by roots,” Dahal says. “There are so many things that can go wrong, and we have to control for so many factors to get this to work. ”

Regardless, we could be nearing a breakthrough. Dahal estimates that biodegradable soil moisture sensors could be manufactured at scale within two or three years. Nitrate sensors will take a little longer.

The other major challenge?

“The talent pool,” Khosla says without hesitation.

Finding researchers with the right combination of ***agricultural*** savvy and computer science acumen is difficult. And with the sheer amount of ***data*** generated by a whole interconnected web of sensors, managing those ***data*** becomes a difficult task.

The next frontier for much of ***agricultural*** research is finding ways to create clever, efficient means of managing ***data***. Whether it’s using artificial intelligence to generate prescriptions for water or ***nutrient*** application or creating neural networks that help farmers predict what’s going to happen in their fields tomorrow based on ***data*** from today, we need researchers with an ***agricultural*** education and knowledge of programming and ***statistics***.

Dahal, who was just hired in Khosla’s lab this year, offers advice for young researchers.

“Don’t just focus on the field you’re working on—try to gain some knowledge and expertise of the fundamentals of ***statistics*** and computer science,” Dahal says. “Big ***data*** is everywhere, no matter which field you’re in. ”Thinking Fourth-Dimensionally

“These are wicked problems,” Khosla says. “We can’t keep doing the same thing and expect different results.…We need to harness the intelligence and expertise of different disciplines. We need to be willing to invest dollars that bring, and continue to bring, different disciplines together to look at the same problems. ”

Undergirding the AIA is the idea that collaboration is the way forward, but to collaborate, researchers need funding.

According to the Farm Bureau, public funding for ***agricultural*** research and development has decreased by 30% in the last 10 years—not to mention, the USDA receives less funding earmarked for research than the Department of Defense, Department of Health and Human Services, Department of Energy, NASA, and the National Science Foundation.

Karl Anderson, director of government relations at the ASA, CSSA, and SSSA Science Policy Office, advocates for ***agricultural*** research interests on Capitol Hill. He likens the federal budget to personal finance.

“You’ve got to pay the mortgage, the utilities, buy food,” Anderson says. “Then you’re left with a little bit of cash, and you have to decide: How do I invest for the future? It’s that last little bit that’s like discretionary funding, and Congress has to decide how to spend it. ”

The timing is right to position ***agriculture*** as part of the solution for the issues facing our environment and a changing climate.

“There’s a lot of interest in things like soil health, water quality, and the environmental footprint of food production,” Anderson says. “That’s the biggest opportunity for us to show what our members are doing to help solve those issues. ”

With investment—in time, talent, and research budgets—we can look out over the unfinished bridge and see where we’ll be in 30 years.

**Load-Date:** January 27, 2021

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[***Sustainability analysis of French dietary guidelines using multiple criteria***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2M1-JCWX-C25X-00000-00&context=1516831)

Nature Sustainability

March 2020

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**Section:** Pg. 377-385; Vol. 3; No. 5; ISSN: 2398-9629

**Length:** 6485 words

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**Body**

Main

In developed countries, Western diets are characterized by a high intake of sugar, salt, saturated fat and meat, together with extensive consumption of highly processed food, raising major health and environmental concerns. Because diet is a major determinant of various non-communicable diseases, official food-based dietary guidelines have been developed and disseminated since the 1950s by governments to promote healthy diets.

Beyond health consequences for individuals, current food systems, from farm to fork, are responsible for about one-quarter to one-third of greenhouse gas emissions (GHGE) and cause major risks in terms of soil and water pollution and biodiversity loss. This has led to the definition of a sustainable diet as ‘protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair, and affordable, nutritionally adequate, safe, and healthy, while optimizing natural and human resources’. Recent projections for the year 2050 suggest that unsustainable dietary patterns rich in meat and processed food may lead to an increase in GHGE of up to 80% from the current baseline. Therefore, changing food production, processing and distribution, as well as dietary patterns, may lead to substantial reductions in GHGE and potentially improve the overall sustainability of the diet.

For instance, some plant-based dietary patterns such as the Mediterranean or vegetarian diets, which exhibit noticeable beneficial effects on health, have been recognized as more respectful of the environment and are considered a model of sustainable diet,,. Promoting a shift toward more plant-based diets, as advised by the food-based dietary guidelines (FBDG), may contribute to reducing both GHGE and morbidity/mortality related to dietary factors,–. A recent report pointed out that the establishment of official dietary guidelines is an action crucial for nutrition policy and education. These guidelines could thus embrace sustainability by encouraging people to consume plant-based diets.

There is a substantial and growing body of evidence supporting the development of integrated dietary approaches to align both long-term health and sustainability dimensions. However, only a few countries have developed official food-based dietary guidelines to include sustainability as a major policy issue. Historically this concept is not recent—in 1986, J. D. Gussow proposed dietary guidelines including sustainability-related dimensions.

In France, the first FBDG were implemented in 2001 within the framework of the French Nutrition and Health Programme (PNNS). Guidelines for the adult population were extensively modified in 2017, and now emphasize the need for alignment between health and the environmental dimensions of the diet. Important modifications were introduced in the updated version of FBDG compared to the original. Briefly, legumes and red and processed meats have been individualized and adequation cut-offs have been lowered for milk and dairy products, seafood and alcohol intake. Nut intake has also been added, and added fat is now focused on alpha-linolenic acid-rich oils (such as canola and walnut oil) and olive oil. Favouring consumption of organic plant foods is now advised as a precautionary principle to limit exposure to pesticides. Of note, weights have been allocated to the different components. To assess the health benefits for individuals following these recommendations, we previously developed and validated two a priori dietary indices reflecting the level of adherence to the 2001 and 2017 national dietary guidelines—namely two versions of the PNNS-guidelines scores (PNNS-GS1 and PNNS-GS2),.

We evaluate the associations between various indicators reflecting the dimensions of dietary sustainability (nutrition, environment, economic and sanitary aspects) and long-term health impacts (deaths avoided), and different levels of adherence to the 2017 FBDG. With regard to nutritional aspects, the indicators encompassed the probability of adequate ***nutrient*** intake (PANDiet) score for overarching ***nutrient*** adequacy and the contribution of organic food to intake, energy intake and energy density. The indicators GHGE, cumulative energy demand and land occupation express environmental pressure, while partial ReCiPe (pReCiPe) score expresses the overall environmental impact. Both the cost of the diet, and exposure to pesticides, were also included as economic and sanitary indicators. It should be noted that pressure indicators are different from impact indicators, as they inform users of the pressure imposed by human activities on ecosystems (for example, the area of land required to produce a crop) rather than of the potential consequences (impact) due to such pressure. They quantify either resource use or pollution, or both. A second objective is to compare these associations with those found when using the 2001 FBDG. To meet these objectives, we conducted a multi-criteria analysis among a large sample of participants in the French NutriNet-Santé cohort based on nutritional, environmental, economic and toxicological indicators.

Results

The sample included 75.6% women and 24.4% men, mean age 49.9 ± 15.9 years. The means of PNNS-GS2 were 2.41 (s.d. = 3.35) and 0.63 (s.d. = 3.75) for women and men, respectively, while those of PNNS-GS1 were 8.27 (s.d. = 1.86) and 8.31 (s.d. = 1.62), respectively.

Sample characteristics

The characteristics of the study population are presented in Table . Participants with higher PNNS-GS2 scores (reflecting higher adherence to the 2017 FBDG) tended to have a higher educational level and monthly household income than individuals with lower scores. In addition, they tended to exhibit high levels of physical activity, a lower body mass index and were more likely to be non-smokers and with a managerial staff or intellectual profession compared to individuals with lower scores.

Participant characteristics across sex-specific quintiles of PNNS-GS2

|  | **All** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** |
| --- | --- | --- | --- | --- | --- | --- |
| **Non-weightedn**a | 28,340 | 4,937 | 5,550 | 5,737 | 5,973 | 6,143 |
| **Cut-off (women)** |  | <?0.22 | ?0.22 to 1.86 | 1.86 to 3.53 | 3.53 to 5.34 | >5.34 |
| **Cut-off (men)** |  | <?2.52 | ?2.52 to ?0.25 | ?0.25 to 1.72 | 1.72 to 3.98 | >3.98 |
| **Age (years)** | 49.9 ± 15.9 | 48.1 ± 0.2 | 49.4 ± 0.2 | 50.1 ± 0.2 | 50.9 ± 0.2 | 51.0 ± 0.2 |
| **Education (%)** |  |  |  |  |  |  |
| <High school diploma | 44.3 | 47.3 | 43.3 | 42.9 | 43.9 | 44.3 |
| High school diploma | 19.0 | 20.6 | 19.4 | 18.6 | 18.1 | 18.4 |
| Postgraduate | 36.6 | 32.2 | 37.3 | 38.5 | 37.9 | 37.3 |
| **Occupation (%)** |  |  |  |  |  |  |
| Unemployed | 4.7 | 4.8 | 4.5 | 4.7 | 4.7 | 4.9 |
| Retired | 31.7 | 27.2 | 31.2 | 32.4 | 33.6 | 34.3 |
| Employee, manual worker | 22.7 | 29.3 | 24.3 | 20.4 | 20.2 | 19.2 |
| Intermediate profession | 16.5 | 16.2 | 16.7 | 18.1 | 16.3 | 15.1 |
| Managerial staff/intellectual profession | 12.2 | 9.4 | 11.4 | 12.7 | 14.1 | 13.4 |
| Never employed | 9.5 | 10.4 | 9.4 | 9.0 | 9.0 | 9.8 |
| Self-employed, farmer | 2.6 | 2.8 | 2.3 | 2.8 | 2.1 | 3.2 |
| **Monthly income (%)** |  |  |  |  |  |  |
| Unwilling to answer | 7.2 | 6.5 | 7.2 | 7.2 | 7.3 | 7.6 |
| <?1,200 | 17.8 | 22.2 | 17.5 | 15.7 | 15.4 | 18.1 |
| ?1,200?1,800 | 28.4 | 31.1 | 30.3 | 29.3 | 26.3 | 25.1 |
| ?1,800?2,700 | 26.7 | 24.4 | 26.2 | 26.8 | 28.8 | 27.4 |
| >?2,700 | 19.9 | 15.8 | 18.8 | 21.0 | 22.2 | 21.8 |
| **Physical activity level (%)** |  |  |  |  |  |  |
| Missing ***data*** | 12.3 | 13.1 | 13.2 | 12.3 | 11.8 | 11.2 |
| Low | 19.9 | 24.7 | 22.0 | 20.4 | 18.8 | 13.8 |
| Moderate | 34.6 | 32.2 | 33.0 | 35.4 | 34.8 | 37.4 |
| High | 33.2 | 30.0 | 31.8 | 31.9 | 34.7 | 37.6 |
| **Tobacco status (%)** |  |  |  |  |  |  |
| Never smoker | 51.0 | 44.4 | 51.3 | 52.9 | 52.6 | 53.9 |
| Former smoker | 37.1 | 39.2 | 36.7 | 35.0 | 37.9 | 36.9 |
| Current smoker | 11.8 | 16.4 | 12.0 | 12.1 | 9.5 | 9.2 |
| **Body mass index (kgm?2)** | 24.16 ± 4.59 | 25.61 ± 0.06 | 24.79 ± 0.06 | 24.19 ± 0.06 | 23.89 ± 0.06 | 23.18 ± 0.06 |

an = 28,340 (NutriNet-Santé, 2014). All values presented are weighted ***data***. Values are means ± s.d. or percentage, as appropriate. P values based on linear contrast test for continuous variables or chi-squared test for all P < 0.0001.

Food consumption

Food group consumptions across quintiles (Q) of PNNS-GS2 are presented in Supplementary Table . As expected by its construction, higher PNNS-GS2 scores were associated with higher consumption of fruit and vegetables, legumes and whole grains but also soya-based food, and lower consumption of seafood, meat, poultry, processed meat and dairy products, sweetened foods and fast foods, alcoholic and non-alcoholic beverages and fats. For comparison, food group consumption across quintiles of PNNS-GS1 is shown in Supplementary Table .

The association between indicators of diet sustainability and adherence to the 2001 and 2017 FBDG are presented in Supplementary Table , while relative differences are shown in Fig. .

Relative differences for sustainable indicators between high and low adherence to PNNS-GS1 and PNNS-GS2.

Relative differences presented as (Q5 – Q1) × 100/Q1. Quintile values are adjusted for energy intake (except daily kcal intake). Percentages for diet cost, pReCiPe, land occupation, GHGE, energy demand, energy density and energy intake are reversed so that a positive value (>reference (ref.) = 0) indicates a positive impact.

Nutritional aspects

Total weight of the diet, proportion of organic food in the diet and the PANDiet (reflecting the probability of adequacy to ***nutrient*** references) were positively associated with the level of adherence, whatever the FBDG score. As expected by its construction, increase in the proportion of organic food in the diet between Q1 and Q5 was stronger for PNNS-GS2 than for PNNS-GS1 quintiles. Lower energy intake and energy density were related to higher adherence to both FBDG scores.

Environmental aspects

After adjustment for energy intake, lower diet-related environmental pressure and impacts were associated with higher level of adherence for both scores (except energy demand for PNNS-GS1); however, the decreases observed across quintiles were much greater for PNNS-GS2. For the pReCiPe comprising GHGE, energy use and land occupation, decreases of about 25 and 50% were observed for PNNS-GS1 and PNNS-GS2, respectively.

Economical aspects

Finally, the cost of the diet was positively associated with PNNS-GS2 and PNNS-GS1 but the magnitude of increase between Q1 and Q5 was smaller for PNNS-GS2. Differences between Q5 and Q1 were €0.91 and 1.29 per day for PNNS-GS2 and PNNS-GS1, respectively.

Overall, larger differences between Q1 and Q5 for the indicators studied were observed for PNNS-GS2 in comparison with PNNS-GS1 (Fig. ).

Pesticide exposure aspects

Correlations (factor loadings) between exposure to individual pesticides and exposure profiles extracted by non-negative matrix factorization (NMF) are presented in Supplementary Table . The first NMF factor was highly positively correlated with exposure to imazalil, profenofos and chlorpyriphos, while the second was positively correlated with exposure to spinosad (mostly used in organic but also in conventional production). The third was positively correlated with exposure to acetamiprid, carbendazim, chlorpyriphos and dimethoate.

Relative differences in NMF-extracted scores between Q5 and Q1 for PNNS-GS1 and PNNS-GS2 are graphically presented in Fig. . Higher PNNS-GS2 scores were associated with lower scores for the first and third NMF-extracted factors (relative differences for Q5 versus Q1 < 0). In regard to PNNS-GS1, a positive association was observed with the first NMF-extracted factor (relative differences for Q5 versus Q1 > 0) and no difference for NMF-extracted factor 3 was detected. Higher PNNS-GS2 scores were associated with higher NMF-extracted factor 2. A similar, but weaker, positive association was observed for PNNS-GS1.

Relative differences for dietary exposure to pesticides between high and low adherence to PNNS-GS1 and PNNS-GS2.

Relative differences presented as (Q5 – Q1) × 100/Q1.

Health aspects

Predicted numbers of deaths averted or delayed (overall and by cause) related to higher PNNS-GS2—as compared to lower PNNS-GS2—and higher PNNS-GS1 are presented in Figs. and . High adherence to 2017 FBDG led to 35,689 predicted averted premature deaths, mostly cardiovascular diseases. When comparing the high level (Q5) of PNNS-GS2 to the high level of PNNS-GS1, 3,408 deaths were averted or delayed with some variation depending on the disease. The diseases most frequently recorded were heart failure, hypertensive disease and cancer of the bronchial tract and lung. On the other hand, high compliance with the 2001 FBDG prevented an additional small number of bronchial and lung cancers compared to high compliance with the 2017 FBDG.

Estimated number of deaths averted or delayed (for year 2014) through use of the EpiDiet comparing high and low adherence to the 2017 FBDG.

Values are estimated (95% uncertainty interval based on Hazard Ratios confidence intervals) for diseases classified according to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision. n = 28,340, NutriNet-Santé, 2014.

Estimated number of deaths averted or delayed (for year 2014) through use of the EpiDiet comparing high adherence to 2017 dietary guidelines and high adherence to 2001 dietary guidelines.

Values are estimated (95% uncertainty interval based on Hazard Ratios confidence intervals) for diseases classified according to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision. n = 28,340, NutriNet-Santé, 2014.

Discussion

This study made it possible to examine the link between compliance with official French dietary recommendations and sustainability through a wide range of indicators covering nutritional, environmental, economic and health dimensions. Indeed, in this large cohort of French adults, we observed that high adherence to the 2017 FBDG led to a more sustainable diet than not following the guidelines. Environmental pressure indicators related to dietary patterns were markedly lower among participants with high (versus low) adherence to the 2017 dietary guidelines. In addition, high adherence to the 2017 FBDG led to far greater sustainability than high adherence to the 2001 recommendations. Overall, the number of averted or delayed deaths by adhering to the more recent guidelines was higher than for the earlier version. However, taking into consideration current market prices, higher level of adherence to the 2017 FBDG diet was associated with higher diet cost. Interestingly, diet costs of participants with high adherence to the 2001 FBDG were higher than for the more recent version.

These findings are important in terms of public health, as they lend credence to the view that there are co-benefits of aligning dietary recommendations for both health promotion and environmental preservation, in the urgent context of climate change. These results provide evidence that the 2017 FBDG, designed in line with sustainability considerations, effectively meet this objective.

Nutritional indicators

It should be noted that the association with PANDiet, expressing overall adequacy to ***nutrient*** references, was very similar between PNNS-GS1 and PNNS-GS2 despite the limitation of animal product consumption in the 2017 FBDG. This indicates that recent modifications to dietary recommendations do not appear to have affected the overall nutritional adequacy of the diet; in addition, the sub-scores of components differed (Supplementary Table ). It is also noteworthy that adherence to the 2017 FBDG was negatively associated with energy intake and energy density, which are risk factors for obesity.

Environmental considerations

Our findings could be interpreted in light of differences in dietary patterns across the different levels of adherence to FBDG. Indeed, the 2017 FBDG promote low consumption of animal products, including the moderation of dairy product consumption and limited intake of red meat and processed meat products. These lower intakes of animal-based products in Q5 are clearly responsible for the much lower levels of dietary GHGE compared to Q1 (refs. ,). Despite somewhat lower yields from organic farming,, land occupation was lower for high versus low adherence to these guidelines. This can be explained by the more plant-based diet among participants following the 2017 FBDG. This association was negative, even after adjustment for energy intake. Although lower GHGE and land occupation were also related to higher PNNS-GS1, the magnitude of the decrease between Q1 and Q5 was less for PNNS-GS1. In addition, due to the recommendation of lower pesticide adherence by the inclusion of organic food, adherence to the 2017 FBDG could also have contributed to biodiversity preservation. Based on French representative dietary surveys, and on dietary ***data*** on our population, it can be postulated that dietary patterns of individuals in Q1 in our study population are close to those of the general French population. In our study, we observed that reaching the highest adherence to the 2017 FBDG (as observed in Q5) would imply a 50% reduction in global environmental impacts (estimated by pReCiPe) and, specifically, a 46% reduction in GHGE (when comparing Q5 to Q1), but would require major changes in current French dietary patterns. To specifically focus on differences in dietary composition for fixed energy intake, the associations were estimated using energy intake adjustment. Indeed, because a marked decrease in daily energy intake was observed across quintiles of adherence, all links would have been driven by the role of energy intake. For instance, without energy adjustment, relative differences between high and low adherence to the 2017 FBDG (Q5 versus Q1 of PNNS-GS2) were −24.0 and −63.1% for dietary cost and GHGE, respectively (Supplementary Table ), while they were +12.9 and −46.6%, respectively, for adjusted parameters.

Economic considerations

In regard to economic aspects, adherence to the 2017 FBDG was related to a higher cost after adjustment for energy intake. However, this increase was small (<€1 per day). Healthier products that are more expensive may explain the higher dietary monetary cost of adherence. In addition, organic foods are generally more expensive than conventional foods, due to more extensive practices, lower productivity, higher labour costs or farmers’ higher income in organic production. The slightly increased cost, in an isocaloric diet, of the new food-based guidelines may be of concern for the most deprived populations for whom food is already an important share of their income exposure.

Exposure to pesticides

Consumption of organic plant food, as promoted in the 2017 FBDG, contributed to a lower exposure to certain pesticide residues whereas promotion of fruit and vegetable consumption without promoting organic food (2001 FBDG) would lead to a higher exposure. A lower bound scenario was used, which tends to underestimate exposure. However, this scenario was selected considering that organic foods contain far lower levels of synthetic pesticides residues compared with conventional foods.

Health considerations

We also showed, using the Evaluate the potential impact of a Diet (EpiDiet) model, that high adherence to the 2017 FBDG would lead to an important predicted number of averted or delayed deaths (about 35,689 for the year 2014). A large portion of the averted or delayed deaths was cardiovascular diseases. These results are consistent with the current epidemiological scientific literature concerning dietary prevention of cardiovascular diseases and cancer,, indicating a beneficial role of dietary patterns rich in fruit and vegetables, nuts, whole grains and fish, and a harmful role of red meat, processed meat and sugar-sweetened beverages. These food groups are specifically emphasized in the 2017 FBDG. Moreover, in line with our present findings, we previously observed in two different French cohorts that higher PNNS-GS (based on the 2001 FBDG, and including physical activity) was prospectively inversely associated with cardiovascular diseases and cancer risk–. Adherence to the 2017 FBDG, compared to the earlier version, allowed the prevention or delay of a substantial number of deaths. It should also be borne in mind that the number of deaths for certain health events was underestimated by the EpiDiet model. This model indeed accounts for only the nutritional values of the diet. Indeed, specific other components, including synthetic pesticide residues or other contaminants such as heavy metals contained in fish, are not taken into account. An important component not considered in the model is pesticide exposure, now accounted for in the 2017 FBDG. Diets based on organic food have indeed been linked with a reduction in overall cancer risk by our team, and in specific cancer site risk by others.

Sustainability

The potential agreement between healthy and environmentally friendly diets has recently been extensively documented,,,–. For instance, a modelling study concluded that changes promoting more plant-based diets (at least five portions per day of fruit and vegetables) would reduce overall mortality by the year 2050 by 6–10% and GHGE from food production by 29–70% compared with a reference scenario. Tilman and Clark, through a modelling study, estimated that following a plant-based diet (vegetarian, pescetarian or Mediterranean) could reduce all-cause mortality rates from 0 to 18% and GHGE from 30 to 55% (ref. ).

Recently, a growing number of countries have integrated sustainability or environmental values in their official dietary guidelines,. However, few observational studies using a multi-criteria approach have documented the sustainable potential of following FBDGs while also focusing on dietary sustainability. A recent study was conducted in Spain aiming to compare environmental values of current diets, adherence to FBDG and other diet models, in particular the Mediterranean diet. The authors found that shifting current dietary patterns to those in line with FBDG and a Mediterranean diet would lead to a reduction of 17 and 11% in GHGE, respectively. They also showed that food loss may contribute to 21% of these emissions. Our findings are also consistent with those of a European modelling study documenting the co-benefits of meeting dietary recommendations for health and the environment.

Certain limitations of our work should be highlighted. First, food consumption ***data*** were self-reported because no objective measurements for assessment of food consumption are available from large-scale population studies. However, the methods used in dietary surveys have been validated, and organic food consumption as assessed by the organic food frequency questionnaire (Org-FFQ) has previously been found to be negatively associated with certain pesticide residues in urine, and positively with certain nutritional biomarkers. Second, the NutriNet-Santé cohort included volunteers, who were probably more concerned by health and diet than the general population. While a weighting procedure was applied, a selection bias limiting extrapolation to the general population may have remained. Third, because there is a lack of ***data*** on post-farm environmental pressure for organic ***agriculture***, life cycle assessments were limited to farm activities and thus transportation and distribution through the food system were not accounted for in the estimation of environmental pressure. However, most environmental pressure in regard to food generally occurs at the farm level,. Fourth, environmental pressures were assessed for a relatively limited number of indicators. According to Kramer et al., the three indicators included in pReCiPe can be considered sufficient for an acceptable representativeness of the overall environmental impact. However, there are many more relevant indicators. For instance, in a recent study, Springman et al. used five of these. In particular, it would be important to consider water use, which was previously included in a study conducted in the United Kingdom, France and Germany. In addition, organic food consumption can be used as a proxy for biodiversity preservation. Furthermore, as regards exposure to pesticides, some key mineral-based pesticides (for instance, copper or sulfur) used in organic ***agriculture*** were not available. Finally, the EpiDiet was based on robust ***data*** from meta-analysis limiting the parametrization of the model and accounting only for nutritional effect, and morbidity was not accounted for.

Some elements should be emphasized. The large sample size covered a wide diversity of dietary patterns. The wide spectrum of accurately ***collected*** ***data*** and the use of the EpiDiet model allowed focus on a large variety of indicators related to sustainability and to provide, for the first-time, a thorough evaluation of the sustainability of the FBDG while accounting for the farming system and other indicators rarely considered. A major strength is also the observational design of our study, because it illustrates that some sectors of the population are actually able to follow the FBDG closely. Thus, following the new FBDG may contribute to both improvement in health and environmental preservation, if widely adopted. However, there is still leeway insofar as the very high adherence exhibited only suboptimal but not optimal diets.

In conclusion, the present study provides an estimate of the sustainable values of the 2017 French FBDG, using available diet sustainability indicators. Adherence to this new FBDG aligns with virtually all sustainability metrics, apart from a slight increase in cost which should be considered by all stakeholders involved in nutrition, health and sustainability. These results therefore underline the urgent need for the development of public health strategies allowing accessibility to healthy and sustainable diets for all segments of the population. Adopted by a large part of the French population, these 2017 dietary guidelines may contribute to a large extent in the prevention of diet-related chronic diseases and in the reduction of environmental impacts, in particular by drastically reducing diet-related GHGE.

Methods

This study is based on ***data*** derived from the NutriNet-Santé study.

Population

The web-based prospective NutriNet-Santé is a cohort initiated in France in May 2009. Participants are adult Internet users recruited on a voluntary basis from the general French population. This study was conducted in accordance with the Declaration of Helsinki, and all procedures were approved by the Institutional Review Board of the French Institute for Health and Medical Research (IRB Inserm, no. 0000388FWA00005831) and the National Commission on Informatics and Liberty (Commission Nationale de l’Informatique et des Libertés, nos. CNIL 908450 and 909216). Electronic informed consent was obtained from all participants. The NutriNet-Santé study is registered in ClinicalTrials.gov (no. NCT03335644).

Dietary ***data***

At inclusion and yearly thereafter, participants completed self-administered questionnaires enquiring about socioeconomic status, anthropometrics, lifestyle, physical activity and dietary intake. They were also regularly invited to fill in complementary questionnaires. The present study is based on ***data*** ***collected*** in the BioNutriNet project, an ancillary project developed within the NutriNet-Santé cohort and which has been extensively described elsewhere. Briefly, from June to December 2014, a self-administered, semi-quantitative organic food frequency questionnaire (Org-FFQ), based on a validated FFQ, was administered. The Org-FFQ includes questions on frequency and quantity of food consumed over the past 12 months, compiled using a five-point ordinal scale aiming to measure the frequency of organic (under official label) food consumption for 264 items. Participants were asked to answer the following question in regard to food items for which an organic alternative was available: ‘How often was the product of organic origin?’, using the following response modalities: never, rarely, half-of-the time, often or always. Organic food consumption was obtained by attributing the respective percentages 0, 25, 50, 75 and 100 to the modalities. Sensitivity analyses in regard to weighting have been published elsewhere. The food and beverage items were gathered into 16 food groups, listed in Supplementary Table . ***Nutrient*** intake estimations were derived from a published food composition database for generic items independently of the farming system (organic versus conventional).

Under- and over-reporting participants were defined as those with a ratio between energy intake and energy requirement below or above cut-offs previously identified, respectively (ratios <0.35 and >1.93 were excluded). Energy requirement was estimated using basal metabolic rate and physical activity level, the former being estimated by Schofield equations dependent on gender, age, weight and height.

To assess the nutritional quality of participants’ diets, a modified version of the validated PNNS-GS (without physical activity) was computed, here named PNNS-GS1 for clarity. This modified score reflects adherence to the official French nutritional recommendations set up in 2001 within the framework of the PNNS. This score (theoretical range –∞ to 13.5) includes 12 components: eight refer to food meeting adequacy recommendations (fruit and vegetables; starchy foods; whole-grain products; dairy products; meat, eggs and fish; fish and seafood; vegetable fat; water versus soda) while four refer to moderation in consumption (added fat; salt; sweets; alcohol). Moreover, points are deducted for overconsumption of salt and added sugars, or when energy intake exceeds estimated energy needs by >5%.

PNNS-GS2 (theoretical range –∞ to 14.25) was developed based on the 2017 dietary guidelines and validated against sociodemographic and biological ***data***. Guidelines, components, scoring and weights of both scores are detailed in Supplementary Table . Penalties were also applied for overconsumption. Cut-offs and scorings were built based on a consensus of experts: 1 and 0 points were allocated for meeting and not meeting, respectively, a guideline for healthy foods, while 0 and −1 points were allocated for meeting and not meeting, respectively, a guideline for unhealthy foods. In addition, half-points were allocated linearly to improve discrimination power between cut-offs. An exception concerned milk and dairy products, as well as fish, for which the relationship to global health has been found nonlinear, and hence a parabolic-shaped relationship in allocated points.

Another holistic nutritional indicator (PANDiet) reflecting the overall probability of ***nutrient*** adequacy was computed, as previously published in detail, to focus on ***nutrient*** intakes beyond food consumption. Briefly, this score is the mean of an adequacy score (which averages the probabilities of adequacy for 27 ***nutrients***) and a moderation score involving 6 ***nutrients*** and 12 potential penalty values that combine the probabilities of exceeding the upper limits of intakes.

Environmental pressure indicators

Assessment of environmental pressure indicators in the BioNutriNet project has been fully described elsewhere. Briefly, three environmental pressure indicators were considered at the farm level (excluding the stages of conditioning, transport, processing, storage and recycling): GHGE (measured as kilograms of CO2-equivalent (CO2e), cumulative energy demand (MJ) and land occupation (em). ***Data*** were ***collected*** from the tool DIALECTE developed by Solagro (Toulouse, France). The DIALECTE database aims to depict French farming systems to evaluate the environmental performance of farms based on >60 raw products. The original database was completed based on other ***data*** sources previously listed, to obtain environmental pressure in organic and conventional for 92 raw ***agricultural*** products covering the 264 food items. A set of conversions was used to estimate environmental pressure to produce food items as consumed, by applying economic allocation (accounting for co-products) and cooking and edibility coefficients.

Dietary environmental impacts per day, at the individual level, were computed by multiplying the daily consumption of each food item by its respective environmental and conversion factor values, and then summing all items consumed while differentiating the farming system (conventional or organic).

To consider trade-offs and conflicts between environmental indicators, the ReCiPe method was previously developed. This method, initially developed in the Netherlands, considers the alignment of midpoint- and endpoint-oriented indicators. In practice, some authors have shown that greenhouse gas emissions, primary energy consumption and land occupation account for approximately 90% of the total environmental dimension of ReCiPe, allowing definition of pReCiPe score for environmental impact assessment of food product and diet.

The pReCiPe score, an indicator of environmental impact, was calculated for each individual:where GHGE is greenhouse gas emissions (kg CO2e kg–1), CED is cumulative energy demand (MJ kg–1) and LO is land occupation (m2 kg–1). By construction, the higher the pReCiPe the higher the environmental impact.

Economic ***data***

In 2014, sites of food purchase for all food groups were ***collected*** by a specific web-based questionnaire. Food prices for each of the 264 FFQ items (organic and conventional) for each site of purchase were estimated by the mean price values obtained from the 2012 Kantar Worldpanel purchase database, based on a representative sample of 20,000 French households. The database was compiled using supplementary ***data*** on prices ***collected*** by the Bioconsom’acteurs association, to take into account specific short supply chains.

The individual daily diet monetary cost (€ d–1) was computed by multiplying each intake of food by the corresponding price, while accounting for the farming system and the place of purchase, and then by summing all items consmed daily.

Pesticide exposure

Exposure to diet-related pesticides—that is, residues of plant protection product—was evaluated by estimation of dietary exposure through plant food items (since these are the most contaminated foods). A total of 15 active substances authorized in the European Union for plant protection product on the date of ***data*** ***collection*** were selected, considering either their frequency of detection above the maximum residue levels, when sufficient ***data*** were available, or their acceptable daily intake. Contamination ***data*** were obtained from the Chemisches und Veterinäruntersuchungsamt (CVUA Stuttgart) database for 180 plant ingredients constituting the 264 food items and available in the CVUA database. For each active substance, the estimated daily intake (in µg kg–1 body weight d–1) was calculated under a lower bound scenario, using the reference method described by Nougadère et al.. Estimated daily intake was used to identify pesticide dietary exposure profiles, as previously described by Traoré et al., using NMF (Supplementary Methods ). This method aims to identify profiles by combining the original variables, namely exposure to several pesticides, with a score value for each participant.

Sample selection

For the present study, we considered participants in the NutriNet-Santé study who (1) completed Org-FFQ between June and December 2014 (n = 37,685), (2) had no missing covariates (n = 37,305), (3) were not detected as an under- or over-energy reporter (n = 35,196) and (4) were living in mainland France, to permit computation of a weighting procedure described below (n = 34,453), and with available ***data*** regarding the place of purchase for the computation of the dietary monetary cost, leading to a final sample of 28,340 participants.

Statistical analyses

To improve representativeness of the sample compared to the overall French population, the study sample was weighted. For each gender, weighting was calculated using the iterative proportional fitting procedure using 2009 French national census reports for age, occupational category, educational level, area of residence and presence of children (<18 years) and marital status. Participants were ranked and categorized into sex-specific weighted quintiles of dietary indices reflecting the level of adherence to the 2001 and 2017 food-based dietary guidelines, using PNNS-GS1 and PNNS-GS2. Associations between food group consumption, nutritional indicators, environmental impact indicators, dietary costs and pesticide residue exposure, and quintiles of PNNS-GSs were modelled with analysis of covariance using observed margins and adjusted for energy intake (unless specified otherwise), providing adjusted means and 95% confidence intervals. The list and details of sustainability indicators are presented in Supplementary Table . Multiple testing was accounted for by Tukey adjustment. P values refer to P trends estimated using linear contrasts. We used the EpiDiet model to evaluate the health benefits of the 2017 FBDG. EpiDiet is a simulation-based nutritional and epidemiological model implementing the comparative risk assessment framework. Like many other simulation-based risk assessment models,, it quantifies the positive or negative changes in risk related to long-term health that would result from changes in the average diet for an individual, groups or population. In this study, we took as baseline and counterfactual situations the extreme quintiles (Q1, Q5) of PNNS-GS2, or the Q5 of PNNS-GS1 and PNNS-GS2, and estimated the health impact of changes in dietary and ***nutrient*** intake. Details of the EpiDiet model and its application are presented in Supplementary Methods . Relative risks were obtained from both ***data*** published for the PRIME model and a recent meta-analysis. Two-sided tests were used, and P < 0.05 was considered significant. ***Data*** management and statistical analyses were performed using SAS v.9.4. NMF was performed using the NMF R package.

Reporting Summary

Further information on research design is available in the linked to this article.

**Acknowledgements**

We thank O. Hamza, C. Boizot-Santai, L.-G. Soler and Bioconsom’acteurs’ members for price ***collection*** and ***data*** management, CVUA for the pesticide residue database and N. Soton for her contribution to ***data*** management of the CVUA database. We also thank C. Agaesse (dietitian); T. H. Van Duong, Y. Esseddik (IT manager), R. Gatibelza, D. Lamri, J. Mohinder and A. Timera (computer scientists); J. Allegre, N. Arnault, L. Bourhis and F. Szabo de Edelenyi (supervision and ***data***/***statistics*** management) for their technical contribution to the NutriNet-Santé study; and N. Druesne-Pecollo (operational coordination). We thank all volunteers of the NutriNet-Santé cohort. The NutriNet-Santé study is funded by French Ministry of Health and Social Affairs, Santé Publique France, Institut National de la Santé et de la Recherche Médicale, Institut National de la Recherche Agronomique, Conservatoire National des Arts et Métiers and Paris 13 University. The BioNutriNet project was supported by the French National Research Agency (Agence Nationale de la Recherche) in the context of the 2013 Programme de Recherche Systèmes Alimentaires Durables (no. ANR-13-ALID-0001). The funders had no role in study design, ***data*** ***collection***, analysis, interpretation of ***data***, preparation of the manuscript or decision to submit the paper.

**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s41893-020-0495-8.Publisher’s*](https://doi.org/10.1038/s41893-020-0495-8.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.Transparency statement E.K.-G. (the guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

**Load-Date:** May 3, 2023

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[***ExpoKids: An R-based tool for characterizing aggregate chemical exposure during childhood***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2N1-F0C0-3510-00000-00&context=1516831)

Journal of Exposure Science & Environmental Epidemiology

October 2020

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**Section:** Pg. 233-247; Vol. 31; No. 2; ISSN: 1559-0631,1559-064X

**Length:** 6749 words

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**Body**

Introduction

Aggregate exposure assessments evaluate the combined exposures to a single chemical across multiple routes (oral, dermal, inhalation) and multiple exposure media/pathways (food, drinking water, dust, etc.). Aggregate exposure assessments are often important in children’s health risk assessments because children’s unique behaviors and physiology can alter chemical exposure rates across different media, routes, and lifestages relative to the adult lifestage. Further, relative to adults, children exhibit increased susceptibility to some chemical exposures during development, defined as a series of temporally and spatially orchestrated events from zygote implantation to completion of puberty [–]. Generally, chemical intake rates may be higher per unit body weight for children than for adults [].

Aggregate exposures are addressed differently among and within organizations. The Food Quality Protection Act (FQPA) requires the US Environmental Protection Agency (EPA) to “ensure… reasonable certainty that no harm will result to infants and children from aggregate exposure to the pesticide chemical residue” []. In response, EPA published guidance for evaluating pesticide aggregate exposures []. Similarly, amendments to the Toxic Substances Control Act require EPA to “describe whether aggregate or sentinel exposures to a chemical substance [are] considered” as part of risk assessment []. Other federal organizations have developed similar methods for assessing aggregate exposure []. Outside of the USA, aggregate exposure assessment approaches for evaluating pesticide and consumer product exposures have also been created [–]. While efforts to comprehensively consider aggregate exposures from all pathways and routes have been developed, implementation has been limited by ***data*** availability for individual chemicals.

We developed ExpoKids to visualize contributions of multiple oral media to aggregate exposures both within and across lifestages. To our knowledge, the development of such approaches has been limited. This tool can effectively visually communicate and compare aggregate exposure information using available exposure ***data***. Although ExpoKids can be used independently, it was developed to work with the Exposure Factors Interactive Resource for Scenarios Tool (ExpoFIRST; [*https://cfpub.epa.gov/ncea/efp/recordisplay.cfm?deid=344928*](https://cfpub.epa.gov/ncea/efp/recordisplay.cfm?deid=344928)). We first describe the development of ExpoKids. Next, we explore the use of ExpoKids to visually illustrate the contributions of ten different oral media to seven lifestage-specific aggregate exposure estimates displaying average daily dose (ADD) and lifetime average daily dose (LADD). ADD refers to the dose rate averaged over a specified exposure interval and expressed as a daily dose on a per unit body weight basis. LADD describes the dose rate averaged over an individual’s anticipated lifetime. The effectiveness of ExpoKids is then evaluated by posing three routine exposure assessment questions that highlight the potential utility of ExpoKids for a variety of stakeholders interested in children’s environmental exposures.

Methods

ExpoKids Version 1.0 was developed in R (Version 3.4.0) and can be used as an extension of ExpoFIRST to illustrate aggregate exposure estimates. ExpoFIRST is a standalone tool that utilizes the EPA’s Exposure Factors Handbook (EFH): 2011 Edition to provide deterministic potential dose estimates for user-defined exposure scenarios []. The EFH summarizes available human exposure ***data***, providing exposure factor estimates [].

ExpoFIRST Integration

Using ExpoFIRST (Version 2.0), we estimated the ADDs from the intake of ten media (i.e., soil, dust, water, breastmilk, dairy, meat, fish, vegetables, fruit, and grains) []. ADD was chosen as the ExpoKids metric to capture typical exposures experienced by average Americans. ExpoFIRST itself did not evaluate aggregate exposure, but rather ran ADD estimates for each medium separately. Subsequently, we exported the medium-specific ADD estimates from ExpoFIRST into ExpoKids to develop aggregate exposure graphs. Central tendency oral ADDs (mg/kg-day) for the EFH’s ten children’s age groups and the adult age group (Table ) within the general population were estimated in ExpoFIRST for each medium using the following general equation []:

ExpoKids recategorizes the Exposure Factors Handbook (EFH) age groups into lifestages based on the EPA’s Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants.

|  | **EFH age groups** | **ExpoKids lifestage** | **Total years in lifestage** |
| --- | --- | --- | --- |
| Childhood | Birth to <1 month | Young Infanta | 1 |
| 1 to <3 months |  |  |  |
| 3 to <6 months |  |  |  |
| 6 to <12 months |  |  |  |
| 1 to <2 years | Infanta | 2 |  |
| 2 to <3 years |  |  |  |
| 3 to <6 years | Young child | 3 |  |
| 6 to <11 years | Child | 5 |  |
| 11 to <16 years | Young youth | 5 |  |
| 16 to <21 years | Youth | 5 |  |
|  | 21 to <70 years | Adult | 49 |
|  | Birth to <70 years | Lifetime | 70 |

aThe “young infant” and “infant” lifestages are the only ExpoKids lifestages to combine multiple EFH/ExpoFIRST age groups.

Above, C = concentration (mg/mL or mg/g), IR = intake rate (mL/kg-day, g/kg-day, or mg/day), EF = exposure frequency (days/year), ED = exposure duration (years), AT = averaging time (days), and BW = body weight (kg) []. Age-specific central tendency estimates (either mean or median, depending on the exposure factor) from the EFH were used for IR, EF, ED, AT, and BW []. Chemical concentrations (C) were based on media-specific values from ***data*** identified in the scientific literature. ExpoFIRST allows users to define an unlimited number of potential scenarios for various populations and lifestages. In running ExpoFIRST for our illustrative case examples, we selected parameters representing general population exposure.

While we recognize that our assumptions have some limitations, they were selected to be consistent and compatible with ExpoFIRST outputs. For the case examples, we estimated average wet weight concentrations based on ***data*** representative of an entire medium, even if only a subset was sampled. For all food categories, we estimated exposure for “total” food groups (e.g., total fruits, total vegetables), developing “per capita” estimates for males and females combined. For drinking water, we estimated exposure to chemicals in community water sources, thereby assuming that contaminants were only present in tap water (i.e., not bottled water) to be consistent with general population exposure scenarios. Once ADDs were estimated from ExpoFIRST, chemical-specific tables were exported and reorganized into Excel tables displaying ADDs for all media by lifestage and then input into ExpoKids to create graphs (see user guide [S-1: Fig. , Tables –] in Supplementary Information for details).

For children under 1 month of age, EFH values were unavailable for soil and dust ingestion; both intake rates were assumed to be 0 mg/day. Furthermore, due to a lack of available ***data*** on formula-fed infants, only breastfeeding ***data*** for young infants was included in ExpoFIRST v2.0.

ExpoKids development

ExpoKids can create five unique graphical displays of ADD by lifestage, LADD by lifestage, percent ADD by lifestage, ADD for individual exposure pathways, and LADD for individual exposure pathways (Table ). Since the EFH followed the EPA’s Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants as available ***data*** allowed, ExpoKids followed a similar renaming structure for reorganizing age groups into lifestages []. The ingestion pathway, for instance, did not have ***data*** for all age groups under 1 year of age and the EFH collapsed these four age groups into one, named young infants in ExpoKids. The infant lifestage in ExpoKids treated the 1–3-year-old EFH age groups similarly. Thus, eleven ExpoFIRST/EFH age groups were converted to seven ExpoKids lifestages (Table ). This facilitated comparisons among six childhood lifestages, as well as between childhood in total (birth to less than 21 years of age), adulthood (21 to less than 70 years of age), and lifetime (birth to less than 70 years of age) ADD. After the ***data*** tables were uploaded (R package: readxl), the melt function (R package: reshape2) rearranged the ***data*** into a readable format for the statistical program to create stacked bar plots using the ggplot function (R package: tidyverse). The resulting eleven graphs (one all media graph and ten medium-specific graphs) displayed the estimated ADD values by lifestage. LADD values were then estimated by time-weighting each ADD value; i.e., each ADD was multiplied by a ratio of time spent within each lifestage divided by the total lifespan (70 years). LADDs were calculated in ExpoKids to streamline calculations and prevent the need for multiple ***data*** exportations into ExpoKids. Estimates were performed and verified by the first author (MD).

Five lifestage and oral media ***data*** visualization graph types produced by ExpoKids: ADD by lifestage, LADD by lifestage, percent ADD by lifestage, ADD for an individual exposure pathway, and LADD for an individual exposure pathway.

| **Graph type** | **Example graph** |
| --- | --- |
| 1. ADD by lifestage: compares lifestages and media as relative contributors to an individual?s lifetime exposure. |  |
| 2. LADD by lifestage: compares lifestage and media ADD contributions scaled by the number of years an individual spends in each lifestage (time duration within a lifestage is considered). |  |
| 3. Percent ADD by lifestage: calculates relative ADD contributions within a lifestage as relative percentages within a lifestage. |  |
| 4. ADD for an individual exposure pathway: focuses on illustrating the relative contribution between lifestages for a specific medium of interest (10 total). |  |
| 5. LADD for an individual exposure pathway: focuses on illustrating the relative contribution between lifestages for a specific medium of interest (10 total) scaled by the number of years an individual spends in each lifestage. |  |

For each medium, ADD per lifestage of interest (ADDj) was estimated from the age groups using the following equation:in which ADDi is the ADD value from the ExpoFIRST age group within the relabeled lifestage of interest, Yi is the length in years of that age group, ∑Yi is the total number of years in the new lifestage, and i represents the age group within the lifestage being estimated.

LADD per lifestage (LADDj) of interest for the media was estimated from:

ADDs were also converted to percentages to estimate the percent contribution of each medium within a lifestage using the following equation:

Case example ***data*** selection

To evaluate the effectiveness of ExpoKids, we developed illustrative exposure scenarios involving environmental chemicals and explored three questions that often arise in exposure assessments:

What are the relative contributions of specific media across lifestages to lifetime aggregate chemical exposure?

Are there differences in exposures across lifestages for an essential ***nutrient*** that is associated with developmental toxicity at elevated exposure rates?

How has an environmental regulation affected aggregate exposure rates to a chemical across lifestages?

Our criteria for selecting environmental chemicals to explore the above research questions included: (1) evidence of developmental toxicity after exposure; (2) evidence of at least one critical or sensitive window of exposure during postnatal development; and (3) available chemical-specific concentration ***data*** in at least four oral exposure media included in ExpoFIRST. Following general assessment procedures to identify appropriate ***data*** [], we searched PubMed in September 2018 to identify peer reviewed articles with clear descriptions of their scientific methodology (see S-3: Table  for search terms). Next, we scanned the article titles and abstracts to ensure that the contents were useful for our illustrative case examples. We then applied the following inclusion criteria to the studies:

Published between January 2000 and September 2018.

***Collected*** ***data*** in the USA, preferably nationwide.

Quantitatively measured chemical levels directly in media.

Conducted from a general population perspective.

All articles retrieved were reviewed to ensure that the general analysis, assumptions, and ***data*** were complete, and that variability was evaluated and characterized. To gauge the accuracy of the selected chemical concentrations, an additional literature search was conducted on the largest relative ADD medium for each chemical (see S-3: Tables –). Within each search, all relevant articles were ***collected*** for each chemical to compare their mean concentration inputs.

We next searched for candidate chemical concentration ***data***. Our inclusion criteria included regularly maintained databases that used well-established methods with at least five years of monitored and/or measured US ***data***. We also performed literature searches using keywords for the chemical of interest in each of the ten media to identify articles reporting media-specific concentrations. Mean media concentrations for chemicals were selected from a single ***data*** source keeping with the following hierarchy—We preferred mean background concentration measures from recently published US nationwide databases and excluded measures from sampling locations with known elevated chemical concentrations (such as near chemical spills or industrial sites). Only measured chemical-specific concentrations were ***collected*** for each case example. Therefore, the accuracy of chemical-specific concentrations relied heavily on measurement methods rather than models. Chemical-specific concentrations identified in the USA were prioritized over international chemical concentrations to avoid capturing differences in chemical production, use, or regulations from other countries. If an appropriate US database could not be found, we used the most recently published national study providing chemical concentrations measured in the media of interest. If nationwide ***data*** were not available, regional US studies were sought. When raw measurement ***data*** were ***collected***, the arithmetic mean concentration was calculated for each medium. We also ***collected*** information regarding limit of detection (LOD), percent of samples above LOD, total number of samples measured (n), median, and standard deviation (SD) (Tables –). Since only one study or ***data*** source was chosen per medium, aggregate ***statistics*** were not calculated. Measurements below the LOD were excluded from mean estimates unless otherwise specified for the purposes of the illustrative case examples. Other non-detect approaches may be appropriate as well.

Statistical descriptions of measured DEHP concentrations in media for the illustrative case example.

| **Media** | ***n*** | **Samples > LOD** | **LOD** | **Mean** | **Median** | **SD** | **Reference** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Dust (mg/g) | 11 | 100% | 0.14?278 ng/mL [dust/hexane: acetone] | 9.73E?02 | 7.31E?02 | 1.11E?01 | Subedi et al. [] |
| Soil (mg/g) | 6 | 100% | 0.2 µg/mL 1-butanol buffer | 9.39E?03 | 8.63E?03 | 2.19E?03 | Lin et al. [] |
| Water (mg/mL) | 15 | 13% | 1.76E-06 | 2.56E?06 | N/A | N/A | Loraine et al. [] |
| Breastmilk (mg/mL) | 21 | 100% | MEHP = 6.18E?7MEOHP = 1.03E?7MEHHP = 1.03E?7 | 7.07E?04 | 1.91E?04 | 8.87E?04 | Hartle et al. [] |
| Dairy (mg/g) | 11 | 100% | 3.70E?06 | 1.26E?04 | 6.97E?05 | 1.25E?04 | Schecter et al. [] |
| Meat (mg/g) | 13 | 69% | 3.70E?06 | 1.01E?04 | 7.00E?06 | 3.18E?04 | Schecter et al. [] |
| Fish (mg/g) | 5 | 80% | 3.70E?06 | 3.14E?05 | 3.96E?05 | 2.60E?05 | Schecter et al. [] |
| Vegetables (mg/g) | 5 | 40% | 3.70E?06 | 5.09E?06 | 1.85E?06 | 8.70E?06 | Schecter et al. [] |
| Fruit (mg/g) | 5 | 40% | 3.70E?06 | 5.09E?06 | 1.85E?06 | 8.70E?06 | Schecter et al. [] |
| Grains (mg/g) | 7 | 100% | 3.70E?06 | 6.16E?05 | 5.06E?05 | 4.25E?05 | Schecter et al. [] |

Statistical descriptions of measured manganese concentrations in media for the illustrative case example.

| **Media** | ***n*** | **Samples > LOD** | **LOD** | **Mean** | **Median** | **SD** | **Reference** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Dust (mg/g) | 661 | N/A | N/A | 2.22E?01 | 1.60E?01 | 2.45E?01 | Gulson et al. [] |
| Soil (mg/g) | 329 | N/A | N/A | 3.41E?01 | 1.80E?01 | 1.90E?01 | Gulson et al. [] |
| Water (mg/mL) | 416 | 57% | 9.00E?07 | 6.35E?05 | 2.80E?06 | 2.19E?04 | Lindsey et al. [] |
| Breastmilk (mg/mL) | 20 | N/A | N/A | 2.71E?06 | N/A | 1.12E?06 | Klein et al. [] |
| Dairy (mg/g) | 759 | 25% | 3.0E?4 to 4.0E?4 | 8.19E?04 | 1.30E?04 | 1.46E?03 | TDS 2006?2013 [] |
| Meat (mg/g) | 1725 | 65% | 3.0E?4 to 4.0E?4 | 1.66E?03 | 1.70E?03 | 1.06E?03 | TDS 2006?2013 [] |
| Fish (mg/g) | 224 | 46% | 3.0E?03 | 9.63E?04 | 4.20E?04 | 1.10E?03 | TDS 2006?2013 [] |
| Vegetables (mg/g) | 1631 | 99% | 2.0E?4 to 4.0E?4 | 1.79E?03 | 1.20E?03 | 1.31E?03 | TDS 2006?2013 [] |
| Fruit (mg/g) | 1055 | 79% | 2.0E?4 to 4.0E?4 | 1.62E?03 | 4.45E?04 | 3.45E?03 | TDS 2006?2013 [] |
| Grains (mg/g) | 1484 | 99% | 3.0E?4 to 4.0E?4 | 7.34E?03 | 4.90E?03 | 7.14E?03 | TDS 2006?2013 [] |

Statistical descriptions of measured endosulfan sulfate concentrations (positive detects only) for the illustrative case example from USDA’s Pesticide Database Program (PDP) [].

| **Media** | ***n*** | **Samples > LOD** | **LOD** | **Mean** | **Median** | **SD** |
| --- | --- | --- | --- | --- | --- | --- |
| Pre Phase-Out: 1994?2010 |  |  |  |  |  |  |
| Dairy (mg/g) | 5220 | 14.80% | 3.00E?08 to 1.00E?06 | 2.55E?06 | 2.00E?06 | 7.45E?03 |
| Meat (mg/g) | 1176 | 1.80% | 3.00E?07 to 2.00E?06 | 1.48E?05 | 4.80E?06 | 2.67E?02 |
| Fish (mg/g) | 1479 | 6.60% | 1.00E?06 | 5.26E?06 | 2.70E?06 | 6.03E?03 |
| Vegetables (mg/g) | 61805 | 11.70% | 2.00E?06 to 4E?04 | 3.80E?05 | 2.00E?05 | 7.49E?02 |
| Fruit (mg/g) | 39871 | 4.60% | 1.00E?06 to 6.80E?02 | 2.16E?05 | 1.20E?05 | 2.63E?02 |
| Grains (mg/g) | 558 | 0.20% | 1.00E?06 | 2.00E?06 | 2.00E?06 | 0.00E+00 |
| Post Phase-Out: 2011?2016 |  |  |  |  |  |  |
| Vegetables (mg/g) | 21355 | 4.40% | 2.00E?06 to 4.00E?04 | 2.53E?05 | 1.40E?05 | 3.49E?05 |
| Fruit (mg/g) | 7415 | 1.50% | 1.00E?06 to 6.80E?02 | 2.26E?05 | 1.90E?05 | 1.28E?05 |

Results

ExpoKids graphs

ExpoKids visually conveys ADD and LADD findings to highlight the relative contributions of media and lifestages for environmental chemicals. ExpoKids’ five aggregate exposure graph types illustrate differences across lifestages and media (Table ). The aggregate ADD by lifestage graph illustrates aggregate media ingestion by lifestage to demonstrate the relative contribution of each medium within each lifestage. Likewise, the aggregate graph for LADD by lifestage depicts LADD contributions scaled by time spent in each lifestage. LADD graphs are useful for visualizing the relative average daily dose of each lifestage. For instance, although an aggregate ADD graph may illustrate higher exposure rates in younger childhood lifestages, the total years in childhood lifestages account for a shorter period of time compared to adulthood. As a result, time duration within a lifestage is considered when comparing estimated LADDs. The percent ADD graph displays ADD values on a cumulative percentage scale to compare relative media contributions within lifestages. The ADD and percent ADD graphs are also generated for childhood, adult, and lifetime exposures to facilitate comparisons. Lastly, these graphs are further individualized into ten ADD and LADD graphs per exposure pathway (20 total) that focus attention on specific media of interest.

Evaluating the effectiveness of ExpoKids

Exposure assessment questions highlight the breadth of possibilities that may be examined by ExpoKids and emphasize the importance of aggregate exposure assessments when evaluating children’s health. The results presented in the following case examples are for illustrative purposes only; alternate concentration estimates may produce different results. The estimated ADD values can be found in S-3: Tables –.

Question 1: What are the relative contributions of specific media across lifestages to lifetime aggregate chemical exposure?

Di[2-ethylhexyl] phthalate (DEHP) was selected to illustrate this first question because of the chemical’s developmental toxicity and historic uses []. DEHP, a “developmentally toxic phthalate”, is associated with adverse reproductive effects following exposures during development []. DEHP assessments for various exposure sources (i.e., food, water, and commercial products) have been conducted by multiple groups [–]. Based on rat studies in which male reproductive effects were observed following gestational exposures, critical windows of exposure for phthalates and male reproductive developmental effects have been identified ranging from the most sensitive gestational exposure window, the moderately sensitive postnatal window, and the least sensitive adulthood window [].

DEHP concentrations were extracted from five studies for the ten media of interest (Table ). Five individual PubMed searches relating phthalates and the respective media of interest were conducted, retrieving 650 total articles. All extracted values were from regional US studies, except for soil concentration. The average DEHP concentration in dust was estimated based on phthalate dust samples ***collected*** in eleven homes from five geographically diverse US states in 2016 []. Since US DEHP soil ***data*** could not be identified, ***data*** ***collected*** from three fields in China over an unspecified time period were used []. Loraine et al. [] reported DEHP concentrations in finished (treated) drinking water samples ***collected*** from California water treatment plants from 2001 to 2002. Hartle et al. [] analyzed 21 human milk samples from 2015 in California; samples below the LOD were input as . Unlike the other studies, three DEHP metabolites (MEHP, MEOHP, and MEHHP) were measured in breastmilk as a proxy for DEHP []. DEHP concentration in breastmilk was estimated by summing these average metabolite levels []. All food (dairy, meat, fish, vegetables, fruit, and grains) concentrations were extracted from Schecter et al. []. While relying on one study for all food groups provided consistency in ***data*** ***collection*** methodology, Schecter et al. sampled few food items overall (n = 41) from one state (New York) and fruits and vegetables were classified together [].

The DEHP ExpoKids graphs (Fig. ) show breastmilk consumption to be the dominant DEHP exposure medium in this illustrative case example based on an intake rate per kilogram body weight basis; among the included media, over 90% of the predicted DEHP exposure was from breastmilk intake for young infants. Young infants had the highest exposure rates to DEHP among all lifestages in this case study. After this lifestage, infants had the next highest aggregate ADD estimate, with declines in ADD in subsequent lifestages. Among all media evaluated, dairy intake accounted for over 50% of estimated DEHP exposures across all lifestages except for young infants. In general, the relative contribution of all media within each lifestage remained relatively constant for individuals older than 1 year of age. Overall, during childhood, both breastmilk and dairy contributed more to ADD than other media evaluated.

DEHP illustrative case example graphs: ADD by lifestage graphs are shown in the top row and cumulative percentage ADD by lifestage graphs are shown in the bottom row.

Question 2: Are there differences in exposures across lifestages for an essential ***nutrient*** that is associated with developmental toxicity at elevated exposure rates?

Manganese was chosen as an illustrative case example for this question. The National Academies of Sciences (NAS) set a specified range for manganese between the lower limit or age-dependent adequate intake (AI) value and the tolerable upper limit (UL) value for discrete age groups to address low dose nutritional benefits and high dose neurotoxicity [, ]. Food is a major source of manganese intake for humans; as a result, assessing average dietary intake is important []. Laboratory animal studies with manganese oral doses during either gestational only, postnatal only, or gestational and postnatal developmental exposure windows reported developmental (e.g., skeletal development and growth) and neurodevelopmental toxicities [–]. These studies indicated that both the perinatal and the postnatal periods are critical windows of exposure. Epidemiologic studies also reported an increase in neurodevelopmental effects associated with increased prenatal or early postnatal manganese exposure [, ]. The EPAʼs Integrated Risk Information System (IRIS) RfD for manganese is 0.14 mg/kg-day, based on central nervous system effects and is consistent with the UL value reported by NAS based on its review of the dietary literature [, ]. Other agencies have also conducted health assessments of orally ingested manganese [–].

Table  lists average manganese concentration inputs to ExpoFIRST. Two studies on dust, soil, and breastmilk were identified from two PubMed searches that returned 464 articles. Since no US studies were available, dust and soil manganese concentration values were extracted from Gulson et al. [] who sampled dust and soil ***collected*** from 108 households in Australia between 2001 and 2006. Mean manganese concentrations in breastmilk were estimated by Klein et al. [] based on twenty 2013 breastmilk samples ***collected*** in Massachusetts. Mean manganese concentrations from 416 water samples from the United States Geological Survey’s (USGS) National Water Quality Assessment’s (NAWQA) dataset from 2013 to 2014 were also identified []. Since NAWQA reported median instead of mean manganese concentrations, these estimates were less outlier influenced []. USGS assigned half of the non-detect concentrations to be 0.05 mg/L (the LOD value) and the other half to be 0.025 mg/L (half of the LOD value) []. While this method may have overestimated manganese concentrations in water if the true concentrations were zero, this was unlikely since manganese naturally occurs in the environment []. The most recent FDA Total Diet Study (TDS) ***data*** ***collected*** from 2006 to 2013 were downloaded for food name, number of detects, LOD, and other summary ***statistics*** []. Each food commodity was sorted into its appropriate category based on its FDA categorization in the TDS food/analyte matrix before the mean manganese concentration for each food group was estimated []. All food commodities were assigned to a food category and average concentrations within each medium were estimated.

Figure  presents aggregate ADD manganese ExpoKids graphs based on inputs from Table . Manganese intake rates for all lifestages were between the AI and the UL, except for adults whose estimated rates were slightly below the AI level. Across lifestages, ADD values generally declined with age. Among the reported media, almost every lifestage followed a similar media ADD contribution pattern. Based on available ***data***, oral ingestion from non-food sources were relatively low overall. However, the estimate for water ingestion may have been underestimated for young infants since ExpoFIRST v2.0 only included ***data*** on breastfeeding. In fact, previous studies reported that manganese intake rates from water in formula-fed young infants yielded the highest calculated dose compared to other lifestages []. This limitation of ExpoFIRST v2.0 may have led to underestimated manganese exposure rates in this lifestage. Instead, this illustrative case example predicted grains as the largest contributor to ADD across all lifestages. Consequently, the second row in Fig.  focuses specifically on ADD and LADD for grains, illustrating that ADD values are highest among infants and decline among subsequently older lifestages. Moreover, the contributions to manganese during adulthood to LADD were larger than other lifestage LADDs due to the longer duration of the adult lifestage.

Manganese illustrative case example graphs: ADD by lifestage graphs are shown in the top row and LADD by lifestage for exposure to grains is shown in the bottom row.

Question 3: How has an environmental regulation affected aggregate exposure rates to a chemical across lifestages?

Endosulfan, an organochlorine insecticide, was selected to ask whether a policy change, in this case a US federal intervention, affected lifestage or media-specific aggregate oral exposure rates using ExpoKids. Endosulfan was commercially applied on crops starting in the 1950s []. US EPA assessed the endocrine disrupting chemical’s human health risks in 2002 and revised its human health and ecological risk assessments in 2007 []. Health assessments by international agencies have investigated the effects of endosulfan intake in food and water [–]. Exposure to endosulfan during prenatal and postnatal development can lead to neurodevelopmental effects []. Furthermore, high levels of endosulfan in the cord blood and breastmilk of pregnant women have been reported [, ]. Although ***data*** gaps exist in the understanding of specific critical windows of exposure, an animal study identified gestational and lactational exposure as sensitive developmental windows for endosulfan, leading to disruption of the nigrostriatal dopamine system development in male offspring []. As a result, historic endosulfan occurrence ***data*** can help explore the impacts of a regulatory decision that banned all uses of this pesticide in 2016 following a formal phase-out agreement in 2010 [].

Dietary exposure to endosulfan before and after the 2010 phase-out was compared using ***data*** from the US Department of ***Agriculture***’s (USDA) Pesticide ***Data*** Program (PDP) []. Specifically, trace detections of endosulfan sulfate (the primary metabolite of endosulfan degradation in soil and sediments) in food commodities were evaluated from PDP reports downloaded for all available years (1994–2016) []. No ***data*** outside of this timeframe were available at the time of ***data*** ***collection***. Table  shows concentration values (positive detects only) for ExpoKids media sources tested for endosulfan sulfate residue for the years 1994–2010 and 2011–2016. PDP measurements were extracted to estimate mean endosulfan sulfate concentrations for six food groups (dairy, meat, fish, fruit, vegetables, and grains).

ExpoKids graphs were generated for both 1994–2010 and 2011–2016 to compare aggregate exposure before and after the 2010 start of the US endosulfan phase-out. Figure  shows aggregate ADD and aggregate LADD by lifestage ExpoKids graphs for dietary intake of endosulfan sulfate prior to 2010 (left column) and after 2010 (right column). For both time periods, infants experienced the largest ADD and the ADD estimates declined as age increased. In addition, graphs from both time periods showed that all childhood lifestages showed similar LADDs and that the adult LADD was highest. Based on PDP concentration ***data*** ***collected*** over these two time periods, endosulfan sulfate residues decreased to below analytical detection limits in all media except for fruits and vegetables for all lifestages after 2010. This would be expected since the crops whose last endosulfan usage dates occurred after 2010 were largely fruits and vegetables [].

Endosulfan sulfate illustrative case example graphs: ADD and LADD by lifestage before the 2010 endosulfan US phase-out are shown in the left column and after the phase-out in the right column.

Discussion

ExpoKids integrates information for a single route of exposure (oral) from multiple media across lifestages to visually display lifetime estimated aggregate chemical exposures for childhood and adult lifestages. In exploring publicly available tools, ExpoKids is the only identified exposure assessment tool that depicts aggregate exposure to any chemical for multiple lifestages using this set of illustrative comparative graphs. However, EPA’s exposure toolbox (ExpoBox; [*https://www.epa.gov/expobox*](https://www.epa.gov/expobox)) lists a variety of other tools that have also been developed for modeling aggregate exposure. Other proprietary tools may exist but are not publicly available. While these tools are powerful for estimating various exposures with a variety of inputs and specificity, each is built for a particular purpose that lacks the flexible ***data*** visualization of ExpoKids. For instance, SHEDS focuses on human activity patterns for chemical concentration and gathers exposure ***data*** from EPA field studies and published literature, IEUBK primarily estimates blood lead levels, and CEM was developed for consumer exposure scenarios [–]. These tools primarily provide calculated table outputs and lack the ***data*** visualization outputs that ExpoKids provides.

Since ExpoKids is coordinated with ExpoFIRST outputs, ExpoKids has the advantage of utilizing the recommended EFH lifestage-specific exposure factors. It can illustrate lifestage-specific aggregate exposure estimates for any chemical with media-specific exposure information. The ExpoKids v1.0 code (S-2) was developed in R, a publicly available, open-source software, for transparency. The user guide and code are available in the Supplementary Information (S-1 and S-2) and future updates to the R tool can be found on the EPA’s ExpoKids webpage ([*www.epa.gov/expobox/expokids-****data****-visualization-tool-aggregate-exposure-lifestage-and-media*](http://www.epa.gov/expobox/expokids-data-visualization-tool-aggregate-exposure-lifestage-and-media)). Although these case examples were estimated using ExpoFIRST v2.0, an updated ExpoFIRST v2.1 was released in June 2019. ExpoKids was developed with ExpoFIRST ADD calculations in mind, but runs separately. Therefore, as ExpoFIRST revisions reflect EFH updates, ExpoKids can continue to display ADDs calculated with the most recent exposure factors. ExpoKids also has the flexibility to visually display exposure estimates for multiple scenarios, as exemplified in the three illustrative case examples. The DEHP case example highlighted individual media contributions to aggregate exposure across developmental lifestages, revealing both specific behaviors and dietary patterns that could impact lifestage aggregate exposures. The manganese case example showed the lifestage- and medium-specific contributions of these exposures relative to established health benefit and toxicity levels. The endosulfan case example depicted decreased media concentrations and lifestage exposure rates following the US phase-out and ban of endosulfan. Yet these illustrative case examples addressed only a fraction of the range of questions that could be addressed using ExpoKids.

Scoping decisions simplified ***data*** acquisition and input for the illustrative case examples. For instance, ExpoKids combined the smallest age groups from ExpoFIRST into the young infant and infant lifestages, resulting in a loss of specific information for newborn ADD. Since sample size was not a selection criterion, some studies with small sample sizes (n < 30) were included. Moreover, per capita central tendency estimates did not capture population variability; actual aggregate exposure likely varied across different populations. For example, ADDs estimated for groups with specific characteristics (e.g., families living near a contaminated area) may be higher compared to the general public. The ADD estimation also assumed that the media concentrations remained constant over time for all lifestages. This fixed chemical concentration captured only a snapshot of the population’s exposure at one point in time; to look at exposure as the population ages, temporal exposure concentration ***data*** would be needed. Similarly, the LADD was estimated separately for each lifestage and therefore, averaged the exposure for each lifestage over a lifetime. This limitation, inherent to the LADD equation, resulted in LADDs that did not account for ingestion during other lifestages. Therefore, total lifetime exposure may have been underestimated. Due to the limited availability of sex-specific ***data***, differences in exposure by sex were not evaluated. Similarly, ExpoKids graphs did not represent comprehensive aggregate exposure from all routes and media for a given chemical due to a lack of chemical-specific ***data*** and the limited number of included media groups. Even though not all exposures were captured in ExpoKids, knowledge on the oral route of exposure was still gained.

ExpoKids also shared limitations with ExpoFIRST. For instance, point estimates were calculated rather than probabilistic distributions. ExpoFIRST does not use physiologically based pharmacokinetic (PBPK) models, so internal doses were not estimated. ExpoFIRST also does not evaluate the prenatal lifestage, although gestation may be a critical window of exposure; current ***data*** gaps render some exposure estimates during the gestational lifestage uncertain. In addition, the effectiveness of ExpoKids relies on the chemical concentration ***data*** that users input into ExpoFIRST and the exposure parameters selected. ExpoFIRST v2.0 did not have an option to evaluate infant formula consumption even though supplementing breastmilk with infant formula is commonly practiced in the USA; studies have indicated that ~24% of 12-month-olds breastfeed []. As a result, ExpoFIRST v2.0 overestimated breastmilk consumption and did not represent formula-fed infants who would have increased water consumption. After the development of ExpoKids, EPA updated the EFH (Chapter 3; [*https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=343661*](https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=343661)) to include ***data*** on drinking water intake among formula-fed infants to address this ***data*** gap. Therefore, ADD calculations made with these and future ***data*** updates may be used to calculate ADDs for visualization in ExpoKids.

Challenges and opportunities

ExpoKids contributes to an improved understanding of relative aggregate exposure by lifestage for various oral media. ExpoKids can facilitate the investigation of a broad range of questions beyond those covered by the illustrative case examples, e.g., evaluating whether multiple chemicals with a similar mode of action reach a level of concern when the chemicals individually may not. For environmental chemical decisions requiring region-specific chemical concentration information, ExpoKids can be used by scientists to assess the aggregate risk among different geographic areas. Specifically, it could be asked: Do aggregate exposures differ for different settings (e.g., urban vs. rural)? Do they correlate with non-environmental factors (sex, behavior, regulation, etc.)? ExpoFIRST and ExpoKids could be used to explore these and other risk assessment questions for available exposure ***data*** from limited media for the oral route of exposure.

Some limitations of ExpoKids reflected ***data*** constraints. More publicly available ***data*** for chemical-specific media concentrations are needed. At this time, chemical monitoring can vary by media; however, comprehensive contaminant ***data*** for all media sources are needed to improve aggregate exposure modeling. For many developmentally toxic chemicals, the most sensitive critical window of exposure is expected to occur during prenatal development. Unfortunately, most chemicals lack a PBPK model for gestation due to ***data*** gaps. Yet some chemicals, including those presented in these illustrative case examples, have prenatal and postnatal critical windows. Therefore, developing methods to incorporate gestational exposure is crucial. In addition, ***data*** ***collected*** from multiple compatible ***data*** sources or from meta-analyses would offer a more comprehensive aggregate exposure assessment and allow for customized analyses in the future, depending on the availability of user-defined ***data*** identifying specific factors (i.e., sex, age, etc.).

By combining the functionality of ExpoFIRST with the visual graphic capabilities of R, ExpoKids facilitates comparisons of aggregate exposure by media both within and across lifestages. A broad range of ExpoKids users is envisioned. These include chemical risk assessors and managers running ExpoKids as a scoping tool to identify relevant exposure questions, as well as teachers using ExpoKids as an aggregate exposure teaching tool. Other potential users, such as pediatric health experts, may wish to use ExpoKids to explore differences in consumption patterns and exposure factors between and within children’s lifestages. Consequently, potential users can focus on relative contributions from different media to estimate the impacts of possible mitigation technologies or policies. Future efforts include enhancing public availability of this tool by converting ExpoKids into a web-based R Shiny application. As more exposure ***data*** for environmental chemicals become available, the capabilities of ExpoKids may be expanded.

**Acknowledgements**

The authors would like to thank Brenda Foos for her suggestion of a children’s health aggregate exposure project. We appreciate the thoughtful and productive discussions about the tool and the chemical illustrations with EPA’s Office of Children’s Health Protection, Office of Water, Office of Pollution Prevention and Toxics, Office of Pesticides, and Office of Research and Development scientists. We are also grateful to Zaida Figueroa, Rebecca Dzubow, and Lisa Melnyk, and to the anonymous reviewers for their thoughtful comments on the pre-submission and submitted draft manuscripts. We gratefully acknowledge Maureen Johnson for developing the EPA ExpoKids website.

**Funding**

This research was supported in part by an appointment to the Internship/Research Participation Program at the Office of Children’s Health Protection, U.S. Environmental Protection Agency, administered by the Oak Ridge Institution for Science and Education (ORISE) through an interagency agreement between the US Department of Energy and EPA.

**Notes**

Supplementary informationThe online version of this article ([*https://doi.org/10.1038/s41370-020-00265-6*](https://doi.org/10.1038/s41370-020-00265-6)) contains supplementary material, which is available to authorized users.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***Impact of Broadband Penetration on U.S Farm Productivity***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61J4-7FB1-JDG9-Y00P-00000-00&context=1516831)

Impact News Service

December 16, 2020 Wednesday

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**Length:** 21865 words

**Body**

Washington: Federal Communications Commission has issued the following news release:

Impact of Broadband Penetration on U.S Farm Productivity Katherine LoPiccalo December 15, 2020 OEA Working Paper 50 Office of Economics and Analytics Federal Communications Commission Washington, DC 20554 Abstract This paper uses ***data*** on broadband connections and the production and sales of agriculturalproducts to empirically estimate the impact of improved connectivity on U.S farming outcomes.The Federal Communications Commission has detailed ***data*** on broadband subscriptions from itssemi-annual Form 477 ***collection***. The USDA’s National ***Agricultural*** ***Statistics*** Service (NASS)releases a complete census of ***agriculture*** every five years to measure ***agricultural*** activity. Bypairing periodic releases of the Form 477 ***data*** ***collection*** with information on farm productionexpenses and crop yields from corresponding releases of the Census of ***Agriculture***, the analysisdirectly evaluates the benefit of rural broadband development on the U.S farming industry.Overall, I find evidence of crop yield improvements from increased Internet penetration rates atthresholds of 25 Megabits-per-second download and 3 Megabits-per-second upload speeds.Among the findings, a 1% increase in the number of 25+/3+ connections per 1,000 households isassociated with a 3.6% increase in corn yields, as measured in bushels per acre. I also find someevidence of cost savings at thresholds of 10 Megabits-per-second download and 0.768 Megabits-per-second upload speeds. A 1% increase in the number of 10+/0.768+ connections per 1,000households is associated with a 2.4% decrease in operating expenses per farm operation. Thepaper also provides an introductory look at changes in the composition and speed thresholds ofconnectivity available for selected field crops over time. These working papers are intended to stimulate discussion and critical comment within the FCC, as well as outside the agency, on issues that may affect communications policy. The analyses and conclusions set forth are those of the authors and do not necessarily reflect the view of the FCC, other Commission staff members, or any Commissioner. Given the preliminary character of some titles, it is advisable to check with the authors before quoting or referencing these working papers in other publications. All titles are available on the FCC website at [*https://www.fcc.gov/reports-*](https://www.fcc.gov/reports-) research/working-papers/.

Impact of Broadband Penetration on U.S Farm Productivity Katherine LoPiccalo11. Introduction The U.S ***agricultural*** sector has undergone a significant transformation in recent years asit has adapted information and telecommunications technologies to farm management practices.High-speed Internet connectivity is considered an essential component of modern ***agriculture***, asfarmers and industry stakeholders report increasing reliance on broadband to remain competitiveand operate efficiently.2 Broadband facilitates not only timely access to and the transmission ofdata, but is also necessary for ***data*** applications that automate field processes or otherwiseimprove business process outcomes for farmers.3 While the qualitative link between connectivityand farming outcomes is likely undisputed, it remains to be credibly established how strong thelink is quantitatively. What is the impact of improved connectivity on farming yields? Doeshigh-speed broadband generate cost savings for farmers, and if so, are they significant? Suchquantitative answers are important as policymakers and other stakeholders weigh the costs andbenefits of subsidies and incentives for improved connectivity. In this paper, I use ***data*** on broadband connections from the Federal CommunicationsCommission and farming ***data*** from the U.S Department of ***Agriculture***’s Census of Agricultureto uncover the relationship between improved connectivity and various U.S farming outcomes.Improved connectivity is defined in this study as the increase over time in the number of Internetconnections per 1,000 households at specific speed thresholds in farming counties. The aim ofthe analysis is to study the nexus between rural infrastructure development, digital technologiesand ***agricultural*** practices, expanding the discussion and understanding of theseinterrelationships. Previous studies and industry estimates find suggestive evidence that Internetconnectivity leads to improved outcomes for connected farms. To my knowledge there exists norigorous, quantitative evaluation of this question using the highly disaggregated ***data*** onbroadband connections ***collected*** by the Commission. This paper also provides a preliminarylook at changes over time in the composition of connectivity in regions where a selected set offive field crops are produced (e.g , corn, cotton, hay, soybeans and wheat). Therefore, this studyis a useful addition to the body of research supporting policy recommendations focused on

1 The initial research was performed while I was an economist at the Federal Communications Commission. I amcurrently an economist at the Consumer Financial Protection Bureau. The views expressed are my own and do notreflect those of the Consumer Financial Protection Bureau, the FCC or the U.S government. I would like to thankJonathan Levy, Jeffrey Prince, Glenn Woroch, Aleks Yankelevich, anonymous reviewers and seminar participants atthe FCC for their helpful comments and suggestions. 2 “For farmers, broadband is a necessity, not a luxury,” Zippy Duvall, president of the American Farm BureauFederation, Opinion Contributor, The Hill. Nov. 1, 2018, [*https://thehill.com/blogs/congress-blog/technology/414370-for-farmers-broadband-is-a-necessity-not-a-luxury*](https://thehill.com/blogs/congress-blog/technology/414370-for-farmers-broadband-is-a-necessity-not-a-luxury), last accessed May 19, 2020; See, e.g ,Jeffcoat et al. (2012).3 This may include changes from the hardcopy distribution of information necessary to operate efficiently to onlinedelivery or the digitization of back-office functions and recordkeeping. See, e.g , Matherly (2016); “A Case forRural Broadband: Insights on Rural Broadband Infrastructure and Next Generation Precision ***Agriculture***,” U.S Department of ***Agriculture***, American Broadband Initiative, April 2019. 1 OEA Working Paper 50promoting the rapid, expanded diffusion of Internet access on unserved and underservedagricultural land. 1.1 Addressing the Digital Divide The Commission has previously addressed the importance of high-speed Internetconnectivity and has stated that further efforts are required to expand broadband to underservedand unserved ***agricultural*** land. Additionally, the Commission is charged by Congress to“encourage the deployment on a reasonable and timely basis of advanced telecommunicationscapability to all Americans,” by removing barriers to infrastructure investment and by promotingcompetition in the telecommunications market.4 Broadband has been clearly show to be a keycontributor to economic development, job creation, education and civic engagement.5 In its 2016Broadband Progress Report, the FCC stated that “Americans continue to turn to advancedtelecommunications capability for every facet of daily life. ”6 In the 2018 Broadband Progressreport, the Commission reemphasized the need to “take concrete steps toward closing the digitaldivide,”7 or the gap between “those who can use cutting-edge communications services andthose who do not. ”8 While progress has been made to reduce both the number of Americans andregions without access to high-speed broadband, many areas – particularly rural areas – remaineither underserved or unserved altogether. While 93.5% of Americans overall had access to high-speed fixed service in 2017, only 26% of rural Americans had access to high-speed fixed servicein 2017, according to the 2019 Broadband Deployment Report.9 Closing the digital divide hasbeen a top priority of the Commission for the last several years, and the 2020 BroadbandDeployment Report states that more Americans than ever have access to high-speedbroadband.10 The 2020 report states that the number of people in the U.S without access to fixedterrestrial broadband service at speeds of 25 Megabits-per-second download and 3-Megabits-per- 4 47 U.S.C SS 1302(a). Congress also entrusted this responsibility to state commissions; In the Matter ofCommunications Marketplace Report, The Stata of Mobile Wireless Competition, Status of Competition in theMarket for the Delivery of Video Programming, Status of Competition in the Marketplace for Delivery of AudioProgramming, Satellite Communications Services for the Communications Marketplace Report, adopted Dec. 12,2018, Released Dec. 26, 2018. 5 “In the Matter of Rural Digital Opportunity Fund Connect American Fund”, Notice of Proposed Rulemaking, WCDocket No. 19-126 and WC Docket No. 10-90, released Aug. 2, 2019, page 1.6 “In the Matter of Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americansin a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 ofthe Telecommunications Act of 1996, as Amended by the Broadband ***Data*** Improvement Act,” 2016 BroadbandProgress Report, released January 29, 2016, Federal Communications Commission, GN-Docket No. 15-191, pg. 3.7 “In the Matter of Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americansin a Reasonable and Timely Fashion,” 2018 Broadband Progress Report, released February 2, 2018, FederalCommunications Commission, GN-Docket No. 17-199, page 5.8 Ajit Pai, FCC Chairman, First remarks as Chairman of the FCC to agency staff. Accessed through “Setting theRecord Straight on the Digital Divide,” Feb. 7, 2017 ([*https://www.fcc.gov/news-events/blog/2017/02/07/setting-record-straight-digital-divide*](https://www.fcc.gov/news-events/blog/2017/02/07/setting-record-straight-digital-divide), last accessed Dec. 12, 2020).9 High-speed fixed service refers to broadband at speeds of 25 Megabits-per-second download and 3 Megabits-per-second upload speeds (“In the Matter of Inquiry Concerning Deployment of Advanced TelecommunicationsCapability to All Americans in a Reasonable and Timely Fashion,” 2019 Broadband Deployment Report, releasedMay 29, 2019, Federal Communications Commission, GN-Docket No. 18-238, pg. 3).10 “In the Matter of Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americansin a Reasonable and Timely Fashion,” 2020 Broadband Deployment Report, released April 24, 2020, FederalCommunications Commission, GN-Docket No. 19-285, page 2. 2 OEA Working Paper 50second upload declined by more than 14% in 2018 and by more than 30% between 2016 and2018.11 Despite recent improvements, however, gaps remain for Americans in rural and Tribalareas in terms of high-speed broadband and access to advanced telecommunications services.12 Several programs are administered by the Commission and targeted to increasing theavailability of fixed and mobile broadband services in underserved and unserved areas. TheCommission’s Universal Service Fund (USF) provides funding to programs and policies thatensure all Americans have access to communications services. While originally focused ontelephone (voice) service, current universal service policies at the Commission recognize theimportance of high-speed broadband in communications technology. Within the UniversalService Fund, the Commission administers four programs to increase the availability of voice,fixed and mobile broadband services in unserved and rural areas: Connect America Fund (CAF)for rural areas; Lifeline for low-income consumers; E-rate for schools and libraries, and; theRural Health Care initiative.13 The Connect America Fund (also known as the universal service high-cost program)supports that consumers in rural and high-cost areas have access to modern telecommunicationsnetworks providing voice and broadband service at rates that are reasonably comparable to thosein urban areas. The CAF rolled out in two phases, with the first phase transitioning legacysupport to a new auction mechanism. In 2018, the Commission announced that 103 winningbidders would receive $1.488 billion in subsidies over 10 years to serve 713,176 rural homes andsmall businesses. On Aug. 1, 2019, the FCC adopted a Notice of Proposed Rulemaking (NPRM)to establish a Rural Digital Opportunity Fund to distribute $20.4 billion in USF subsidiestargeting at least 4 million rural homes and small business in unserved areas over 10 years.14 Asof October 2019, the Commission has approved six waves of funding from its CAF Phase IIauction totaling approximately $1.2 billion.15 The Commission has also taken steps to makeuniversal service support available to mobile providers. In April 2020, the Commission issued aNotice of Proposed Rulemaking and Order that would propose to establish the 5G Fund to makeup to $9 billion in USF subsidies available over 10 years to carriers to deploy advanced mobilewireless services throughout rural America.16 Additionally, the 5G Fund would set aside at least$1 billion in support for deployments that address precision ***agriculture*** needs.17 In 2019, the 11 FCC 2020 Broadband Deployment Report, April 24, 2020, page 2.12 FCC 2020 Broadband Deployment Report, April 24, 2020, page 5.13 FCC-18-181A, Connect America Fund et al, Report and Order and Further Notice of Proposed Rulemaking, 26FCC Rcd 17663, 17668-69, paras. 1-5 (2011) (USF/ICC Transformations Order), aff’d sub nom, In re: FCC 11-161,753 F.3d 1015 (10th Cir. 2014).14 See, e.g , RDOF NPRM, Aug. 2, 2019.15 The CAF Phase II auction funds, $116.6 million for 37,148 homes in 12 states over 10 years. On June 10, theFCC announced the second wave of funding for rural broadband from its CAF Phase II auction for UniversalService Fund broadband subsidies; on Aug. 12, 2019, it announced $121 million in funding over 10 years to expandbroadband to 36,579 unserved rural homes and businesses in 16 states as part of the fourth; On Sept. 12, 2019, theFCC authorized $112.2 million in funding over 10 years to expand broadband to nearly 48,000 unserved rural homesand businesses in nine states, representing the fifth wave of support from the 2018 CAF Phase II auction.16 Notice of Proposed Rulemaking and Order (FCC 20-52), GN Docket No. 20-32. FCC Proposes the 5G Fund forRural America ([*https://docs.fcc.gov/public/attachments/DOC-363946A1.pdf).17*](https://docs.fcc.gov/public/attachments/DOC-363946A1.pdf).17) Precision ***agriculture*** is generally categorized as farm management technologies that take advantage of timely,detailed and site-specific ***data*** (Schimmelpfennig and Ebel, 2016). The 5G Fund replaced the planned Mobility FundPhase II (MF-II). The MF-II program was designed to distribute up to $4.53 billion in support available over 10 3 OEA Working Paper 50FCC announced the formation of a new task force in support of provisioning connectivity onunserved ***agricultural*** land that can be used by U.S ***agricultural*** producers.18 The task forceprovides advice and recommendations for the Commission on how to assess and advancedeployment of broadband and to promote ***agricultural*** practices that rely on real-time ***data*** andmetrics. 1.2 Purpose of the Present Study This paper uses ***data*** on broadband connections and the production and sales ofagricultural products to empirically estimate the impact of improved Internet connectivity onU.S farming outcomes. Improvement in connectivity is defined as the increase in the penetrationof broadband connections at either a minimum threshold of 25 Mbps download and 3 Mbpsupload speeds, or a minimum threshold of 10 Mbps download and 0.768 Mbps upload speeds.The analysis seeks to determine whether farms in counties with higher broadband penetrationrates fare better over time in terms of higher crop yields or lower production expenses than thosein counties with lower levels of Internet penetration. Policy makers in the ***agricultural*** andtelecommunications sectors have long supported the expansion of rural broadband.19 This studyadds to that discussion by evaluating how increased broadband penetration rates affect businessoutcomes for U.S farms. The Commission has detailed internal ***data*** on broadband connections from its semi-annual Form 477 ***collection***. USDA’s National ***Agricultural*** ***Statistics*** Service (NASS) releases aCensus of ***Agriculture*** every five years to measure ***agricultural*** activity. By pairing periodicreleases of the Form 477 ***data*** ***collection*** to information on farm expenses and crop yields fromcorresponding releases of the Census of ***Agriculture***, this study directly evaluates the benefit ofrural infrastructure development on the U.S farming industry from 2007 to 2017. The present study innovates over the existing literature in several important ways. First,the paper is the most comprehensive study to make extensive use of the Commission’s internalForm 477 ***data*** on broadband connections by speed threshold and technology of transmission(e.g , cable or Asymmetric DSL) over time to examine the research question. Second, I constructa panel to estimate the extent to which improvements in Internet penetration at two speedthresholds result in better business outcomes for farm operations. This rich dataset allows a moredirect estimate of the causal relationship between improved connectivity and farming outcomesas a function of other county-level characteristics such as median household income, the

years to increase access to 4G Long Term Evolution (LTE) service in primarily rural areas([*https://www.fcc.gov/mobility-fund-phase-ii-mf-ii*](https://www.fcc.gov/mobility-fund-phase-ii-mf-ii), last accessed Dec. 12, 2020).18 Congress directed the FCC, in consultation with the Secretary of the Department of ***Agriculture***, to establish thetask force in the ***Agricultural*** Improvement Act of 2018 (2018 Farm Bill); “FCC Announces the Establishment of theTask Force for Reviewing Connectivity and Technology Needs of Precision ***Agriculture*** in the United States andSeeks Nominations for Membership,” Public Notice, DA 19-568, Federal Communications Commission, releasedJune 17, 2019. 19 See, e.g , “A Case for Rural Broadband,” USDA, April 2019; 2020 Broadband Deployment Report, April 24,2020, Federal Communications Commission. 4 OEA Working Paper 50unemployment rate, population density and area education levels, among other demographiccharacteristics.20 Overall, I find robust evidence that improved connectivity using a threshold of at least 25Mbps download and 3 Mbps upload speeds (25+/3+) result in higher crop yields. Corn, cotton,hay, soybeans and wheat yields are all positively and significantly correlated with increased25+/3+ broadband penetration rates. Among my findings, a 1% increase in the number of 25+/3+connections per 1,000 households in a county is associated with an approximately 3.6% increasein corn yields, and a 3.8% increase in soybean yields. While the results for all five crops are notas strong at the slower 10+/0.768+ speed threshold, I do find that a 1% increase in 10+/0.768+broadband penetration rates is associated with a 5.5% and 3.6% increase in corn and soybeanyields, respectively. By contrast, this study finds lower production expenses per farm operationat the 10+/0.768+ threshold. I find, for example, that a 1% percent increase in the number of10+/0.768+ connections per 1,000 households is associated with an approximately 6.5% declinein fertilizer expenses per operation and a 3.4% decrease in seed and plants expenses peroperation. These results indicate farm operations in counties with increased 10+/0.768+broadband penetration rates from 2007 to 2017 realized lower operating expenses on averagethan counties without increased penetration during the same time frame. The evidence remainsmixed for expense improvements from increased broadband penetration rates at the 25+/3+threshold. Further discussion of these results is given in Section 5. The findings contribute to a body of literature that builds directly on work that examinesthe impact of Internet on a range of outcomes, including health (Whitacre and Brooks, 2014),jobs and economic productivity (Atif et. al., 2012). The paper is most closely associated withstudies measuring the effect of broadband service or e-Commerce expansion in ruralcommunities (Atif et. al., 2012) and on farms (Kuttner, 2016; Kim and Orazem, 2016). However,empirical analyses of the benefits of Internet connectivity on farms remain mixed in othercontexts (Achenreiner and Cylhoff, 2005; Guo et. al., 2018; Stenberg et al., 2009). Studies havefound that improved connectivity may contribute directly to sales growth and profitability bylowering input or other supply costs. Access to the Internet decouples purchasing patterns fromspatial constraints by providing farmers the ability to comparison shop for farm inputs,machinery, and even credit among local, near local or national suppliers (Just and Just, 2001;Achenreiner and Dylhoff, 2005; Stenberg et. al., 2009; Jeffcoat et. al., 2012). Evidence suggeststhat U.S farmers use e-Commerce to obtain lower prices on seeds, herbicides and other cropsupplies.21

20 While the ***data*** comprehensively archive broadband technologies in U.S census tracts over time, ***collection*** andreporting methodologies limit some of the analyses I’m able to perform. For instance, the paper relies on fixedterrestrial broadband services (including fixed terrestrial wireless) and satellite connections but excludes terrestrialmobile wireless technology. The Commission’s Form 477 ***collected*** ***data*** on terrestrial mobile wireless at the statelevel, while ***data*** for other technologies of transmission were ***collected*** at the census tract level. See Section 3 on datafor an extensive definition and description of broadband terminology. 21 “E-Commerce for Farmers: Shopping Online for $26,000 of Herbicides”, Wall Street Journal, Jesse New andJacob Bunge, Feb. 16, 2017; An earlier article finds that connectivity can contribute savings of up to 30 percent byeliminating suppliers and distributors for seeds, fertilizers and crop protection chemicals (“Old Mac Donald Has aWebsite: Online exchanges for farmers are cutting costs for seed, feed, and chemicals while boosting prices forproducts,” Darnell Little, Businessweek (now Bloomberg Businessweek), May 15, 2000 5 OEA Working Paper 50 Further studies indicate that broadband adoption is not homogenous across farms. Farmsfurther upstream (e.g feed suppliers) are more likely to adopt the Internet and engage in e-Commerce (Henderson et. al., 2004). Likewise, larger firms are more likely to adopt broadband,engage in e-Commerce, and create an online presence through digital marketing strategies(Smith et. al., 2004; Burke, 2009). Large agribusiness firms with an international scope are morelikely to adopt Internet use than others whose scope remains more local (McFarlane et. al., 2003;Ehmke et. al., 2001). Other factors that contribute to broadband adoption include farmer age andeducational achievement, family size, and previous exposure to computers and the Internet(Briggeman and Whitacre, 2010; Mishra et. al., 2009; Mishra and Williams, 2006; Gloy andAkridge, 2000; Smith et. al., 2004). This paper is also associated with literature estimating theimpact of the USDA’s Broadband Loan Program on economic outcomes for farmers (Dintermanand Renkow, 2017; Kandilov and Renkow, 2010; Kandilov et.al , 2011).22 Broadly, the paper isrelated to literature examining the importance of broadband connectivity on “big ***data***”applications as well as precision ***agriculture***. Some studies have identified a difference in the effect of broadband adoption vs.availability on outcomes of interest (Whitacre, Gallardo and Strover, 2014; Whitacre, Mark andGriffin, 2014). Historically, the Commission has measured broadband both in terms of adoptionrates as well as deployment rates. Broadband availability is generally characterized by thedeployment rate, which is the ratio of the population with access to fixed broadband service at orabove a speed benchmark to the total population.23 While historical ***data*** on broadbanddeployment and availability back to 2010 is publicly available, the Commission has also releasedpublicly limited ***data*** on household broadband adoption rates and the number of providers at thecounty level since 2008.24 The Commission has measured the adoption rate of services at orabove a speed benchmark using both its Form 477 subscription and deployment ***data***.25 Theadoption rate is the ratio of the number of residential Form 477 broadband subscriptions to thetotal number of households where the same minimum broadband speed of service has beendeployed.26

([*https://www.bloomberg.com/news/articles/2000-05-14/old-mac-donald-has-a-web-site*](https://www.bloomberg.com/news/articles/2000-05-14/old-mac-donald-has-a-web-site), last accessed Dec. 12,2020).22 To expand rural broadband availability, the USDA created a Broadband Loan Program to incentivize Internetservice providers to increases service in rural areas (Dinterman and Renkow, 2017).23 The Commission has also calculated deployment rates using the number of housing units and the number ofhouseholds.24 From 2010 to 2014, the National Telecommunications and Information Administration (NTIA) State BroadbandInitiative (SBI) released to the public semi-annual ***data*** on fixed Internet availability by provider, technology type,and speed threshold at a census block level. The Commission took over this ***data*** ***collection*** in 2014. The publiclyreleased ***data*** on adoption rates are split into five categories based on the proportion of household broadbandadoption rates: proportion of households at less 20 percent adoption; from 20 percent to 39.9 percent adoption; 40percent to 59.9 percent adoption; 60 percent to 79.9 percent adoption, and; 80 percent adoption and above.25 In June 2013, the Commission approved changes to the Form 477 ***collection*** that affected the ***data*** beginning inJune 2014. Before 2014, the National Telecommunications and Information Administration (NTIA) oversaw thecollection of ***data*** on broadband deployment in coordination with the States. Beginning in 2014, the FCC assumedresponsibility for the ***collection*** of broadband deployment. The first filings at the FCC were due on Oct. 1, 2014,representing ***data*** as of June 30, 2014, while NTIA’s final ***collection*** was also for ***data*** as of June 30, 2014. The FCChas ***collected*** census-tract level ***data*** as of Dec. 31, 2008. Post-2014, deployment and subscription ***data*** collectionefforts were consolidated into the Form 477 ***data*** ***collections***.26 FCC 2020 Broadband Deployment Report, April 24, 2020, GN-Docket No. 19-285, page 30. 6 OEA Working Paper 50 The variable of interest in this paper is the broadband penetration rate, which is the ratioof the number of connections at given speed threshold in a county over the total number ofhouseholds in a county.27 While prior empirical studies have focused on the role of broadbandaccess in facilitating job growth, firm creation or health outcomes, to my knowledge there are noempirical studies that directly measure the impact of rural broadband penetration on U.S cropyields and farm expense measures. Further, no studies directly analyze farming outcomes withrespect to broadband penetration at the county level using internal Commission ***data*** on thenumber broadband connections. The rest of the paper proceeds as follows. Section 2 describes the link between Internetconnectivity and farming outcomes. Section 3 describes the primary datasets and presentssummary ***statistics***. Section 4 describes the empirical strategy. I present results in Section 5.Section 6 provides a discussion of potential policy implications and concludes.

2. The Link Between Internet Connectivity and Farm Outcomes It is useful to frame the analysis by identifying the various mechanisms through whichInternet connectivity may influence farm outcomes. As stated in Section 1, broadband mayimpact farm profitability by directly lowering input or other supply costs. While online pricediscovery enables farmers to directly source materials at a lower cost, an indirect effect may bean improved bargaining position from the elimination of information asymmetries.28 Access toonline databases of nationwide prices provide farmers the ability to negotiate with theirtraditional suppliers for better prices, as farmers are no longer locked into offered rates from thelocal farm store or co-operative.29 A corresponding argument could be made that connectivityenables farmers to obtain the highest prices for their crops or livestock via the same mechanisms.U.S farmers may also depend on the Internet to access up-to-date information on weather andcommodity markets, to automate record-keeping and reporting tasks, and to engage in onlinebanking30. A more salient mechanism derives from the use of Internet connectivity to extract real-time, accurate ***data*** on crop yields, soil moisture levels, plant health, and equipment conditions.31Farm management technologies that take advantage of timely, detailed and site-specific ***data*** areclassified broadly as “precision ***agriculture***. ”32 More specifically, precision ***agriculture*** (PA) is a“management strategy that gathers, processes and analyzes temporal, spatial and individual dataand combines it with other information to support management decisions according to estimated

27 Although the results are not included in this paper, the main empirical regressions were also run using housingunits and total population as the denominator in the penetration rate, with little change in the ultimate findings.28 McFarlane et. al., 2003; Ibid, footnote 21, page 8.29 McFarlane et. al., 2003. Ibid, footnote 21, page 8.30 See, e.g , Briggeman and Whitacre (2010); United Soybean Board, White Paper (2019).31 Ibid, footnote 30. 32 See e.g , Schimmelpfennig and Ebel (2016). 7 OEA Working Paper 50variability for improved resource use efficiency, productivity, quality, profitability andsustainability of ***agricultural*** production. ”33 PA technologies are varied but are generally grouped into three categories that may beimplemented either sequentially or in tandem: monitoring and sensing applications; variable ratetechnology; and farm operation applications (i.e ***data*** management systems).34 Farmers maychoose to integrate one or several PA technologies into the farm management process, but allprocesses depend significantly on high-quality Internet connectivity. Monitoring and sensingapplications most often include GPS-based mapping of yield and soil ***data***, unmanned aerialvehicles or drones, and remote soil sensors that generate real-time ***data*** on soil ***nutrient*** levels.35Computer mapping using GPS and variable rate technologies enables targeted input applicationor management of low-yielding or less-productive subareas within larger farm fields. Satellite-guided auto-steer systems for combines and tractors improve accuracy in tilling, planting, andspraying, particularly when paired with telematics, or the real-time ***data*** ***collection*** for machineand harvesting efficiency management. Information generated by PA technologies can then betransmitted via short-range wireless or WiFi technologies (which are more efficient than amanual transfer of ***collected*** ***data***) to cloud-based farm ***data*** management systems for furtheranalysis. According to industry estimates, technological innovation made possible by precisionagriculture and the deployment of broadband, has “lowered farm expenses on seed, fertilizer andpesticides by an average of 15 percent, and raised crop yields by an average of 13 percent. ”36 Precision ***agriculture*** applications depend on both within-farm infrastructure and a robustconnection to the Internet. Farms can implement these technologies in similar ways as homebroadband connectivity devices are used in the residential context. Farms have the option ofpurchasing additional fixed or wired lines through their Internet service provider (ISP) to connectbarns or other outbuildings. Farms may also extend a single home or base wired or satelliteconnection to fields, tractors, barns or outbuildings via antennas, extenders or repeaters.37 Moreformally, some companies offer mesh systems that use standard WiFi signals and Ethernetconnectivity that connect to a router and transmit that connectivity to hubs and receivers acrossfields, tractors, barns and other outbuildings.38 Reliable and affordable high-speed broadband connectivity has the capacity to furthertransform the U.S farming industry.39 Ge, Thomasson and Sui (2012) illustrate this potential inrelated work describing field tests of a wireless-and-GPS system for mapping cotton fiberquality. According to the authors, cotton prices are based on fiber quality, therefore identifying 33 “ISPA Forms Official Definition of ‘Precision ***Agriculture***’”, PrecisionAg.com, International Society for PrecisionAgriculture ([*https://www.precisionag.com/market-watch/ispa-forms-official-definition-of-precision-****agriculture****/*](https://www.precisionag.com/market-watch/ispa-forms-official-definition-of-precision-agriculture/), lastaccessed Oct. 24, 2019).34 See e.g , Schimmelpfennig and Ebel (2016).35 See, e.g , Bramley (2009); Schimmelpfennig and Ebel (2016).36 See, e.g , CoBank Report, March 2016.37 “Best WiFi for Rural Areas: The Definitive Guide”, Simple WIFI ([*https://www.simplewifi.com/blogs/news/best-wifi-for-rural-areas-extenders-repeaters*](https://www.simplewifi.com/blogs/news/best-wifi-for-rural-areas-extenders-repeaters), last accessed Dec. 12, 2020).38 Ayrstone Productivity ([*https://ayrstone.com/www/how-it-works/longer-range-networks/*](https://ayrstone.com/www/how-it-works/longer-range-networks/), last accessed Nov. 22,2020); “Boost wireless signals around the farm,” Jessica Michael, Farm Progress([*https://www.farmprogress.com/blogs-boost-wireless-signals-around-farm-10265*](https://www.farmprogress.com/blogs-boost-wireless-signals-around-farm-10265), last accessed Dec. 10, 2020).39 [*https://www.cnet.com/news/in-rural-farm-country-forget-broadband-you-might-not-have-internet-at-all/*](https://www.cnet.com/news/in-rural-farm-country-forget-broadband-you-might-not-have-internet-at-all/) 8 OEA Working Paper 50spatial variability in quality across fields could benefit farmers by focusing crop inputs tooptimize quality and yield. Manually testing and mapping cotton fiber quality is both time andresource intensive, especially during the cotton harvest when workers’ attentions areconcentrated on ensuring the harvest is completed quickly with minimal degradation in quality.Upgrading harvesting and dumping equipment with sensors that automatically record positiondata for each harvested basket of cotton, farmers can pair that location ***data*** to the qualityclassification of cotton modules done by USDA ***Agricultural*** Marketing Service classingoffices.40 After harvesting and classification, ***data*** from the wireless-and-GPS-enabled systemcan be downloaded for GIS analysis, fiber-quality mapping and other post-processingprocedures. Paired with yield maps and other ***data***, the system can be used to increase not onlyfuture crop quality but yield and farm profitability. The authors also find some potential toreduce energy use, labor time and stress or fatigue on the farmer.

3. ***Data*** Several ***data*** sources are combined to determine the relationship between improvedbroadband connectivity and farming outcomes. The dependent variables are derived from threesuccessive waves of the USDA’s Census of ***Agriculture*** (Ag. Census). The Ag. Census is acomplete record of U.S farms and ranches and the people who operate them.41 All plots of land,whether rural or urban, are included in the census if ***agricultural*** products valued at $1,000 ormore were produced and sold – or normally would have been sold – during the census year.42The census is taken once every five years for years ending in 2 and 7 and “provides the onlysource of uniform, comprehensive, and impartial ***agriculture*** ***data*** for every county in thenation. ”43 The primary analysis focuses on both farm expenses – chemical, seed and plants,fertilizer, fuel and operating expenses per operation – as well as production (yield) measures forfive row crop commodities – corn, cotton, hay, soybeans and wheat – from the 2007, 2012, and2017 censuses. The row crop commodities are chosen for two reasons: 1) related literatureindicates that row crops such as corn, soybeans, wheat and cotton are more likely to benefit fromimproved connectivity since they have been targeted for the application of precision agriculturetechnologies like yield monitors; and 2) the Ag. Census ***data*** indicate they are among the topcommodities in the U.S in terms of production.44 40 Cotton classing office locations: [*https://www.ams.usda.gov/about-ams/programs-offices/cotton-tobacco/classing-offices*](https://www.ams.usda.gov/about-ams/programs-offices/cotton-tobacco/classing-offices), last accessed Dec. 7, 2020.41 ***Collection*** is done by the USDA’s National ***Agricultural*** ***Statistics*** Service (NASS). According the USDA’s reportform guide for the 2017 Census of ***Agriculture***, “a census of ***agriculture*** is taken to measure ***agriculture*** activity andproductivity for each county and state of the United States. A national census of ***agriculture*** was first taken in 1840and was conducted every 10 years thereafter until 1920. Since 1982, the Census of ***Agriculture*** has been conductedon a 5-year cycle for years ending in 2 and 7. ”42 Census of ***Agriculture***, USDA, Frequently Asked Questions ([*https://www.nass.usda.gov/AgCensus/FAQ/2017/index.php*](https://www.nass.usda.gov/AgCensus/FAQ/2017/index.php), last accessed Dec. 11, 2020).43 [*https://www.nass.usda.gov/AgCensus/*](https://www.nass.usda.gov/AgCensus/), last accessed Dec. 11, 2020.44 See, e.g , Whitacre, Mark, and Griffin (2014); According to the U.S Department of ***Agriculture***, corn, soybeansand wheat are the top U.S field crops in planted acreage, production, and gross farm receipts([*https://www.ers.usda.gov/topics/crops/wheat/wheat-sector-at-a-glance/*](https://www.ers.usda.gov/topics/crops/wheat/wheat-sector-at-a-glance/), last accessed Nov. 24, 2020). 9 OEA Working Paper 50 Note that the yield ***data*** are crop specific while the expense measures are farm specific.The Ag. Census ***data*** do not distinguish expenses by crop type, it is an aggregate measure acrossall operation types including aquaculture, animal farming, and nurseries. It is useful to studyyields because they are directly related to productivity. Since precision ***agriculture*** may impactcrops differentially, crop-specific ***data*** are well suited to the purpose. On the other hand,expenses are closely tied to profitability and are therefore also important to study. Sinceprecision ***agriculture*** likely affects crop production differentially, it would be ideal to haveexpense ***data*** that exists at the crop level. As noted above in the case study of cotton, someprecision ***agriculture*** techniques are applied post-harvest and so the impact would not show up inyields. While the impact would show up in expenses, those ***data*** are not available per crop. Limited descriptive analysis focuses on select machinery that may be related to precisionagriculture, including the number of self-propelled combines, cotton pickers and strippers, andforage harvesters, in use and purchased by farm operators, particularly those purchased withinfive years. They are not included formally in the modeling because there is no method of linkingthis machinery use to the production processes of farms specifically engaged in corn, cotton, hay,soybean or wheat production. Additional control variables relating to county agricultureproduction characteristics, specifically average farm size (both overall and by crop type) or theaverage number of workers per operation, are drawn from the ***Agricultural*** Census and includedin the formal modeling. The ***Agricultural*** Census ***data*** exist at the county level. The primary independent variables of interest are derived from internal FCC subscriptiondata and exists in its native format at the census tract level.45 The Commission collectsbroadband subscribership ***data*** through its semi-annual Form 477 ***data*** ***collection***. The Form 477collection gathers standardized information about the number of Internet access connections byprovider, downstream and upstream speeds, technology of transmission (e.g , cable modem orAsymmetric DSL), and end-user type (e.g , residential vs. business), over time and across censustracts through semi-annual ***data*** releases. Connections are also classified according to ninetechnology types. Figure 1 enumerates these technology categories. Fixed broadband accessconnections are defined in the ***data*** as “wired ‘lines’ or fixed terrestrial wireless ‘channels’ ” inservice with transfer rates exceeding 200 kilobits per second (kbps) in at least one direction.46The Form 477 ***data*** ***collection*** also includes census tract level connections from satellitetransmission. The analysis relies on fixed terrestrial Internet services, including terrestrial fixedwireless service, and satellite Internet connections.47 Evidence suggests that satellite Internet 45 Census tracts are small, relatively permanent statistical subdivisions of a county or equivalent entity, according tothe U.S Census ([*https://www.census.gov/programs-surveys/geography/about/glossary.html*](https://www.census.gov/programs-surveys/geography/about/glossary.html), last accessed Dec. 12,2020). Census tracts generally have a population size between 1,200 and 8,000 people, with an optimum size of4,000 people. (See 2010 Census Summary File 1 Urban/Rural Update Technical Documentation prepared by theU.S Census Bureau, 2012, at A-12, [*http://www.census.gov/prod/cen2010/doc/sf1.pdf*](http://www.census.gov/prod/cen2010/doc/sf1.pdf) A census tract usually coversa contiguous area; however, the spatial size of census tracts varies widely depending on the density of thesettlement. See United States Census Bureau, Geographic Terms and Concepts – Census Tract([*https://www.census.gov/geo/reference/gtc/gtc\_ct.html*](https://www.census.gov/geo/reference/gtc/gtc_ct.html), last accessed March 4, 2020).46 Fixed Broadband Subscription, FCC Form 477 definitions sheet. 47 While some ***data*** on terrestrial mobile wireless connections are available beginning with the December 2008 datacollection, providers were not required to report this information at the census tract level. Instead, providers offacilities-based mobile wireless service reported the “census tracts in the state that best represent the areas whereservice is available over the provider’s own network, for each of the speed tiers in which the provider offers service” 10 OEA Working Paper 50may not be fully capable of supporting advanced precision ***agriculture*** technologies due to higherlatency, capacity constraints, and higher costs for securing ***data*** flows.48 However, this studyremains agnostic with respect to technologies of transmission. To the extent a transmissiontechnology is capable of providing a connection at a given speed threshold in the analysis, thatconnection is included. Figure 1: Technology Types in Form 477 ***Collection*** Technology Codes Type Description 1 Asymmetric DSL 2 Symmetric DSL 3 Other Wireline 4 Cable Modem 5 Fiber-to-the-premises (FTTP) 6 Satellite 7 Terrestrial Fixed Wireless 8 Terrestrial Mobile Wireless 9 All Other Internet access connections are classified according to eight download speed categories and nineupload speed categories (shown in Figure 2). Form 477 subscription ***data*** from December 2014and later include the paired download and upload speeds (in Mbps) for each observation, whileearlier vintages provide speed characteristics by paired download and upload tiers only.49Therefore, the analysis is restricted to the use of speed tiers in order to maintain consistencyacross all vintages of the 477 ***data***.50 Connections are aggregated from the census tract to thecounty level for a given speed threshold. The primary independent variable of interest is thenumber of connections at or exceeding 25 Mbps download and 3 Mbps upload speeds per 1,000households in a county. An alternative measure uses the threshold of 10 Mbps download and0.768 Mbps upload speeds per 1,000 households. I focus on 25+/3+ connections for two reasons:1) 25+/3+ is the current FCC definition of “high-speed” broadband Internet51, and 2) literature (“Internet Access Services: Status as of December 31, 2009,” Federal Communications Commission, IndustryAnalysis and Technology Division, Wireless Competition Bureau, December 2010, page 81).48 “A Case for Rural Broadband,” USDA, April 2019, page 7.49 Connections are classified by a paired download and upload speed, for instance: the number of residentialconnections using Asymmetric DSL with a download speed greater than or equal to 3 Mbps and less than 6 Mbpsand an upload speed greater than or equal to 768 kbps and less than 1.5 Mbps.50 I convert enumerated upload and download speeds in their corresponding speed tiers using the classificationscheme of earlier Form 477 ***collections***.51 In 2015, the Commission concluded the broadband speeds of 4 Megabits per second download and 1 Megabit persecond upload were no longer sufficient to be considered advanced telecommunications capability, and insteadadopted the benchmark of download speeds of at least 25 Mbps and upload speeds of at least 3 Mbps. See “In theMatter of Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in aReasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of theTelecommunications Act of 1996, as Amended by the Broadband ***Data*** Improvement Act,” 2015 BroadbandProgress Report and Notice of Inquiry on Immediate Action to Accelerate Deployment, released February 4, 2015,Federal Communications Commission, GN-Docket No. 14-126. 11 OEA Working Paper 50suggests higher thresholds are required for some applications of precision ***agriculture***, althoughnot all applications.52 Figure 2: Speed Thresholds in Form 477 ***Collection*** Upload/Download Rates Tier Description 1 Less than or equal to 200 kbps (upload rates only) 2 Greater than 200 kbps and less than 768 kbps 3 Greater than or equal to 768 kbps and less than 1.5 Mbps 4 Greater than or equal to 1.5 Mbps and less than 3 Mbps 5 Greater than or equal to 3 Mbps and less than 6 Mbps 6 Greater than or equal to 6 Mbps and less than 10 Mbps 7 Greater than or equal to 10 Mbps and less than 25 Mbps 8 Greater than or equal to 25 Mbps and less than 100 Mbps 9 Greater than or equal to 100 Mbps Estimation of the sample ***data*** and descriptive ***statistics*** include market and demographiccharacteristics from several sources. County-level demographic ***data*** from the U.S CensusBureau include overall population, population by age cohorts, population by race, populationshare by educational attainment, median household income and median age.53 ***Data*** on theunemployment rate from the BLS is included the analysis. The percent of farm proprietors’employment in each county from the Bureau of Economic Analysis is included in the descriptivecharacteristics. ***Data*** on the total number of establishments, number of establishments in theagriculture sector and in crop production, total employed in all establishments, and averageannual pay in a county, from the Bureau of Labor ***Statistics***’ (BLS) Quarterly Census ofEmployment and Wages are included in the descriptive analysis. Counties can be designatedmetropolitan (i.e larger labor market areas) or non-metropolitan using the USDA’s EconomicResearch Service’s rural classification scheme in the descriptive analysis. According to the ERS,nonmetro counties include some combination of open countryside, rural towns with fewer than

52 One example of high bandwidth connected technologies is drone imagery of fields (“A Case for RuralBroadband,” USDA, April 2019, pages 3 and 27).53 For 2007 household counts, I use 2005-2009 ACS 5-year Estimates for households, and for 2012 and 2017household counts, I use FCC Staff Block Estimates ([*https://www.fcc.gov/staff-block-estimates*](https://www.fcc.gov/staff-block-estimates)). For 2007 housingunits, I use the 2000-2010 intercensal ***data***, and for 2012 and 2017, I use annual Census estimates of housing unitsand population from 2010-2018. For median household income, I use 2007-2017 Census ***data*** from the Small AreaIncome and Poverty Estimates (SAIPE) Program ([*https://census.gov/programs-surveys/saipe/****data***](https://census.gov/programs-surveys/saipe/data)). For median age,population, population by gender, and population by age, I use Census ***data*** from the Annual Estimates of theResident Population for Selected Age Groups by Sex for the United States, States, Counties and Puerto RicoCommonwealth and Municipios: April 1, 2010 to July 1, 2018, Release Date: June 2019. For other Census ***data***, Iuse 2005-2009 ACS 5-year Estimates for 2007; the 2010-2014 ACS 5-Year Estimates for 2012; the 2014-2018 ACS5-year Estimates is used for 2017 (NHGIS ***Data*** Citation: Steven Manson, Jonathan Schroeder, David Van Riper,and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 14.0 [Database].Minneapolis, MN: IPUMS. 2019. [*http://doi.org/10.18128/D050.V14.0*](http://doi.org/10.18128/D050.V14.0) ) Land area for each county derived fromU.S Census 2010 TigerLine Shapefiles and population counts. 12 OEA Working Paper 502,500 people, and urban areas with populations ranging from 2,500 to 49,999 which are not partof the larger labor market areas (metropolitan areas).54 To assess the relationship between connectivity and farming outcomes, I first obtain thecomplete list of all U.S counties or county equivalents from the Census Bureau. The analysiscomprises the 48 contiguous states, and excludes Alaska, Hawaii, Puerto Rico and the U.S territories of Guam, the U.S Virgin Islands, N. Mariana Islands, and American Samoa. Eachcounty is matched to its corresponding demographic attributes from the sources enumeratedabove. I construct a panel for approximately 3,070 counties across 3 time periods (2007/2008,2012 and 2017), for a total of 9,210 observations in the pooled sample. Given the time series andcross-section components in the ***data***, my analysis relies on changes in broadband penetrationrates at different speed thresholds over time and across counties. 3.1 ***Data*** Limitations The analysis has several limitations. Timing may be of key importance in estimating acausal effect of improved connectivity on farming outcomes. The mechanisms through whichInternet connectivity affects farm outcomes would require that connectivity first be available forfarms to incorporate into their production and management processes. Therefore, I cannot matchthe 2007, 2012, and 2017 Ag. Census ***collections***, which report annual measures as of December31 of each census year, with corresponding December vintages of the Form 477 ***data***. Instead, Ipair the 2012 and 2017 Ag. Census ***data*** ***collections*** with the June 2012 and June 2017 vintagesof the Form 477 ***data***, respectively. This pairing should support the requirement that connectivitybe substantially available during the bulk of the planting, growing, and harvesting seasons.55 Asa robustness check, I also implement the main analysis pairing the December 2011 andDecember 2016 vintages of the Form 477 ***data*** with the 2012 and 2017 Ag. Census datacollections. However, December 2008 is the earliest vintage to which I can pair the 2007 Ag. Censusdata. The Commission began ***collecting*** census tract-level subscription ***data*** with the December2008 release. The 2004 revisions of the Form 477 ***data*** ***collections*** did require all facilities-basedproviders to report broadband connections, but providers generally reported these counts at thestate level and then provided a list of zip codes where broadband technologies were being used.56While recognizing that pairing December 2008 Form 477 ***data*** to 2007 Ag. Census ***data*** is lessthan ideal, this paper’s primary analysis relies both on changes over time and across regions inboth the dependent and independent variables of interest to infer causal impact. The estimatedeffect of improved connectivity from December 2008 to June 2012 on the change in farmingoutcomes from 2007 to 2012 should represent a lower bound, as the level change from December2008 to June 2012 is lower than that from June 2007 to June 2012. It may be argued that bias 54 [*https://www.ers.usda.gov/topics/rural-economy-population/rural-classifications/*](https://www.ers.usda.gov/topics/rural-economy-population/rural-classifications/) (last accessed March 11, 2020).55 The season for field crops depends on the crop, location and soil temperature. Planting for corn, for instance, takesplace from April to May (Sheperd and Harrington, 1998).56 See, e.g , Modernizing the FCC Form 477 ***Data*** Program, final rule, WC Docket No. 11-10 FCC 13-87, EffectiveSeptember 12, 2013, 78 FR 49126, pages 49126-49149 ([*https://www.federalregister.gov/documents/2013/08/13/2013-19493/modernizing-the-fcc-form-477-****data****-program,last*](https://www.federalregister.gov/documents/2013/08/13/2013-19493/modernizing-the-fcc-form-477-data-program,last) accessed Dec. 12, 2020). 13 OEA Working Paper 50may result if connectivity exhibits different patterns across census tracts from June 2007 to June2012 as from December 2008 to June 2012. However, this is less of a concern for the primaryempirical methodology, which relies on the change from one period to the next, and specificallyfor the first time period in the time series. As a robustness check, results are presented for boththe full model – including the paired 2008 broadband and 2007 Ag. Census ***data*** – and aparsimonious model using only the paired 2012 and 2017 ***data*** from each source.57 ***Data*** limitations also preclude the use of terrestrial mobile wireless connections in theanalysis. Terrestrial mobile wireless connection ***data*** was not ***collected*** at the census tract level inForm 477. To the extent that farm operations rely on cellular technology when wired or satellitebroadband technology is unavailable or insufficient, this represents a disadvantage in theempirical methodology. The paper’s analysis is conducted at the county level, as the county is the smallest levelof geographic disaggregation for which there is information on U.S farming outcomes. Form477 ***data*** are provided at the census tract level, while the Ag. Census ***data*** exist at the countylevel. The independent variable of interest is defined as the broadband penetration rate, or thetotal number of 25+/3+ or 10+/0.768+ connections per 1,000 households in a county. It isrelatively straightforward to nest tracts within counties, but the differing levels of geographicaggregation between outcome and independent variables may affect precision of the results. Earlier in the paper, I identified several mechanisms through which increased broadbandpenetration rates may influence farming outcomes. Broadband penetration may contribute tobusiness process efficiency and sales growth through the reduction of input costs such as seedsand fertilizer, access to better information, or by lowering transportation or other transactioncosts. Improved Internet access may also drive the adoption of farm management systems orprecision ***agriculture*** technologies that facilitate increased production or lower costs. Datalimitations preclude direct identification of these mechanisms at the farm level. The Ag. Censusdoes not distinguish crop yields or farm expenses for farm operations that either have or do nothave Internet, nor the speed thresholds of those connections. Therefore, while the analysisleverages changes in broadband penetration at specific speed thresholds over time and geographyto uncover the potential impact on crop yields and farm expenses, the estimate of this linkremains indirect. This limitation is consistent with related literature but does invite caution inevaluating the strength of any implied causality. 3.2 Descriptive ***Statistics*** Tables 1 through 8 provide descriptive ***statistics*** for the ***data*** in the full sample. Table 1reports on county-level means for general, expenses, land use, and selected Internetcharacteristics from the 2007, 2012 and 2017 waves of the Ag. Census. The Internetcharacteristics included in Table 1 are derived from the Ag. Census only, not from theCommission’s Form 477 ***data*** ***collection***. The first panel of Table 1 provides general information 57 I also implement a limited analysis using only the first two periods (2007/2008 and 2012) to examine whetherthere are differing treatment effects over time. 14 OEA Working Paper 50on county-level farm operation characteristics for each time period, including the averagenumber of operated acres, harvested acres of cropland, and the number of farm operations (e.g farms) with operated acres. Cropland includes land from which field crops were harvested or haywas cut, and land used for vegetables, nursery and greenhouses, orchards, vineyards, citrusgroves, Christmas trees, short rotation woody crops, fruits, nuts and berries.58 The ***data*** indicatethat while the average number of farm operations and farm operations with operated acres havedeclined slightly from 2007 to 2017, the number of operated and harvested acres of croplandhave remained relatively stable. This seems to indicate that the average size of farms hasincreased over time, perhaps through larger farms acquiring smaller farms. Most of the selectedexpense characteristics (e.g chemical, operating, and seed and plants expenses) indicateincreasing county-level average expenses per operation over time, while others exhibit a peak in2012 (e.g fertilizer and fuel).59 Again, farm expenses are not distinguished by crop type.Chemical expenses are an aggregate measure that includes insecticides, herbicides, fungicides,and other pesticides, and includes the costs of custom application.60 It does not include the costsof commercial fertilizer. Operating expenses include all production expenses for all farmoperation types, such as field crops, aquaculture and animal farming. Seed and plants expensesinclude the cost of all seeds, bulbs, plants, propagation materials, trees, seed treatments, and seedcleaning costs purchased in the Ag. Census year.61 Most acres (either operated or not) are treatedwith fungicide, herbicide, insecticide and fertilizer. Relatively few farm operations employ self-propelled machinery, including combines, cotton pickers/strippers, or forage harvesters. Evenfewer operations have self-propelled machinery that were manufactured in the last five years ofthe Ag. Census. More importantly, these numbers exhibit little change across all three waves ofthe Ag. Census. This seems to indicate relatively little implementation of at least one type ofprecision ***agriculture*** technology, but as noted previously, broadband can be integrated into manytypes of farm management processes. Additionally, this paper’s estimation results suggest futureadoption of some precision ***agriculture*** technologies may depend on high-speed broadbandavailability. The Ag. Census ***collects*** limited information from farm operations about Internet use,including how farms connect to the Internet (e.g cell phones, laptops, or tablets) and technologyused (e.g DSL or cable modem). In most cases, the ***data*** only exist for the 2012 and 2017 waves.Table 1 indicates that farm operations with Internet access have increased through each of thethree waves of the Ag. Census, although the ***data*** does not include information about speedthresholds. For example, one survey question in the 2007 Ag. Census provides the number offarm operations with “high-speed Internet access,” but the report form guide for the 2007 censusdoes not specify which Internet service qualifies as “high speed” and would meet thisthreshold.62 The ***data*** do indicate that a greater number of operations access Internet via mobile 58 If two or more crops were harvested from the same land in the census year, the acres are counted for each cropand the total acres of all crops harvested could exceed the acres of cropland harvested (General Explanation andCensus of Ag Report Form, Appendix B, 2017 Census of ***Agriculture***, page 2).59 Total farm production expenses include the production expenses provided by the producers, landlords (excludingproperty taxes), and production 60 General Explanation and Census of Ag Report Form, Appendix B, 2017 Census of ***Agriculture***, page 22. 61 It does not include items purchased for resale or the value of seed that is grown on the farm (General Explanationand Census of Ag Report Form, Appendix B, 2017 Census of ***Agriculture***, page 24).62 The question in the 2007 survey is “At any time during 2007, did this operation have high speed Internet access?”(2007 Census of ***Agriculture***, U.S Department of ***Agriculture***, National ***Agricultural*** ***Statistics*** Service, Report Form 15 OEA Working Paper 50wireless than wired connections such as FTTN or cable. Second, the number of operations usingDSL or dialup technologies has significantly declined from 2012 to 2017. Tables 2 through 6 report production and wired Internet characteristics for each of thefive selected field crops in the counties where those crops are produced. The variables reportedunder the row title General Characteristics are drawn from the Ag. Census ***data*** and representfield crop averages for those counties in which that field crop was reported to have beenharvested. For instance, Table 2 lists 2,319 counties in which at least some corn was harvested in2007. In those 2,319 counties, there were on average approximately 150 farms with harvestedacres of corn in 2007. Average county yield measures for each row crop are also given. Corn,soybeans, wheat and hay are produced across the U.S in at least two-thirds of all counties in thefull sample. Cotton is produced in relatively few counties across the U.S Wired and satellite broadband characteristics in Tables 2 through 6 are reported using thepaired Form 477 ***data*** in all counties where a specific crop was harvested. Using the previousexample of corn-producing regions, in the set of 2,319 counties where corn was harvested in2007, 33.8% of all wired and satellite broadband connections were transmitted through cablemodems in 2007 (December 2008), whereas 38.5% of all wired and satellite broadbandconnections were transmitted through cable modems in June 2017. Speed thresholds in corn,cotton, hay, soybean, and wheat regions are reported for matched download and upload rates andseparately by download and upload speeds in Tables 2 through 6. Following past practice, speedsare in Megabits per second (Mbps). For two-way speed thresholds in corn-producing regions,Table 2 indicates the share of all connections that were at least 3 Mbps download speed and0.768 Mbps upload speed increased from 19.8% in 2007 (December 2008) to 46.3% in 2012 andto 87.4% in 2017. Overall, the tables indicate that Internet penetration has significantly improvedin each crop region from 2007 to 2017. This is true both in terms of the number of connectionsper 1,000 households overall, as well as the speeds of those connections. Connectivity at lowerspeed thresholds has declined in each crop region from 2007 and 2017, as the number higherspeed connections has increased. In addition, the composition of wired broadband connectionshas transitioned from majority DSL (either Asymmetric or Symmetric) to cable modem andFTTN technology.63 Table 7 presents county-level means for other independent variables that couldpotentially impact observed changes in farming outcomes as well as descriptive characteristics atthe county level. These variables were enumerated previously and include socio-economiccontrols such as the unemployment rate, population, age and median household income. Table 8presents overall county-level means for broadband subscription characteristics for the 2008, 2012and 2017 releases of the Form 477 ***data***. Overall, the ***data*** show improvements in broadband

Guide, Survey Form, Section 32. Practices, page 124) The only further clarification of the survey question is that“regardless of the provider, dial-up Internet access is not considered ‘high speed’ Internet access” (2007 Census ofAgriculture, U.S Department of ***Agriculture***, National ***Agricultural*** ***Statistics*** Service, Report Form Guide, page 52,94)63 Fiber-to-the-Node (FTTN) is not identified as a separate technology of transmission in the Form 477 ***data***. Instead,I define Fiber-to-the-Node (FTTN) as any Asymmetric DSL technology of transmission capable of at least 10 Mbpsdownload and 0.768 kbps upload speeds. Therefore, Asymmetric DSL connections are all those connections that donot reach the speed threshold of 10+/0.768+. 16 OEA Working Paper 50penetrations measured either as a function of the number of households, housing units orpopulation. These findings are consistent with the results from individual crop regions. The datain Table 8 also show improvements in speed thresholds over time from 2008 to 2017.

4. Empirical Strategy Having presented the ***data***, I turn next to a summary of the estimation strategy. This paperseeks to determine whether broadband penetration at a given speed threshold is associated withimproved crop yields and/or lower farm expenses. I use a panel dataset comprised of county-level U.S farming outcomes and Internet connection counts in 2007/2008, 2012, and 2017, for atotal of 9,210 county-year observations in the full sample. Dependent variables are classified as either an expense (e.g operating or chemicalexpenses per operation) or a productivity measure (e.g corn yields measured in bushels perharvested acre). For crop productivity measures, I estimate the model for the set of countiesspecializing in the production of each of the selected crops in the sample. For instance, inColumn 1 of Table 9, I estimate the regression model for corn yields in all counties withharvested acres of corn. For expense measures, the approach is similar. I estimate the model forthe set of counties with any harvested acres of cropland. The primary independent variable of interest is the broadband penetration rate, or thenumber of Internet connections with at least 25 Mbps download and 3 Mbps upload speeds per1,000 households in a county. Additional analysis uses the number of Internet connections withat least 10 Mbps download and 0.768 Mbps upload speeds per 1,000 households in a county. Idiscuss each component of the empirical strategy in more detail below. 4.1 Fixed Effects Model The primary relationship of interest is between the change in broadband penetration andfarming outcomes over time. I estimate the effect of broadband on farming outcomes using afixed effects technique, which models the change in farming outcomes as dependent variablesand uses varying levels of socioeconomic and other demographic characteristics as explanatoryvariables. A pooled estimator, which utilizes repeated cross-section ***data***, does not control foreither time or county fixed effects, although each observation in the model is assumed to betaken from the same distribution. Coefficients in the fixed effects model represent averagechanges within counties, only for counties that experienced changes in broadband penetration.This approach approximates estimating an average treatment effect among the treated. Thisapproach is preferred if individual county fixed effects are correlated with other exogenousvariables. Generally, a fixed effects technique is more appropriate because the ***data*** includes allcounties in which a commodity is grown and/or sold, not a sampling of counties across theU.S.64

64 Fixed effects analysis supports inference when a sample exhausts the population (Green and Tukey, 1960). 17 OEA Working Paper 50 The fixed effects estimator is based solely on variation within units, and automaticallycontrols for all observable and unobservable unit-specific characteristics: = + + + + + , 0 1 2 3 where is the outcome of interest, farming outcome measures in county i at time t; is the unit-specific intercept, the county fixed effect; are observed county-level socioeconomic control variables such as income, unemployment rates, education and other demographic characteristics enumerated in Table 7; , is the variable of interest thatmeasures the broadband penetration rate in county i at time t; denotes the county-invariant time fixed effects, the coefficients , , and are associated parameter vectors, and help evaluate the effects of improvements in broadband penetration for farming counties over time, 1 2 3and; is the error term. The ***data*** indicate that some estimates of broadband penetration,specifically the number of connections with at least 25 Mbps download and 3 Mbps upload speedsɛ per 1,000 households, are zero for some counties in some time periods. Theseobservations are meaningful zeros instead of missing observations, in the sense that zeroconnections indicate that no broadband connections exist, and therefore should not be droppedfrom the analysis. All dependent variables and the primary independent variables of interest aretransformed using the inverse hyperbolic sine (Burbidge, Magee and Robb, 1988; MacKinnonand Magee, 1990).65 The transformation is defined at zero but can be interpreted similarly to astandard logarithmic transformation. The model controls for several other characteristics that could affect either farmproductivity or expense measures.66 Related literature finds that large corn farms are moreprofitable and adopt technology earlier than smaller corn farms.67 Additionally, the size ofcounties are fixed, but larger operations may exploit economies of scale in crop production thatshould be controlled for in the analysis. Therefore, the yield regressions include crop-specificaverage farm size (e.g , for corn yields, I include a variable for harvested acres of corn per cornoperation) and workers per operation to capture scale economies at the county level. The expenseregressions include a variable for the average number of harvested acres of cropland per croplandfarm operation as a scale measure. Other explanatory variables include median household 65 From Bellemare and Wichman (2019), applying the inverse hyperbolic sine transformation to a variable x yields anew variable: = arcsinh( ) = ln + + 1 2 The inverse hyperbolic sine transformation is defined for both zeros and negative values, although it is noted that thetransformation is not concave for negative values (Ravallion, 2017). However, Bellemare and Wichman (2019)show that the derived elasticities from an arcsinh-arcsinh specification are equivalent to logarithmic transformations(Burbidge et. al., 1988; MacKinnon and Magee, 1990; Pence, 2006). An alternative, but somewhat morecomplicated, approach would be to represent the broadband penetration rate as two variables, one of which is the logof the independent variable of interest when that variable is non-zero and is set to zero otherwise, and a secondvariable which is a dummy variable for non-zero Internet penetration (Hosmer and Lemeshow, 2000; Robertson etal., 1994). I rely on the former transformation due to the ease of interpretation.66 Some variables, such as share of the county population that is male, does not vary much over each 5-year periodand may be subsumed by the fixed effects.67 Schimmelpfenning, 2016. 18 OEA Working Paper 50income, unemployment rate, population density, share of male population, share of population 25and older with high school only education, share of population age 25 and older with somecollege education only, share of population age 25 and older with bachelor’s degree and above,share of the population ages 15-24, ages 25-44, ages 45-64, ages 65-plus and the share ofpopulation white, black, or Asian, and the share of population of Hispanic origin.68 4.2 Instrumental Variables Model The primary specification leverages changes in broadband penetration over time andacross counties to estimate the effect on farming outcomes, but endogeneity concerns mightremain. Standard OLS methods would result in biased estimators and invalid inferences if thereexists two-way causality between farm productivity and improved broadband penetration.Demand for broadband may rise with economic growth and farm profitability at the county level.Additionally, there exists the possibility that improvements in farming outcomes are insteaddriven by omitted factors that are unrelated to increased broadband penetration as specific speedthresholds. To address this and other concerns, I implement an instrumental variables (IV) approachusing two-stage least squares (2SLS) to account for the possibility that broadband penetration isendogenous. The fixed effects modeling relies on the natural variation in broadband penetrationrates across counties and time periods in the sample. The IV model relies on variation from theinstrument. I construct a version of a Hausman-type instrument for the broadband penetrationvariable (Hausman, 1997). The assumption is that the instruments are correlated with broadbandpenetration in a target county but remain uncorrelated with farming outcomes such as crop yieldsor expenses. For each county i, I instrument for broadband penetration at each threshold in year tusing the average broadband penetration rates for the same speed threshold in all adjacentcounties.69 Broadband penetration rates are likely correlated across neighboring counties throughnetwork buildouts or through similar topography. However, instrument exogeneity might beviolated if spatial correlation of broadband penetration in neighboring counties determines cropproduction or expenses in county i. The IV models are just identified, and I cannot directly testexogeneity. If the instruments are not exogenous, then the estimates would be biased. Early research on Internet use indicates that education levels, age, income, and thenumber of children in the household are demographic determinants for whether households adoptthe Internet (Stenberg et al., 2009). Therefore, I also conducted the analysis using a measure of 68 Hispanic origin is considered an ethnicity, not a race ([*https://www.census.gov/topics/population/hispanic-origin/about.html*](https://www.census.gov/topics/population/hispanic-origin/about.html), last accessed Dec. 8, 2020). All explanatory variables are transformed using the inversehyperbolic sine (variables given as a proportion are also transformed for consistency in the event of zero values;although interpretation may be more difficult in these instances).69 An additional Hausman instrument was considered using the average broadband penetration in all counties in thesame state as the target county, minus the target county’s penetration rate. While the results using the state averagebroadband penetration rate were generally similar to those using adjacent counties, diagnostics following estimationof the IV model of the former instrument indicate a potential weak instrument problem (the Kleibergen-Paap Wald Fstatistics were much smaller). Therefore, this paper relies on adjacent county averages as the more appropriateinstrument. States are quite large, and there may be less correlation in same-state counties than in adjacent countiesthat are contiguous. This is even more true if target counties are located near state borders (in which adjacentcounties would be removed from the calculation if located in another state). 19 OEA Working Paper 50educational attainment and median household income. Unfortunately, the Ag. Census does notinclude much demographic information on farm operators, so the instruments were constructedusing Census ***data*** at the county level. Diagnostics indicated that the education instruments wererelatively weak and explained little of the variation in Internet penetrations rates, therefore theseresults are not included in this study. Median household income performed significantly better asan instrument than education, especially at the 25+/3+ threshold, but diagnostics indicatedincome was a weak instrument at the 10+/0.768+ threshold. These results are not included in thisstudy.

5. Results Having presented the empirical methodology, I turn now to the study’s main findings.Results for crop yields using the fixed effects (FE) and 2SLS models for the 25+/3+ thresholdcan be viewed in Table 9; Table 10 displays the crop yield results using the FE and 2SLS modelsat the 10+/0.768+ threshold. Results for expenses per operation using the FE and 2SLS modelsfor the 25+/3+ threshold can be viewed in Table 11; Table 12 displays the results of the FE and2SLS specifications for expenses per operation at the 10+/0.768 thresholds. Each column inTables 9 through 12 corresponds to either a different crop yield or expense measure. The full setof control variables are listed in the footnote of each table.70 The coefficients of the controlvariables are not included due to brevity.71 All models include time and county fixed effects androbust standard errors clustered at the county level. Coefficient and standard error estimates are displayed for the key variables of interest,which are the Internet penetration rates at either the 25+/3+ or 10+/0.768 speed threshold. Asboth the dependent variables are transformed using the inverse hyperbolic sine, the coefficientsin both specifications can be interpreted as an elasticity. The number of observations and ameasure of the goodness of fit are shown for each FE specification. The number of observations,a test for weak instruments (the Kleibergen-Paap (KP) Wald F ***statistic***) and a test forunderidentification (the KP rk LM ***statistic***) are shown for the 2SLS regressions.72 Whilecoefficients under FE and 2SLS are not directly comparable, it may be useful to contrast theresults. Generally, the IV standard errors are larger than the FE standard errors. Larger standarderrors may indicate weak instruments, however the KP Wald F ***statistics*** indicate this is not thecase. Instead, the result may confirm the trade-off between bias and efficiency, and the 2SLS 70 Additional explanatory variables include county average median household income, unemployment rate,population density, share of population male, share of population with high school only education, share ofpopulation with some college education only, share of population with bachelor’s degree and above, share of thepopulation ages 15-24, ages 25-44, ages 45-64, ages 25-44, ages 65 plus, share of population white, black and Asian,and population share of Hispanic origin. All control variables are transformed using the inverse hyperbolic sine forconsistency, although I note this makes interpretation of some control variables potentially more difficult. 71 Additionally, coefficients of control variables do not necessarily have a structural interpretation (Cinelli andHazlett, 2020)72 The KP Wald ***statistic*** is based on the Stock and Yogo (2005) test of weak instruments using the first-stage Fstatistic, where the null hypothesis is that the instruments are weak using the Stock-Yogo critical values. The KPWald ***statistic*** is valid when errors are not independent and identically distributed. The KP rk LM ***statistic*** testswhether the excluded instruments are correlated with the endogenous regressors, where the null hypothesis is nocorrelation. 20 OEA Working Paper 50coefficients are in most instances larger than the FE estimates. One possible explanation forlarger coefficients under 2SLS is that the FE and 2SLS estimates apply to different populations— the average treatment effect among the treated vs. the local average treatment effect. Otherpotential reasons are omitted variables which may be biasing the FE estimates downward, ormeasurement imprecision in the broadband variable of interest. Several findings are immediately noticeable in the yield regressions in Tables 9 and 10.In the IV regression, the instrument is the average number of 25+/3+ connections per 1,000households of a target county’s contiguous neighboring counties. Diagnostic tests suggest theinstrument is strong. Evaluating the effect of changes in 25+/3+ connections on crop yields, Ifind positive and significant coefficients for most field crop types. Corn, cotton, hay, andsoybean yields display positive and significant coefficients for the Internet penetration rate ofinterest in both the FE and 2SLS regressions in Table 9. Using a 2SLS estimation, I find that a1% increase in the number 25+/3+ connections per 1,000 households is associated with a 3.63%increase in corn yields (measured in bushels per harvested acre). The coefficient is over twotimes the magnitude of coefficient in the FE regression, suggesting potential downward bias inthe FE estimates. For soybeans, a 1% increase in the number of 25+/3+ connections per 1,000households is associated with a 3.76% increase in yields (measured in bushels per harvestedacres). The coefficient is also over twice as large as the coefficient in the FE regression. Forcotton and hay yields, the 2SLS regression indicates that a 1% increase in broadband penetrationat 25+/3+ speeds is associated with a 10.1% and 2.15% increase in yields, respectively. Thecoefficient for cotton yields is four to five times larger than the coefficient in the FE regression,indicating significant downward bias. The diagnostics on the 2SLS regression for cotton yieldsindicate a strong instrument, but the magnitude of the KP Wald F ***statistic*** is much lower thanthose in other 2SLS regressions illustrated in Table 9. I note that the coefficient on wheat yieldsis negative under FE and positive under 2SLS, although both are insignificant. Descriptivestatistics for wheat regions in Table 6 indicate that the number of counties in which wheat washarvested declined from 2007 through 2017. Therefore, the effect on wheat yields may be due tolack of power, or from counties exiting the sample. Table 10 replicates the analysis for crop yields using the number of 10+/0.768+connections per 1,000 households as the key independent variable of interest. Using the 2SLSestimation, I find that a 1% increase in the number 10+/0.768+ connections per 1,000 householdsis associated with a 5.5% increase in corn yields. For soybeans, a 1% increase in the number of10+/0.768+ connections per 1,000 households is associated with a 3.55% increase in yields. Thecoefficient is also over twice as large as the coefficient in the FE regression. In the FEestimation, the coefficient on wheat yields is positive and significant at conventional levels. Thissuggests that a 1% increase in broadband penetration at 10+/0.768+ speeds is associated with a0.7% increase in wheat yields (bushels per harvested acre). The results for the lower speed threshold in Table 10 are not as robust as those for the25+/3+ threshold in Table 9. The coefficients on cotton and hay yields are negative andeconomically significant in the 2SLS estimation. It’s possible that beneficial yield outcomes incrop-producing counties require a higher speed threshold than 10+/0.768+. Some evidencesuggests that some precision ***agriculture*** technologies require 25+/3+ connections while others do

21 OEA Working Paper 50not.73 The negative and significant coefficients on cotton and hay crop yields may indicate theimprecision inherent in measuring the types of technological applications that may be used byfarm operations at lower thresholds. This connects generally to the study’s limitation in beingunable to directly tie broadband penetration rates in a county to the use of that connectivity on afarming operation. Last, I cannot rule out that some technologies supported by Internetarchitecture may be implemented post-harvest. The case study presented in Section 2 on theintegration of connected technologies into cotton harvesting indicated that much of the potentialgains materialized post-harvest through quality classifications and/or through technologies thatmay require higher speeds.74 Therefore, the impact of improved connectivity would show up inexpenses for cotton farms rather than in yields, and the ***data*** does not allow me to identifyexpenses for cotton farming alone. The expense regressions in Tables 11 and 12 illustrate a more mixed result than the yieldregressions. In contrast to the results for crop yields, the findings in Tables 11 and 12 indicate aclear benefit in the form of reduced expenses per operation at 10+/0.768+ speeds which appearsto dissipate at 25+/3+ speeds. Using the 2SLS estimation, Table 12 indicates that a 1% increasein 10+/0.768+ speeds is associated with a 2.37% decrease in total operating expenses peroperation. In Column 2, a 1% increase in 10+/0.768+ speeds is associated with a 2.63% decreasein chemical expenses per operation under the 2SLS estimation. Using the 2SLS estimation,Columns 3 through 5 indicate a 1% increase in the Internet penetration rate at 10+/0.768 speedsis associated with a 6.47%, and 3.43% decline in fertilizer and seed and plants expenses peroperation, respectively. I note that while fuel expenses per operation are negative butinsignificant in the 2SLS estimation, the coefficient is positive and insignificant in the FEestimation in Table 12. The 2SLS estimations in Table 11 using the broadband penetration rate at25+/3 speeds show mostly positive but insignificant coefficients for each cost type. Although thecoefficient on seed and plants expenses per operation is negative and significant at conventionallevels in the FE estimation, it is negative and insignificant in the 2SLS estimation. Thecoefficient on fertilizer expenses per operation is positive and significant in the 2SLS estimation. There are many possible reasons for the disparate findings in Tables 11 and 12. First,there may be some efficiency gains that are initially achievable for farm operations at lowerspeed thresholds but that are less salient at higher thresholds. More importantly, there issignificant imprecision in how expenses per operation are measured for the purposes of thisstudy. In Section 3 where I describe the ***data***, I noted that the expense measures, unlike theproduction measures, were aggregate measures across all farming purposes. Expense measuresas defined in the Ag. Census are not restricted to corn or cotton operations, for instance, nor canthey be restricted to field crops more generally. Expenses per operation as defined in Tables 11and 12 include expenses for all farm operation types, such as field crops, nurseries andgreenhouses, aquaculture and animal farming. While some types of expenses, such as those forseeds, plants or fertilizer, may be the provenance of farm operations that concentrate oncropland, there is no way to strictly isolate those expenses to corn, cotton, hay, soybean or wheatproduction, let alone to field crops themselves. Cropland can include not only land for field cropsand hay, but land used for vegetables, nursery and greenhouses, orchards, vineyards, citrus

73 “A Case for Rural Broadband”, USDA, April 2019, page 3.74 Ge. Y, Thomasson, J.A , and Sui, R. (2012). 22 OEA Working Paper 50groves, Christmas trees, fruits, nuts and berries. And seeds and plant expenses can include thecost of all seeds, bulbs, plants, propagation materials, trees, seed treatments, and seed cleaningcosts. One possible alternative specification would be to restrict the expense regressions to onlythose counties in which the predominant share of total crop sales is derived from a single crop,such as corn or soybeans. However, counties are quite large, and there are only a handful of areasin which corn or soybeans sales comprise 90% or more of total crop sales. In fact, the mediancorn share of all crop sales is approximately 26%. 5.1 Robustness I next turn to a set of robustness checks to the main empirical specification, focusing oncrop outcomes at the 25+/3+ speed threshold.75 As an alternative specification, Table 13 reportsa limited analysis for crop yields using only the 2012 and 2017 paired ***data*** sets at the 25+/3+speed threshold. The findings generally correspond to the results in Table 9, which uses all threematched time periods. In the 2SLS estimation, a 1% increase in Internet penetration at 25+/3+speeds are associated with a 2.23% increase in corn yields and a 3.04% increase in soybeanyields. For hay yields, the impact of improved connectivity at 25+/3+ is associated with a 1.33%increase in production. The coefficients on cotton and wheat yields are negative but insignificantin the FE estimation, and positive and insignificant at conventional levels in the 2SLS estimation.I also note the coefficients on corn, hay and soybean yields in the restricted sample are slightlysmaller than those in the full sample displayed in Table 9. This could be a factor of insufficientdata in the restricted time period analysis, or from declining treatment effects over time. To explore this issue of declining treatment effects, Table 14 reports a second limitedanalysis for crop yields using only the 2007/2008 and 2012 paired ***data*** sets at the 25+/3+threshold. In the 2SLS estimation in Table 14, the coefficients on corn, hay and soybean yieldsare positive and significant, and larger than the 2SLS coefficients in either Table 9 or Table 13.This would tend to suggest larger treatment effects captured in the earlier time periods and whichdissipate over time. For the limited sample using the early time periods, the coefficient on cottonyields in the IV estimation is approximately the same as that in Table 9 with the full sample, anestimated effect of 9.68% vs. 10.1%. This coefficient was positive but insignificant in the lateperiod limited sample shown in Table 13. This result also suggests declining effects over time.However, I note that the coefficient on wheat yields in Table 14 is negative and insignificantunder both the FE and the 2SLS estimation. The coefficient for wheat in the 2SLS estimationwas positive and insignificant in Table 9 using the full sample, and positive and insignificant inTable 13 using the early period limited sample. This could suggest a delay in the treatment effectfor wheat producing regions, or a process particular to wheat farming not well-captured in themodel. 75 The various robustness checks in this section were also run for the expense measures, and additionally at10+/0.768+ speeds for both crops and expenses. The findings of these analyses, while not included in this study, arelargely similar to the pattern of results displayed in the main empirical strategy and illustrated in Tables 9 through12. The strongest association between improved broadband penetration rates and increased crop yields are found at25+/3+ speeds, as opposed to 10+/0.768+ speeds. For the expense regressions, the strongest association betweenimproved broadband penetration rates and lower expenses per operation are found at 10+/0.768+ speeds, as opposedto 25+/3+ speeds. 23 OEA Working Paper 50 Last, I present results using only December 2011 and December 2016 vintages of theForm 477 Internet ***data*** paired to the 2012 and 2017 Ag. Censuses. There may be a greater lagbetween broadband take-up rates and the implementation of that connectivity into ***agricultural*** orfarm management processes. But to avoid further confounding the timing issue, the first pairedtime period (2007/2008) is omitted from the analysis. Table 15 reports results of thismethodology using Internet penetration rates at 25+/3+ speeds. The results correspond generallyto those of the main specification in Table 9. I find that the coefficients on corn, cotton, hay,soybean and wheat yields are positive and significant in the 2SLS estimation. In the FEestimation for wheat yields, the coefficient in Table 15 is positive and insignificant. In Table 9,the wheat yield coefficient was negative and insignificant in the FE estimation, but positive andinsignificant in the 2SLS estimation. This could indicate an increased lag for farming in wheatregions that was not picked up in the original specification. Or it may suggest that there is someprocess or pattern to wheat farming that is not being well-captured in the original timing of themodel. In the 2SLS estimation, a 1% increase in the number of 25+/3+ connections per 1,000households is associated with a 2.44%, 2.81%, 1.81%, 6.05%, and 1.28% increase in corn,cotton, hay, soybean and wheat yields, respectively. Unlike the findings in Table 9, thecoefficient on broadband penetration in the FE estimation for cotton yields is negative andinsignificant; the coefficient on broadband penetration is positive and economically significant inthe 2SLS estimation for cotton yields. Overall, however, the findings in Table 15 using only thelatter two December vintages show a similar pattern of results as Table 9, although thecoefficients in Table 9 are somewhat larger for corn, cotton and hay. This suggests furtheranalysis would be needed to identify if there is a meaningful lag in the implementation ofavailable Internet.

6. Conclusion Overall, I find robust evidence that an increase in broadband penetration rates at the25+/3+ speed thresholds is associated with higher crop yields. The results are particularly robustfor corn and soybeans, for which the study found a positive and significant correlation across allalternative specifications, even at the lower 10+/0.768+ speed threshold.76 This study focused oncorn, cotton, hay, soybeans and wheat for two primary reasons. First, they are among the topagricultural commodities produced in the U.S Second, related literature suggests these fieldcrops are the most likely to benefit from, and thus implement, precision ***agriculture*** technologiesand other Internet-dependent processes into farm management. For the expense regressions, I find that an increase in broadband penetration rates at the10+/0.768+ speed threshold is associated with lower expenses per operation. However, this resultdoes not hold for expenses per operation at the higher 25+/3+ speed threshold. Unlike the cropyield ***data***, the expense measures I examined cannot be limited to either field crops generally orto one crop type such as corn. The expense measures are defined for all ***agricultural*** processescovered in the Ag. Census, including animal farming, aquaculture and nursery and greenhouses.Therefore, the results indicate imprecision in the aggregate definition of expenses analyzed in the

76 Robustness checks were run for costs at the 25+/3+ speed threshold and for both crops and costs at the10+/0.768+ speed threshold but are not included in the paper. 24 OEA Working Paper 50study and could stem from the inability to directly measure expenses for the types of crops thatmay be more likely to implement Internet technologies into the farm process. The expenseregressions results may also derive from the fact that there may be efficiencies that require alower speed threshold but for which higher speeds are not additively beneficial. This study also provides some descriptive evidence of the composition and quality ofbroadband connectivity in the five crop regions and across the U.S For all five crop regions, Ifind that the majority of broadband connections transitioned from Asymmetric DSL technologiesto cable modem and FTTN technologies from 2007 through 2017. In addition, counties in theseregions experienced an increase in speed thresholds over time. This occurs not only for one-waydownload and upload speed thresholds, but also for matched download and upload speedthresholds. Therefore, it appears that previously unserved and underserved counties areexperiencing increased access and adoption of broadband. I note several other limitations associated with this study. While the analysis implementsa panel comprised on three Form 477 broadband vintages and three waves of the Ag. Census,***data*** limitations preclude a precise match for the earliest time period. Form 477 broadband datawas ***collected*** at the census tract level beginning only in December 2008, which I match to theDecember 2007 wave of the Ag. Census. However, robustness checks using only 2012 and 2017paired ***data*** support claims that improved 25+/3+ penetration rates are associated with highercrop yields. In fact, a separate robustness check using only the earlier time periods (2007/2008and 2012) indicates that a significant portion of the benefits to improved 25+/3+ penetrationrates in terms of higher crop yields were captured early, and then displayed declining treatmenteffects over time. The study presents a rigorous, quantitative evaluation of the impact of improved Internetconnectivity on a variety of farming outcomes. It leveraged in its approach the highlydisaggregated ***data*** on broadband connections that has been ***collected*** by the Commission since2008. In addition to providing an introductory look at changes over time in the composition ofconnectivity in regions where a selected set of field crops are produced, the study is a usefuladdition to the body of research supporting policy recommendations focused on promoting therapid, expanded diffusion of broadband to unserved and underserved ***agricultural*** areas. TheCommission and other federal agencies have long expressed commitment to closing the digitaldivide in rural areas. This paper provides evidence that improved connectivity at higher speedthresholds is an important factor in improving outcomes for U.S farmers. Limited evidence alsosuggests that lower speed thresholds may be sufficient to support the realization of some expensesavings for U.S farmers. For those farming activities such as precision ***agriculture*** that mayindicate a higher speed threshold, further analysis would be necessary. While this study makesno effort to evaluate the cost-benefit analysis of continued institutional support for networkbuildout in unserved and underserved areas, the results clearly indicate that Internet accessmeaningfully contributes to rural infrastructure development.

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AppendicesTable 1: County-level Means from ***Agricultural*** CensusTable 2: Production and Internet Characteristics for Corn RegionsTable 3: Production and Internet Characteristics for Cotton RegionsTable 4: Production and Internet Characteristics for Hay RegionsTable 5: Production and Internet Characteristics for Soybean RegionsTable 6: Production and Internet Characteristics for Wheat RegionsTable 7: County-Level MeansTable 8: Characteristics of Broadband SubscriptionsTable 9: Crop Yield Regressions at 25+/3+ Connection SpeedsTable 10: Crop Yield Regressions at 10+/0.768+ Connection SpeedsTable 11: Expense Regressions at 25+/3+ Connection SpeedsTable 12: Expense Regressions at 10+/0.768+ Connection SpeedsTable 13: 2012/2017 Crop Yield Regressions at 25+/3+ Connection SpeedsTable 14: 2007/2008 and 2012 Crop Yield Regressions at 25+/3+ Connection SpeedsTable 15: Crop Yield Regressions at 25+/3+ Connection Speeds

30 OEA Working Paper 50 Table 1: County-level Means from ***Agricultural*** Census 2007 2012 2017General characteristics Operated acres (000s) 298.0 297.6 293.3Harvested acres of cropland (000s) 100.2 102.0 103.6Total farm operations 716.4 685.2 663.1Farm operations with harvested cropland acres 430.4 417.9 403.7Farm operations with acres operated 715.4 684.5 662.4Crop sales per operation with sales ($000s) 130.9 190.5 174.5Farm-related income per operation ($000s) 16.2 21.2 21.9Other farm-related income per operation ($000s) 15.5 16.6 23.4 Selected expense characteristics Chemical expenses per operation ($000s) 10.6 15.9 18.8Operating expenses per operation ($000s) 116.6 166.0 172.8Feed costs per operation ($000s) 51.3 77.9 64.2Fertilizer expenses per operation ($000s) 16.4 28.1 23.1Fuel expenses per operation ($000s) including lubricants 6.7 9.4 8.0Seeds and plants costs per operation ($000s) 13.3 20.3 25.7 Selected land-use characteristics Acres per farm operation treated with fungicide 218.0 258.9 346.2Acres per farm operation treated with herbicide 308.2 339.7 404.0Acres per farm operation treated with insecticide (nematicides) 205.7 222.6 316.8Acres per farm operation treated with fertilizer 284.5 293.9 305.4Operations with self-propelled (SP) combines 105.0 104.3 98.0Operations with SP combines (< 5-years-old) 18.9 25.7 20.2Operations with SP cotton pickers/strippers 20.1 23.7 21.5Operations with SP cotton pickers/strippers (< 5-years-old) 8.4 7.6 6.7Operations with SP forage harvesters 21.6 23.0 21.1Operations with SP forage harvesters (< 5-years-old) 4.2 4.3 4.5 Selected Internet characteristics from Census of ***Agriculture*** Farm operations with Internet access 405.1 476.9 500.0Farm operations with high-speed Internet access 236.2 . .Farm operations with Internet access over power lines . 13.6 .Farm operations with Internet access over cable . 73.3 97.1Farm operations with Internet access via dialup . 46.3 17.0Farm operations with Internet access via DSL . 190.7 126.8Farm operations with Internet access via fiber optics . 26.6 51.9Farm operations with Internet access via mobile . 88.0 193.7Farm operations with Internet access via other method . 14.7 18.6Farm operations with Internet access via satellite . 93.1 98.7Farm operations with Internet access via unknown method . . 38.0Note: County-level averages from the 2007, 2012, and 2017 ***Agricultural*** Census.

31 OEA Working Paper 50 Table 2: Production and Internet Characteristics for Corn Regions 2007 2012 2017General Characteristics Counties with harvested corn 2319 2352 2332 Farm operations with harvested acres 149.7 147.9 130.4 Harvested acres (000s) 37.2 37.1 36.3 Harvested acres of corn per operation 208.2 210.9 245.7 Yield (bushels / harvested acre) 118.9 106.7 149.1 Overall Internet Penetration Rates Number of connections per 1000 housing units 423.4 531.6 615.0 Number of connections per 1000 people 190.2 245.1 289.7 Number of connections per 1000 households 498.5 624.8 721.8 By Technology Type (% of all connections) Cable 33.8 35.6 38.5 FTTP 1.9 5.0 11.7 FTTN 0.3 3.0 14.7 Asymmetric DSL 54.8 46.8 23.3 Satellite 5.1 5.6 6.8 Terrestrial Fixed Wireless 3.1 3.2 4.7 Symmetric DSL 0.5 0.3 0.1 Other Copper 0.5 0.5 0.3 Two-way Speed Thresholds (% of all connections) 3+/0.768+ 19.79 46.32 87.38 10+/0.768+ 5.94 25.28 66.74 10+/3+ 0.25 9.92 44.43 25+/3+ 0.04 4.20 38.43 25+/10+ 0.04 0.47 14.46 100+/25+ 0.01 0.05 2.01 100+/100+ 0.01 0.05 1.37 Downspeed Tiers (% of all connections) (0.200 to 0.768) Mbps max down 15.61 5.74 0.70 [0.768 to 1.5) Mbps max down 17.74 12.49 2.00 [1.5 to 3) Mbps max down 21.17 16.54 4.49 [3 to 6) Mbps max down 22.84 25.07 13.15 [6 to 10) Mbps max down 15.52 12.38 12.78 [10 to 25) Mbps max down 7.03 23.10 27.08 [25 to 100) Mbps max down 0.03 4.56 28.28 100+ Mbps max down 0.06 0.12 11.51 Upspeed Tiers (% of all connections) [0, 200] Mbps max up 13.74 6.68 NA (0.200 to 0.768) Mbps max up 60.01 41.71 10.22 [0.768 to 1.5) Mbps max up 23.03 30.86 34.16 [1.5 to 3) Mbps max up 2.58 10.21 9.54 [3 to 6) Mbps max up 0.49 9.39 26.75 [6 to 10) Mbps max up 0.08 0.16 2.40 [10 to 25) Mbps max up 0.04 0.69 12.22 [25 to 100) Mbps max up 0.02 0.25 2.61 100+ Mbps max up 0.01 0.05 1.37Source: County-level averages, Ag. Census and Form 477 ***data***.

32 OEA Working Paper 50 Table 3: Production and Internet Characteristics for Cotton Regions 2007 2012 2017General Characteristics Counties with harvested cotton 469 501 488 Farm operations with harvested acres 39.1 35.8 32.6 Harvested acres (000s) 22.2 18.6 23.1 Harvested acres of per operation 466.5 473.3 595.8 Yield (bales / harvested acre) 1.6 1.8 1.9 Overall Internet penetration rates Number of connections per 1000 housing units 372.0 470.2 538.5 Number of connections per 1000 people 160.8 208.4 243.3 Number of connections per 1000 households 447.6 557.0 633.7 By Technology Type (% of all connections) Cable 29.7 31.5 33.2 FTTP 1.1 2.6 8.0 FTTN 0.3 3.0 17.1 Asymmetric DSL 58.8 52.4 26.6 Satellite 5.9 6.9 9.6 Terrestrial Fixed Wireless 3.0 2.6 5.1 Symmetric DSL 0.7 0.3 0.0 Other Copper 0.6 0.7 0.4 Two-way Speed Thresholds (% of all connections) 3+/0.768+ 9.99 34.98 83.20 10+/0.768+ 2.54 18.52 61.62 10+/3+ 0.12 5.33 36.66 25+/3+ 0.03 1.70 31.16 25+/10+ 0.03 0.15 11.43 100+/25+ 0.02 0.03 0.96 100+/100+ 0.02 0.03 0.67 Downspeed Tiers (% of all connections) (0.200 to 0.768) Mbps max down 16.23 6.68 0.74 [0.768 to 1.5) Mbps max down 19.67 14.01 2.36 [1.5 to 3) Mbps max down 23.46 19.80 5.58 [3 to 6) Mbps max down 22.83 27.84 15.74 [6 to 10) Mbps max down 14.93 10.90 13.75 [10 to 25) Mbps max down 2.86 18.11 29.09 [25 to 100) Mbps max down 0.01 2.59 22.43 100+ Mbps max down 0.02 0.07 10.31 Upspeed Tiers (% of all connections) [0, 200] Mbps max up 14.38 8.33 NA (0.200 to 0.768) Mbps max up 72.67 52.71 14.56 [0.768 to 1.5) Mbps max up 10.84 24.87 35.65 [1.5 to 3) Mbps max up 1.70 8.06 10.76 [3 to 6) Mbps max up 0.29 5.13 24.19 [6 to 10) Mbps max up 0.05 0.26 1.75 [10 to 25) Mbps max up 0.04 0.51 10.10 [25 to 100) Mbps max up 0.01 0.08 1.45 100+ Mbps max up 0.02 0.03 0.67Source: County-level averages, Ag. Census and Form 477 ***data***. 33 OEA Working Paper 50 Table 4: Production and Internet Characteristics for Hay Regions 2007 2012 2017General Characteristics Counties with harvested hay (total) 3017 3005 3003 Farm operations with harvested acres 288.0 270.5 266.1 Harvested acres (000s) 20.4 18.5 18.9 Harvested acres of hay (total) per operation 81.1 80.2 83.1 Yield (bales / harvested acre) 2.6 2.5 2.9 Overall Internet penetration rates Number of connections per 1000 housing units 417.0 526.2 611.1 Number of connections per 1000 people 191.2 247.9 293.8 Number of connections per 1000 households 503.1 630.0 731.4 By Technology Type (% of all connections) Cable 32.5 34.5 37.6 FTTP 1.8 4.5 10.7 FTTN 0.3 3.1 15.1 Asymmetric DSL 55.8 47.9 23.9 Satellite 5.5 6.0 7.2 Terrestrial Fixed Wireless 3.0 3.3 5.0 Symmetric DSL 0.7 0.3 0.1 Other Copper 0.5 0.5 0.3 Two-way Speed Thresholds (% of all connections) 3+/0.768+ 19.24 45.70 86.80 10+/0.768+ 5.36 25.00 65.65 10+/3+ 0.31 9.36 43.32 25+/3+ 0.05 3.96 37.39 25+/10+ 0.04 0.43 13.57 100+/25+ 0.02 0.05 1.83 100+/100+ 0.02 0.05 1.26 Downspeed Tiers (% of all connections) (0.200 to 0.768) Mbps max down 16.57 6.06 0.70 [0.768 to 1.5) Mbps max down 17.76 12.67 2.09 [1.5 to 3) Mbps max down 21.81 17.58 4.79 [3 to 6) Mbps max down 21.85 24.71 13.75 [6 to 10) Mbps max down 15.68 11.89 12.87 [10 to 25) Mbps max down 6.23 22.60 27.08 [25 to 100) Mbps max down 0.03 4.38 27.22 100+ Mbps max down 0.06 0.11 11.51 Upspeed Tiers (% of all connections) [0, 200] Mbps max up 14.22 6.96 NA (0.200 to 0.768) Mbps max up 59.57 41.60 10.61 [0.768 to 1.5) Mbps max up 22.78 30.77 34.86 [1.5 to 3) Mbps max up 2.75 10.73 9.52 [3 to 6) Mbps max up 0.52 8.88 26.83 [6 to 10) Mbps max up 0.07 0.14 2.32 [10 to 25) Mbps max up 0.05 0.64 11.50 [25 to 100) Mbps max up 0.02 0.23 2.36 100+ Mbps max up 0.02 0.05 1.26Source: County-level averages, Ag. Census and Form 477 ***data***

34 OEA Working Paper 50 Table 5: Production and Internet Characteristics for Soybean Regions 2007 2012 2017General Characteristics Counties with harvested soybeans 1738 1878 1913 Farm operations with harvested acres 160.3 161.0 158.2 Harvested acres (000s) 36.7 40.5 47.1 Harvested acres of soybeans per operation 220.2 243.7 290.3 Yield (bales / harvested acre) 34.5 37.2 44.8 Overall Internet penetration rates Number of connections per 1000 housing units 428.0 532.3 613.0 Number of connections per 1000 people 192.1 245.1 288.5 Number of connections per 1000 households 497.8 621.2 714.4 By Technology Type (% of all connections) Cable 35.1 36.5 38.7 FTTP 2.2 5.2 12.0 FTTN 0.3 2.8 14.7 Asymmetric DSL 53.6 46.3 22.9 Satellite 4.9 5.5 6.9 Terrestrial Fixed Wireless 3.1 2.9 4.4 Symmetric DSL 0.4 0.3 0.1 Other Copper 0.5 0.4 0.3 Two-way Speed Thresholds (% of all connections) 3+/0.768+ 19.88 45.16 87.60 10+/0.768+ 6.31 25.22 67.38 10+/3+ 0.25 10.12 44.71 25+/3+ 0.05 4.21 38.36 25+/10+ 0.04 0.45 14.49 100+/25+ 0.02 0.03 1.94 100+/100+ 0.02 0.03 1.33 Downspeed Tiers (% of all connections) (0.200 to 0.768) Mbps max down 15.30 5.73 0.70 [0.768 to 1.5) Mbps max down 17.70 12.79 2.01 [1.5 to 3) Mbps max down 20.71 15.94 4.37 [3 to 6) Mbps max down 22.98 25.47 12.90 [6 to 10) Mbps max down 15.76 11.80 12.50 [10 to 25) Mbps max down 7.46 23.59 27.75 [25 to 100) Mbps max down 0.03 4.58 28.70 100+ Mbps max down 0.06 0.09 11.07 Upspeed Tiers (% of all connections) [0, 200] Mbps max up 13.91 6.75 NA (0.200 to 0.768) Mbps max up 60.57 43.38 10.15 [0.768 to 1.5) Mbps max up 22.36 29.34 33.79 [1.5 to 3) Mbps max up 2.48 9.80 9.69 [3 to 6) Mbps max up 0.52 9.57 26.82 [6 to 10) Mbps max up 0.08 0.14 2.38 [10 to 25) Mbps max up 0.04 0.76 12.47 [25 to 100) Mbps max up 0.02 0.25 2.63 100+ Mbps max up 0.02 0.03 1.33Source: County-level averages, Ag. Census and Form 477 ***data***

35 OEA Working Paper 50 Table 6: Production and Internet Characteristics for Wheat Regions 2007 2012 2017General Characteristics Counties with harvested wheat 2057 2144 1901 Farm operations with harvested acres 77.8 68.5 54.7 Harvested acres (000s) 24.7 22.8 20.3 Harvested acres of wheat per operation 218.6 219.3 241.6 Yield (bales / harvested acre) 44.8 51.5 55.7 Overall Internet penetration rates Number of connections per 1000 housing units 423.5 530.3 622.1 Number of connections per 1000 people 190.4 244.0 292.2 Number of connections per 1000 households 499.5 623.5 729.5 By Technology Type (% of all connections) Cable 32.9 34.6 38.1 FTTP 2.1 5.1 12.1 FTTN 0.3 3.1 14.9 Asymmetric DSL 54.6 46.9 22.3 Satellite 5.2 5.8 6.3 Terrestrial Fixed Wireless 3.6 3.8 5.9 Symmetric DSL 0.8 0.3 0.1 Other Copper 0.5 0.5 0.3 Two-way Speed Thresholds (% of all connections) 3+/0.768+ 18.77 45.15 87.48 10+/0.768+ 5.50 24.67 66.55 10+/3+ 0.24 9.88 44.68 25+/3+ 0.06 4.20 38.41 25+/10+ 0.05 0.45 14.10 100+/25+ 0.03 0.06 2.03 100+/100+ 0.03 0.05 1.35 Downspeed Tiers (% of all connections) (0.200 to 0.768) Mbps max down 16.37 5.93 0.71 [0.768 to 1.5) Mbps max down 17.78 12.97 1.97 [1.5 to 3) Mbps max down 21.77 17.32 4.54 [3 to 6) Mbps max down 21.97 24.79 13.53 [6 to 10) Mbps max down 15.32 12.11 12.49 [10 to 25) Mbps max down 6.67 22.10 27.15 [25 to 100) Mbps max down 0.03 4.65 27.70 100+ Mbps max down 0.08 0.12 11.90 Upspeed Tiers (% of all connections) [0, 200] Mbps max up 13.61 6.68 NA (0.200 to 0.768) Mbps max up 60.66 42.66 10.03 [0.768 to 1.5) Mbps max up 22.58 30.12 34.13 [1.5 to 3) Mbps max up 2.55 10.03 9.37 [3 to 6) Mbps max up 0.44 9.37 27.16 [6 to 10) Mbps max up 0.07 0.16 2.44 [10 to 25) Mbps max up 0.04 0.70 12.28 [25 to 100) Mbps max up 0.02 0.22 2.55 100+ Mbps max up 0.03 0.05 1.35Source: County-level averages, Ag. Census and Form 477 ***data***

36 OEA Working Paper 50 Table 7: County-Level Means 2007 2012 2017General Characteristics Metropolitan counties (1 = Yes) (USDA-ERS) 0.3 0.4 0.4 % farm proprietors' employment (BEA) 19.2 18.2 17.2 Unemployment rate (BLS) 4.9 7.8 4.6 Census ***data*** Median age 40.4 40.8 41.5 Median household income ($) 42,555.4 44,690.1 50,925.9 Population 98,861.4 100,494.9 104,130.6 Housing units 41,325.2 42,512.9 43,976.8 Households 36,037.7 37,579.7 39,004.4 % population male 49.97 50.03 50.10 % population age 25+ high school graduate only 36.0 34.9 34.5 % population age 25+ with some college only 20.5 21.9 21.8 % population age 25+ with bachelor's degree or more' 18.6 20.0 21.1 % population between ages 15 and 24 12.9 13.0 12.5 % population between ages 25 and 44 23.7 23.3 23.3 % population between ages 45 and 64 28.2 28.0 26.9 % population between ages 65 and above 16.0 16.8 18.9 % population Hispanic only 7.8 8.7 9.5 % population Black only 8.9 9.0 9.2 % population Asian only 1.0 1.2 1.4 % population Other only 3.3 3.7 4.1 Quarterly Census of Employment and Wages (BLS) Total establishments 2,705.9 2,742.8 2,932.8 No. establishments in ***agricultural*** sector 31.3 31.7 34.0 No. establishments in crop production 16.5 16.7 17.6 Total employed in all establishments 42,260.8 41,030.5 44,759.7 Average annual pay ($) 31,684.7 35,761.9 39,926.4Note: An establishment is a single physical location where one predominant activity occurs (BLS). According to theU.S Census, a household includes people who are living in a housing structure and housing units describe the actualstructure in which residents live. For 2007, household counts derived from 2005-2009 ACS 5-Year Estimates, whilefor 2012 and 2017, household counts derived from FCC Staff Block Estimates.

37 OEA Working Paper 50 Table 8: Characteristics of Broadband Subscriptions 2008 2012 2017Number of connections per 1000 households 506.2 632.9 735.0 Number of connections per 1000 housing units 419.1 527.5 612.8 Number connections per 1000 people 192.5 249.1 295.1 Number of residential connections per 1000 households 451.2 569.9 664.1 Number of residential connections per 1000 housing units 374.3 475.6 554.3 Number of residential connections per 1000 people 171.4 224.1 266.5 Number of non-residential connections per 1000 households 55.0 63.0 70.9 Number of non-residential connections per 1000 housing units 44.8 51.8 58.5 Number of non-residential connections per 1000 people 21.0 24.9 28.7 Number 100+/100+ connections per 1000 people 0.0 0.1 4.2 Number 100+/25+ connections per 1000 people 0.0 0.1 6.3 Number 25+/3+ connections per 1000 people 0.1 11.4 118.6 Number 10+/1+ connections per 1000 people 12.7 68.2 198.8 Number 3+/1+ connections per 1000 people 43.3 120.2 259.0 Fixed terrestrial Internet connections per 1000 households 485.4 602.1 691.1 Fixed terrestrial Internet connections per 1000 housing units 402.6 502.8 577.4 Fixed terrestrial Internet connections per 1000 people 184.5 236.8 277.3 Fixed terrestrial connections at 100+/100+ per 1000 people 0.0 0.1 4.2 Fixed terrestrial connections at 100+/25+ per 1000 people 0.0 0.1 6.3 Fixed terrestrial connections at 25+/3+ per 1000 people 0.1 11.4 116.1 Fixed terrestrial connections at 10+/1+ per 1000 people 12.7 67.4 185.7 Fixed terrestrial connections at 3+/1+ per 1000 people 43.3 119.2 242.7Note: County-level averages derived from internal FCC Form 477 ***data***. Fixed terrestrial Internet comprised ofconnections from Asymmetric and Symmetric DSL, fixed terrestrial wireless, cable modem, other copper wireline,fiber to the home, electric power line and other wired connections. It does not include satellite.

38 OEA Working Paper 50 Table 9: Crop Yield Regressions at 25+/3+ Connection Speeds (1) (2) (3) (4) (5) Corn yield Cotton yield Hay yield Soybean Wheat yield (FE) (FE) (FE) yield (FE) (FE)Log number of 0.0158\*\*\* 0.0185\*\* 0.0102\*\*\* 0.0173\*\*\* -0.0017925+/3+ connections (4.14) (2.90) (5.38) (4.92) (-0.73)per 1,000 householdsObservations 6620 1346 8315 5272 5720F 135.1 12.38 38.71 108.5 48.34Adj. R-Squared 0.569 0.495 0.714 0.527 0.700 (1) (2) (3) (4) (5) (2SLS) (2SLS) (2SLS) (2SLS) (2SLS)Log number of 0.0363\*\*\* 0.101\*\*\* 0.0215\*\*\* 0.0376\*\*\* 0.00094625+/3+ connections (5.58) (6.26) (6.14) (6.04) (0.22)per 1,000 householdsObservations 6620 1346 8315 5272 5720KP Wald F Stat 1574.9 158.5 1918.8 1258.8 1306.2KP rk LM Stat 749.8 89.03 931.7 589.8 641.7Note: Corn, soybean and wheat yields in bushels per harvested acre; cotton yield in bales perharvested acre, and; hay yield in dry tons per harvested acre. Each regression includes a measurefor average crop-specific farm size and average workers per farm operation. Other controlsinclude median household income, unemployment rate, population density, share of populationmale, share of population with high school only education, share of population with some collegeeducation only, share of population with bachelor’s degree and above, share of the populationages 15-24, ages 25-44, ages 45-64, age 65 and above, share of population white, black andAsian, and population share of Hispanic origin (Robust t ***statistics*** in parentheses + p < 0.10, \* p <0.05, \*\* p < 0.01, \*\*\* p < 0.001).

39 OEA Working Paper 50 Table 10: Crop Yield Regressions at 10+/0.768+ Connection Speeds (1) (2) (3) (4) (5) Corn yield Cotton yield Hay yield Soybean Wheat yield (FE) (FE) (FE) yield (FE) (FE)Log number of 0.0142\*\*\* 0.00259 -0.00218 0.0198\*\*\* 0.00738\*10+/1+ connections (3.32) (0.35) (-0.90) (4.24) (2.18)per 1,000 householdsObservations 6620 1346 8315 5272 5720F 134.8 11.72 37.51 111.6 48.40Adj. R-Squared 0.568 0.491 0.712 0.527 0.701 (1) (2) (3) (4) (5) (2SLS) (2SLS) (2SLS) (2SLS) (2SLS)Log number of 0.0550\*\*\* -0.0467\*\* -0.0199\*\*\* 0.0355\*\*\* 0.0010710+/1+ connections (6.45) (-2.62) (-4.06) (4.18) (0.15)per 1,000 householdsObservations 6620 1346 8315 5272 5720KP Wald F Stat 1120.1 171.6 1193.6 795.9 778.0KP rk LM Stat 476.3 93.19 541.4 357.9 361.7Note: Corn, soybean and wheat yields in bushels per harvested acre; cotton yield in bales perharvested acre, and; hay yield in dry tons per harvested acre. Each regression includes a measurefor average crop-specific farm size and average workers per farm operation. Other controlsinclude median household income, unemployment rate, population density, share of populationmale, share of population with high school only education, share of population with some collegeeducation only, share of population with bachelor’s degree and above, share of the populationages 15-24, ages 25-44, ages 45-64, age 65 and above, share of population white, black andAsian, and population share of Hispanic origin (Robust t ***statistics*** in parentheses + p < 0.10, \* p <0.05, \*\* p < 0.01, \*\*\* p < 0.001).

40 OEA Working Paper 50 Table 11: Expense Regressions at 25+/3+ Connection Speeds (1) (2) (3) (4) (5) Operating Chemical Fertilizer Fuel Seed, plants expenses expenses expenses expenses expenses (FE) (FE) (FE) (FE) (FE)Log number of -0.00168 -0.00274 0.00378 0.000342 -0.00621+25+/3+ connections (-0.86) (-0.97) (1.48) (0.18) (-1.95)per 1,000 householdsObservations 9171 8945 9059 9146 8908F 382.8 322.2 334.1 210.8 376.8Adj. R-Squared 0.965 0.956 0.959 0.949 0.933 (1) (2) (3) (4) (5) (2SLS) (2SLS) (2SLS) (2SLS) (2SLS)Log number of 0.000644 0.0000671 0.0137\*\* 0.00406 -0.0024725+/3+ connections (0.20) (0.01) (3.02) (1.18) (-0.46)per 1,000 householdsObservations 9171 8945 9059 9146 8908KP Wald F Stat 2189.4 2080.5 2152.7 2174.5 2064.2KP rk LM Stat 1031.8 994.8 1017.5 1027.9 989.6

Note: Expenses measures are per farm operation. Each regression includes a measure for averagefarm size. Other controls include median household income, unemployment rate, populationdensity, share of population male, share of population with high school only education, share ofpopulation with some college education only, share of population with bachelor’s degree andabove, share of the population ages 15-24, ages 25-44, ages 45-64, age 65 and above, share ofpopulation white, black and Asian, and population share of Hispanic origin (Robust t ***statistics*** inparentheses + p < 0.10, \* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001).

41 OEA Working Paper 50 Table 12: Expense Regressions at 10+/0.768+ Connection Speeds (1) (2) (3) (4) (5) Operating Chemical Fertilizer Fuel Seed, plants expenses expenses expenses expenses expenses (FE) (FE) (FE) (FE) (FE)Log number of -0.00420 -0.00421 -0.0139\*\*\* 0.00425 -0.00950\*10+/1+ connections (-1.51) (-1.16) (-4.26) (1.60) (-2.08)per 1,000 householdsObservations 9171 8945 9059 9146 8908F 385.5 321.2 336.7 210.4 377.8Adj. R-Squared 0.965 0.956 0.960 0.949 0.934 (1) (2) (3) (4) (5) (2SLS) (2SLS) (2SLS) (2SLS) (2SLS)Log number of -0.0237\*\*\* -0.0263\*\*\* -0.0647\*\*\* -0.00554 -0.0343\*\*\*10+/1+ connections (-4.19) (-3.47) (-9.94) (-1.05) (-3.52)per 1,000 householdsObservations 9171 8945 9059 9146 8908KP Wald F Stat 1455.2 1356.4 1414.1 1442.6 1351.0KP rk LM Stat 660.3 625.6 644.9 656.0 622.2Note: Expenses measures are per farm operation. Each regression includes a measure for averagefarm size. Other controls include median household income, unemployment rate, populationdensity, share of population male, share of population with high school only education, share ofpopulation with some college education only, share of population with bachelor’s degree andabove, share of the population ages 15-24, ages 25-44, ages 45-64, age 65 and above, share ofpopulation white, black and Asian, and population share of Hispanic origin (Robust t ***statistics*** inparentheses + p < 0.10, \* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001).

42 OEA Working Paper 50 Table 13: 2012/2017 Crop Yield Regressions at 25+/3+ Connection Speeds (1) (2) (3) (4) (5) Corn yield Cotton yield Hay yield Soybean Wheat yield (FE) (FE) (FE) yield (FE) (FE)Log number of 0.0106\* -0.00555 0.00361 0.0101\*\* -0.0015525+/3+ connections (2.15) (-0.85) (1.59) (2.58) (-0.48)per 1,000 householdsObservations 4292 862 5802 3528 3554F 108.5 6.609 34.49 55.88 9.355Adj. R-Squared 0.542 0.674 0.770 0.550 0.766 (1) (2) (3) (4) (5) (2SLS) (2SLS) (2SLS) (2SLS) (2SLS)Log number of 0.0223\* 0.0250 0.0133\*\* 0.0304\*\*\* 0.0033825+/3+ connections (2.56) (1.52) (3.07) (4.40) (0.53)per 1,000 householdsObservations 4292 862 5802 3528 3554KP Wald F Stat 873.0 91.37 1003.4 717.5 587.7KP rk LM Stat 495.9 65.96 576.7 422.8 349.7Note: Corn, soybean and wheat yields in bushels per harvested acre; cotton yield in bales perharvested acre, and; hay yield in dry tons per harvested acre. Each regression includes a measurefor average crop-specific farm size and average workers per farm operation. Other controlsinclude median household income, unemployment rate, population density, share of populationmale, share of population with high school only education, share of population with some collegeeducation only, share of population with bachelor’s degree and above, share of the populationages 15-24, ages 25-44, ages 45-64, age 65 and above, share of population white, black andAsian, and population share of Hispanic origin (Robust t ***statistics*** in parentheses + p < 0.10, \* p <0.05, \*\* p < 0.01, \*\*\* p < 0.001).

43 OEA Working Paper 50Table 14: 2007/2008 and 2012 Crop Yield Regressions at 25+/3+ Connection Speeds (1) (2) (3) (4) (5) Corn yield Cotton yield Hay yield Soybean Wheat yield (FE) (FE) (FE) yield (FE) (FE)Log number of 0.0170\*\*\* 0.0183\* 0.0131\*\*\* 0.0188\*\*\* -0.0024525+/3+ connections (3.68) (2.14) (5.47) (4.08) (-0.79)per 1,000 householdsObservations 4288 862 4876 3334 3794F 22.79 18.05 32.60 29.97 36.28Adj. R-Squared 0.510 0.541 0.702 0.469 0.689 (1) (2) (3) (4) (5) (2SLS) (2SLS) (2SLS) (2SLS) (2SLS)Log number of 0.0478\*\*\* 0.0968\*\*\* 0.0247\*\*\* 0.0427\*\*\* -0.00025625+/3+ connections (6.33) (4.80) (5.90) (5.52) (-0.05)per 1,000 householdsObservations 4288 862 4876 3334 3794KP Wald F Stat 1168.2 107.6 1344.3 946.6 1033.0KP rk LM Stat 597.9 64.53 664.3 479.7 518.7Note: Corn, soybean and wheat yields in bushels per harvested acre; cotton yield in bales perharvested acre, and; hay yield in dry tons per harvested acre. Each regression includes a measurefor average crop-specific farm size and average workers per farm operation. Other controlsinclude median household income, unemployment rate, population density, share of populationmale, share of population with high school only education, share of population with some collegeeducation only, share of population with bachelor’s degree and above, share of the populationages 15-24, ages 25-44, ages 45-64, age 65 and above, share of population white, black andAsian, and population share of Hispanic origin (Robust t ***statistics*** in parentheses + p < 0.10, \* p <0.05, \*\* p < 0.01, \*\*\* p < 0.001).

44 OEA Working Paper 50 Table 15: Crop Yield Regressions at 25+/3+ Connection Speeds (December Vintages) (1) (2) (3) (4) (5) Corn yield Cotton yield Hay yield Soybean Wheat yield (FE) (FE) (FE) yield (FE) (FE)Log number of 0.0149\*\* -0.00766 0.00271 0.0160\*\*\* 0.0028825+/3+ connections (2.94) (-1.10) (1.22) (3.85) (0.88)per 1,000 householdsObservations 4292 862 5802 3528 3554F 108.8 6.608 34.18 56.25 9.380Adj. R-Squared 0.542 0.674 0.770 0.552 0.766 (1) (2) (3) (4) (5) (2SLS) (2SLS) (2SLS) (2SLS) (2SLS)Log number of 0.0244\* 0.0281+ 0.0181\*\*\* 0.0605\*\*\* 0.0128+25+/3+ connections (2.52) (1.65) (3.81) (7.20) (1.86)per 1,000 householdsObservations 4292 862 5802 3528 3554KP F Stat 718.1 68.69 758.9 570.5 448.3KP rk LM Stat 467.3 47.29 522.6 382.5 323.4Note: Corn, soybean and wheat yields in bushels per harvested acre; cotton yield in bales perharvested acre, and; hay yield in dry tons per harvested acre. Each regression includes a measurefor average crop-specific farm size and average workers per farm operation. Other controlsinclude median household income, unemployment rate, population density, share of populationmale, share of population with high school only education, share of population with some collegeeducation only, share of population with bachelor’s degree and above, share of the populationages 15-24, ages 25-44, ages 45-64, age 65 and above, share of population white, black andAsian, and population share of Hispanic origin (Robust t ***statistics*** in parentheses + p < 0.10, \* p <0.05, \*\* p < 0.01, \*\*\* p < 0.001).

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[***Environmental Accounts – Emissions to air Q4 2019: Greenhouse gas emissions intensity for Sweden’s economy decreased in 2019***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YX2-8JM1-F0YC-N211-00000-00&context=1516831)

Nordic Daily

May 14, 2020 Thursday

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**Length:** 2551 words

**Body**

Stockholm, Sweden: ***Statistics*** Sweden has issued the following news release:

Greenhouse gas emissions intensity for Sweden’s economy decreased by 4 percent in 2019 compared to 2018, according to preliminary ***statistics*** for 2019. This is due to a 3 percent decrease in greenhouse gas emissions and economic growth of 1 percent between 2018 and 2019. In terms of percent, this is the largest yearly decrease in greenhouse gas emissions since 2012.

Preliminary ***statistics*** for 2019 on emissions by industry are now available. Preliminary ***statistics*** are the sum of the quarterly ***statistics*** in 2019, where the fourth quarter is now available.

The preliminary ***statistics*** show that the trend toward reduced greenhouse gas emissions that started in 2016 continued in 2019. Greenhouse gas emissions have decreased by 7 percent in total between 2016 and 2019. Economic growth also continued in 2019, though at a decreased rate compared to the period 2016–2018. GDP for 2019 was 5 percent higher than 2016.

Greenhouse gas emissions, GDP and emissions intensity 2008–2019, constant prices 2018 (summed quarters)

Index 2008=100, \*2019 preliminary, Source: ***Statistics*** Sweden

Emissions from the energy sector decreased

Emissions by electricity, gas, heat, water and waste industry, in which the production of electricity and heat account for a considerable part, decreased between 2018 and 2019. Preliminary results show that greenhouse gas emissions in 2019 were 7.1 million tonnes of carbon dioxide equivalents, down by 14 percent compared with a year ago. Value added in the sector increased by 3 percent during the same period.

Greenhouse gas emissions from the manufacturing sector, which account for nearly a quarter of total emissions by the Swedish economy, were largely unchanged between 2018 and 2019. Value added in the sector was also largely unchanged over the same period. Greenhouse gas emissions increased in certain manufacturing sub-sectors, such as basic metals (including steel), but decreased in others, in particular coke and refined petroleum production.

Emissions from households also decreased in 2019 compared to 2018, largely due to reduced emissions from private cars.

Greenhouse gas emissions and value added, 2019, percentage change compared with 2018

Source: ***Statistics*** Sweden

Greenhouse gas emissions and value added, 2019, by industry NACE 2007. Thousand tonnes of carbon dioxide equivalents, SEK millions, constant prices 2018 (summed quarters)

| **NACE 2007 industry** | **Greenhouse gas emissions** | **Value Added** |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **2019** | **Change compared to 2018** | **2019** | **Change compared to 2018** |  |  |
| ***Agriculture***, forestry and fishery | 8729 | ?17 | ?0,2% | 72320 | 5883 | 8,9% |
| Mining | 1119 | 10 | 0,9% | 26128 | 142 | 0,5% |
| Manufacturing | 14834 | ?47 | ?0,3% | 646640 | 2422 | 0,4% |
| Electricity, gas, heat, water, waste | 7088 | ?1143 | ?13,9% | 134536 | 3846 | 2,9% |
| Construction | 1795 | ?12 | ?0,7% | 294003 | 4358 | 1,5% |
| Transport | 9386 | ?161 | ?1,7% | 174988 | ?1015 | ?0,6% |
| Other services | 3335 | ?60 | ?1,8% | 2064697 | 42337 | 2,1% |
| Public sector | 611 | ?15 | ?2,5% | 873583 | 780 | 0,1% |
| Households and non-profit institutions [1] | 8596 | ?285 | ?3,2% | 56722 | 784 | 1,4% |
| Total economy | 55492 | ?1730 | ?3,0% | 4893333 | 59548 | 1,2% |

[1] Only non-profit institutions provide value added. Source: ***Statistics*** Sweden

Emissions decreased in fourth quarter of 2019

Greenhouse gas emissions from the Swedish economy amounted to 13.9 million tonnes of carbon dioxide equivalents in the fourth quarter of 2019. This is 6 percent lower than the same period in 2018. GDP for the fourth quarter of 2019 was 1 percent higher than the same quarter a year ago.

Greenhouse gas emissions, economic development and emissions intensity, non-seasonally adjusted. 2008Q1-2019Q4

Index 2008Q1=100, Source: ***Statistics*** Sweden

***Statistics*** from the Swedish Environmental Protection Agency

The Swedish Environmental Protection Agency is also publishing ***statistics*** today about territorial greenhouse gas emissions in Sweden, in which emissions from international transport are not included. Read more about their ***statistics*** and results here (in Swedish):

Naturvårdsverket

Revisions

Since the previous publication on 2020-01-30, the following revisions have been made.

A new method for residence adjustment was introduced:

In accordance with the yearly ***statistics*** on air emissions from environmental accounts, a new method for residence adjustment has been implemented in the quarterly ***statistics***. This residence adjustment is applied to adjust statistical sources with a territorial perspective used to produce these ***statistics*** to the national and environmental accounts’ economic perspective. The new residence adjustment applies primarily to transport: heavy duty road transport (primarily within H49 land transport companies, but also other industries such as construction), maritime transport (H50) and aviation (H51). The new residence adjustment for heavy duty road vehicles is based on ***data*** on transport work (in tonne-km) for Swedish companies abroad and foreign companies in Sweden. These input ***data*** are produced by Transport Analysis (Trafikanalys). For maritime transport and aviation, the new residence adjustment is based on ***data*** for Swedish companies’ expenditure on fuel from ***Statistics*** Sweden’s National Accounts database on intermediate use in the economy, PRIOR.

A new ***data*** source for emissions from transport was introduced:

For the reference year 2018, the register of reports to the Swedish Energy Agency in accordance with Sweden’s implementation of the EU’s Renewable Energy Directive (2009/28/EC) has been used as a source for activity ***data*** for the transport sector. Up to reference year 2017, energy ***data*** from ***Statistics*** Sweden’s monthly fuel, gas and inventory ***statistics*** are used as a source of activity ***data*** for the transport sector. The reason for the change of input ***data*** is that the monthly fuel, gas and inventory ***statistics*** have been deemed to be associated with significant uncertainties from the start of reference year 2018. These uncertainties are considered to have arisen due to a revision of the ***data*** ***collection*** survey used for the monthly fuel, gas and inventory ***statistics*** that was implemented at the start of 2018.

A new model for emissions form the transport sector for reference year 2019 was introduced:

Air emissions for the transport sector for reference period 2019Q1–2019Q4 were previously calculated according to an extrapolation from previous years based on the change in value added in the sector. For this publication a new method has been applied for this extrapolation, according to transport mode and vehicle type. For heavy goods vehicles and reference period 2019Q1–2019Q4, emissions have been calculated from the equivalent values for 2018 and the quarterly development of transport work (in ton-km) according to Sweden’s official ***statistics*** on road goods transport (from Transport Analysis). For private cars, fuel demand for the whole reference year 2019 has been calculated from the equivalent values for 2018 and the development of vehicle kilometres on Swedish roads according to Sweden’s official ***statistics*** on driving distances with Swedish-registered vehicles (from Transport Analysis). The quarterly disaggregation for private cars for 2019Q1–2019Q4 has been directly imputed from 2018Q1 to 2018Q4. Fuel demand for maritime transport for 2019Q1–2019Q4 has been calculated from fuel demand in the equivalent period for 2018 and the quarterly development of the number of vessels docking in Swedish ports (in gross tonnage) between the years, according to Sweden’s official ***statistics*** on shipping goods (from Transport Analysis). Fuel demand for aviation 2019Q1–2019Q4 has been calculated from the relevant period for 2018 and the quarterly development of the number of landings at Swedish airports, according to the Swedish Transport Agency. Residence adjustment factors from reference periods 2018K1–2018K4 have also been used for the corresponding periods in 2019.

More information (in Swedish) on the revisions is available at the Environmental Accounts’ product page under Documentation.

Environmental Accounts

Frequently asked questions

***Statistics*** Sweden and the Swedish Environmental Protection Agency both publish preliminary ***statistics*** about air emissions for 2019.

The ***statistics*** presented by ***Statistics*** Sweden and the Swedish Environmental Protection Agency differ. Below, answers to some frequently asked questions explain how the two ***statistics*** differ and what they can be used for.

What are the ***statistics*** about?

These ***statistics*** cover emissions of greenhouse gases and air pollution.

The Swedish Environmental Protection Agency is responsible for ***statistics*** from the territory of Sweden, also called territorial ***statistics***, while ***Statistics*** Sweden is responsible for ***statistics*** on emissions from an economic perspective, as a part of the System of Environmental Economic Accounting. Both of these statistical products are classified as official ***statistics***, which means that they follow guidelines on when and how the ***statistics*** are to be published, how the quality is to be assured and the ***statistics*** are documented.

Are there differences in the ***statistics*** – and if so, why?

The System of Environmental Economic Accounting (SEEA) is constructed using the national accounts as a foundation and present environmental and economic ***statistics*** in a common system. The starting point is Swedish economic actors, independent of where in the world their environmental impact occurs. As the focus is on economic actors, activities such as international transport are included in the same way that they are included in economic ***statistics***. As such, SEEA ***statistics*** typically show larger emission levels than the territorial emissions.

The territorial ***statistics*** on greenhouse gas emissions show territorial emissions, that is, the emissions occurring within Sweden’s borders.

This often leads to different levels in these two statistical products.

Are the differences significant for how the ***statistics*** can be used?

Yes, they are significant. Territorial ***statistics*** show the amount of emissions of climate change gases released within Sweden’s borders and are used to monitor the development of emissions in comparison with defined climate change targets in Sweden, the EU and the UN.

The climate change ***statistics*** that are reported to the UN are constructed to show which emission sources are present in different countries. Here, it can be expected that countries have significant control over laws and regulations that apply and are able to make calculations on reduction targets for the country.

The ***statistics*** that are produced within the environmental accounts can, instead, answer questions about which components of production and consumption contribute to emissions. It is also possible to perform analyses by aggregating ***statistics*** according to industrial sectors and products, and analyses can be made about the impact intensity of employment for example.

Why are two different government agencies producing almost identical ***statistics***?

In Sweden, there are 28 government agencies that are responsible for official ***statistics*** within their respective areas. Within the area of environment, four government agencies are responsible for official ***statistics***. The Swedish EPA is responsible for official ***statistics*** on emissions, waste, implementation of the Environmental Code and the state of the environment. ***Statistics*** Sweden is responsible for official ***statistics*** on environmental accounts, based on economic ***statistics*** for which ***Statistics*** Sweden is also responsible, and sustainable development, that links ***statistics*** from a range of areas including land use, water use, fertilisers, and lime.

Why are there two different statistical frameworks on emissions to air and climate?

The two different statistical standards for emissions to air and climate answer different questions. Questions about how the economy affects the environment need to be answered using other system boundaries than questions about environmental impacts within a country’s territorial border. The frameworks have been developed by experts who have ensured that the ***statistics*** that are produced are globally comparable for the specific purpose they serve. All countries that produce this type of ***statistics*** follow the dedicated framework and strive to ensure that the same activities are included in the ***statistics*** for comparability.

For international reporting to the climate change convention, the guidelines have been developed by the UN panel on climate change: [*https://www.ipcc.ch/*](https://www.ipcc.ch/).

For environmental accounts, a statistical standard is available, developed by the UN Statistical Division.

Both types of statistical products are reported at international level, to the UN, to ***Eurostat***, and to the European Environment Agency, in accordance with regulations and conventions.

What are the government agencies doing to cooperate?

To create a consensus on the work being done, the two government agencies develop common documents that describe the ***statistics***. The two agencies also jointly take part in conferences and other forums to inform about current efforts. In a podcast hosted by ***Statistics*** Sweden, representatives of the two agencies discuss climate change ***statistics*** (in Swedish):Miljö och klimat, soundcloud

The largest cooperation by far is conducted through the SMED consortium (Swedish Environmental Emissions ***Data***), in which ***Statistics*** Sweden is a major partner and for whom the Swedish EPA is the principal client. For example, SMED produces the annual and quarterly territorial ***statistics*** on behalf of the Swedish EPA. The production of quarterly ***statistics*** is carried out in close cooperation with the team for environmental accounts that has developed an effective production system for producing quarterly ***statistics*** for both the economy and the territory of Sweden. This work includes an exchange of ***data*** and knowledge between the agencies.

If you are interested in learning more about the differences between the ***statistics***, read more here (in Swedish):

About territorial ***statistics***:

Naturvårdsverket, kvartals- och preliminära årsvisa växthusgasutsläpp

About the environmental accounts calculations for emissions to air and climate change:

Kvalitetsdeklaration 2008-2018 (pdf)

Definitions and explanations

The System of Environmental-Economic Accounting (SEEA) is constructed with the national accounts as a foundation, and presents environmental and economic ***statistics*** in a common system. The point of departure is Swedish economic actors’ environmental impact, regardless of where in the world the impact occurs. As the focus lies on economic actors, activities such as international transport are included in the same way as in economic ***statistics***. Emissions and sequestration due to land use (LULUCF) and carbon capture and storage (CCS) are not included.

These ***statistics*** on air emissions apply a production perspective. This means that only direct emissions from Swedish economic actors are included. Indirect emissions arising from products imported to Sweden and other consumption activities are not included.

The ***statistics*** produced here are not used to follow-up emissions in relation to agreed-upon climate change goals in Sweden and internationally. Territorial ***statistics***, reporting emissions occurring within the territory of Sweden are used for that purpose. More information about different principles applied in emissions reporting is available here:

Naturvårdsverket, tre sätt att beräkna klimatpåverkande utsläpp

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[***Western Kenyan Anopheles gambiae showing intense permethrin resistance harbour distinct microbiota***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H841-F129-P27D-00000-00&context=1516831)

Malaria Journal

February 2021

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**Section:** Vol. 20; No. 1; ISSN: 1475-2875

**Length:** 6252 words

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**Body**

Background

Malaria remains an important global health problem, with 92 % of all deaths occurring in Africa []. In Kenya, more than 70 % of the population is at risk of the disease, with children aged ≤ 5 years and pregnant women being the most vulnerable to infection []. The use of indoor residual spraying (IRS), long-lasting insecticidal nets (LLINs) and other interventions have led to measurable improvements in preventing malaria []. Continued reliance on insecticide-based interventions has also resulted in widespread insecticide resistance in malaria vectors, thus threatening malaria control efforts [, ]. This is the case in western Kenya, where malaria vector control is increasingly being threatened by insecticide resistance due to selection pressure imposed by continued exposure to insecticides [, ].

Although insecticide resistance is increasingly prevalent [], its underlying mechanisms are not fully understood. So far, four principal mechanisms of insecticide resistance have been described in mosquitoes, including: (i) metabolic resistance due to elevated activity of detoxification enzymes, (ii) target-site resistance due to genetic alterations at insecticide binding sites, (iii) cuticle modifications that prevent or reduce insecticide penetration, and (iv) behavioral changes resulting in avoidance of, or reduced contact with, insecticides []. Recent studies suggest that the mosquito microbiota may provide a fifth mechanism contributing to insecticide resistance [, ]. Focusing largely on Anopheles albimanus across different geographical locations including Peru [] and Guatemala [], these studies have identified significant alterations of the mosquito microbiota associated with insecticide resistance, with enrichment of insecticide-degrading bacteria and enzymes in resistant mosquitoes [].

The mosquito microbiota has been shown to affect mosquito physiology []. These microbes, which are predominantly acquired during the aquatic life stage from aquatic habitats, colonize mosquito tissues including the gut, reproductive tracts, exoskeleton, and haemocoel [, ]. Some of these microbes are beneficial to mosquitoes through their role in ***nutrient*** provisioning, immunity and development, and subsequent contributions to mosquito fitness []. They also help provide protection against pathogens by modifying the host’s immune system or by synthesizing specific toxins []. The mosquito microbiota can influence and/or be influenced by several mosquito-related factors including mosquito species, developmental stage, genetics, and sex []. In mosquito vectors of malaria, the microbiota play important roles in malaria parasite development, survival, and sporozoite prevalence, thus modulating vector competence [–].

Recent studies on the effects of insecticide exposure on microbes associated with mosquitoes and their habitats have so far focused on Anopheles stephensi, Anopheles albimanus and Anopheles arabiensis [, , , ]. The microbiota of Anopheles gambiae sensu stricto (s.s.) has, however, largely been unexplored in relation to insecticide resistance. Of particular importance is pyrethroid resistance—a major concern in Kenya, where this class of insecticide is predominantly used in LLINs and IRS [, , ]. To address this research gap, this study characterized and compared microbiota between pyrethroid resistant and susceptible An. gambiae s.s. from an area with intense pyrethroid resistance in Western Kenya. Mosquitoes were also screened for gene mutations that mediate knockdown resistance (kdr) to pyrethroids, in order to characterize any associations between the mosquito microbiota and kdr genotype. We discuss these findings on An. gambiae s.s., and highlight their implications for insecticide resistance monitoring and management.

Methods

Mosquito ***collections***

Mosquito ***collections*** were conducted in April and May 2018 in Tulukuyi village located in Bungoma County 0.56°N 34.56°E 1427 m ASL (Fig. ). Previous studies conducted by Ochomo, et al. [] indicated that An. gambiae s.s. was the most predominant species in Bungoma and had high resistance levels to pyrethroids. Sampling was performed by aspiration of blood fed and gravid mosquitoes from 39 houses. Mosquitoes were placed in labelled paper cups with information identifying the ***collection*** date and ***collection*** site. A piece of cotton wool soaked in 10 % w/v sugar solution was placed on top of the netting material covering the paper cup to sustain the ***collected*** mosquitoes. The paper cups were then placed in a cool box and transported to the laboratory.

Map of Kenya (Right) showing Bungoma County (in expanded view) where adult mosquito ***collections*** were conducted. Adult female Anopheles gambiae s.s. were ***collected*** from Tulukuyi village and F1 progeny resulting from these mosquitoes were analysed

Generation of F1 progeny from field‐***collected*** mosquitoes

Prior to species identification, forced oviposition was used to generate isofemale F1 progeny from field ***collected*** blood-fed and/or gravid female mosquitoes. In this study, we focused on the F1 generation (closest to the wild population) in order to standardize rearing conditions and physiological characteristics so as to eliminate any confounding that not standardizing would have introduced—the wild-caught mosquitoes were only used to generate sufficient samples for this standardized design and were not processed beyond species identification. Individual mosquitoes were placed in separate 50 ml falcon tubes containing damp cotton wool topped with filter paper for egg laying. Following egg laying, each adult female was transferred into individual 1.5 ml reaction tubes for molecular species identification (described below). F1 eggs from each isofemale were removed and placed into separate clean larval trays containing distilled water for hatching, while the parents underwent species identification as described below. Following species identification, all larvae from isofemales identified as An. gambiae s. s. were pooled, approximately 200 larvae per tray measuring 46 cm by 35 cm by 5 cm and reared together. Larvae were fed a combination of ground Brewer’s yeast (Health Aid Company, Inc.), and Koi’s choice premium fish food (Foster & Smith, Inc. Rhinelander, WI) at a ratio of 1:2 for An. gambiae until pupation. Using a dissecting microscope (Nikon C-PS, model no. 1,071,990), male and female pupae were separated within 24 hours of pupation in order to obtain virgin adult females. Female pupae were subsequently placed into cages for adult eclosion, while the males were euthanized and discarded. The resulting F1 adult females (~ 377) were sustained on cotton balls soaked in 10 % sugar solution for 2–3 days prior to insecticide susceptibility bioassays. In order to avoid potential confounding factors, all mosquitoes underwent identical standard handling and rearing in the insectary at the Kenya Medical Research Institute -Center for Global Health Research (KEMRI-CGHR), Kisian, Kisumu, under the following conditions: temperature of 27 ± 2 °C, relative humidity of 80 ± 10 %, and photoperiod of 12:12 light: dark cycle.

Molecular identification of mosquito species

Using the ethanol precipitation method described by Collins, et al. [], genomic DNA was extracted from whole individual field-***collected*** female mosquitoes that were used to generate the F1 progeny. 2 µl of DNA from each individual, along with known An. gambiae s.s. DNA as positive control, were used as templates for the PCR reaction []. The reactions were performed using BIO-RAD thermal cycler model T100 under the following conditions: 95 °C for 5 min followed by 95 °C for 30 sec, 56 °C for 30 sec and 72 °C for 30 sec for 30 cycles, with a final extension at 72 °C for 5 min. Amplicons (~ 390 bp for An. gambiae s.s.) were resolved by ethidium bromide-stained agarose gel 2 % electrophoresis.

Permethrin resistance phenotyping

A total of 133 F1 virgin, non-blood fed adult females aged 2–3 days were tested for permethrin resistance following the Centers for Disease Control and Prevention (CDC) guidelines for evaluating insecticide resistance []. The control bottle was coated with 1 ml of acetone while the four test bottles were coated with 1 ml of permethrin stock solution prepared with acetone, at a final concentration of 107.5 µg/ml (5× the dose for discriminating permethrin resistance in Anopheles). Anopheles gambiae Kisumu susceptible strain of the same age and physiological status were used to confirm the viability of the prepared bottles—all mosquitoes in the insecticide treated bottles died, while those in the acetone-treated bottles survived. Using the F1 progeny, the bioassays were conducted for 30 minutes at the end of which permethrin resistance was recorded. Mosquitoes that were alive after the bioassay were categorized as resistant and subsequently killed by freezing, while those that were dead or moribund were categorized as susceptible. Phenotyped mosquitoes were immediately placed in 1.5 ml Eppendorf tubes with unique identification codes and preserved at − 20 °C for subsequent molecular processing. Mosquitoes from the control bottles were not further processed.

Genomic DNA isolation and molecular processing

DNA isolation and purification

250 µl of 70 % ethanol was added to each tube of individual F1 mosquitoes and vortexed at high speed for ~ 10 seconds to surface sterilize the mosquitoes. This was followed by a vigorous rinse using a vortex mixer at high speed for ~ 10 seconds, then a gentle rinse by pipetting for ~ 10 seconds; each with 250 µl of nuclease free water. Genomic DNA from the whole mosquito was isolated and purified using the MasterPure™ Gram Positive DNA Purification Kit following the manufacturer’s instructions (Epicentre Biotechnologies, Madison, USA). During DNA extraction, four blank controls (containing all the reagents used sans mosquito) and two 1 g soil samples from Kisian (as a distinct source of microbes) were also processed to catch any potential sample processing and cross contamination respectively. Purified DNA samples were stored at − 20 °C for subsequent analysis.

Detection of kdr-East and kdr-West alleles

RT-PCR was used to detect the presence of both kdr-East and kdr -West alleles using DNA from F1 mosquitoes. Following the protocol by Bass, et al. [], samples were processed using the MxPro-Mx3005P software ‘Allele Discrimination-SNP’s’ program with 1.5 µl (≥ 20 ng/µl) of DNA as template. PCR was carried out under the following cycling conditions for kdr-East: 95˚C for 10 min then 40 cycles of 95˚C for 10secs and 60˚C for 45 sec. For kdr- West, the cycling conditions were 95˚C for 10 min followed by 40 cycles of 92˚C for 15 sec and 60˚C for 60 sec.

Library preparation and 16S rRNA gene amplicon sequencing

Using the 341f (TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGCCTACGGGNGGCWGCAG) and 805r (GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGGACTACHVGGGTATCTAATCC) primers [] with Illumina® (San Diego, CA USA) overhang (in bold typeface), the V3- V4 region of the universal bacterial and archaeal 16S rRNA gene was amplified using genomic DNA from F1 mosquitoes. Four no-template controls (PCR grade water), along with the six controls from the DNA extraction step—two cross-contamination controls (soil samples), and four blanks—were also processed. The PCR reaction mixture (25 µl total volume) comprised of 10 µl of 2× KAPAHiFi HotStart Mix (Roche, Switzerland), 5 µM each of 341f and 805r primers and 5 µl of DNA template which was ≥ 20 ng/µl. Reactions were conducted using the BIO-RAD T100 thermal cycler with the following cycling conditions: 95 °C for 3 min for initial denaturation, followed by 25 cycles of 95 °C for 30 sec, 55 °C for 30 sec, 72 °C for 30 sec and extension at 72 °C for 5 min. The resulting amplicons of ~ 460 bps were purified using Agencourt AMPure XP beads (Beckman Coulter Inc., Indianapolis, IN, USA) at 0.87 × sample volume and eluted in 45 µL TE buffer. The purified amplicons including those from blank and cross contamination controls were submitted to the Biotechnology Core Facility at the US Centers for Disease Control and Prevention, Atlanta for library preparation and sequencing.

Sequencing libraries were obtained using index PCR. This comprised NEBNext Hig-Fidelity 2× PCR master mix New England Biolabs Inc., Ipswich, MA), index primers from Nextera XT Index kit v2 set A, B and D; (Illumina, San Diego, CA), and 10–300 ng of each 16S rRNA gene amplicon, along with all controls, as template. PCR thermal cycler conditions were set to: 98 ºC for 30 sec, followed by 8 cycles of 98 ºC for 10 sec, 55 ºC and 65 ºC for 30 sec each, followed by a final extension at 65 ºC for 5 min. The resulting products were cleaned using Agencourt AMPure XP beads at 1.2 × volume of each library. These were subsequently analysed for size and concentration, normalized and pooled at a final concentration of 2 nM. The pool was denatured using Illumina guidelines for loading onto flow cell for cluster generation, and sequencing was performed on an Illumina Miseq using Miseq 2 × 250 cycle paired-end sequencing kits. The resulting sequence reads were filtered for read quality, basecalled and demultiplexed using bcl2fastq (v2.19.1).

Sequencing ***data*** quality control and generation of amplicon sequence variants (ASV) table

Resulting raw paired-end sequencing reads were demultiplexed and imported into the Quantitative Insights Into Microbial Ecology (QIIME) 2 pipeline v.2018.11 [] for analysis. Primers and adapter sequences were removed using the QIIME2 cutadapt plugin v.2018.11.0 []. This was followed by quality filtering using the QIIME2 DADA2 plugin v.2018.11.0 to remove any sequencing errors, denoise and dereplicate paired-end sequences, filter out chimeras, and finally generate a frequency table of Amplicon Sequence Variants (ASVs, also referred hereafter as features) []. The quality filtering step was achieved using the denoise-paired command with the following parameters; max\_ee: 2, trunc\_q: 2, trim\_left\_f: 10, trim\_left\_r: 10, n\_reads\_learn: 1,000,000 and all other parameters left as default. The resulting frequency table was subsequently filtered to remove features associated with the controls, and those with frequency < 100 prior to downstream analysis. Following these steps, 36 susceptible and 39 resistant mosquitoes remained, and were used for downstream analysis. The raw sample sequencing reads generated from this project, including those from negative (blank) and cross contamination (soil samples) controls, along with sample metadata, have been deposited in the National Center for Biotechnology Information (NCBI), Sequence Read Archive under the BioProject PRJNA672031.

Microbial community diversity analysis

Alpha and beta diversity indices [] were computed and compared between samples with differing resistance phenotypes. Shannon alpha diversity index, a quantitative measure of community richness and evenness, was computed using the q2-diversity plugin. To avoid introducing bias due to unequal sampling depth, prior to alpha diversity analysis, all samples were rarefied to a depth of 100 ASVs per sample (Additional file ), which was sufficient to capture the typical low microbiota diversity in individual mosquitoes. The Kruskal-Wallis test was used to compare Shannon diversity indices between insecticide resistant and susceptible samples with Benjamini-Hochberg false discovery rate (FDR) corrections.

Bray-Curtis dissimilarity beta diversity index, a quantitative measure used to determine compositional dissimilarity of features between samples, was also computed using the q2-diversity plugin. The Bray-Curtis dissimilarity matrices were computed using both rarefied (to a sampling depth of 100 ASVs per sample as described above) and unrarefied ASVs. Both resulted in significant differences between the microbiota of resistant and susceptible mosquitoes (Additional file ), thus, ordination outputs of only the latter are presented. Comparisons of the resulting distance matrices between resistant and susceptible samples were performed using permutational multivariate analysis of variance (PERMANOVA) at 999 permutations with Benjamini-Hochberg FDR corrections. Outputs were visualized using phyloseq package [] in R [].

Taxonomic annotation of microbial features

QIIME2 v 2018.11 q2-feature-classifier plugin [] was used for taxonomic annotation. The Naïve Bayes classifier [] was pre-trained on 16S SILVA reference (99 % identity) database v.128 []. Using the qiime feature-classifier extract-reads command, trimming was done to only target the V3-V4 region of the 16S rRNA gene (~ 425 bps length). The qiime feature-table heatmap plugin was subsequently used to visualize the resulting relative abundance of annotated ASVs across samples. The plugin’s metrics and clustering methods were set to braycurtis and features respectively.

Testing for differentially abundant microbial features between permethrin resistant and susceptible mosquitoes

The linear discriminant analysis (LDA) effect size method (LEfSe) [] was used to identify ASVs that were differentially abundant between resistant and susceptible mosquitoes. Annotated ASVs were converted into abundance tables and uploaded to LEfSe Galaxy v.1.0 ([*http://huttenhower.sph.harvard.edu/lefse/*](http://huttenhower.sph.harvard.edu/lefse/)). With default parameters, an alpha value of 0.05 was used for both the factorial Kruskal-Wallis and pairwise Wilcoxon tests within LEfSe, and a threshold value of > 2 was used on the resulting logarithmic LDA score to identify differentially abundant ASVs. The effect sizes of differentially abundant ASVs were visualized as bar plots.

The analysis of composition of microbiome method, ANCOM [], was used to verify the results obtained from LEfSe. The ANCOM analysis was called using the q-2 composition plugin, with the transform and difference functions set to log\_transform and mean\_difference, respectively. All other parameters were set to default. The resulting ***statistic***, W, and its default cut off was used to identify differentially abundant features between resistant and susceptible mosquitoes.

Results

Summary ***statistics*** of permethrin resistance phenotypes, kdr mutations and sequencing ***data***

A total of 133 adult F1 female An. gambiae s.s. were tested for resistance to permethrin using 5 × (107.5 µg/ml) the discriminating dose (21.5 µg/ml) of the insecticide, and 52.6 % of the samples tested were found to be susceptible. One hundred of the screened samples (50 resistant and 50 susceptible) were subsequently processed for characterizing the microbiota and kdr allele frequencies. Of all 100 samples, 99 % had the kdr east (Vgsc\_1014S) mutation and the remaining one had the kdr west (Vgsc\_1014F) gene mutation. This high frequency of kdr east mutation indicated fixation in the mosquito population and thus precluded further correlation analysis between microbial composition and kdr allele frequencies. Microbial community characterization of all 100 samples yielded 4,319,065 raw sequencing reads, in addition to 5,226 raw reads from blank and cross-contamination controls (Additional file ). Following sequencing ***data*** quality control and subsequent removal of features associated with controls and those with frequency < 100, 36 susceptible and 39 resistant samples remained and were used for downstream analysis.

Microbiota composition differed between permethrin resistant and susceptible An. gambiae s.s

Comparison of Bray-Curtis dissimilarity indices using PERMANOVA, showed significant differences in bacterial composition between permethrin resistant and susceptible mosquitoes (pseudo-F = 2.33, p = 0.001). This heterogeneity in microbial community structure associated with insecticide resistance status was further illustrated by principal coordinates analysis (PCoA), in which the microbiota of susceptible samples clustered closely together and away from those of primarily dispersed resistant samples (Fig. ).

A Principal Coordinate analysis (PCoA) plot of Bray-Curtis distances between the microbiota of permethrin resistant and susceptible An. gambiae s.s. Each point on the plot represents the microbial composition of a single mosquito. The susceptible samples clustered closely together and away from the primarily dispersed resistant samples. The Bray-Curtis comparison using permutational multivariate analysis of variance (999 permutations) showed a significant difference in microbial composition between resistant and susceptible samples (pseudo-F = 2.33, p = 0.001)

Considering microbial diversity within each group, a Kruskal-Wallis comparison showed no difference in Shannon diversity between the microbiota of permethrin resistant and susceptible mosquitoes (H = 0.45, p = 0.50) (Additional file ).

Anopheles gambiae s.s. from Tulukuyi consisted of sparse but diverse microbial taxa that differed by permethrin susceptibility status

Taxonomic annotation was performed to the genus level or to the lowest possible taxonomic rank. The relative frequencies of annotated bacterial taxa for each sample are presented in Fig. . Overall, ASVs from An. gambiae s.s. microbiota were assigned to 84 bacterial taxa (Additional file ), and out of these, less than half (36 taxa) were shared between permethrin resistant and susceptible An. gambiae s.s. There were 28 and 20 unique bacterial taxa in permethrin susceptible and resistant samples, respectively (Fig. a, Additional file ). At the genus level, a total of 66 bacterial genera were identified, 29 of which were shared between resistant and susceptible mosquitoes, while 21 and 16 were unique to permethrin susceptible and resistant mosquitoes, respectively (Fig. b, Additional file ).

Venn diagrams showing number of bacterial taxa unique to or shared between 39 permethrin resistant and 36 susceptible mosquitoes. a shows number of bacterial taxa annotated to the genus or lowest possible taxonomic rank, and b shows number at the genus level

The most abundant bacterial taxa across all samples were those assigned to Asaia (38.33 %), Enterobacter (7.25 %), Acinetobacter (3.88 %), Klebsiella (3.84 %), an uncharacterized Enterobacteriaceae (3.30 %), and Lysinibacillus (3.27 %), together accounting for more than 55 % of ASVs (Additional file ). A total of 16 genera were unique to resistant mosquito samples including Lysinibacillus, Thorsellia, Streptococcus and Altererythrobacter, among others (Suppl 4). The six most dominant genera among resistant mosquitoes were Lysinibacillus (13.97 %), Pseudomonas (11.95 %), Acinetobacter (8.54 %), Thorsellia (6.49 %), Asaia (4.23 %) and Bacillus (4.08 %). On the other hand, 21 genera were only found in the susceptible mosquito samples including Marmoricola, Roseomonas, Dyadobacter, Lactococcus, and Myxococcus, among others. Among susceptible mosquitoes, Asaia was the most dominant, with a relative abundance of 48.76 % followed by Enterobacter (9.23 %), Klebsiella (4.41 %), Enterococcus (3.63 %) and Acinetobacter (2.45 %).

A few resistant and susceptible individuals had highly diverse microbiota, with ASVs assigned to between 14 and 37 bacterial taxa (Fig.  and Additional file ). The sample with the highest bacterial diversity was a permethrin susceptible mosquito. Notably, some bacterial taxa were detected more frequently in resistant compared to susceptible mosquitoes. These included the genus Rubrobacter which was detected at low abundance in 20 of the 39 permethrin resistant samples and only in two susceptible mosquito samples, also at low levels of abundance. Similarly, ASVs assigned to unclassified Rhodospirillales (JG37-AG-20) and unclassified Obscuribacteriales were detected in 18 and 9 resistant mosquitoes, respectively, but only in 1 and 4 susceptible mosquitoes, respectively. ASVs assigned to the genera Streptococcus, Thermomonas, Sphingobacterium, Ornithinimicrobium and Lysinibacillus were detected in more permethrin resistant samples compared to the susceptible samples (Fig.  and Additional file ). On the other hand, ASVs annotated as unclassified Enterobacteriaceae were predominant in the susceptible mosquitoes and were detected in 10 of these samples in contrast to only 4 resistant samples.

Heat map showing frequency of annotated ASVs. Frequency of ASVs from the microbiota of individual permethrin resistant (n = 39) and susceptible (n = 36) An. gambiae s. s. from Tulukuyi. The annotation of ASVs was done to the genus level or lowest possible taxonomic level

Differentially abundant bacterial taxa between insecticide resistant and susceptible mosquitoes

Linear discriminant analysis (LEfSe) also revealed significant differences in microbiota composition between susceptible and resistant mosquitoes. Focusing on the genus level, four bacterial genera, Sphingobacterium, Streptococcus, Lysinibacillus, and Rubrobacter, and an uncultured bacterium were highlighted by LEfSe as more abundant in resistant mosquitoes (Fig. ). The first three genera were only detected in resistant mosquitoes, while Rubrobacter and the uncultured bacterium were at least three-fold more abundant in resistant compared to susceptible mosquitoes (Fig.  and Additional file ). On the other hand, LEfSe identified only one bacterial genus, Myxococcus, as more abundant in the susceptible samples (Fig. ); this genus was not detected at all in the resistant samples (Additional file ). Although more bacterial genera were unique to either resistant or susceptible mosquitoes (Fig. b and Additional file ), LEfSe highlighted those that were present in at least four individuals.

Differentially abundant bacterial genera between permethrin resistant and susceptible mosquitoes. The green and the red bars represent taxa which were significantly more abundant in the susceptible and resistant samples, respectively, at log 10 transformation. Taxonomic levels are designated as D\_1\_phylum, D\_2\_class, D\_3\_order, D\_4\_family, D\_5\_genus

The ANCOM method further corroborated these results. Being more stringent, and not considering features that were unique to either sample category, it identified features assigned to the genus Rubrobacter (W = 51) and unclassified Rhodospirillales (JG37-AG-20) (W = 63) as significantly more abundant in resistant compared to susceptible samples (Additional file ).

Discussion

Recently, studies of An. stephensi, An. arabiensis and An. albimanus have shown links between mosquito-associated microbiota and resistance to pyrethroids and organophosphates [, , , ]. In this study the microbiota of pyrethroid resistant and susceptible F1 progeny of field-derived An. gambiae s.s. were comparatively characterized. Results showed significant differences in microbiota composition between resistant and susceptible mosquitoes with enrichment of different bacterial taxa between resistant and susceptible mosquitoes.

Intense resistance (at 5× the diagnostic dose) to permethrin was detected, along with high frequency (99.14 %) of the kdr east allele in the F1 progeny originating from Tulukuyi, Western Kenya. These findings corroborate earlier reports of high pyrethroid resistance in the same area [, ]. Multiple studies from western Kenya have indicated that the high intensity of insecticide resistance may be contributing to mosquito control failure [, ]. The high frequency of the kdr east allele suggests that the mutation is fixed in this mosquito population. Other studies conducted in western Kenya have also reported the presence of high kdr east allele frequencies which is attributed to the continued use of insecticide–based vector control methods [, –]. However, results showed that the allele was fixed regardless of resistance phenotype, suggesting that additional mechanisms, such as the overexpression of detoxification enzymes (e.g. cytochrome P450s []), are more important than kdr in conferring the intense permethrin resistance detected in the population. The fixation of the kdr east mutation in the population also precluded further analysis of any associations between kdr alleles and the mosquito microbiota. Indeed, a recent study identified no links between the two []. The authors thus hypothesize that any microbe-mediated mechanism of insecticide resistance would be largely distinct from the mosquito host’s genetics, and likely of a metabolic nature.

Results showed diverse bacterial taxa from individual An. gambiae s.s. samples, a majority of which have previously been identified in Anopheles and other mosquito genera including Aedes aegypti [–]. However, less than half of the detected microbial taxa were shared between permethrin resistant and susceptible mosquitoes, suggesting insecticide resistance-related physiological differences that favored different bacterial taxa.

Significant differences in microbiota composition and structure between permethrin resistant and susceptible An. gambiae s.s. were also shown. There is evidence that insecticide detoxifying microbes in ***agricultural*** insect pests contribute to insecticide resistance in their hosts [, ]. Recent studies on mosquitoes have also identified insecticide resistance- and/or exposure-driven alterations of the host microbiota. In particular, An. albimanus microbiota differed by resistance to fenitrothion and was altered by exposure to different pyrethroids, and Aedes aegypti microbiota differed by resistance to lambda-cyhalothrin [, , ]. These findings suggest that insecticide resistance in mosquitoes favour and/or is a consequence of the proliferation of certain bacterial taxa, possibly those that can degrade and metabolize insecticides. Recent studies [, ] identified known insecticide-metabolizing bacterial taxa in An. albimanus that were exposed or resistant to insecticides. Huang et al. [] and Tang et al. [] documented that certain microorganisms (considered as potential candidates for bioremediation), including bacteria, degrade pesticides in the soil by breaking them down into smaller compounds, utilizing them as their source of ***nutrients*** and making them less toxic to the environment. Some of these microorganisms degrade pesticides to create conducive environments for their survival and not for nutritional requirements []. The different taxa present in the resistant versus susceptible mosquitoes, particularly those of resistant mosquitoes, is suggestive of this type of adaptation.

Despite significant differences in microbiota composition and structure (beta diversity), there was no significant difference in alpha (Shannon) diversity between the microbiota of resistant and susceptible mosquitoes. This is suggestive of a homeostatic-controlled number of microbial taxa across individual mosquitoes, with an insecticide resistance-associated perturbation of the type and relative abundance of specific microbial taxa. Mosquitoes used in this study were F1 progeny of wild adult females ***collected*** from the same location and reared under identical conditions. Except for their permethrin resistance status, which was determined at 2–3 days post adult eclosion, the mosquitoes had identical physiological characteristics. These identical rearing conditions and subsequent uniform physiological characteristics may explain the homogeneity in alpha diversity across samples. On the other hand, the differences in microbial composition associated with their permethrin resistance status provide further evidence of insecticide selection pressure on the mosquito microbiota. Previous studies have shown that a majority of the mosquito microbiota is obtained from mosquito aquatic habitats at the larval stage, and also from food sources as adults []. Newly emerged adults can also imbibe bacteria along with water from their larval habitats during eclosion or through transstadial transmission []. However, other factors such as mosquito physiological status [, , ] affect what microbes persist and colonize the mosquitoes following acquisition, and this could explain the insecticide resistance-associated differences in composition despite similar alpha diversity across all individual samples.

Differential abundance testing identified Sphingobacterium, Lysinibacillus, Streptococcus and Rubrobacter as significantly more abundant in resistant mosquitoes and Myxococcus as significantly more abundant in susceptible mosquitoes. The first three genera were only detected in resistant mosquitoes, while Rubrobacter was at least three-fold more abundant in resistant compared to susceptible mosquitoes. In a study conducted by Hu et al. [], Lysinibacillus sphaericus was identified as a microbe with the ability to degrade up to 83 % of cyfluthrin (a pyrethroid) after 5 days of incubation by utilizing the insecticide as its source of carbon or nitrogen. In the current study, Lysinibacillus was only detected in resistant mosquitoes, likely as a result of its ability to utilize pyrethroids. Lozano and Dussán [] also described the potential of Lysinibacillus sphaericus to be used in bioremediation of heavy metals. Sphingobacterium and Streptococcus, also only detected in resistant mosquitoes in this study, are bacterial genera known to degrade pyrethroid insecticides such as cypermethrin [–]. Bacteria belonging to the genera Streptococcus and Rubrobacter have been categorized as core microbiota of the digestive system of Anopheles culicifacies []. Although not documented for pyrethroid degradation or metabolism, Rubrobacter are known to be thermophilic and extremely resistant to UV thermal and gamma radiations []. Other bacterial genera belonging to Actinobacteria, the phylum to which Rubrobacter belongs, have been associated with degradation of insecticides including pyrethroids [, ], and the increased relative abundance of Rubrobacter in insecticide resistant mosquitoes could suggest their contribution to resistance. On the other hand, the genus Myxococcus was only detected in susceptible mosquitoes. This bacterial genus is known to be predatory on other bacteria [], chitinase-producing [], capable of producing various bioactive antifungal agents [], and inhibitors of cellular respiration []. However, their association with mosquito physiology or insecticide susceptibility has not yet been described. Given what is known about this bacterial genus as highlighted above, it is possible that they could also be toxic to mosquitoes by directly inhibiting host’s cellular respiration and/or indirectly preying on other members of the mosquito microbiota that are necessary for host’s survival and or insecticide metabolism. Further studies are necessary to elucidate the role of Myxococcus and their secondary metabolites on mosquito physiology, including insecticide susceptibility.

In an aquatic microcosm, it has been demonstrated that insecticides, if used singly or in combination, can reduce microbial diversity and/or induce shifts in microbial community structure []. Recent studies have also demonstrated shifts in mosquito microbiota and larval water microbiota that were associated with insecticide exposure [, ]. This indicates that insecticide exposure shapes the microbial composition of mosquitoes and their habitats. This is likely due to the toxic effects of insecticides on some microbes, while at the same time favoring the proliferation of other tolerant microbes as described by Johnsen et al. []. It is also possible that in addition to, or rather than selection pressure, the presence of specific insecticide-metabolizing microbes in mosquitoes induce resistance to insecticides and precludes colonization by other microbes. In Ae. aegypti it has been demonstrated that infections with certain microbes precludes colonization by others [], and that microbial interactions within mosquitoes shape their microbial community [, ]. Further research on these microbial networks could shed more light on the role of the mosquito microbiota in insecticide resistance. [, ].

Conclusions

In this study, intense permethrin resistance in F1 progeny of field-***collected*** An. gambiae s.s. from Tulukuyi, Bungoma, western Kenya was detected. This was accompanied by a high frequency of (> 99 %) of the kdr east allele, suggesting fixation in the population. These results also show, for the first time, significant differences in microbiota composition between permethrin resistant and susceptible An. gambiae s.s. These findings corroborate results of previous research on other Anopheles species from different geographic locations. The abundance of Rubrobacter, Lysinibacillus, Sphingobacterium and Streptococcus were associated with resistant mosquitoes, while the abundance of Myxococcus was associated with susceptible mosquitoes. The enrichment of these specific bacterial taxa highlights the potential for discovering novel microbial markers of insecticide resistance that could complement existing insecticide resistance surveillance tools. With this increasing evidence of associations between mosquito microbiota and insecticide resistance, future work will evaluate the underlying microbial mechanisms of insecticide resistance.

**Acknowledgements**

We acknowledge and thank the homeowners in Tulukuyi village for access to their homes during mosquito ***collections***, without which this study would not have been possible; Evans Olang and Duncan Omondi from Kenya Medical Research Institute, for assistance during mosquito ***collections***; Maurice Ombok from Kenya Medical Research Institute for the map of Tulukuyi, and the Biotechnology Core Facility at the US Centers for Disease Control and Prevention for sequencing our samples. We are grateful to the KEMRI Director General for the permission to publish this work.

**Notes**

Supplementary InformationThe online version contains supplementary material available at [*https://doi.org/10.1186/s12936-021-03606-4.Publisher’s*](https://doi.org/10.1186/s12936-021-03606-4.Publisher’s) noteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

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[***Woody litter protects peat carbon stocks during drought***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2B1-JCWX-C2C1-00000-00&context=1516831)

Nature Climate Change

March 2020

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**Section:** Pg. 363-369; Vol. 10; No. 4; ISSN: 1758-678X,1758-6798

**Length:** 7458 words

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**Body**

Main

Northern peatlands store around 250–450 Pg of carbon, and contribute to cooling the planet,. Afforestation has long been recognized as a valuable tool for countering the build-up of atmospheric CO2–, for example, offsetting an estimated 11% of annual GHG emissions in the United States. Forests store around 861 PgC (refs. ,,), with net ecosystem production generally considered to be high–,. Soil stocks account for 44%, live biomass 42%, deadwood 8% and litter 5% (ref. ). The latter live and dead compartments are vulnerable to re-release when trees die and decompose or are subject to pests, diseases, deforestation and forest fires–,. However, unlike forests, peatlands are unusually effective at preventing re-release of stored carbon to the atmosphere. Traditionally, this is attributed to slow decomposition rates in relation to production rates as a result of waterlogging, low pH and cool conditions,,,. Sphagnum peatlands were found to possess a particularly effective mechanism for restricting enzymic decomposition whereby oxygen constraints associated with waterlogging suppress the activity of phenol oxidase enzymes.

This, in turn, allows an accumulation of enzyme-inhibiting phenolic compounds to impede the activity of the major agents of ***nutrient*** cycling and decomposition, namely, hydrolase enzymes. This ‘enzymic latch’ was later found to sit within a biogeochemical cascade whereby multiple constraints were preventing decomposition, rather than just waterlogging, but severe drought could disrupt this by accelerating ***nutrient*** cycling and raising pH.

Combining forest carbon capture with peatland preservation to improve carbon sequestration has been proposed but never tested, and whether the approach is vulnerable to release of carbon in gaseous or dissolved form,, during increasing drought events remains unknown. Thus, we investigated the stability of woody litter in peatland ecosystems and the impact of lowered water tables (due to drainage or drought) on peatland decomposition. Our results suggest not only that the woody material is effectively preserved, but that the additional soluble polyphenols that the wood leaches inhibit both extracellular and intracellular metabolism and deprive microbial growth of both iron and substrates. This further limits decomposition, protecting the host ecosystem carbon stock, even during severe drought. Such findings held true across successional stages and water table regimes, which have been proposed to account for differences in sensitivity to drought and further our understanding of how wooded peatlands can exist under intermittently dry conditions. In addition, these findings suggest that natural ecosystem resilience mechanisms could be harnessed, with applications in geological and ecological engineering to protect carbon stocks and increase sequestration in pristine drought-sensitive systems through to highly degraded drought-resistant systems.

Determining the stability of exogenous carbon in peat

Initial studies investigated whether peat could stabilize exogenous carbon captured as wood, that is, whether inserted wood decomposed at a slower rate than exposed wood. For this, we used an in vitro standard biodegradation approach with durable oak (Quercus robur) and non-durable poplar (Liriodendron tulipifera), as defined by percentage mass loss. Wood remaining on the surface of the peat showed an average mass loss of 49% y−1 (oak) and 73% y−1 (poplar), while timber inserted 5 cm below the peat’s surface lost only 12% y−1 and 18% y−1, respectively, under waterlogged (anaerobic) conditions, confirming that insertion preserved exogenous carbon.

This was followed by incubating wood inserted into Sphagnum peat (site 1, Supplementary Table ) under anaerobic, aerobic, anaerobic conditions in sequence to determine whether the exogenous carbon was resilient to changes in redox potential, that is, whether drainage or drought would increase mass loss, as would be expected from traditional and enzymic-latch theories. Surprisingly, no increase in mass loss was found, compared with the waterlogged control, suggesting the carbon was stabilized within the peat regardless of oxygen status. Furthermore, there was an increase in soluble polyphenolics (oak: 0.5 mg l−1, 36%; poplar: 0.4 mg l−1, 24%). A reduction in global warming potential (GWP) was also found (oak 173%; poplar 72%). Oak was particularly effective, shifting the peat from a source of 183 mg CO2-equivalent (CO2e) m−2 h−1 to a sink of 251 mg CO2e m−2 h−1 (Fig. ), suggesting not only suppressed decomposition (that is, a reduction in source strength) but also uptake of GHGs (that is, ‘scrubbing’ from the atmosphere). While variation was relatively high, N2O contributions shifted from a source of 5.54 ± 6.14 mg CO2e m−2 h−1 to a sink of −14.95 ± 17.22 mg CO2e m−2 h−1 and showed the largest percentage change (370%) with oak addition, suggesting the potential for large effects on GWP. Similar patterns were found for poplar but with more variation (Fig. ). However, suppression was greatest during the aerobic phase compared with the anaerobic phase for both wood types (Fig. ).

Effect of changes in redox potential on GHG fluxes from ombrotrophic peat.

a,b, GWP CO2e of GHGs from in vitro microcosms containing durable oak (a) and non-durable poplar (b) overall (that is, the duration of the anaerobic-aerobic-anaerobic 60 d incubation) and when exposed to anaerobic and aerobic conditions. Oak was significantly different from the control (overall paired T = −3.66, P = 0.006) with a 341% and 190% reduction under aerobic and anaerobic conditions, respectively. Poplar showed a large reduction under aerobic and anaerobic conditions (1,388% and 220%, respectively) but was more variable (overall paired T = −1.36, P = 0.211). Negative fluxes represent uptake from the atmosphere. n = 6 microcosms per treatment; error bars denote s.e.m.

The experiment suggests that the durable wood induces stronger constraints on decomposition than the non-durable wood and that the threat of carbon loss due to a drought-induced destablization of the enzymic latch is much reduced, even in these predominantly waterlogged and therefore drought-sensitive systems. Furthermore, adding phenol oxidase enzymes to further test the threat to carbon stocks posed by a temperature- or ***nutrient***-mediated opening of the latch when exposed to the simulated drought did not increase mass loss, suggesting ‘excess’ inhibiting capacity or resilience.

Effects of peat type on exogenous carbon stability

Wood was then inserted (5 cm depth) into intact plant–peat mesocosms, representing more-natural conditions than the previous experiment, by including natural peat profiles and microsites. These were ***collected*** from a range of peatland types (Supplementary Table ) across four trophic statuses (ombrotrophic, oligotrophic, mesotrophic and eutrophic) because ***nutrients*** and pH drive decomposition, with nitrogen levels being inversely correlated with phenolics in bogs. However, it should be noted that the range of trophic status includes co-varying physicochemical variables such as ***nutrients***, pH and organic matter. The exogenous carbon was again stabilized, with poplar losing only 1.2% y−1 (0.14 g y−1) of its mass in the ombrotrophic system, 1.4% y−1 (0.15 g y−1) in the oligotrophic system and 1.9% y−1 (0.22 g y−1) in the mesotrophic system. However, oak again was more resistant, losing 1% y−1 (0.12 g y−1), 1.1% y−1 (0.12 g y−1) and 1.4% y−1 (0.16 y−1), respectively (Fig. ). As with the in vitro results, polyphenolics concentrations increased with wood additions, and this was true for both wood types across all peatlands. Oak showed higher polyphenolics concentrations (Fig. ) though, suggesting wood type, and therefore leachate character, is probably important in determining microbial decomposition.

Effect of peat type on wood preservation and polyphenolic accumulation.

a,b, Oak and poplar mass loss (a) and soluble polyphenolics concentration (b) after addition to a range of peatland types over 3 yr, including simulated 1 per 100 yr drought (60 d duration, water table 30 cm below surface). Mass loss was strongly related to trophic status (oak: R2 = 40.93, T = 6.82, P = 0.000; poplar: R2 = 36.15, T = 6.23, P = 0.000), as was polyphenolic concentration (oak: R2 = 91.95, T = 6.03, P = 0.000; poplar: R2 = 94.74, T = 4.78, P = 0.000). n = 6 plant–peat mesocosms per trophic level per treatment; error bars denote s.e.m.

Thus, ombrotrophic bogs were the most effective exogenous carbon preservation systems, showing the lowest mass loss and highest accumulation of polyphenolics (Fig. ), consistent with their exceptionally slow decomposition rates (attributed to low pH, high polyphenolics and unusual tanning properties, which make nitrogen unavailable). However, mass loss in the oligotrophic and mesotrophic sites showed no substantial difference from the ombrotrophic system (Fig. ), and even in the eutrophic system there was an accumulation of polyphenolics and low mass loss rates for both oak (3.1% y−1, 0.36 g y−1) and poplar (4.1% y−1, 0.42 g y−1). The latter is supported by natural alluvial recruitment of coarse woody debris and preserved archaeological relicts. It should be noted, however, that these systems are still relatively ***nutrient***-poor (Supplementary Table ), and both woods became more vulnerable to decay with increasing trophic status (Fig. ).

Focussing on oak, due to its higher polyphenolics concentrations, the flux of all GHG species was reduced (Supplementary Fig. and Fig. ), leading to decreased GWP across all systems (Fig. ). The greatest percentage change was found in the ombrotrophic system (35%), which also showed the strongest N2O reduction, acting as a sink overall (Fig. ). Simulated drought, following 2 yr of waterlogged conditions, further enhanced this effect in the ombrotrophic, oligotrophic and mesotrophic systems (Fig. and Supplementary Fig. ), with N2O contributions particularly inhibited in ombrotrophic systems (Fig. and Supplementary Fig. ), consistent with in vitro results.

Effect of oak addition on GHG fluxes across peat types.

a, N2O contributions to GWP (in CO2e) after oak addition compared with controls across a range of peatland types over 3 yr, including simulated 1 per 100 yr severe drought (60 d duration, water table 30 cm below surface). b, Total GWP over 3 yr for control and oak-supplemented peat and showing greater effects in drought. Overall percentage suppression due to oak: ombrotrophic, 35%; oligotrophic, 31%; mesotrophic, 19%; eutrophic, 18%. Drought suppression due to oak: ombrotrophic, 38% (T = 3.30, P = 0.021); oligotrophic, 34% (T = 5.03, P = 0.004); mesotrophic, 23%; eutrophic, 13%. c, N2O contributions to GWP after oak addition compared with controls in ombrotrophic peat (overall, 198% reduction: paired T = 4.29, P = 0.008; severe drought, 67% reduction: T = 10.78, P = 0.000). Negative fluxes represent uptake from the atmosphere. The ombrotrophic site was found to be a net sink when averaged overall (Supplementary Text ) but a source during drought. n = 6 plant–peat mesocosms per trophic level per treatment; error bars denote s.e.m.

While CO2 and CH4 contribute more to GWP, N2O is most affected by supplementation (Supplementary Fig. , Fig. and Supplementary Text ). Given that drainage releases N2O, altering peatlands globally from a net sink to a source of GHG, and that emissions from tropical and drained peatlands are likely being underestimated, such a property could be invaluable.

Similarly, we also measured dissolved organic carbon (DOC) and dissolved organic nitrogen (DON) concentrations leaching from the peat as intermediates of decomposition available for export to receiving waters with the potential to reduce drinking water quality or act as substrates for further GHG production,. DOC concentrations fell significantly (24%, 18 mg l−1) over 3 yr and 28% (16 mg l−1) in severe drought, with polyphenolics concentrations increasing by 26% (3.8 mg l−1) and 59% (5.0 mg l−1) within this pool, respectively, giving an increased polyphenolics-to-DOC ratio, thought to be more important in limiting microbial metabolism than high concentrations of polyphenolics alone. DON showed a similar pattern (36% overall, 59% during severe drought, Supplementary Table ). In addition, an illustration of the extent of the impact of polyphenolics on decomposition can be seen in shifts in the isotopic signatures of these intermediates (Supplementary Text and Supplementary Fig. ).

Pre-aged oak

The preceding wood mass loss rates are calculated from short-term experiments and, as such, may be faster than long-term averages due to preferential decomposition of labile organic matter. However, conversely, polyphenolic extractive concentration may decline with time, through leaching, which can reduce durability in some species. Thus, we investigated the rates of loss for pre-aged oak, which had been naturally decomposing where it fell for >5 yr. Exposed oak lost 9% y−1 (0.90 g y−1) of its mass, compared with 1% y−1 (0.13 g y−1) for that inserted into mesotrophic peat (Fig. ). For the non-aged oak inserted into the same peat type (Fig. ), the rate of loss is also 1% y−1 (0.16 g y−1), suggesting that peat preserves oak irrespective of age. Pre-aged oak also significantly reduced GWP, even during drought (Fig. ), suggesting that protective effects on the host peat carbon stock are likely to last in the medium to long term.

Preservation of pre-aged oak in peat and its effect on GHG fluxes.

a,b, Effects of inserting pre-aged oak into mesotrophic peat over 3 yr on mass loss (86% reduction compared with exposed wood: T = 3.69, P = 0.014) (a), and contributions of GHG species to GWP ((CO2e) 26% reduction: T = 11.28, P = 0.000)) showing greater effect of wood in drought (simulated 1 per 100 yr severe drought, 60 d duration, water table 30 cm below surface) compared with the control (55%, T = 7.46, P = 0.001) (b). n = 6 mesotrophic plant–peat mesocosms; error bars denote s.e.m.

Hydrological legacy

Evidence suggests that long-term hydrological regime affects the response of peatlands to drought via the kinetics of phenolic inhibition. Therefore, we tested whether wood supplements had the same effect using peat from a ‘natural laboratory’, which included four hydrological regimes (or drought sensitivities): waterlogged pristine, increased moderate drought frequency, drainage, and drainage with rewetting. Overall, there was a 50% difference due to oak addition for the pristine peat (Fig. ), with GWP in the drought phase under wood treatment being similar to the control under waterlogged conditions. In the case of N2O contributions, these shifted from a source to a sink because of wood supplements. Similar effects were seen for the moderate drought site (41%, P = 0.05), and while the drained and rewetted sites showed a lower magnitude of effect, this was still substantial (25%, P = 0.001 and 30%, P = 0.005, respectively), suggesting that the treatment also could benefit degraded and restored peatlands, irrespective of hydrological legacy.

Oak additions reduce the impacts of drought and drainage on peatland carbon losses.

a, Effects of in situ oak supplementation within oligotrophic pristine peat on GHG species contributions to GWP over 3 yr and during drought (simulated 1 per 100 yr severe drought, 60 d duration, water table 30 cm below surface). Overall, there was a 50% difference and in the drought phase, 47% (T = 6.89, P = 0.001 and T = 5.40, P = 0.003, respectively), due to treatment. b, Comparison of pristine (waterlogged Sphagnum-dominated) and drained (shrubby) peatland leachable polyphenolics before and after the 2006 severe natural drought (1 per 100 yr), showing higher levels of polyphenolics in the drained site and as a result of drought in both systems. Before drought, concentrations were 31.3% higher in the drained site (T = −3.39, P = 0.043); for the severe drought year, there was an 8.4% difference (T = −2.31, P = 0.033). c, Comparison of Sphagnum-dominated and shrubby peatland GWP (in CO2e) over 5 yr (100%, T = 3.07, P = 0.037). Pristine sites were dominated by Sphagnum species and Juncus effusus (80% and 20%, respectively), while the drained site was of mixed composition (grass species, 30%; Polytrichum commune, 20%; Sphagnum species, 20%; shrubs, 20%; bare peat, 10%). Negative fluxes represent uptake from the atmosphere. Five in situ sampling stations were used per peatland type; error bars denote s.e.m.

Naturally wooded systems

If leached wood polyphenolics protect the host peat carbon stock against drought effects, then naturally shrubby or forested peatlands might be expected to be particularly resistant to drought. Recent evidence from US Pocosin systems supports this, suggesting that these systems can exist with unusually low water tables due to an accumulation of polyphenolics from woody shrubs over millennia. Thus, we investigated the effect of a shift from Sphagnum–Juncus communities to woody shrubs (Erica and Calluna) as a result of drainage in an upland UK system. Leachable polyphenolic levels increased (31%, Fig. ) despite a relatively short period of effect and mixed plant community composition (20% shrubs), in line with findings that polyphenolics increase with the expansion of shrubs in European peat. A 1 per 100 yr natural drought also increased polyphenolics in both systems (Fig. ), in line with complex limitations on decomposition, rather than just oxygen,,, such as moisture stress, pH,, and litter type,. A large and significant GWP saving was also found under the shrubby peatland systems here (Fig. ), suggesting there is a protection mechanism preventing carbon stocks from disappearing as CO2. Indeed, Laiho et al, working on Scots pine (Pinus sylvestris) litter, found that long-term forestry drainage does not increase decomposition of fresh organic matter, and moderate drainage actually increased carbon sequestration in alder carr peatlands.

Mechanisms inhibiting decomposition

Four non-mutually exclusive mechanisms are proposed to account for the antimicrobial properties of polyphenolics (particularly tannins) in the literature: (1) inhibition of extracellular enzyme activities, (2) deprivation of substrates required for growth, (3) direct inhibition of microbial metabolism and (4) iron deprivation–.

Inhibition of extracellular enzyme activities

A suppression of all extracellular enzymes activities involved in carbon and nitrogen cycles was observed (Supplementary Table and Supplementary Text ), consistent with the main mechanism of antimicrobial action proposed in the literature, that is, inactivation via protein precipitation and competitive inhibition,–. In line with the increased effect on decomposition during drought, the majority of enzymes were suppressed to a greater degree. Extracellular phenol oxidase showed the largest inhibition, 58% during drought (33% overall) with NAGase being inhibited by 52% under drought, the latter showing the largest inhibition of all the biological indices measured overall (47%).

Deprivation of substrates required for growth

In addition to DOC (Supplementary Table ), DON concentrations in the pore waters were particularly affected (−36%, P = 0.044), and polyphenolics have been reported to protect polymeric substrates from decomposition more efficiently via complexation mechanisms than those of low molecular weight (for example, peptides and amino acids) due to differences in affinity. However, ammonium was also significantly reduced (17%). Given the particularly low inorganic ***nutrient*** concentrations in ombrotrophic peatland systems (Supplementary Tables and ), where DON is likely to be a major N source for microbial growth, this may explain the particularly efficient sequestration and protection of host ecosystem soil carbon in such bogs, especially when combined with tanning effects. The potential for reduced primary production in the long term as a result of supplementation requires further research (Supplementary Text ).

Direct inhibition of microbial metabolism

Intracellular indices were also inhibited, suggesting that polyphenolics are acting on microbial metabolism directly (for example, through oxidative phosphorylation). Bacterial growth rates were 37% lower and intracellular C23O (catechol 2,3-dioxygenase, a key enzyme in lignin degradation) activities were inhibited by 40% overall (Supplementary Table ).

Iron deprivation

Wood treatments appeared to induce iron deficiency with concentrations being lowered by 28% overall (Supplementary Table ). In ***nutrient***-poor wetlands, ferrous iron (Fe2+) has long been known to stimulate decomposition. Many types of phenol oxidases synthesised by both bacteria and fungi contain Fe2+ in their haem complex, and this, together with H2O2, generates OH radicals representing a strong polyphenolic oxidizing agent, particularly in drought conditions (known as the Fenton reaction). Tannin has also been reported to bind manganese, which is also used in certain phenol oxidases, with oxidation of Mn2+ forming H2O2 and, hence, strongly catalysing oxidation of phenolics. Thus, polyphenolics apparently have broad ‘metal scavenging’ effects, potentially inhibiting both intracellular and extracellular metabolism.

Protection of host ecosystem soil carbon during drought

The preceding evidence suggests that all four mechanisms are contributing to the inhibitory effect of wood treatments. These mechanisms are likely to be inextricably linked, rather than additive, and we discuss this as a ‘quadruple lock’ on peat decomposition. For example, inhibited extracellular enzymes would lead to deprivation of substrates required for microbial growth, and direct effects on microbial metabolism could reduce de novo enzyme synthesis, reducing ***nutrient*** acquisition further. If we assume that abundance of microbes is an integrated measure of inhibitory effects on all metabolic pathways, this also suggests suppression (20% across morphotypes (for example, cocci (spherical-shaped cells), bacillus (rod-shaped cells) and spirochaetes (spiral-shaped cells)); Supplementary Table and Supplementary Text ).

The effect of wood additions was most pronounced under drought conditions for most enzymes (Supplementary Table ), and this could relate to the fact that phenolic compound oxidation increases enzyme inhibition, by both higher molecular weight substances (such as tannic acid, that is, polyphenolics) and lower molecular weight phenols (present in the peat as intermediates from polyphenolic degradation, for example, catechol, protocatechuic acid or caffeic acid). This has been attributed to oxidized phenols reacting with an enzyme’s sulfhydryl groups to form covalent linkages and/or oxidative polymerization, causing an increase in molecular weight, thereby enhancing protein binding through non-covalent bonds. Indeed, the higher the molecular weight, the more inhibitory phenolic compounds are found to be in peatlands. The latter would also explain the greater effect on DON concentrations and iron scavenging, with both mechanisms having knock-on effects for ***nutrient*** acquisition and bacterial growth and proliferation (Supplementary Table ). New evidence also suggests that drought causes the oxidation of soluble Fe2+ to less-soluble Fe3+ and that this may reduce activities of both oxidative and hydrolytic enzymes, thereby counteracting the ‘enzymic latch’ and enhancing carbon preservation.

Similar effects were found using in vitro leachate additions from a suite of wood types and tannic acid (Supplementary Table and Supplementary Text ). However, more research is needed on their potential as a substitute for wood amendments.

Carbon sequestration and ecosystem restoration applications

Taken together, our results suggest that forest carbon capture combined with peatland storage could improve protection of host ecosystem soil carbon stock, even during drought. We attribute this to the extra polyphenols that wood releases and their quadruple lock on decomposition. However, while the results appear to hold across the UK peatlands and small-scale incubations here, demonstrating scalability via large-scale studies across a latitudinal gradient would be prudent before considering these mechanisms in geoengineering strategies.

Geoengineering pristine systems (for example, Sphagnum peatlands covering 3.8 million–4.1 million km (refs. ,), Supplementary Text ) would be controversial, and the economic and carbon costs of upscaling the strategies described here (for example, transporting and inserting supplements) may be prohibitive in remote locations. However, degraded sites are extensive and inherently more accessible; globally, 15% of all peatlands (500,000 km2) are considered degraded (50.9 Mha) (ref. ) and 80,000 km2 are drained. Leifeld and Menichetti called for mitigation via peatland rehabilitation because emissions could be reduced by 0.3–3.4 GtCO2e while using 3.4 times less nitrogen and a smaller land area than other techniques. Our ***data*** suggest that drained and rewetted peat behaves similarly to pristine peat and could, therefore, be supplemented to save double this (Supplementary Table ). Peatland restoration combined with supplementation could thus re-establish and enhance ecosystem function. We propose that restoration and conservation policymakers consider supplementation because peatland rewetting alone can cause increased GHG and ***nutrient*** release, representing a eutrophication risk for receiving aquatic systems.

The evidence from boreal and temperate peatlands studied here suggests that wood supplementation may harness natural ecosystem drought-resistance mechanisms and warrants research as an approach to offset rising CO2 that does not risk collateral damage. However, it also offers a potential route to stabilization of carbon stores via ecological engineering, whereby shrub and tree encroachment is encouraged (for example, by planting, herbivore exclusion or water table management), to create drought-resistant ecosystems. This would also circumvent the need to transport supplements and the disturbance due to wood insertion (Supplementary text ). Indeed, where sufficient ***nutrients*** are available to sustain woody vegetation, natural succession will often occur from Sphagnum-dominated mire to shrubby and wooded heath communities, and with climate change, arboreal peatlands are likely to expand.

We propose the following priorities to understand whether these approaches could be upscaled: (1) screening wood types for optimal carbon sequestration and ecosystem soil carbon protection, (2) determining whether supplements can protect against droughts across temporal and spatial scales and across peatland types, (3) investigating the viability of supplementation across terrain types and (4) researching the potential for using industrial polyphenolic waste products. Furthermore, given the extent of drained peat and increasing demand for food and energy, both geological and ecological approaches probably need to be embedded into strategies that sustainably use and profit from restored peatlands by encouraging peat formation and production of renewable resources, that is, ‘paludiculture’ (including crops for food, construction and energy,,,). Thus, we encourage research into ‘geo-paludiculture’ (Supplementary Text ), which may hold potential for harnessing natural resilience mechanisms in waterlogged ***agriculture***,,–.

Methods

Site descriptions

Site characteristics (Supplementary Table ) are described by Fenner and Freeman, but briefly, the ombrotrophic site (site 1) is represented by the upland Migneint bog complex and contains ombrotrophic areas fed only by rainfall with an acidic pH (4.0) and oligotrophic areas where the pH is slightly less acidic (4.2) due to water inputs from the surrounding land as well as rainfall. The water table is high (at the surface, that is, 0 cm, to 5 cm below the surface of the peat). The vegetation is dominated by Sphagnum species (S. subnitens, S. capillifolium), and the peat type is hemist. Organic matter (OM) content is 99%, and bulk density is 0.05 g cm−3. The oligotrophic peat (site 2) also has a high water table (0 cm on average) with an average pH of 4.8. and is generally characterized by S. subnitens and J. effusus with a hemist texture, OM content of 95% and bulk density of 0.06 g cm−3. Mesotrophic peat was ***collected*** from a calcareous lowland fen (site 3) with a pH of ~6.0 and water table between 0 and −10 cm. Vegetation is diverse but dominated by J. acutiflorus and Festca rubra. The peat type is fibrist with an OM content of 94% and bulk density of 0.08 g cm−3. Eutrophic peat was ***collected*** from a minerotrophic riparian wetland (site 4) draining farmland in a U-shaped valley carved out by glaciers in the last Ice Age. The pH is 5.1, and the site is waterlogged (water table 0 cm). Dominant vegetation is S. recurvum, J. effusus and Polytrichum species with additional macrophytes, and the peat is classified as fibrist. OM content is 90%, and bulk density is 0.16 g cm−3.

Determining the stability of exogenous carbon in peat

To investigate the stability of wood (1) when inserted into peat compared with that exposed on the peat surface and (2) as a result of changes in redox potential of the peat during drought (anaerobic–aerobic–anaerobic sequence), we used a controlled in vitro microcosm approach (50 cm3). Peat was ***collected*** from the biologically active surface layer (acrotelm, site 1, Supplementary Table ) and green vegetation removed, with the remaining peat being gently homogenized to ensure differences were due to treatment rather than pre-existing heterogeneity. Uniform wood pieces (poplar and oak: 10 mm × 10 mm × 2 mm, ~121 mg dry weight; 10 units, 2 cm3) were soaked in site water and inserted 5 cm below the surface of the peat. For the first experiment, peat was maintained under field conditions (anaerobic with the water table at the surface), and the total incubation time was 60 d. For the second experiment, the incubation time was the same, but it included a 32 d aerobic phase after 14 d. Intensive aeration was carried out using compressed air, manifold units with flow regulation valves and flexible air lines (autoclavable to allow sterilization) connected to a pipette tip with an inline sterilizing air filter (Millipore 0.2 µm, autoclavable). Oxygen saturation was calibrated using an inline flow metre (Whatman).

Mass loss was calculated according to equation (), and for experiment 1, inserted versus exposed wood was compared. For experiment 2, mass loss in control (waterlogged) microcosms versus the simulated drought microcosms was measured. To investigate the potential for temperature- or ***nutrient***-mediated opening of the latch, we added phenol oxidase weekly in a parallel test within experiment 2:where m0 wood is the dry weight of the wood sample before incubation and md wood is the dry weight of the wood sample after incubation.

Investigations into durability and dosage were also carried out using standard tests. Dosage was investigated using 1, 5, 10 and 20 wood units (for example, 0.2, 1, 2, 4 cm3); it was found that low and intermediate doses (5–10 units of wood, 1–2 cm3) were generally optimal since disturbance effects begin to occur at high dosages. Standard timber durability tests were carried out at 25 °C and 65% relative humidity to confirm timber durability ratings (mass loss <6%, very durable; 5%–11%, durable; 10%–21%, fairly durable; >20%, little durable; >30%, non-durable). However, these rely on exposure to one fungal species (Coriolus versicolor) only, and wood degradation in waterlogged conditions is likely to be primarily due to bacteria.

Polyphenolic compounds were quantified colorimetrically at 750 nm on leachate water treated with alkali (NaCO3) and Folin–Ciocaltaeu reagent. Gases were ***collected*** using a closed chamber technique with CO2, CH4 and N2O concentrations analysed by gas chromatography (Varian model 450 gas chromatograph). Linearity of gas emissions was first determined by capping the in vitro systems, microcosms/mesocosms, or using chambers (in the case of in situ measurements) and removing gas samples after 0, 10, 20, 30, 60, 120, 240 min. The slope of the regression (R2 > 0.99, P < 0.01) between concentration and time and increase in concentration (above initial background concentrations) were used to estimate ‘net’ fluxes (accounting for photosynthesis). GWP was calculated by summing all gases converted to CO2e (see ***Statistics*** and calculations). Water content was determined gravimetrically. Plastic controls were included to account for any potential physical disturbance effects due to treatment but showed negligible contributions (for example, Supplementary Fig. ).

Effects of peat type on exogenous carbon stability

Intact plant–peat monoliths in 11 cm × 40 cm deep (3,802 cm3) mesocosms were ***collected*** from sites 1–4. Monoliths were maintained under natural conditions (outdoor research compound) using site water. Severe drought manipulations involved water table lowering over 14 d to 30 cm (maximum) below the surface, followed by 60 d drought and 14 d rewet phases, mimicking the 2006 severe natural drought (1 in 100 yr) effects monitored in the field (natural laboratory), following 2 yr of waterlogged conditions (depth to water table 0–5 cm). Ten poplar wood pieces (160 mm × 40 mm × 3 mm; ~11 g dry weight; 192 cm3) were inserted vertically to 5 cm depth in the plant–peat monoliths, and mass loss and so on were determined as in the preceding.

Leachate DOC and DON were analysed using a total organic C analyser (Thermalox, Analytical Sciences). Isotopic signatures (δ13C and δ15N) were determined using an isotope ratio mass spectrometer (Hydra 20/20, SerCon) with solid (elemental analyser, Costech Instruments) and trace gas (gas chromatograph, SerCon) interfaces. Liquids (pore water or leachate for DOC and DON analysis) were first adsorbed to chromosorb (W 30–60 mesh acid washed, SerCon) and analysed as solids.

Pre-aged oak

Natural fallen oak (Quercus robur >5 yr on the surface of park grassland, Caernarfon, Wales) was inserted into mesocosms ***collected*** from site 3 (as in the preceding, Supplementary Table ).

Hydrological legacy

The effects of hydrological legacy on exogenous carbon stability were studied using the ‘natural laboratory’, along with the effects of a natural shift from Sphagnum to woody shrubs as a result of drainage. The site consists of four flush wetlands in a discontinuous serial cascade located within a mire peatland system in the Upper Wye catchment (Cerrig-yr-Wyn sub-catchment) on Plynlimon (mid-Wales, UK, National Grid reference SN 820 866; 52° 26’ N, 3° 55’ W), typical of many in the uplands of Wales. Different hydrological conditions can be applied to the various wetlands because of these discontinuities, giving a water table gradient (pristine waterlogged control > experimental summer drought > experimental rewetting > drained control) plus associated areas of similar characteristics.

The upper pair (site 2, Supplementary Table ) have a higher water table with an average pH of 4.8 in the pristine peatland (water table 0 cm on average) and 4.7 in the increased-drought-frequency peatland (water table 0 cm on average). The upper two wetlands are characterized by water tables at or near the surface for non-drought years but, for example, −15 cm for the moderate drought of 1995 and −30 cm for the severe drought of 2006.

The lower pair (experimental rewetting and drained control) have lower water tables (generally ranging from 49 cm to 9 cm below the surface of the peat in the drained wetland and between 16 cm and 1 cm in the rewetted system) and are more acidic, pH 4.4 and 4.5, respectively. Hydraulic recharge is from water sources deep within the peat profile rather than surface flow. During the flood year of 2000, the control water table ranged between −49 and −7 cm and the experimental site between −18 and 0 cm, while during the severe drought year of 2006 these figures were −71 to −27 cm and −58 to −11 cm in the control and rewetted wetlands, respectively.

The peat is generally characterized by J. effusus, J. acutiflorus and S. subnitens with a hemist texture, OM content of 95% and bulk density of 0.06 g cm−3. However, the lower pair are characterized by less Sphagnum cover and more vascular plant and shrub species (Erica tetralix and Calluna vulagris).

Mechanisms inhibiting decomposition

Polyphenolic concentrations, enzyme activities and growth rates were measured using routine techniques (). All enzyme activities were measured at field temperature and pH using 1 cm3 of peat. Phenol oxidase activities were measured using dihydroxy phenylalanine (L-DOPA) as the substrate, and extracellular hydrolase activities were measured using fluorogenic methylumbelliferyl (MUF) substrates. The protocols followed are detailed by Fenner et al. Briefly, 10 mM L-DOPA (Merck) and a homogenate of 1 cm3 of peat per 2 ml of ultrapure water was prepared using a low-intensity homogenizer (Stomacher, Seward Colworth, model 400). The homogenate was diluted 1/1 with ultrapure water, and 1 ml aliquots were transferred to 2.5 ml centrifuge tubes. Then 1 ml L-DOPA solution or ultrapure water (control) was added to each tube. The tubes were shaken and incubated at field temperature for 1 or 9 min followed by immediate centrifugation at 72,000g for 5 min. The absorbance was measured at 460 nm using a spectrophotometer. Original peat samples were dried to constant weight to determine the dry weight and OM content. Activity was expressed in terms of nanomoles 2,3-dihydroindole-5,6-quinone-2-carboxylate (diqc) min−1 g−1 peat. The difference in absorbance, as a result of the two incubation periods, was used to determine the rate of product formation. Intracellular phenol oxidase (C23O) activity was measured spectrophotometrically (375 nm) at pH 7.5 using catechol as the substrate and detecting the product muconic semialdehyde.

Peat extracellular hydrolase activities were measured fluorimetrically: 2 ml of Methylcellosolve (2-ethoxyethanol (ethylene glycol monoethyl ether) Merck) was used to pre-dissolve all substrates. Then 1 cm3 of peat was gently homogenized for 30 s with 1 ml of ultrapure water. To 1 ml of this peat slurry, 3.5 ml of either 500 mM MUF-ß-D-glucoside, 1,000 mM MUF-phosphate or 1,000 mM MUF-sulphate substrate solution (Merck) was added. These concentrations were above the concentration at which substrate availability limits activity but below the concentration at which substrate inhibition occurs. The samples were mixed and allowed to incubate for 1 h at field temperature, except for those peats where phosphatase was very active, in which case the incubation time was reduced to 45 min. Samples (1.5 ml) were then centrifuged at 72,000g for 5 min. A range of standard concentrations of MUF free acid (Merck), within the range of the peat activities, was made up in the sample matrix (that is, slurry incubated under identical conditions as those described in the preceding, except for the substrates). Saturation concentrations for the assay were established by varying concentrations of MUF substrate (0–4 mM) added to samples. A luminescence spectrometer (Perkin–Elmer LS50) was used to determine fluorescence, at 450 nm emission and 330 nm excitation (slit setting 1), immediately after centrifugation.

Bacterial growth rates were estimated using incorporation of 3H into bacterial extractions from 1–3 g of peat and 40 ml of ultrapure water according to ref. . Extractions were performed on a shaker for 15 min using 40 ml of ultrapure water. A sample of 1–3 g was optimal (>75% extraction efficiency). Washed glass wool was used to remove remaining floating organic debris following centrifugation to separate cells from organic matter. [Methyl-3H]TdR (925 GBq mmol−1, Amersham) was added to 2 ml of bacterial suspension, giving a final concentration of 100 nM. Zero-time controls were included to determine the level of non-specific labelling in each case. All samples were read on a Wallac (Winspectal 1414) scintillation counter.

‘Follow-up’ in vitro leachate and tannic acid additions

The effects of adding polyphenolics leached from the chips of poplar (Liriodendron tulipifera), oak (Quercus robur), alder (Alnus glutinosa) and black locust (Robinia pseudoacacia; very durable under waterlogged conditions), sapele (Entandrophragma cylindricum; tropical African distribution) and tannic acid (across a range of concentrations; Merck) was investigated in vitro using peat from site 1 (Supplementary Table ) to better understand potential mechanisms and viability for geoengineering techniques. Leachate was ***collected*** from wood chips incubated in ultrapure water for 12 months and added to 30 cm3 of peat in 50 cm3 microcosms. Tannic acid (10 mg l−1, gallotannin, tannin, MW = 1,701.20, Merck) treatments used concentrations matched to that of the natural leachates measured from wood additions (Supplementary Table ) and were chosen due to the considerable literature suggesting that tannic acid is primarily responsible for antimicrobial effects and because it is commercially available. Control microcosms consisted of ultrapure water added to peat. The focus was on N levels, since NAGase along with N2O showed the highest suppression, and iron, because phenol oxidases rely on it for their activity, with these enzymes being most affected (extracellular phenol oxidase and intracellular C23O).

‘Knock-out’ procedures, used to disentangle, for example, effects on pre-existing extracellular enzyme activities compared with de novo synthesis (described in ref. ), confirmed that all four proposed mechanisms of antimicrobial activity and toxicity were likely to contribute to the properties conferred on the host peat and again were enhanced under oxygenation.

***Statistics*** and calculations

Minitab (version 17) was used for all statistical investigations. ***Data*** were first tested for normality and equality of variance before paired T tests, ANOVA or regression analysis was done. For in vitro work, averages for distinct periods were calculated, for example, aerobic phase or anaerobic phase for control versus wood treatments. Similarly, for the mesocosms, averages for distinct periods were calculated, and paired T tests were used. ANOVA (GLM; ANOVA) was used to determine whether supplements induced a significant effect at each trophic level overall or during the drought phase. Paired T tests were used to determine significance at each trophic level, both overall and under drought conditions within trophic systems and across systems (that is, using all ***data*** with a comparison between treatments and control). Regression analysis using categorical predictor coding was used to investigate relationships between trophic level and determinands for control and wood-treated mesocosms, both overall and for the drought phase. GLM ANOVA with treatment and trophic level as the model was used to determine that interactions were additive rather than synergistic.

For the hydrological legacy work, mesocosms (n = 5) taken from within each peatland type were used as replicates, and paired T tests were used as in the preceding. The effect of treatment was confirmed at site 2 (Supplementary Table ) in situ, as were the effects of shifts in vegetation as a result of drainage.

We adopted GHG emission factors from ref. by including CO2, CH4 and N2O, but not DOC, due to the large uncertainty in downstream reactions. GWP refers to the 100 yr time horizon. The saving in GWP of 0.9 × 1015 g y−1 to 1.0 × 1015 g y−1 CO2e was based on the in situ study (site 2, Supplementary Table ). It was determined by summing the three GHG species (average over 3 yr in CO2e) expressed in g km−2 y−1 (that is, 9.41E + 08 and 4.57E + 08 for control and wood addition, respectively) then multiplying the saving in GWP (that is, the difference) by 3.8 million and 4.1 million to find the range depending on area of peatlands used (3.8 million km2 lower, 4.1 million km2 upper), then assuming that half this area might be accessible for wood supplementation.

Online content

Any methods, additional references, Nature Research reporting summaries, source ***data***, extended ***data***, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of ***data*** and code availability are available at [*https://doi.org/10.1038/s41558-020-0727-y*](https://doi.org/10.1038/s41558-020-0727-y).

**Acknowledgements**

We thank the NERC, the Leverhulme Trust and the Royal Society for funding this research. We also thank S. Hughes of the Centre for Ecology and Hydrology for providing ***data*** and field assistance.

**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s41558-020-0727-y.Peer*](https://doi.org/10.1038/s41558-020-0727-y.Peer) review informationNature Climate Change thanks Tim Moore, Hongjun Wang and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***Council of the European Union: COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A new Circular Economy Action Plan "For a cleaner and more competitive Europe" PDF document ST 6766 2020 INIT11-03-2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YDF-TJP1-JDG9-Y15M-00000-00&context=1516831)

Impact News Service

March 12, 2020 Thursday

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**Length:** 9838 words

**Body**

Brussels: Council of the European Union has issued the following document:

6766/20 KS/mbTREE.1.A ENCouncil of theEuropean UnionBrussels, 11 March 2020(OR. en)6766/20ENV 168COMPET 115AGRI 88TRANS 113MI 72IND 32CONSOM 54ECOFIN 182ENER 82RECH 97SAN 88MARE 2SOC 144CHIMIE 7ENT 33COVER NOTEFrom: Secretary-General of the European Commission,signed by Mr Jordi AYET PUIGARNAU, Directordate of receipt: 11 March 2020To: Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council ofthe European UnionNo. Cion doc.: COM(2020) 98 finalSubject: COMMUNICATION FROM THE COMMISSION TO THE EUROPEANPARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC ANDSOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONSA new Circular Economy Action Plan 'For a cleaner and more competitiveEurope'Delegations will find attached document COM(2020) 98 final.Encl.: COM(2020) 98 finalEN ENEUROPEANCOMMISSIONBrussels, 11.3.2020COM(2020) 98 finalCOMMUNICATION FROM THE COMMISSION TO THE EUROPEANPARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIALCOMMITTEE AND THE COMMITTEE OF THE REGIONSA new Circular Economy Action PlanFor a cleaner and more competitive Europe1CONTENTS1. 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Global consumption of materials such as biomass, fossil fuels, metals and minerals is expected to double in the next forty years2, while annual waste generation is projected to increase by 70% by 20503.As half of total greenhouse gas emissions and more than 90% of biodiversity loss and water stress come from resource extraction and processing, the European Green Deal4 launched a concerted strategy for a climate-neutral, resource-efficient and competitive economy. Scaling up the circular economy from front-runners to the mainstream economic players will make a decisive contribution to achieving climate neutrality by 2050 and decoupling economic growth from resource use, while ensuring the long-term competitiveness of the EU and leaving no one behind.To fulfil this ambition, the EU needs to accelerate the transition towards a regenerative growth model that gives back to the planet more than it takes, advance towards keeping its resource consumption within planetary boundaries, and therefore strive to reduce its consumption footprint and double its circular material use rate in the coming decade.For business, working together on creating the framework for sustainable products will provide new opportunities in the EU and beyond. This progressive, yet irreversible transition to a sustainable economic system is an indispensable part of the new EU industrial strategy. A recent study estimates that applying circular economy principles across the EU economy has the potential to increase EU GDP by an additional 0.5% by 2030 creating around 700 000 new jobs5. There is a clear business case for individual companies too: since manufacturing firms in the EU spend on average about 40% on materials, closed loop models can increase their profitability, while sheltering them from resource price fluctuations.Building on the single market and the potential of digital technologies, the circular economy can strengthen the EU’s industrial base and foster business creation and entrepreneurship among SMEs. Innovative models based on a closer relationship with customers, mass customisation, the sharing and collaborative economy, and powered by digital technologies, such as the internet of things, big ***data***, blockchain and artificial intelligence, will not only accelerate circularity but also the dematerialisation of our economy and make Europe less dependent on primary materials.For citizens, the circular economy will provide high-quality, functional and safe products, which are efficient and affordable, last longer and are designed for reuse, repair, and high-quality recycling. A whole new range of sustainable services, product-as-service models and digital solutions will bring about a better quality of life, innovative jobs and upgraded knowledge and skills.This Circular Economy Action Plan provides a future-oriented agenda for achieving a cleaner and more competitive Europe in co-creation with economic actors, consumers, citizens and civil society organisations. It aims at accelerating the1 [*https://www.un.org/sustainabledevelopment/sustainable-consumption-production/2*](https://www.un.org/sustainabledevelopment/sustainable-consumption-production/2) OECD (2018), Global Material Resources Outlook to 2060.3 World Bank (2018), What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050.4 COM(2019) 640 final.5 Cambridge Econometrics, Trinomics, and ICF (2018), Impacts of circular economy policies on the labour market.3transformational change required by the European Green Deal, while building on circular economy actions implemented since 20156. This plan will ensure that the regulatory framework is streamlined and made fit for a sustainable future, that the new opportunities from the transition are maximised, while minimising burdens on people and businesses.The plan presents a set of interrelated initiatives to establish a strong and coherent product policy framework that will make sustainable products, services and business models the norm and transform consumption patterns so that no waste is produced in the first place. This product policy framework will be progressively rolled out, while key product value chains will be addressed as a matter of priority. Further measures will be put in place to reduce waste and ensure that the EU has a well-functioning internal market for high quality secondary raw materials. The capacity of the EU to take responsibility for its waste will be also strengthened.Europe will not achieve transformative change by acting alone. The EU will continue to lead the way to a circular economy at the global level7 and use its influence, expertise and financial resources to implement the 2030 Sustainable Development Goals. This plan aims also at ensuring that the circular economy works for people, regions and cities, fully contributes to climate neutrality and harnesses the potential of research, innovation and digitalisation. It foresees the further development of a sound monitoring framework contributing to measuring well-being beyond GDP.2. A SUSTAINABLE PRODUCT POLICY FRAMEWORK2.1 Designing sustainable productsWhile up to 80% of products’ environmental impacts are determined at the design phase8, the linear pattern of “take-make-use-dispose” does not provide producers with sufficient incentives to make their products more circular. Many products break down too quickly, cannot be easily reused, repaired or recycled, and many are made for single use only. At the same time, the single market provides a critical mass enabling the EU to set global standards in product sustainability and to influence product design and value chain management worldwide.EU initiatives and legislation already address to a certain extent sustainability aspects of products, either on a mandatory or voluntary basis. Notably, the Ecodesign Directive9 successfully regulates energy efficiency and some circularity features of energy-related products. At the same time, instruments such as the EU Ecolabel10 or the EU green public procurement (GPP) criteria11 are broader in scope but have reduced impact due to the limitations of voluntary approaches. In fact, there is no comprehensive set of requirements to ensure that all products placed on the EU market become increasingly sustainable and stand the test of circularity.In order to make products fit for a climate-neutral, resource-efficient and circular economy, reduce waste and ensure that the performance of front-runners in sustainability6 COM(2015) 614 final.7 SWD(2020) 100.8   [*https://op.europa.eu/en/publication-detail/-/publication/4d42d597-4f92-4498-8e1d-857cc157e6db9*](https://op.europa.eu/en/publication-detail/-/publication/4d42d597-4f92-4498-8e1d-857cc157e6db9) Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, OJ L 285, 31.10.2009, p. 10.10 Regulation (EC) No 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel, OJ L 27, 30.1.2010, p. 1.11   [*https://ec.europa.eu/environment/gpp/eu\_gpp\_criteria\_en.htm4progressively*](https://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm4progressively) becomes the norm, the Commission will propose a sustainable product policy legislative initiative.The core of this legislative initiative will be to widen the Ecodesign Directive beyond energy-related products so as to make the Ecodesign framework applicable to the broadest possible range of products and make it deliver on circularity.As part of this legislative initiative, and, where appropriate, through complementary legislative proposals, the Commission will consider establishing sustainability principles and other appropriate ways to regulate the following aspects:• improving product durability, reusability, upgradability and reparability, addressing the presence of hazardous chemicals in products, and increasing their energy and resource efficiency;• increasing recycled content in products, while ensuring their performance and safety;• enabling remanufacturing and high-quality recycling;• reducing carbon and environmental footprints;• restricting single-use and countering premature obsolescence;• introducing a ban on the destruction of unsold durable goods;• incentivising product-as-a-service or other models where producers keep the ownership of the product or the responsibility for its performance throughout its lifecycle;• mobilising the potential of digitalisation of product information, including solutions such as digital passports, tagging and watermarks;• rewarding products based on their different sustainability performance, including by linking high performance levels to incentives.Priority will be given to addressing product groups identified in the context of the value chains featuring in this Action Plan, such as electronics, ICT and textiles but also furniture and high impact intermediary products such as steel, cement and chemicals. Further product groups will be identified based on their environmental impact and circularity potential.This legislative initiative and any other complementary regulatory or voluntary approaches will be developed in a way to improve the coherence with existing instruments regulating products along various phases of their life cycle. It is the intention of the Commission that the product sustainability principles will guide broader policy and legislative developments in the future. The Commission will also increase the effectiveness of the current Ecodesign framework for energy-related products, including by swiftly adopting and implementing a new Ecodesign and Energy Labelling Working Plan 2020-2024 for individual product groups.The review of the Ecodesign Directive as well as further work on specific product groups, under the Ecodesign framework or in the context of other instruments, will build, where appropriate, on criteria and rules established under the EU Ecolabel Regulation, the Product Environmental Footprint approach12 and the EU GPP criteria. The Commission will consider the introduction of mandatory requirements to increase the12   [*https://ec.europa.eu/environment/eussd/smgp/PEFCR\_OEFSR\_en.htm5sustainability*](https://ec.europa.eu/environment/eussd/smgp/PEFCR_OEFSR_en.htm5sustainability) not only of goods, but also of services. The possibility to introduce requirements linked to environmental and social aspects along the value chain, from production through use to end of life, will also be carefully assessed, including in the context of WTO rules. For instance, ensuring the accessibility of certain products and services13 next to contributing to social inclusion can have the added benefit of increasing product durability and reusability.Furthermore, to support the effective and efficient application of the new sustainable product framework, the Commission will:• establish a common European Dataspace for Smart Circular Applications14 with ***data*** on value chains and product information;• step up efforts, in cooperation with national authorities, on enforcement of applicable sustainability requirements for products placed on the EU market, in particular through concerted inspections and market surveillance actions.2.2 Empowering consumers and public buyersEmpowering consumers and providing them with cost-saving opportunities is a key building block of the sustainable product policy framework. To enhance the participation of consumers in the circular economy, the Commission will propose a revision of EU consumer law to ensure that consumers receive trustworthy and relevant information on products at the point of sale, including on their lifespan and on the availability of repair services, spare parts and repair manuals. The Commission will also consider further strengthening consumer protection against green washing and premature obsolescence, setting minimum requirements for sustainability labels/logos and for information tools.In addition, the Commission will work towards establishing a new ‘right to repair’ and consider new horizontal material rights for consumers for instance as regards availability of spare parts or access to repair and, in the case of ICT and electronics, to upgrading services. Regarding the role that guarantees can play in providing more circular products, the Commission will explore possible changes also in the context of the review of Directive 2019/77115.The Commission will also propose that companies substantiate their environmental claims using Product and Organisation Environmental Footprint methods. The Commission will test the integration of these methods in the EU Ecolabel and include more systematically durability, recyclability and recycled content in the EU Ecolabel criteria.Public authorities’ purchasing power represents 14% of EU GDP and can serve as a powerful driver of the demand for sustainable products. To tap into this potential, the Commission will propose minimum mandatory green public procurement (GPP) criteria and targets in sectoral legislation and phase in compulsory reporting to monitor the uptake of Green Public Procurement (GPP) without creating unjustified administrative burden for public buyers. Furthermore, the Commission will continue to13 Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services, OJ L 151, 7.6.2019, p. 70.14 COM (2020) 67 final.15 Directive (EU) 2019/771/EC of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the sale of goods, OJ L 136, 22.5.2019, p. 28.6support capacity building with guidance, training and dissemination of good practices and encouraging public buyers to take part in a “Public Buyers for Climate and Environment” initiative, which will facilitate exchanges among buyers committed to GPP implementation.2.3 Circularity in production processesCircularity is an essential part of a wider transformation of industry towards climate-neutrality and long-term competitiveness. It can deliver substantial material savings throughout value chains and production processes, generate extra value and unlock economic opportunities. In synergy with the objectives laid out in the Industrial Strategy16, the Commission will enable greater circularity in industry by:• assessing options for further promoting circularity in industrial processes in the context of the review of the Industrial Emissions Directive17, including the integration of circular economy practices in upcoming Best Available Techniques reference documents;• facilitating industrial symbiosis by developing an industry-led reporting and certification system, and enabling the implementation of industrial symbiosis;• supporting the sustainable and circular bio-based sector through the implementation of the Bioeconomy Action Plan18;• promoting the use of digital technologies for tracking, tracing and mapping of resources;• promoting the uptake of green technologies through a system of solid verification by registering the EU Environmental Technology Verification scheme as an EU certification mark.The new SME Strategy19 will foster circular industrial collaboration among SMEs building on training, advice under the Enterprise Europe Network on cluster collaboration, and on knowledge transfer via the European Resource Efficiency Knowledge Centre.3. KEY PRODUCT VALUE CHAINSThe sustainability challenge posed by key value chains requires urgent, comprehensive and coordinated actions, which will form an integral part of the sustainable product policy framework outlined in section 2. Those actions will contribute to the response to the climate emergency and will feed into the EU Industrial Strategy, as well as into the forthcoming biodiversity, Farm to Fork and forest strategies. As part of the governance of the sectorial actions, the Commission will cooperate closely with stakeholders in key value chains to identify barriers to the expansion of markets for circular products and ways to address those barriers.16 COM(2020) 102.17 Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control),OJ L 334, 17.12.2010, p. 17.18 COM(2018) 763 final.19 COM(2020) 103.73.1 Electronics and ICTElectrical and electronic equipment continues to be one of the fastest growing waste streams in the EU, with current annual growth rates of 2%. It is estimated that less than 40% of electronic waste is recycled in the EU20. Value is lost when fully or partially functional products are discarded because they are not reparable, the battery cannot be replaced, the software is no longer supported, or materials incorporated in devices are not recovered. About two in three Europeans would like to keep using their current digital devices for longer, provided performance is not significantly affected21.To address these challenges, the Commission will present a ‘Circular Electronics Initiative’ mobilising existing and new instruments. In line with the new sustainable products policy framework, this initiative will promote longer product lifetimes and include, among others, the following actions:• regulatory measures for electronics and ICT including mobile phones, tablets and laptops under the Ecodesign Directive so that devices are designed for energy efficiency and durability, reparability, upgradability, maintenance, reuse and recycling. The upcoming Ecodesign Working Plan will set out further details on this. Printers and consumables such as cartridges will also be covered unless the sector reaches an ambitious voluntary agreement within the next six months;• focus on electronics and ICT as a priority sector for implementing the ‘right to repair’, including a right to update obsolete software;• regulatory measures on chargers for mobile phones and similar devices, including the introduction of a common charger, improving the durability of charging cables, and incentives to decouple the purchase of chargers from the purchase of new devices;• improving the ***collection*** and treatment of waste electrical and electronic equipment22 including by exploring options for an EU-wide take back scheme to return or sell back old mobile phones, tablets and chargers;• review of EU rules on restrictions of hazardous substances in electrical and electronic equipment23 and provide guidance to improve coherence with relevant legislation, including REACH24 and Ecodesign.3.2 Batteries and vehiclesSustainable batteries and vehicles underpin the mobility of the future. To progress swiftly on enhancing the sustainability of the emerging battery value chain for electro-mobility and boost the circular potential of all batteries, this year the Commission will propose a new regulatory framework for batteries. This legislative proposal will build on the20   [*https://ec.europa.eu/****eurostat****/tgm/table.do?tab=table&init=1&language=en&pcode=t2020\_rt130&plugin=121*](https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_rt130&plugin=121) Special Eurobarometer 503, January 2020.22 Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE), OJ L 197, 24.7.2012, p. 38.23 Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment, OJ L 305, 21.11.2017, p. 8.24 Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and establishing a European Chemicals Agency, OJ L396, 30.12.2006, p. 1.8evaluation of the Batteries Directive25 and the work of the Batteries Alliance with the consideration of the following elements:• rules on recycled content and measures to improve the ***collection*** and recycling rates of all batteries, ensure the recovery of valuable materials and provide guidance to consumers;• addressing non-rechargeable batteries with a view to progressively phasing out their use where alternatives exists;• sustainability and transparency requirements for batteries taking account of, for instance, the carbon footprint of battery manufacturing, ethical sourcing of raw materials and security of supply, and facilitating reuse, repurposing and recycling.The Commission will also propose to revise the rules on end-of-life vehicles26 with a view to promoting more circular business models by linking design issues to end-of-life treatment, considering rules on mandatory recycled content for certain materials of components, and improving recycling efficiency. Moreover, the Commission will consider the most effective measures to ensure the ***collection*** and the environmentally sound treatment of waste oils.From a broader perspective, the forthcoming Comprehensive European Strategy on Sustainable and Smart Mobility will look into enhancing synergies with the circular economy transition, in particular by applying product-as-service solutions to reduce virgin material consumption, use sustainable alternative transport fuels, optimise infrastructure and vehicle use, increase occupancy rates and load factors, and eliminate waste and pollution.3.3 PackagingThe amount of materials used for packaging is growing continuously and in 2017 packaging waste in Europe reached a record – 173 kg per inhabitant, the highest level ever. In order to ensure that all packaging on the EU market is reusable or recyclable in an economically viable way by 2030, the Commission will review Directive 94/62/EC27 to reinforce the mandatory essential requirements for packaging to be allowed on the EU market and consider other measures, with a focus on:• reducing (over)packaging and packaging waste, including by setting targets and other waste prevention measures;• driving design for re-use and recyclability of packaging, including considering restrictions on the use of some packaging materials for certain applications, in particular where alternative reusable products or systems are possible or consumer goods can be handled safely without packaging;• considering reducing the complexity of packaging materials, including the number of materials and polymers used.25 Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC, OJ L 266, 26.9.2006, p. 1.26 Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles, OJ L 269, 21.10.2000, p. 34.27 European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, OJ L 365 31.12.1994, p. 10.9As part of the initiative to harmonise separate ***collection*** systems referred to in section 4.1, the Commission will assess the feasibility of EU-wide labelling that facilitates the correct separation of packaging waste at source.The Commission will also establish rules for the safe recycling into food contact materials of plastic materials other than PET.The Commission will also strictly monitor and support the implementation of the requirements of the Drinking Water Directive to make drinkable tap water accessible in public places, which will reduce dependence on bottled water and prevent packaging waste.3.4 PlasticsThe EU Strategy for Plastics in the Circular Economy28 has set in motion a comprehensive set of initiatives responding to a challenge of serious public concern. However, as consumption of plastics is expected to double in the coming 20 years, the Commission will take further targeted measures to address the sustainability challenges posed by this ubiquitous material and will continue to promote a concerted approach to tackle plastics pollution at global level as set out in section 7.To increase uptake of recycled plastics and contribute to the more sustainable use of plastics, the Commission will propose mandatory requirements for recycled content and waste reduction measures for key products such as packaging, construction materials and vehicles, also taking into account the activities of the Circular Plastics Alliance.In addition to measures to reduce plastic litter, the Commission will address the presence of microplastics in the environment by:• restricting intentionally added microplastics and tackling pellets taking into account the opinion of the European Chemicals Agency;• developing labelling, standardisation, certification and regulatory measures on unintentional release of microplastics, including measures to increase the capture of microplastics at all relevant stages of products’ lifecycle;• further developing and harmonising methods for measuring unintentionally released microplastics, especially from tyres and textiles, and delivering harmonised ***data*** on microplastics concentrations in seawater;• closing the gaps on scientific knowledge related to the risk and occurrence of microplastics in the environment, drinking water and foods.Furthermore, the Commission will address emerging sustainability challenges by developing a policy framework on:• sourcing, labelling and use of bio-based plastics, based on assessing where the use of bio-based feedstock results in genuine environmental benefits, going beyond reduction in using fossil resources;• use of biodegradable or compostable plastics, based on an assessment of the applications where such use can be beneficial to the environment, and of the criteria for such applications. It will aim to ensure that labelling a product as28 COM(2018) 28 final.10‘biodegradable’ or ‘compostable’ does not mislead consumers to dispose of it in a way that causes plastic littering or pollution due to unsuitable environmental conditions or insufficient time for degradation.The Commission will ensure the timely implementation of the new Directive on Single Use Plastic Products29 and fishing gear to address the problem of marine plastic pollution while safeguarding the single market, in particular with regard to:• harmonised interpretation of the products covered by the Directive;• labelling of products such as tobacco, beverage cups and wet wipes and ensuring the introduction of tethered caps for bottles to prevent littering;• developing for the first time rules on measuring recycled content in products.3.5 TextilesTextiles are the fourth highest-pressure category for the use of primary raw materials and water, after food, housing and transport, and fifth for GHG emissions30. It is estimated that less than 1% of all textiles worldwide are recycled into new textiles31. The EU textile sector, predominantly composed of SMEs, has started to recover after a long period of restructuring, while 60% by value of clothing in the EU is produced elsewhere.In the light of the complexity of the textile value chain, to respond to these challenges the Commission will propose a comprehensive EU Strategy for Textiles, based on input from industry and other stakeholders. The strategy will aim at strengthening industrial competitiveness and innovation in the sector, boosting the EU market for sustainable and circular textiles, including the market for textile reuse, addressing fast fashion and driving new business models. This will be achieved by a comprehensive set of measures, including:• applying the new sustainable product framework as set out in section 2 to textiles, including developing ecodesign measures to ensure that textile products are fit for circularity, ensuring the uptake of secondary raw materials, tackling the presence of hazardous chemicals, and empowering business and private consumers to choose sustainable textiles and have easy access to re-use and repair services;• improving the business and regulatory environment for sustainable and circular textiles in the EU, in particular by providing incentives and support to product-as-service models, circular materials and production processes, and increasing transparency through international cooperation;• providing guidance to achieve high levels of separate ***collection*** of textile waste, which Member States have to ensure by 2025;• boosting the sorting, re-use and recycling of textiles, including through innovation, encouraging industrial applications and regulatory measures such as extended producer responsibility.29 Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment, OJ L 155, 12.6.2019, p. 1.30 EEA Briefing report Nov 2019.31 Ellen McArthur Foundation (2017), A new Textiles Economy113.6 Construction and buildingsThe built environment has a significant impact on many sectors of the economy, on local jobs and quality of life. It requires vast amounts of resources and accounts for about 50% of all extracted material. The construction sector is responsible for over 35% of the EU’s total waste generation32. Greenhouse gas emissions from material extraction, manufacturing of construction products, construction and renovation of buildings are estimated at 5-12% of total national GHG emissions33. Greater material efficiency could save 80% of those emissions34.To exploit the potential for increasing material efficiency and reducing climate impacts, the Commission will launch a new comprehensive Strategy for a Sustainable Built Environment. This Strategy will ensure coherence across the relevant policy areas such as climate, energy and resource efficiency, management of construction and demolition waste, accessibility, digitalisation and skills. It will promote circularity principles throughout the lifecycle of buildings by:• addressing the sustainability performance of construction products in the context of the revision of the Construction Product Regulation35, including the possible introduction of recycled content requirements for certain construction products, taking into account their safety and functionality;• promoting measures to improve the durability and adaptability of built assets in line with the circular economy principles for buildings design36 and developing digital logbooks for buildings;• using Level(s)37 to integrate life cycle assessment in public procurement and the EU sustainable finance framework and exploring the appropriateness of setting of carbon reduction targets and the potential of carbon storage;• considering a revision of material recovery targets set in EU legislation for construction and demolition waste and its material-specific fractions;• promoting initiatives to reduce soil sealing, rehabilitate abandoned or contaminated brownfields and increase the safe, sustainable and circular use of excavated soils.Furthermore, the ‘Renovation Wave’ initiative announced in the European Green Deal to lead to significant improvements in energy efficiency in the EU will be implemented in line with circular economy principles, notably optimised lifecycle performance, and longer life expectancy of build assets. As part of the revision of the recovery targets for construction and demolition waste, the Commission will pay special attention to insulation materials, which generate a growing waste stream.32 ***Eurostat*** ***data*** for 2016.33   [*https://www.boverket.se/sv/byggande/hallbart-byggande-och-forvaltning/miljoindikatorer---aktuell-status/vaxthusgaser/34*](https://www.boverket.se/sv/byggande/hallbart-byggande-och-forvaltning/miljoindikatorer---aktuell-status/vaxthusgaser/34) Hertwich, E., Lifset, R., Pauliuk, S., Heeren, N., IRP, (2020), Resource Efficiency and Climate Change: Material Efficiency Strategies for a Low-Carbon Future.35 Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, OJ L 88, 4.4.2011, p. 5.36   [*https://ec.europa.eu/docsroom/documents/3998437*](https://ec.europa.eu/docsroom/documents/3998437)   [*https://ec.europa.eu/environment/eussd/buildings.htm123.7*](https://ec.europa.eu/environment/eussd/buildings.htm123.7) Food, water and nutrientsThe circular economy can significantly reduce the negative impacts of resource extraction and use on the environment and contribute to restoring biodiversity and natural capital in Europe. Biological resources are a key input to the economy of the EU and will play an even more important role in the future. The Commission will aim at ensuring the sustainability of renewable bio-based materials, including through actions following the Bioeconomy Strategy and Action Plan.While the food value chain is responsible for significant resource and environmental pressures, an estimated 20% of the total food produced is lost or wasted in the EU. Therefore, in line with the Sustainable Development Goals and as part of the review of Directive 2008/98/EC38 referred to in section 4.1, the Commission will propose a target on food waste reduction, as a key action under the forthcoming EU Farm-to-Fork Strategy, which will address comprehensively the food value chain.The Commission will also consider specific measures to increase the sustainability of food distribution and consumption. Under the sustainable products initiative, the Commission will launch the analytical work to determine the scope of a legislative initiative on reuse to substitute single-use packaging, tableware and cutlery by reusable products in food services.The new Water Reuse Regulation will encourage circular approaches to water reuse in ***agriculture***. The Commission will facilitate water reuse and efficiency, including in industrial processes.Furthermore, the Commission will develop an Integrated ***Nutrient*** Management Plan, with a view to ensuring more sustainable application of ***nutrients*** and stimulating the markets for recovered ***nutrients***. The Commission will also consider reviewing directives on wastewater treatment and sewage sludge and will assess natural means of ***nutrient*** removal such as algae.4. LESS WASTE, MORE VALUE4.1 Enhanced waste policy in support of waste prevention and circularityDespite efforts at EU and national level, the amount of waste generated is not going down. Annual waste generation from all economic activities in the EU amounts to 2.5 billion tonnes, or 5 tonnes per capita a year, and each citizen produces on average nearly half a tonne of municipal waste. The decoupling of waste generation from economic growth will require considerable effort across the whole value chain and in every home.Rolling out the sustainable product policy and translating it into specific legislation (see sections 2 and 3) will be key to making progress on waste prevention. In addition, we need to build on, further strengthen and better implement EU waste laws.EU waste laws have driven major improvements in waste management since the 1970s, supported by EU funds. However, they need to be modernised on an ongoing basis to make them fit for the circular economy and the digital age. As explained in section 3, revision of EU legislation on batteries, packaging, end-of-life vehicles, and hazardous substances in electronic equipment will be proposed with a view to38 Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, OJ L 312, 22.11.2008, p. 3.13preventing waste, increasing recycled content, promoting safer and cleaner waste streams, and ensuring high-quality recycling.In addition, the Commission will put forward waste reduction targets for specific streams as part of a broader set of measures on waste prevention in the context of a review of Directive 2008/98/EC. The Commission will also enhance the implementation of the recently adopted requirements for extended producer responsibility schemes, provide incentives and encourage sharing of information and good practices in waste recycling. All this shall serve the objective to significantly reduce total waste generation and halve the amount of residual (non-recycled) municipal waste by 2030.High quality recycling relies on effective separate ***collection*** of waste. To help citizens, businesses and public authorities better separate waste, the Commission will propose to harmonise separate waste ***collection*** systems. In particular, this proposal will address the most effective combinations of separate ***collection*** models, the density and accessibility of separate ***collection*** points, including in public spaces, taking account of regional and local conditions ranging from urban to outermost regions. Other aspects that facilitate consumer involvement will also be considered, such as common bin colours, harmonised symbols for key waste types, product labels, information campaigns and economic instruments. It would also seek standardisation and the use of quality management systems to assure the quality of the ***collected*** waste destined for use in products, and in particular as food contact material.Additional efforts are necessary to support the Member States in waste management. Half of them are at risk of non-compliance with the 2020 target to recycle 50% of municipal waste. To drive policy reforms, the Commission will organise high-level exchanges on the circular economy and waste and step up cooperation with Member States, regions and cities in making the best use of EU funds. Where necessary, the Commission will also use its enforcement powers.4.2 Enhancing circularity in a toxic-free environmentEU chemicals policy and legislation, in particular REACH, encourage a shift to ‘safe-by-design chemicals’ through the progressive substitution of hazardous substances to better protect citizens and the environment. However, the safety of secondary raw materials can still be compromised, for instance, where banned substances persist in recycled feedstock. To increase the confidence in using secondary raw materials, the Commission will:• support the development of solutions for high-quality sorting and removing contaminants from waste, including those resulting from incidental contamination;• develop methodologies to minimise the presence of substances that pose problems to heatlh or the environment in recycled materials and articles made thereof;• co-operate with industry to progressively develop harmonised systems to track and manage information on substances identified as being of very high concern and other relevant substances, in particular those with chronic effects39,39 As identified under Regulation (EC) 1907/2006 and Regulation (EC) 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures,14and substances posing technical problems for recovery operations present along supply chains, and identify those substances in waste, in synergy with measures under the sustainable products policy framework and with the ECHA Database on articles containing substances of very high concern;• propose amending the annexes to the Regulation on Persistent Organic Pollutants, in line with scientific and technical progress and the international obligations under the Stockholm Convention;• improve the classification and management of hazardous waste so as to maintain clean recycling streams, including through further alignment with the classification of chemical substances and mixtures where necessary.The forthcoming Chemicals Strategy for Sustainability will further address the interface between chemicals, products and waste legislation and strengthen synergies with the circular economy.4.3 Creating a well-functioning EU market for secondary raw materialsSecondary raw materials face a number of challenges in competing with primary raw materials for reasons not only related to their safety, but also to their performance, availability and cost. A number of actions foreseen in this Plan, notably introducing requirements for recycled content in products, will contribute to preventing a mismatch between supply and demand of secondary raw materials and ensure the smooth expansion of the recycling sector in the EU. Furthermore, to establish a well-functioning internal market for secondary raw materials the Commission will:• assess the scope to develop further EU-wide end-of-waste criteria for certain waste streams based on monitoring Member States’ application of the revised rules on end-of-waste status and by-products, and support cross-border initiatives for cooperation to harmonise national end-of-waste and by-product criteria;• enhance the role of standardisation based on the on-going assessment ofexisting standardisation work at national, European and international levels;• make timely use of the restrictions on the use of substances of very high concern in articles for cases where the use of the substance is subject to an authorisation requirement, while continuing to improve enforcement at borders;• assess the feasibility of establishing a market observatory for key secondary materials.4.4 Addressing waste exports from the EUThe global market for waste is undergoing considerable changes. In the past decade, millions of tonnes of European waste has been exported to non-EU countries, often without sufficient consideration of proper waste treatment. In many cases, waste exports result both in negative environmental and health impacts in the countries of destination, and in loss of resources and economic opportunities for the recycling industry in the EU. Recent import restrictions introduced by some third countries have exposed theamending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, OJ L 353, 31.12.2008, p. 1.15overdependence of the EU on foreign waste treatment, but they have also mobilised the recycling industry to increase its capacity and add value to waste in the EU.In the light of these developments, and considering that illegal shipments of waste remain a source of concern, the Commission will take action with the aim to ensure that the EU does not export its waste challenges to third countries. Actions on product design, quality and safety of secondary materials and enhancing their markets will contribute to making “recycled in the EU” a benchmark for qualititative secondary materials.Facilitating preparing for re-use and recycling of waste in the EU will be enhanced by a thorough review of EU rules on waste shipments40. The review will also aim at restricting exports of waste that have harmful environmental and health impacts in third countries or can be treated domestically within the EU by focusing on countries of destination, problematic waste streams, types of waste operations that are source of concern, and enforcement to counteract illegal shipments. The Commission will also support measures at multilateral, regional and bilateral levels to combat environmental crime notably in the areas of illegal exports and illicit trafficking, strengthen controls of shipments of waste, and improve the sustainable management of waste in these countries.5. MAKING CIRCULARITY WORK FOR PEOPLE, REGIONS AND CITIESBetween 2012 and 2018 the number of jobs linked to the circular economy in the EU grew by 5% to reach around 4 million41. Circularity can be expected to have a positive net effect on job creation provided that workers acquire the skills required by the green transition. The potential of the social economy, which is a pioneer in job creation linked to the circular economy, will be further leveraged by the mutual benefits of supporting the green transition and strengthening social inclusion, notably under the Action Plan to implement the European Pillar of Social Rights42.The Commission will ensure that its instruments in support of skills and job creation contribute also to accelerating the transition to a circular economy, including in the context of updating its Skills Agenda, launching a Pact for Skills with large-scale multi-stakeholder partnerships, and the Action Plan for Social Economy. Further investment in education and training systems, lifelong learning, and social innovation will be promoted under the European Social Fund Plus.The Commission will also harness the potential of EU financing instruments and funds to support the necessary investments at regional level and ensure that all regions benefit from the transition. In addition to awareness-raising, cooperation and capacity-building, Cohesion Policy funds will help regions to implement circular economy strategies and reinforce their industrial fabric and value chains. Circular economy solutions will be tailored to the outermost regions and islands, due to their dependence on resource imports, high waste generation fuelled by tourism, and waste exports. The Just Transition Mechanism43 proposed as part of the European Green Deal Investment Plan and InvestEU will be able to support projects focusing on the circular economy.40 Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste, OJ L 190, 12.7.2006, p. 1.41   [*https://ec.europa.eu/****eurostat****/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=cei\_cie010&language=en42*](https://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=cei_cie010&language=en42) COM(2020) 14 final43   [*https://ec.europa.eu/commission/presscorner/detail/en/fs\_20\_3916The*](https://ec.europa.eu/commission/presscorner/detail/en/fs_20_3916The) proposed European Urban Initiative, the Intelligent Cities Challenge Initiative, and the Circular Cities and Regions Initiative will provide key assistance to cities. Circular economy will be among the priority areas of the Green City Accord.The European Circular Economy Stakeholder Platform will continue to be the place for stakeholders to exchange information.6. CROSSCUTTING ACTIONS6.1 Circularity as a prerequisite for climate neutralityIn order to achieve climate neutrality, the synergies between circularity and reduction of greenhouse gas emissions need to be stepped up. The Commission will:• analyse how the impact of circularity on climate change mitigation and adaptation can be measured in a systematic way;• improve modelling tools to capture the benefits of the circular economy on greenhouse gas emission reduction at EU and national levels;• promote strengthening the role of circularity in future revisions of the National Energy and Climate Plans and, where appropriate, in other climate policies.Next to reducing greenhouse gas emissions, achieving climate neutrality will also require that carbon is removed from the atmosphere, used in our economy without being released, and stored for longer periods of time. Carbon removals can be nature based, including through restoration of ecosystems, forest protection, afforestation, sustainable forest management and carbon farming sequestration, or based on increased circularity, for instance through long term storage in wood construction, re-use and storage of carbon in products such as mineralisation in building material.To incentivise the uptake of carbon removal and increased circularity of carbon, in full respect of the biodiversity objectives, the Commission will explore the development of a regulatory framework for certification of carbon removals based on robust and transparent carbon accounting to monitor and verify the authenticity of carbon removals.6.2 Getting the economics rightAccelerating the green transition requires careful yet decisive measures to steer financing towards more sustainable production and consumption patterns. The Commission has already taken a series of initiatives in this respect, including integrating the circular economy objective under the EU Taxonomy Regulation44, and carrying out preparatory work on EU Ecolabel criteria for financial products. The Circular Economy Finance Support Platform will continue to offer guidance to project promoters on circular incentives, capacity building and financial risk management. EU financial instruments, such as SME guarantees under the current framework and InvestEU as of 2021, mobilise private financing in support of the circular economy. The Commission has also proposed a new own resource for the EU budget based on the amount of non-recycled plastic packaging waste. In addition, the Commission will:44 The EU classification system for environmentally sustainable activities:   [*https://eur-lex.europa.eu/legal-content/en/HIS/?uri=CELEX%3A52018PC035317•*](https://eur-lex.europa.eu/legal-content/en/HIS/?uri=CELEX%3A52018PC035317•) enhance disclosure of environmental ***data*** by companies in the upcoming review of the non-financial reporting directive;• support a business led initiative to develop environmental accounting principles that complement financial ***data*** with circular economy performance ***data***;• encourage the integration of sustainability criteria into business strategies by improving the corporate governance framework;• reflect objectives linked to the circular economy as part of the refocusing of the European Semester and in the context of the forthcoming revision of the State Aid Guidelines in the field of the environment and energy;• continue to encourage the broader application of well-designed economic instruments, such as environmental taxation, including landfill and incineration taxes, and enable Member States to use value added tax (VAT) rates to promote circular economy activities that target final consumers, notably repair services45.6.3 Driving the transition through research, innovation and digitalisationEuropean businesses are frontrunners in circular innovations. The European Regional Development Fund, through smart specialisation, LIFE and Horizon Europe will complement private innovation funding and support the whole innovation cycle with the aim to bring solutions to the market. Horizon Europe will support the development of indicators and ***data***, novel materials and products, substitution and elimination of hazardous substances based on “safe by design” approach, circular business models, and new production and recycling technologies, including exploring the potential of chemical recycling, keeping in mind the role of digital tools to achieve circular objectives. Marie Sklodowska Curie Actions can in addition support development of skills, training and mobility of researchers in this area.Digital technologies can track the journeys of products, components and materials and make the resulting ***data*** securely accessible. The European ***data*** space for smart circular applications referred to in section 2 will provide the architecture and governance system to drive applications and services such as product passports, resource mapping and consumer information.The European Institute of Innovation and Technology will coordinate innovation initiatives on circular economy in collaboration with universities, research organisations, industry and SME’s within the Knowledge and Innovation Communities.The regime for intellectual property needs to be fit for the digital age and the green transition and support EU businesses’ competitiveness. The Commission will propose an Intellectual Property Strategy to ensure that intellectual property remains a key enabling factor for the circular economy and the emergence of new business models.45 Subject to the outcome of the on-going legislative procedure.187. LEADING EFFORTS AT GLOBAL LEVELThe EU can only succeed if its efforts drive also the global transition to a just, climate-neutral, resource-efficient and circular economy. There is a growing need to advance discussions on defining a “Safe Operating Space’ whereby the use of various natural resources does not exceed certain local, regional or global thresholds and environmental impacts remain within planetary boundaries.For countries with an EU accession perspective, our closest neighbours in the South and the East, emerging economies and key partners across the world, the new sustainable models will open up business and employment opportunities, while strengthening the ties with European economic actors46.To support a global shift to a circular economy, the Commission will:• building on the European Plastics Strategy, lead efforts at international level to reach a global agreement on plastics, and promote the uptake of the EU’s circular economy approach on plastics;• propose a Global Circular Economy Alliance to identify knowledge and governance gaps in advancing a global circular economy and take forward partnership initiatives, including with major economies;• explore the feasibility of defining a ‘Safe Operating Space’ for natural resource use and consider initiating discussions on an international agreement on the management of natural resources;• build a stronger partnership with Africa to maximise the benefits of the green transition and the circular economy;• ensure that Free Trade Agreements reflect the enhanced objectives of the circular economy;• continue promoting the circular economy in the accession process with the Western Balkans, and in the context of bilateral, regional and multilateral policy dialogues, fora and environmental agreements, as well as of pre-accession assistance and neighbourhood, development and international cooperation programmes, including the International Platform on Sustainable Finance;• step up outreach activities, including through the European Green Deal diplomacy and the Circular Economy missions, and work with EU Member States to enhance coordination and joint efforts for a global circular economy.8. MONITORING PROGRESSIn line with the European Green Deal and the 2020 Annual Sustainable Growth Strategy47, the Commission will reinforce the monitoring of national plans and measures to accelerate the transition to a circular economy as part of refocusing the European Semester process to integrate a stronger sustainability dimension.46 SWD(2020) 100.47 COM (2019) 650 final.19The Commission will also update the Monitoring Framework for the Circular Economy48. Relying on European ***statistics*** as much as possible, new indicators will take account of the focus areas in this action plan and of the interlinkages between circularity, climate neutrality and the zero pollution ambition. At the same time, projects under Horizon Europe and Copernicus ***data*** will improve circularity metrics at various levels not yet reflected in official ***statistics***.Indicators on resource use, including consumption and material footprints to account for material consumption and environmental impacts associated to our production and consumption patterns will also be further developed and will be linked to monitoring and assessing the progress towards decoupling economic growth from resource use and its impacts in the EU and beyond.9. CONCLUSIONThe transition to the circular economy will be systemic, deep and transformative, in the EU and beyond. It will be disruptive at times, so it has to be fair. It will require an alignment and cooperation of all stakeholders at all levels - EU, national, regional and local, and international.Therefore, the Commission invites EU institutions and bodies to endorse this Action Plan and actively contribute to its implementation, and encourages Member States to adopt or update their national circular economy strategies, plans and measures in the light of its ambition. Furthermore, the Commission will recommend including the circular economy among the topics for discussion on the future of Europe and a regular theme of citizens’ dialogues.48   [*https://ec.europa.eu/****eurostat****/web/circular-economy/indicators/monitoring-framework*](https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework)

**Load-Date:** March 12, 2020

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[***Discrepancy between perceived diet quality and actual diet quality among US adult cancer survivors***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2C1-JCWX-C1J5-00000-00&context=1516831)

European Journal of Clinical Nutrition

April 2020

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**Section:** Pg. 1457-1464; Vol. 74; No. 10; ISSN: 0954-3007,1476-5640

**Length:** 4153 words

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**Body**

Introduction

More than 15.5 million Americans today are cancer survivors, that is, individuals with a history of cancer that becomes a part of their health profile from the time of diagnosis to the end of their lives []. A large body of literature has shown that energy balance factors are associated with the risk of cancer recurrence, progression, and mortality []. In general, energy balance factors occur in three domains: energy intake, energy expenditure, and energy storage.

Postdiagnosis diet and food choices, which determine the quantity and quality of energy intake, are essential for survivorship management [–]. The nutrition and physical activity guidelines for cancer survivors developed by the American Cancer Society emphasize the importance of a healthy diet in ensuring adequate ***nutrient*** intake []. For example, the guideline recommends a high intake of whole grains, vegetables and fruits, a low intake of saturated fats, and a reduced intake of empty calories such as added sugar from beverages. A well-balanced diet will help maintain a healthy weight and reduce the risk of cancer recurrence and mortality, especially for breast, colon, and prostate cancers [, , ].

A conventional belief is that a diagnosis of cancer can be a “teachable moment” and a “cue for action” that leads the individual to positive dietary changes [–]. Some studies have indeed shown that cancer diagnosis was associated with improved lifestyle behaviors [, ]. However, other studies have suggested a lower post-diagnosis diet quality and poor adherence to dietary guidelines among cancer survivors [–].

Empirical research and the theory of planned behavior suggest that behavioral attitude is an important construct associated with behavior intentions, for example, cancer survivors’ intentions to eat a healthful diet []. Self-perceived diet quality is a key factor that influences behavioral attitude. People without an experience of cancer who tend to overestimate the healthiness of their diets may be less likely to change their dietary behavior [–]. However, little is known about cancer survivors’ self-perception of their dietary quality compared with their measured diet quality and how those perceptions may influence their actual diet.

To fill this research gap, we used a large national ***data*** set to examine the temporal trends of diet quality of cancer survivors compared with the general, nonsurvivor population, assessed the discrepancy between self-perceived and actual diet quality, and examined these disparities across subpopulations.

Methods

***Data***

The National Health and Nutrition Examination Survey (NHANES) ***data*** from 2005 to 2014 were used in this study. NHANES is administered by the National Center for Health ***Statistics*** of the Centers for Disease Control and Prevention. Since 1999, continuous ***data*** ***collection*** has been conducted biannually on about 10,000 individuals in each wave; ***collecting*** nationally-representative ***data*** on a wide range of nutrition- and health-related factors. The survey results provide an objective assessment of the health and nutritional status of adults and children in the United States. The dietary ***data*** used in this study was ***collected*** through 24-h dietary recall. The ***data*** were then used to derive daily total energy intake, amount of ***nutrients***, and amount of non-***nutrients***. The Food Patterns Equivalents Database, developed by the United States Department of ***Agriculture*** (USDA) starting in 2005, was used to construct the Healthy Eating Index (HEI)-2010 based on the NHANES dietary ***data***. The original sample had 27,421 subjects. Observations from 1946 subjects were excluded due to missing ***data***, resulting in an analytical sample of 25,475.

Key variables

Outcome

HEI-2010—The Healthy Eating Index (HEI) is a measure of diet quality used to evaluate the conformance between dietary intake and federal dietary guidance. The HEI-2010 assesses diet quality as defined by the 2010 Dietary Guidelines for Americans, which includes 12 subcomponents. The total HEI-2010 is the sum of these 12 subscores and has a maximum value of 100 points. In the present study, we examined the total HEI score and four subdomain scores that may influence cancer survivorship, as the Nutrition and Physical Activity Guidelines for Cancer Survivors suggests, including total fruit (with a maximum of 5 points), total vegetables (with a maximum of 5 points), whole grains (with a maximum of 10 points), and empty calories (with a maximum of 20 points). The validity and reliability of HEI-2010 have been assessed and supported by empiric studies [].

Exposure

Self-perceived diet quality

The variable of self-perceived diet quality, which is recorded in the Diet Behavior and Nutrition Questionnaire, records self-assessed healthy diet evaluation. This variable was recoded from one (excellent) to five (poor); to make the result more easily interpreted, we recoded this variable as one (poor) to five (excellent).

When the rating of self-perceived eating healthiness was higher than the diet quality that the HEI score indicated, we defined such misperception as over-rated; when the self-rating was lower than the diet quality that the HEI score indicated, we defined such misperception as under-rated. If there was no mismatch, we labeled it as correct perception.

Other covariates

Age, sex, ethnicity, education, and income were included in our regression analyses as covariates.

Statistical analysis

We conducted descriptive analyses to examine the temporal trends and differences of diet quality measured by HEI scores for the general population and for cancer survivors in the US. We estimated Kappa ***statistics*** to assess the extent of mismatch between self-rated and HEI-measured diet quality among cancer survivors.

Linear regression models were fit to assess the relationship between misperception of diet quality and actual diet intake as measured by the HEI. The effects of misperception on fruit intake, vegetable intake, grain intake, and empty calorie intake, which are closely related to cancer survivorship as suggested by the Nutrition and Physical Activity Guidelines for Cancer Survivors, were estimated by regression analyses. Multinomial logistic regression models were fit to examine the likelihood of misperception (under-rated and over-rated vs. correctly rated) across age, gender, ethnicity, education level, and income subgroups. Complex survey design and sampling weights were taken into account in our analyses. ***Data*** analyses were performed with SAS software version 9.4 of the SAS System for Windows, SAS Institute Inc., Cary, NC, USA.

Results

Sample characteristics

Table reports the characteristics of the study population: the general population, cancer survivors, and survivors of each cancer type in NHANES 2005–2014. Compared with the general population, cancer survivors were older (62.10-year-old (yo) vs. 45.48 yo, P < 0.001), more likely to have a college education or higher (33.33% vs. 27.44%, P < 0.001), and more likely to have a higher income (40.39% vs. 32.96% in the income group with a ratio of income to poverty of four and greater). Most cancer survivors were female (57.57%), and non-Hispanic white (86.61%), with 33.33% having at least a college degree (33.33%). A quarter of survivors were in the income group with a ratio of income to poverty between two and four; 40.39% in the income group with a ratio of income to poverty above four.

Sociodemographic characteristics of study sample.

|  | **General population** | **Cancer survivor** |  | **Cancer type** | | | | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **(Unweighted sample size *N* = 23,114)** | **(Unweighted sample size *N* = 2361)** | ***P* value** | **Breast (unweighted sample size *N* = 333)** | **Prostate (unweighted sample size *N* = 310)** | **Colon (unweighted sample size *N* = 119)** | **Lung (unweighted sample size *N* = 43)** | **Multiple (unweighted sample size *N* = 246)** | **Other (unweighted sample size *N* = 1310)** | ***P* value** |
| Age (years) | 45.47 (SD: 0.28) | 62.11 (SD: 0.43) | <0.0001 | 64.98 (1.00) | 71.55 (0.63) | 67.46 (1.52) | 64.41 (2.45) | 66.14 (1.23) | 59.28 (0.58) | <0.0001 |
| Gender |  |  |  |  |  |  |  |  |  |  |
| ?Male | 48.73% | 42.38% | <0.0001 | ? | 100% (0.00) | 52.74% (5.91) | 56.46% (9.57) | 43.81% (4.03) | 43.10% (1.93) | <0.0001 |
| ?Female | 51.27% | 57.62% |  | 100% (0.00) | ? | 47.26% (5.91) | 43.54% (9.57) | 56.19% (4.03) | 56.90% (1.93) |  |
| Race |  |  |  |  |  |  |  |  |  |  |
| ?NH white | 66.77% | 86.76% | <0.0001 | 80.57% (2.44) | 73.70% (2.59) | 86.01% (2.80) | 78.48% (6.10) | 90.14% (2.40) | 89.35% (1.03) | <0.0001 |
| ?NH black | 12.02% | 5.66% |  | 10.37% (1.65) | 17.65% (1.99) | 9.92% (2.28) | 12.37% (4.02) | 2.29% (0.60) | 3.33% (0.50) |  |
| ?Hispanic | 14.28% | 4.40% |  | 6.09 (1.35) | 5.18% (1.23) | 2.92% (1.23) | ? | 3.38% (1.21) | 4.35% (0.61) |  |
| ?Others | 6.94% | 3.17% |  | 2.96% (0.96) | 3.47% (1.05) | 1.15% (0.69) | 9.15% (4.06) | 4.19% (2.14) | 2.97% (0.68) |  |
| Education |  |  |  |  |  |  |  |  |  |  |
| ?Less than 9th grade | 5.62% | 5.13% | <0.0001 | 5.56% (1.31) | 7.30% (1.43) | 9.99% (2.72) | 13.29% (6.70) | 4.45% (1.51) | 4.34% (0.63) | <0.0001 |
| ?9?11th grade | 12.01% | 9.50% |  | 12.11% (1.61) | 8.73% (1.59) | 15.38% (3.25) | 10.88% (4.42) | 9.10% (2.27) | 8.68% (1.02) |  |
| ?High school grade | 23.42% | 20.48% |  | 24.64% (3.22) | 21.14% (3.30) | 21.43% (4.81) | 29.51% (9.84) | 16.05% (3.29) | 19.96% (1.61) |  |
| ?Some college/AA | 31.51% | 31.46% |  | 27.42% (3.19) | 27.93% (3.69) | 36.02% (6.11) | 30.83% (9.32) | 32.69% (4.47) | 32.26% (2.02) |  |
| ??College graduate | 27.44% | 33.43% |  | 30.27% (3.19) | 34.90% (3.51) | 17.19% (6.03) | 15.49% (7.71) | 37.71% (4.76) | 34.76% (2.39) |  |
| Income |  |  |  |  |  |  |  |  |  |  |
| ?Poverty income ratio ?1 | 20.79% | 14.90% | <0.0001 | 14.89% (1.86) | 13.21% (2.04) | 16.85% (4.57) | 22.14% (8.34) | 12.22% (2.70) | 15.24% (1.38) | <0.0001 |
| ?<1 Poverty income ratio ? 1.25 | 5.78% | 5.42% |  | 5.68% (1.27) | 5.76% (1.65) | 9.17% (3.26) | 4.84% (3.00) | 6.56% (1.80) | 4.90% (0.54) |  |
| ?1.25 < Poverty income ratio ? 2 | 13.70% | 14.18% |  | 19.05% (3.00) | 15.74% (2.72) | 11.36% (3.38) | 8.87% (4.37) | 12.56% (2.84) | 13.57% (1.17) |  |
| ?2 < Poverty income ratio ? 4 | 26.77% | 24.99% |  | 24.06% (2.69) | 28.56% (3.29) | 31.50% (5.42) | 51.32% (9.13) | 26.36% (3.56) | 23.37% (1.51) |  |
| ?Poverty income ratio > 4 | 32.96% | 40.51% |  | 36.33% (3.88) | 36.73% (3.64) | 31.12% (6.29) | 12.83% (6.25) | 42.28% (4.80) | 42.93% (2.00) |  |

Temporal trends of HEI in cancer survivors

The overall average HEI score was about 53 out of 100. As Table shows, between 2005 and 2014, there was an increasing trend in total HEI score among cancer survivors, with a small but significant increase of 0.7 points per year. However, there was a decreasing trend in vegetable and fruit intake, though the trend was not statistically significant. Cancer survivors experienced a slight annual increase of about 0.19 points in whole grain intake. There was a significant reduction in empty calorie intake over the past decade. However, the magnitude of the reduction was only about 0.4 points per year. There was no significant change in self-perceived eating healthiness among cancer survivors.

Temporal trend of HEI-measured and self-perceived eating healthiness among cancer survivors in NHANES 2005–2014.

|  |  | **2005?2006** | **2007?2008** | **2009?2010** | **2011?2012** | **2013?2014** | **Temporal trend (*P* value)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| HEI total | Mean (95% CI) | 52.63 (50.37, 54.89) | 52.19 (48.89, 55.5) | 53.69 (52.12, 55.25) | 54.23 (52.46, 56) | 55.26 (52.71, 57.8) | 0.729 (0.0193) |
| HEI vegetable (maximum 5) | Mean (95% CI) | 3.26 (3, 3.52) | 2.99 (2.71, 3.26) | 3.28 (3.05, 3.52) | 3.21 (3.05, 3.36) | 3.09 (2.89, 3.28) | ?0.013 (0.7958) |
| HEI fruit (maximum 5) | Mean (95% CI) | 2.57 (2.26, 2.87) | 2.74 (2.4, 3.09) | 2.57 (2.3, 2.83) | 2.2 (1.9, 2.49) | 2.38 (2.12, 2.65) | ?0.091 (0.1909) |
| HEI whole grains (maximum 10) | Mean (95% CI) | 2.8 (2.43, 3.17) | 2.76 (2.16, 3.35) | 3.09 (2.57, 3.62) | 3.48 (3.11, 3.85) | 3.38 (2.85, 3.92) | 0.19 (0.0319) |
| HEI empty calories (maximum 20) | Mean (95% CI) | 12.46 (11.15, 13.77) | 12.4 (11.76, 13.04) | 12.77 (11.92, 13.62) | 13.53 (12.65, 14.41) | 13.67 (12.65, 14.7) | 0.356 (0.0179) |
| Self-assessed eating health | Mean (95% CI) | 3.25 (3.1, 3.41) | 3.26 (3.06, 3.46) | 3.37 (3.22, 3.53) | 3.26 (3.1, 3.42) | 3.28 (3.18, 3.38) | 0.005 (0.8036) |

P values are for linear trend tests.

Self-perceived eating healthiness in cancer survivors

Among cancer survivors, 11.66, 29.67, and 38.02% rated their overall diet quality as excellent, very good, or good, respectively, while 16.96 and 3.69% perceived their overall diet as fair and poor, respectively. Female survivors were slightly more likely to rate their diet as excellent (11.74% vs. 11.54%), very good (30.38% vs. 28.70%), fair (18.12% vs. 15.39%), or poor (4.62% vs. 2.42%) compared with male survivors. Non-Hispanic white survivors had the highest proportion of those who perceived their eating healthiness as excellent, very good, or good. In contrast, Hispanic survivors had the highest proportion of self-perceived eating healthiness as fair, and non-Hispanic black survivors had the highest proportion of self-perceived eating healthiness as poor.

Association between HEI and self-perceived eating healthiness in cancer survivors

We examined the agreement between self-perceived eating healthiness and diet quality. The HEI score was categorized based on the USDA criteria as excellent (scores between 80 and 100), good (scores between 50 and 80), and need improvement (scores under 50) based on the common practice in the field []. Kappa ***statistics*** indicated a low agreement between self-perceived diet quality and actual diet quality as measured by the HEI among cancer survivors (0.06, 95% CI: 0.02, 0.09) (Table ). Stratified analyses indicated similar patterns among male cancer survivors (Kappa: 0.04, 95% CI: −0.02, 0.08) and female cancer survivors (Kappa: 0.07, 95% CI: 0.03, 0.12). The agreement was generally low across racial/ethnic cancer survivor groups as well, including non-Hispanic whites (Kappa: 0.05, 95% CI: 0.01–0.09), non-Hispanic blacks (Kappa: 0.05, 95% CI: −0.06–0.16), and Hispanics (Kappa: 0.04, 95% CI: −0.06–0.15).

Agreement between self-perceived eating healthiness and HEI-measured diet quality among cancer survivors, by gender and race/ethnicity.

|  | **Under-rated (%)** | **Correct (%)** | **Over-rated (%)** | **Kappa *Statistics* (95% CI)** |
| --- | --- | --- | --- | --- |
| Female | 5.59 | 20.50 | 31.52 | 0.07 (0.03, 0.12) |
| Male | 3.63 | 14.13 | 24.62 | 0.04 (?0.02, 0.08) |
| White | 7.42 | 29.32 | 50.03 | 0.05 (0.01, 0.09) |
| Black | 7.4 | 2.16 | 2.76 | 0.05 (?0.06, 0.16) |
| Hispanic | 0.83 | 1.81 | 1.76 | 0.04 (?0.06, 0.15) |

When the rating of self-perceived eating healthiness was higher than the diet quality that the HEI score indicated, misperception was defined over-rated; when rating of self-perceived eating healthiness was lower than the diet quality that the HEI score indicated, misperception was defined as under-rated. If there was no mismatch, it was defined as correct perception.

Diet quality misperception and HEI among cancer survivors

As the regression estimates in Table suggested, with adjustment for age, sex, race/ethnicity, and SES status, an over-rated misperception was associated with a 5.39 point lower total HEI score (P < 0.0001), 1.00 point lower HEI score for empty calorie intake (P = 0.0028), 0.15 point lower score for vegetable intake (P = 0.108), and 0.29 point lower score for fruit intake. On the other hand, an under-rated misperception was associated with a 7.12 higher total HEI score (P < 0.0001), 2.57 higher HEI score for empty calorie intake (P < 0.0001), 0.02 higher score for vegetable intake (P = 0.904), and 0.84 higher score for fruit intake (P = 0.001). We did not detect gender or racial/ethnic differences in these associations.

Associations between misperception of diet quality and HEI-measured diet quality among cancer survivors.

| **Variable** | **Whole sample** | **Stratified by gender** | | **Stratified by ethnicity** | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Male** | **Female** | **White** | **Black** | **Hispanic** | **Other** |
| Total HEI |  |  |  |  |  |  |  |
| Under-rate | 7.12 (*P* < 0.0001) | 7.24 (*P* = 0.0022) | 7.03 (*P* < .00001) | 5.88 (*P* = 0.0001) | 12.47 (*P* < 0.0001) | 8.38 (*P* < 0.0001) | 29.17 (*P* < 0.0001) |
| Over-rate | ?5.39 (*P* < 0.0001) | ?6.79 (*P* < 0.0001) | ?4.44 (*P* = 0.0001) | ?5.8 (*P* < 0.0001) | ?5.75 (*P* = 0.0016) | ?4.35 (*P* = 0.0718) | 2.46 (*P* = 0.5648) |
| Total Vegetable |  |  |  |  |  |  |  |
| Under-rate | 0.02 (*P* = 0.9041) | ?0.24 (*P* = 0.3493) | 0.20 (*P* = 0.4199) | ?0.07 (*P* = 0.7018) | 0.15 (*P* = 0.7410) | 0.31 (*P* = 0.3418) | 1.75 (*P* = 0.0054) |
| Over-rate | ?0.15 (*P* = 0.1077) | ?0.25 (*P* = 0.0414) | ?0.09 (*P* = 0.5438) | ?0.19 (*P* = 0.0833) | ?0.28 (*P* = 0.3197) | ?0.11 (*P* = 0.7351) | 0.78 (*P* = 0.0289) |
| Total Fruit |  |  |  |  |  |  |  |
| Under-rate | 0.84 (*P* = 0.0006) | 1.07 (*P* = 0.0017) | 0.65 (*P* = 0.0185) | 0.68 (*P* = 0.0149) | 1.36 (*P* = 0.0008) | 1.15 (*P* = 0.0109) | 3.21 (*P* < 0.0001) |
| Over-rate | ?0.29 (*P* = 0.0285) | ?0.15 (*P* = 0.4573) | ?0.41 (*P* = 0.0072) | ?0.36 (*P* = 0.0151) | ?0.21 (*P* = 0.4200) | ?0.03 (*P* = 0.9370) | 1.02 (*P* = 0.0857) |
| Total Empty Calories |  |  |  |  |  |  |  |
| Under-rate | 2.57 (*P* < 0.0001) | 1.86 (*P* = 0.0012) | 3.06 (*P* < 0.0001) | 2.48 (*P* < 0.0001) | 3.31 (*P* = 0.0069) | 2.12 (*P* = 0.0521) | 5.28 (*P* = 0.0005) |
| Over-rate | ?1.00 (*P* = 0.0028) | ?1.45 (*P* = 0.0060) | ?0.68 (*P* = 0.1633) | ?0.97 (*P* = 0.0078) | ?2.13 (*P* = 0.0556) | ?2.37 (*P* = 0.0106) | 0.27 (*P* = 0.8344) |

All models controlled for age, gender, race/ethnicity, income, and education level.

Multinomial logistic regression models were used to investigate demographic and socioeconomic factors associated with the misperception of dietary intake by modeling the odds of under-/over- rated vs. correctly-rated status. As shown in Table , a significant negative association was found between the odds of being an over-rater and age. Each 10-year increase in age was associated with an increase in the odds of being an over-rater vs. a correct-rater (OR: 11.4, 95% CI: 10.01, 10.2). Higher income was also associated with higher odds of being an over-rater. Individuals with college education or above were more likely to over-rate their diet quality compared with those with high school or less education (OR: 1.32, 95% CI: 1.005 1.732). Also, Hispanics were more likely than non-Hispanic whites to over-rate their diet quality (OR: 1.792, 95% CI: 1.062, 3.024).

Multinomial logistic regression estimates of factors associated with misperception of diet quality.

|  | **Misperception type** | **Odds ratio** | **95% Confidence interval** | |
| --- | --- | --- | --- | --- |
| Age | Under-rate | 1.00 | 0.99 | 1.01 |
|  | Over-rate | 1.02 | 1.01 | 1.02 |
| Gender (ref: Male) |  |  |  |  |
| Female | Under-rate | 1.01 | 0.64 | 1.61 |
| Gender (ref: Male) |  |  |  |  |
| Female | Over-rate | 0.99 | 0.75 | 1.31 |
| Ethnicity (ref: White) |  |  |  |  |
| Black | Under-rate | 1.38 | 0.75 | 2.52 |
| Hispanic | Under-rate | 1.91 | 1.12 | 3.26 |
| Other | Under-rate | 0.65 | 0.17 | 2.57 |
| Ethnicity (ref: White) |  |  |  |  |
| Black | Over-rate | 0.88 | 0.63 | 1.23 |
| Hispanic | Over-rate | 0.79 | 0.53 | 1.18 |
| Other | Over-rate | 0.74 | 0.35 | 1.56 |
| Income | Under-rate | 0.87 | 0.73 | 1.04 |
|  | Over-rate | 1.10 | 1.00 | 1.20 |
| Education | Under-rate | 1.20 | 1.00 | 1.43 |
|  | Over-rate | 1.11 | 1.01 | 1.21 |

The group without misperception, i.e., self-rated eating health matched HEI-measured diet quality agreed, was set as the reference group in the multinomial logistic regression.

Discussion

This study examined the temporal trends of diet quality among cancer survivors in the US and assessed cancer survivors’ self-rated diet healthfulness in relation to their actual diet quality. We found that the diet quality of cancer survivors measured by their overall HEI score has not increased significantly over the past decade. Self-assessed eating health, however, was found to be an important factor that may have influenced cancer survivors’ diet behavior and diet quality.

The diet quality of cancer survivors, while slightly higher than the general population, was found to be poor in general. Our analyses suggested that the mean total HEI score was only around 50 out of 100 in this population. Between 2005 and 2015 there was no significant increase in HEI score. In addition, the American Cancer Society’s Guidelines on Nutrition and Physical Activity for Cancer Survivors recommends a dietary pattern high in vegetables and fruits []. However, the mean fruit and vegetable HEI scores for cancer survivors were only slightly above half of the maximum possible score (maximum five points each for fruit and vegetable HEI) in the past decade, indicating the need for a substantial increase in these food groups to promote better diet-related survivorship outcomes.

Perception of diet quality is an important psychological factor that influences actual diet quality. Previous research has suggested that the perception does not always reflect reality, however, when it comes to actual consumption and diet quality [, ]. In line with these findings, we found there was a high prevalence of cancer survivors who misperceived their eating healthfulness. Approximately 56% were optimistic (over-rated their perceived vs. actual diet quality), and 9% were pessimistic (under-rated their perceived vs. actual diet quality).

The effects of mismatching were substantial and both statistically and nutritionally significant. Compared with those who correctly rated their eating habits healthfulness, those who over-rated its healthfulness tended to have a lower total HEI score, while those who under-rated their eating healthfulness tended to have a higher total HEI score.

Our estimates indicate gender differences in the relationship between misperception and diet quality among cancer survivors. In terms of total HEI score, over-rating one’s eating healthfulness was associated with a greater decrease of HEI scores among men than among women. Over-rating was also associated with a lower HEI score for vegetable intake, while this effect was not significant among women. With respect to empty calorie intake, under-rating had a greater impact on HEI scores in women than men, while over-rating had a greater impact on HEI scores in men than women.

Our multinomial regression estimates also suggested that certain subgroups may be at higher risk of over-rating their diet quality, which, as demonstrated, adversely influences their dietary intake and actual diet quality. We found that cancer survivors with higher income and a higher education level were more likely to over-rate their eating healthfulness compared with those with lower income and educational attainment.

Racial/ethnic disparities were also evident. Hispanic cancer survivors had higher odds of over-rating than non-Hispanic whites. Age was also a risk factor. Older cancer survivors were more likely to be over-raters, such that for every additional decade in age attained at the time of the study, there was a 14% increase in OR of over-rating one’s diet quality among cancer survivors.

The divergence between self-perception and reality found in this study is consistent with previous findings [–]. These results echo the difficulties of self-assessment of health behaviors. One plausible psychological mechanism is that people with higher income and education have unobservable characteristics that may lead to a higher likelihood of over-optimism about the health risks they face. In addition, cultural differences, given different racial/ethnic backgrounds and their related dietary behaviors (i.e., types of food/food groups eaten), and age-related nutrition and dietary experiences may also influence people’s competency to correctly self-assess. Although the mechanisms behind inaccurate self-assessment remain unclear and further research is warranted, our findings suggest that tailored interventions including counseling and education for specific subgroups to improve self-assessment are needed to help improve nutrition among cancer survivors.

There are some limitations of the present study worth mentioning. First, NHANES is nationally representative, and thus the sample size of cancer survivors in each wave is modest. This limited our subsample analyses for disparities across racial/ethnic groups. Second, the relationship we identified should not be understood as causal. As NHANES is cross-sectional, our estimates cannot support causal inference. Third, there are potential issues related to under-reporting of dietary intake. However, we could not examine the potential influence and associations between under-reporting and under-rating due to ***data*** limitation and the scope of the study.

This study has a number of notable strengths. First, to our knowledge, this is the first study that has examined the divergence between self-perceived diet quality and actual diet quality among cancer survivors. Our study identified important risk factors and obstacles that have the potential to substantially improve current nutrition interventions for cancer survivors. Second, national-level ***data*** were used to examine the temporal trends of overall diet quality and specific food group intakes that are closely related to cancer survivorship. The ***data*** were from nationally-representative samples covering a 10-year period from 2005 to 2014. Third, we used individual-level 24-h dietary recall ***data*** linked with a USDA database to measure cancer survivors’ dietary intake and quality. Compared with other nutrition and dietary assessment tools, 24-h recall ***data*** allowed us to more accurately assess diet quality and to objectively estimate HEI scores.

Conclusions

Our findings suggest that the diet quality of cancer survivors as measured by the HEI has not increased substantially over the past decade, though there was a statistically significant increasing trend with a small annual increase. The divergence between self-assessed dietary quality and HEI-measured diet quality was an important factor in cancer survivors’ diet behaviors and diet quality. Tailored nutrition interventions and guidance aimed at reducing this divergence have the potential to improve cancer survivorship and narrow racial/ethnic and socioeconomic disparities.

**Acknowledgements**

The study was supported in part by research grants: P30 CA016059 “Massey Cancer Center Core Support” (NIH-NCI) and U54TR001366 “Racial Disparities in Breast Cancer Treatment and Outcomes: A Transdisciplinary Approach” (NCATS/CTSA). The content is the responsibility of the authors and does not necessarily represent the official views of the funder.

**Notes**

Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***The Food Systems Dashboard is a new tool to inform better food policy***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H841-F129-P4KG-00000-00&context=1516831)

Nature Food

May 2020

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**Section:** Pg. 243-246; Vol. 1; No. 5; ISSN: 2662-1355

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**Body**

The Global Burden of Disease study showed that unhealthy diets contribute to 11 million deaths per year. The double burden of malnutrition — the coexistence of overweight, obesity and non-communicable diseases with underweight, micronutrient deficiencies, wasting and stunting — is being driven by changes in food systems and in some cases increased availability of cheap, highly processed, ***nutrient***-poor foods, impacting the lowest-income countries in sub-Saharan Africa, South and East Asia, and the Pacific the hardest.

Diets are shaped by food systems. Food systems are made up of all the people, institutions, environments, infrastructure and activities that relate to the production, processing, distribution, marketing, sale, preparation and consumption of food. Food systems are intrinsically related to health, environment, culture, politics and economy. The food systems framework depicts these outcomes as well as characteristics such as food availability and affordability and personal knowledge, preferences, resources and behaviours (Fig. ). Policy interventions that address one part of the system will impact many outcomes that food systems contribute to. Importantly, actions can have both unintended consequences and multiple benefits due to this interconnectivity.

Food Systems Framework.

The different components of food systems, their drivers and outcomes are interconnected. Figure adapted with permission from ref. .

Though there is widespread agreement that our food systems are unsustainable,, identifying ways to change and improve them is difficult. Food systems are complex and offer many entry points for change. Additionally, even when actions have been identified, they often lack public acceptance and may not be politically feasible. However, it has been found that policies can be modified or combined in ways that increase their acceptance and, therefore, policy packaging is an important strategy to make policies both effective and politically feasible. Policymakers, non-governmental organizations, civil society leaders and other actors do not currently have a holistic tool to enable visualization of their own national food systems, understand the interconnections across multiple sectors, perform comparisons with other countries, identify key challenges and prioritize actions.

This lack of accessible information on the status quo significantly hinders evidence-based policymaking to improve food systems. Given the level of complexity and interconnections inherent to food systems, the ***data*** that describe these systems and their linkages to diets and nutrition need to be aggregated and presented in a way that is easily understandable. ***Data*** visualizations are potentially an important way to facilitate understanding, decision making and advocacy.

The Food Systems Dashboard

The Food Systems Dashboard is a new tool that aims to describe global, regional and national food systems; to assess the challenges for improving diets, nutrition and health; and to guide its users to set priorities and decide on actions. The need for this tool was identified by Jess Fanzo at Johns Hopkins University and Lawrence Haddad at The Global Alliance for Improved Nutrition (GAIN) in 2018 when working on the team that wrote the UN High Level Panel of Experts on Food Systems and Nutrition report. Work on the Dashboard started that year, bringing together a team from Johns Hopkins University, GAIN, Harvard University, the University of Michigan and Michigan State University. Once the framework was finalized, the team worked to find indicators that described the different components of food systems and had high-quality ***data*** for countries at all income levels. The team started working with iTech Mission in 2019 to create the website and continually improve its design and usability. The Dashboard is still currently in development and the launch of the beta version is forthcoming in June. The ***data*** are publicly accessible via the online Dashboard, which has a well-designed and easy-to-navigate user interface, as designed by iTech Mission with user testing and feedback from our team and additional pilot testing and modifications planned following the launch. Figure shows how food systems ***data*** are transformed from original ***data*** sources to metadata that can be altered through ***data*** structural changes and visual mapping resulting in graphical views of ***data***. iTech has visual information design experience across a range of platforms, including the Sustainable Development Goals (SDGs) Dashboard. Throughout the process of designing the Food Systems Dashboard, we have brought together a diverse set of perspectives, with some more experienced with ***data*** navigation and others less so, to ensure that the tool is ready before it reaches decision makers. The next step will be to test with those working in food systems in a diverse set of countries who need to understand the ***data*** to make sound decisions.

The steps involved in shaping the Food Systems Dashboard.

***Data*** visualization and transformation leads to dissemination.

Describing food systems

The Dashboard describes food systems by bringing together extant ***data*** across over 140 indicators from over 30 sources. These sources, which are both public and private, include UN agencies, the World Bank, CGIAR agencies, Euromonitor and cross-country research. The indicators are organized using a conceptual framework adapted from the High-Level Panel of the UN Committee on Food Security in 2017, as shown in Fig. 1. The framework describes the entire food system, including food supply chains, food environments, individual factors, consumer behaviour, diets and nutrition, and environmental, social, political and economic drivers — factors that push or pull the system. Aggregating these diverse ***data*** will improve stakeholders’ understanding of their national food systems in terms of the different food systems’ components (food supply chains, food environments and individuals), their cross-sectional nature and how these components may influence diet and nutrition outcomes. The Dashboard will provide country profile snapshots of a curated set of indicators that capture these components in an ‘infographic’ type visual that explains the ***data***, is easy to understand, shows the connections and can be downloaded for dissemination purposes. The country profiles are meant to tell a story about a country’s food system.

Assessing food systems

The Dashboard enables stakeholders to compare their food systems with those of other countries. This comparison can be done regionally, by income classification, or based on a food system typology. To develop the typologies, 146 countries were grouped into five country-level food system types using a composite index score. The typologies are meant to characterize broad patterns across households, neighbourhoods, regions and countries in their ***agricultural*** production practices, supply chains and food environments. Though it is recognized that the full complexity of food systems and heterogeneity across countries cannot be adequately conveyed through a typology, typologies may be useful in identifying broad patterns across countries and better enabling countries to learn from one another. The Dashboard has developed case studies of these five food system typologies that provide a typical context of what one may find in these typologies and there are plans to develop more cases that illustrate how food system types are characterized and changing in the context of other macro-drivers such as urbanization and climate change.

Prioritizing actions

The Dashboard will provide guidance on potential priority actions to improve food systems’ impacts on diets and nutrition. These actions may take the form of policy and programme interventions, tools, or investments. It proposes the food system actors that need to be involved in making the desired changes. While the current focus is on diets and nutrition, the dashboard includes several environmental and natural resource indicators that are important for the resilience of food systems and these will be expanded to increase the focus on sustainability. The methods to develop priority actions are in progress, but there are several policy streams that will inform the key evidence-based policies that can impact diets and nutrition, including City, University of London’s and GAIN’s work on No Regrets Policy Actions and the UN Voluntary Guidelines on Food Systems for Nutrition.

Decision-making

The Dashboard is intended as the primary resource for decision makers to find curated, high-quality ***data*** and analytics on their country’s food systems. The ***data*** gives users insight into the state of their food systems and their effects on nutrition and health. The Dashboard also suggests parts of the food system that may require corrective action through actionable indicators. The ***Data*** for Decisions to Expand Nutrition Transformation (DataDENT) Initiative — a four-year initiative led by Johns Hopkins University, the International Food Policy Research Institute and Results for Development aimed at transforming the availability and use of nutrition ***data*** — found that providing such guidance on needed corrective actions is important to increase the practical utility of ***data*** visualization tools such as dashboards. The Food Systems Dashboard will provide broad recommendations for policy, programme and investment actions to address these food systems’ shortcomings using actionable indicators. We hope that this will facilitate higher-quality decision-making to construct better National Food System Action Plans, which ultimately will advance human and planetary health.

Advance of the dashboard

With advanced information connectivity, it is perhaps predictable that a number of ***data*** visualization tools are proliferating in the nutrition space. The DataDENT Initiative found that there were over 22 global visualization tools in the nutrition space alone, with at least 14 of these tools launched or refreshed between July 2017 and June 2018. The Initiative reported overlap and inconsistencies within available tools, which can cause confusion and fatigue for decision makers. The Dashboard is taking the lessons learned from these tools and working to ensure the ***data*** are visually appealing and easy to understand. We will also test the Dashboard with different users to see what types of visual are the most understandable across various stakeholders.

The Dashboard brings together ***data*** from many different sources. The ***data*** provide insights into different aspects of food systems that are not commonly included in other nutrition ***data*** visualization tools, allowing users to understand food systems in a more comprehensive way. In addition to diets, nutrition and health indicators, the Dashboard also includes indicators from other sectors — ***agriculture***, food prices, retail, marketing, climate change, urbanization, poverty, literacy and others — that connect to food systems. The Dashboard presents ***data*** on almost all countries, whereas other food indices and platforms often only capture ***data*** from countries with many ***data*** points. These countries are usually a select number of high-income countries.

Developing the dashboard

Limited ***data*** availability is a challenge that hinders all ***data*** visualization tools — the Dashboard included. The DataDENT Initiative showed that in many ***data*** visualization tools there are no ***data*** for the indicators of interest, ***data*** are out of date, trend ***data*** are not available, ***data*** are only available for a small number of countries, or ***data*** are not available at the geographic level needed such as sub-national ***data***. Given these limitations, the Dashboard can also be used as a tool for advocacy. We hope that flagging important indicators that have limited or no ***data*** will generate more ***data*** ***collection*** and sharing. More ***data*** are needed, especially for diets, individual factors, consumer behaviour and food environments, as well as disaggregated ***data*** at sub-national levels. We are reaching out to research groups around the world from various disciplines and sectors who are willing to work with us and share ***data***.

The dietary ***data*** included in the Dashboard are from the Global Burden of Disease study. While these are the most accessible ***data*** currently available, they are from modelled estimates that may under- or over-represent actual dietary intakes. While there may be typical diets in some countries, there is also a lot of variation and thus individual dietary intake ***data*** that are nationally representative are critical, but this does not exist. Thus, ***data*** are needed on dietary intakes for people in different age groups, genders and in different regions. The World Bank’s Living Standards Measurement Study (LSMS) includes ***data*** on food consumption and expenditures, which would be a useful addition to the Dashboard, but these ***data*** would need to be processed in a comparable way to the Global Burden of Disease ***data*** to be included. Specifically, household expenditures on various items would have to be combined such that expenditures on individual dietary risk factors, including vegetables (as a whole group), legumes, nuts and seeds, sugar-sweetened beverages, processed meats and other food groups, can be determined. Additionally, household expenditures would need to be analysed to determine expenditures on food components that are dietary risk factors, such as expenditures on fibre and sodium.

For individual factors — a person’s economic status, knowledge, aspirations and life situation — limited information is available. Of all these, the Dashboard only has robust ***data*** for economic factors (that is, income). ***Data*** on individual information, knowledge and preferences, as well as food acquisition and consumer behaviour, would further strengthen understanding of the relationship between food systems, behaviour and diets. For example, it would be useful to better use the LSMS and other Household Consumption and Expenditure Surveys (HCES) ***data*** to characterize food acquisition at the household level in a centralized ***data*** repository. Additionally, while there are ***data*** on food sales, that ***data*** were determined to be more of a reflection of the food environment and food prices rather than food acquisition. Further, there are limited ***data*** available for consumer behaviour related to food preparation, meal practices and storage. These areas of consumer behaviour, more commonly addressed in smaller-scale qualitative studies, are all critical determinants of diets and health, and we urgently need to ***collect*** ***data*** to better understand them and take informed action.

Food environments also need better and more complete ***data***. While food availability, food prices and access to specific food outlet types (often in urban areas) have been fairly well characterized, we have limited ***data*** available on other aspects of the food environment, such as food quality and safety. In particular, food safety indicators are needed to assess contamination of food with toxins, chemical contaminants and adulteration, in addition to ***statistics*** on foodborne illness in light of the Ebola epidemic and COVID-19 pandemic. Food marketing and packaging ***data*** are also needed to shed light on desirability and convenience of foods — much of these ***data*** may be ***collected*** but are inaccessible behind paywalls. Another critical gap is the understanding of how individual factors interact with food environment characteristics to determine the desirability and convenience of certain foods.

The Food Systems Dashboard will be launched 1 June 2020 and can be accessed at foodsystemsdashboard.org. The Dashboard will continually be updated with new ***data***, new indicators and sub-national ***data*** when available. Over the course of 2020, the Dashboard will be piloted among policymakers in several countries with distinct food system challenges, including Tanzania and Indonesia, as well as others to be determined in the future, to assess usability, utility, and sub-national ***data*** collation for deeper food systems analysis.

The Food Systems Dashboard is a community resource that we believe has the capacity to allow policymakers to understand their national food systems and the challenges they face, to prioritize and decide on actions to improve diets for health. We are seeking more ***data*** from those working in food metrics and databases, more partners and, ultimately, more users to contribute to, and avail of, this resource.

**Acknowledgements**

The development of the Food Systems Dashboard has been supported by the Johns Hopkins University’s Alliance for a Healthier World, The Bill and Melinda Gates Foundation, German Federal Ministry of Economic Cooperation and Development (BMZ), Irish Aid, Ministry of Foreign Affairs, Netherlands, IDRC, and Swiss Development Corporation.

**Load-Date:** September 6, 2023

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[***dpa WEEKLY PLANNER for OCTOBER 19-25, 2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:613H-PCK1-JB0G-F4XD-00000-00&context=1516831)

dpa international (Englischer Dienst)

October 19, 2020 Monday 8:57 AM GMT

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**Length:** 1244 words

**Highlight:** All times GMT. If you have any questions about the weekly planner contact please call or email the dpa desks. Berlin (Mon-Sun 0600-2100) Tel: +49 30 285231472 Sydney (Mon-Sun 2000-0700) Email: [*international@dpa.com*](mailto:international@dpa.com) Sign up here to receive the dpa Weekly News Guide by email: [*http://dpaq.de/8OlYR*](http://dpaq.de/8OlYR)

**Body**

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MONDAY, OCTOBER 19

GENEVA: Officers from Libya's UN-recognized Tripoli government and eastern forces under military strongman Khalifa Haftar start talks in Geneva; the meeting comes ahead of political talks scheduled for early November

\* HANOI: New Japanese Prime Minister Yoshihide Suga continues Vietnam visit until October 20, before heading to Indonesia

TALLINN: Three Seas virtual summit and web forum; 12 EU states between the Baltic, Black and Adriatic Seas launched the initiative in 2015, seen as a Eastern European counterweight to the Paris-Berlin axis in Western Europe

COPENHAGEN: The European Environment Agency (EEA) presents its latest report on ecological challenges facing Europe including status updates for various species

PARIS: End of period when bars in Paris and its inner suburbs were ordered to be closed two weeks ago to slow the spread of the coronavirus

PARIS: Organization for Economic Cooperation and Development (OECD) publishes its annual International Migration Outlook

LUXEMBOURG: EU ***agriculture*** and fisheries ministers discuss Baltic Sea fishing, organic farming and policy reforms (until October 20)

LUXEMBOURG: ***Eurostat*** publishes GDP index for the second quarter

\* BEIJING: China's Statistical Office publishes economic growth for September and third quarter, putting growth at 4.9 per cent

ISTANBUL: Turkey said a gas exploration ship would continue looking for gas reserves south of the Greek island of Kastellorizo until this date

BRUSSELS: EU parliament plenary session

TOKYO: Japan releases trade figures for September

NEW YORK: IBM presents third quarter results

KUALA LUMPUR: Hearings resume in inquest into death of 15-year-old French-Irish girl who disappeared from a jungle resort last year and was later found dead nearby

BERLIN: German Chancellor Angela Merkel to speak at online Asia-Pacific Conference of German Business

FRANKFURT: European Central Bank virtual conference on monetary policy: bridging science and practice (until October 20)

HAVANA: 60 years since the US imposed a trade embargo on Cuba

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TUESDAY, OCTOBER 20

WASHINGTON: NASA's Osiris-Rex craft makes a first-ever attempt at retrieving a sample from an asteroid

COPENHAGEN: International donor conference for Africa's Sahel zone; online conference - hosted by Denmark, along with Germany, the EU and the United Nations - aims to ***collect*** aid for the border regions of Burkina Faso, Mali and Nigeria

NEW YORK: Streaming giant Netflix presents third-quarter results

BRUSSELS: European Parliament votes on amendments regarding its negotiating position on the Digital Services Act

STOCKHOLM: Truck maker Volvo presents third-quarter results

PARIS: French Food giant Danone gives third-quarter results

IRUN, SPAIN: The delayed Spanish Vuelta cycling race starts

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WEDNESDAY, OCTOBER 21

\* PARIS: State memorial service for Samuel Paty, a teacher who was killed in suburban Paris apparently for discussing controversial caricatures of the Muslim prophet Mohammed

BERLIN: Start of official government flights at the new and long-delayed BER airport serving the German capital

ATHENS: Coronavirus quarantine measures due to end for migrants at the Vial camp on the island of Chios.

NEW YORK: Electric car pioneer Tesla Motors presents third-quarter results

TOKYO: Japan National Tourism Organization publishes number of overseas visitors in September

STOCKHOLM: Swedish telecommunications technology company Ericsson presents third-quarter results

GENEVA: Swiss food giant Nestle presents nine-month sales results

INTERNATIONAL: 500th anniversary of the discovery of the Magellan Strait by Portuguese navigator Ferdinand Magellan

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THURSDAY, OCTOBER 22

NASHVILLE, US: Final Trump-Biden debate scheduled to take place on Belmont University campus, ahead of US presidential elections on November 3; the second debate on October 15 was cancelled after Trump caught Covid-19

WASHINGTON: US Senate committee votes on sending nomination of Supreme Court hopeful Amy Coney Barrett to the full Senate, which must confirm her appointment

STRASBOURG: EU parliament announces winner of Sakharov Prize for Freedom of Thought 2020; the opposition in Belarus, and Polish LGBTI activists are among the nominees

BEIRUT: Binding consultations aimed at choosing a new prime minister scheduled to resume

GENEVA: Aid conference to shore up funds for Myanmar's Rohingya minority; the United Nations says it needs 1 billion dollars to help Rohingya who have fled to Bangladesh, but less than half has been delivered

ZURICH: Credit Suisse presents annual Global Wealth Report, including global trends in household wealth, as well as the world's millionaires

WASHINGTON: US reports weekly first-time unemployment claims

NEW YORK: Southwest Airlines presents third-quarter results

SYDNEY: Australian Bureau of ***Statistics*** releases business indicators, including business impacts of Covid-19

LONDON: German former tennis star Boris Becker defends himself against accusations that he did not cooperate sufficiently in connection with his insolvency proceedings; Becker was declared insolvent by a British court in 2017

VIENNA: The Viennale International Film Festival begins (until November 1)

INTERNATIONAL: International Stuttering Awareness Day

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FRIDAY, OCTOBER 23

LUXEMBOURG: EU environment ministers discuss the proposed European Climate Law and negotiate how deeply to cut greenhouse gas emissions; the European Commission had proposed a 55-per-cent reduction, the European Parliament 60 per cent

STUTTGART, GERMANY: Carmaker Daimler presents third-quarter results

PARIS: French car manufacturer Renault presents third-quarter results

NEW YORK: American Express presents third-quarter results

HELSINKI: Nordea banking group presents third-quarter results

LONDON: Barclays bank presents third quarter results

TOKYO: Japan reports consumer price index ***data*** for September

KOENIGSWINTER, GERMANY: EU ministers for industry and internal market affairs hold informal meeting

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SATURDAY, OCTOBER 24

CAIRO: Egypt parliamentary elections first phase; the second and final phase will be conducted on November 7-8

INTERNATIONAL: World Polio Day

INTERNATIONAL: United Nations Day, which marks the anniversary of the entry into force in 1945 of the UN Charter

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SUNDAY, OCTOBER 25

SANTIAGO: Chile holds national referendum on the constitution; a new constitution was one of the core demands of the demonstrators who took to the streets in autumn 2019

\* MINSK: Deadline set by opposition for authoritarian President Alexander Lukashenko to release all political prisoners and step down

\* TAIPEI: Taiwanese NGOs and Hong Kongers living in Taiwan will demonstrate to urge China to release 12 Hong Kong youths who tried to escape Hong Kong by speedboat in late August

VILNIUS: Lithuania holds second round of parliamentary elections

KIEV: Ukraine holds local elections

EUROPE: Clocks go back one hour across Europe

BERLIN: 12th World Health Summit goes digital

PORTIMAO, PORTUGAL: Formula One Portuguese Grand Prix

**Load-Date:** October 19, 2020

**End of Document**



[***Request for Information and Comments on Consumption of Certain Uncommon Produce Commodities in the United States; Establishment of a Public Docket***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60KR-6FC1-F0YC-N4B4-00000-00&context=1516831)

Impact News Service

August 11, 2020 Tuesday

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**Length:** 2490 words

**Body**

Washington, DC: This Proposed Rule document was issued by the Food and Drug Administration (FDA)

Action

Notification; establishment of docket; request for comments.Summary

The Food and Drug Administration (FDA, the Agency, or we) is opening a docket to receive information and comments related to certain produce commodities with no or low reported consumption in the database relied on to create the list of rarely consumed raw commodities that are exempt from the Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption regulation. FDA intends to use the information to consider whether any of these commodities should be added to the rarely consumed raw list.Dates

Submit either electronic or written comments by November 9, 2020.Addresses

You may submit comments as follows. Please note that late, untimely filed comments will not be considered. Electronic comments must be submitted on or before November 9, 2020. The [*https://www.regulations.gov*](https://www.regulations.gov) electronic filing system will accept comments until 11:59 p.m Eastern Time at the end of November 9, 2020. Comments received by mail/hand delivery/courier (for written/paper submissions) will be considered timely if they are postmarked or the delivery service acceptance receipt is on or before that date.Electronic Submissions

Submit electronic comments in the following way:

Federal eRulemaking Portal: [*https://www.regulations.gov*](https://www.regulations.gov) Follow the instructions for submitting comments. Comments submitted electronically, including attachments, to [*https://www.regulations.gov*](https://www.regulations.gov) will be posted to the docket unchanged. Because your comment will be made public, you are solely responsible for ensuring that your comment does not include any confidential information that you or a third party may not wish to be posted, such as medical information, your or anyone else's Social Security number, or confidential business information, such as a manufacturing process. Please note that if you include your name, contact information, or other information that identifies you in the body of your comments, that information will be posted on [*https://www.regulations.gov*](https://www.regulations.gov) If you want to submit a comment with confidential information that you do not wish to be made available to the public, submit the comment as a written/paper submission and in the manner detailed (see “Written/Paper Submissions” and “Instructions”).

Written/Paper Submissions

Submit written/paper submissions as follows:

Mail/Hand delivery/Courier (for written/paper submissions): Dockets Management Staff (HFA-305), Food and Drug Administration, 5630 Fishers Lane, Rm. 1061, Rockville, MD 20852. For written/paper comments submitted to the Dockets Management Staff, FDA will post your comment, as well as any attachments, except for information submitted, marked and identified, as confidential, if submitted as detailed in “Instructions.”

Instructions: All submissions received must include the Docket No. FDA-2020-N-1119 for “Request for Information and Comments on Consumption of Certain Uncommon Produce Commodities in the United States.” Received comments, those filed in a timely manner (see ADDRESSES), will be placed in the docket and, except for those submitted as “Confidential Submissions,” publicly viewable at [*https://www.regulations.gov*](https://www.regulations.gov) or at the Dockets Management Staff between 9 a.m and 4 p.m , Monday through Friday, 240-402-7500.

Confidential Submissions—To submit a comment with confidential information that you do not wish to be made publicly available, submit your comments only as a written/paper submission. You should submit two copies total. One copy will include the information you claim to be confidential with a heading or cover note that states “THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION.” The Agency will review this copy, including the claimed confidential information, in its consideration of comments. The second copy, which will have the claimed confidential information redacted/blacked out, will be available for public viewing and posted on [*https://www.regulations.gov*](https://www.regulations.gov) Submit both copies to the Dockets Management Staff. If you do not wish your name and contact information to be made publicly available, you can provide this information on the cover sheet and not in the body of your comments and you must identify this information as “confidential.” Any information marked as “confidential” will not be disclosed except in accordance with 21 CFR 10.20 and other applicable disclosure law. For more information about FDA's posting of comments to public dockets, see 80 FR 56469, September 18, 2015, or access the information at: [*https://www.govinfo.gov/content/pkg/FR-2015-09-18/pdf/2015-23389.pdf*](https://www.govinfo.gov/content/pkg/FR-2015-09-18/pdf/2015-23389.pdf)

Docket: For access to the docket to read background documents or the electronic and written/paper comments received, go to [*https://www.regulations.gov*](https://www.regulations.gov) and insert the docket number, found in brackets in the heading of this document, into the “Search” box and follow the prompts and/or go to the Dockets Management Staff, 5630 Fishers Lane, Rm. 1061, Rockville, MD 20852, 240-402-7500.For Further Information Contact

Samir Assar, Center for Food Safety and Applied Nutrition (HFS-317), Food and Drug Administration, 5001 Campus Dr., College Park, MD 20740, 240-402-1636.Supplementary InformationI. Background

In the Federal Register of November 27, 2015, we issued the final rule, “Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption” (80 FR 74354), which established at 21 CFR part 112 science-based minimum standards for fruits and vegetables grown for human consumption (produce safety regulation). The produce safety regulation is one of the seven foundational regulations that we issued as part of our implementation of the FDA Food Safety Modernization Act (Pub. L. 111-353), which directs FDA to better protect public health by, among other things, adopting a modern, preventive, and risk-based approach to food safety.

Produce is subject to the produce safety regulation (i.e , is “covered produce”) unless it is “not covered” because it is: (1) Rarely consumed raw (RCR) (§ 112.2(a)(1) (21 CFR 112.2(a)(1))) (the RCR exemption); (2) produced for personal or on-farm consumption (§ 112.2(a)(2)); or (3) not a raw ***agricultural*** commodity (§ 112.2(a)(3)). This request for information pertains to certain commodities that were not categorized as RCR.

The RCR list is a list of produce commodities that we determined are almost always consumed in the United States only after being cooked. Cooking is a kill step that can be expected to adequately reduce the presence of microorganisms of public health significance in most cases. FDA concluded that it is not reasonably necessary to subject RCR commodities to the produce safety regulation.

FDA's classification of produce as RCR was based on food consumption patterns reported in a robust dataset: The National Health and Nutritional Examination Survey/What We Eat in America (NHANES/WWEIA) dataset (Ref. 1), which is the most comprehensive, robust, and nationally representative dataset currently available on dietary intake in the United States. We also used the U.S Environmental Protection Agency's Food Commodity Intake Database (Ref. 2), which is a recipe database that identifies proportions of commodity ingredients in NHANES/WWEIA codes, and also identifies the cooking status (uncooked or cooked) and the food forms (e.g , fresh, frozen, canned) associated with each commodity ingredient. We provided background information and ***data*** analyses informing the inclusion of produce commodities in the RCR list in a memorandum (the Produce RCR memorandum) that we made available in the administrative record of the produce safety rulemaking (Ref. 3).

Note that the identification of a commodity on the RCR list does not mean the produce is never eaten raw or that it is not eaten raw, typically or occasionally, in specific regions of the United States (or among specific ethnic communities in the United States). The RCR list also does not reflect the form in which these commodities are consumed by populations in other countries.

Consumption patterns for a commodity had to meet three criteria that were used to determine if a commodity qualified as rarely consumed raw. First, the commodity had to be consumed uncooked by less than 0.1 percent of the United States population. Second, the commodity had to be consumed uncooked on less than 0.1 percent of eating occasions. Third, at least 1 percent of the weighted number of survey respondents must have reported consuming the commodity in any form for the ***data*** to provide a reasonable representation of how that commodity is consumed by U.S consumers. The purpose of the third criteria was to ensure that we had sufficient ***data*** to provide a reasonable representation of how the commodity is consumed in the United States for the purpose of exempting commodities from the coverage of the produce safety regulation (80 FR 74354 at 74388). For commodities not reported as consumed by at least 1 percent of the weighted number of respondents, we consider the overall reported rate to be too low to justify relying on these ***data*** as a reasonable representation of consumption among all U.S consumers.

Commodities that failed to satisfy all three NHANES/WWEIA food consumption criteria were not included in the RCR list. Several produce commodities satisfied the first two NHANES/WWEIA food consumption criteria for demonstrating that the commodities are almost always eaten only after being cooked, but are covered by the produce safety regulation because the 2003-2010 NHANES/WWEIA dataset did not demonstrate consumption of the commodities in any form by at least 1 percent of survey respondents. (See Response to Comments 68 and 69, 80 FR 74354 at 74392 to 74394.) In the remainder of this document, we refer to these commodities as “produce commodities with low reported consumption.” The following is an exhaustive list (1) of these produce commodities with low reported consumption according to the methodology used in developing the RCR list: Artichoke, globe‐type; artichoke, Jerusalem; arugula; balsam pear; boysenberry; Brazil nut; breadfruit; broccoli, Chinese; brussels sprouts; burdock; cabbage, Chinese, bok choy; cabbage, Chinese, mustard; cabbage, Chinese, Napa; cactus; celeriac; chayote fruit; chestnut; Chinese waxgourd; chrysanthemum garland; citron; cress, garden; currant; dandelion leaves; dasheen (taro) (leaves and corm); fennel, Florence; genip; gooseberry; grape, leaves; guava; huckleberry; jicama; kale; kohlrabi; kumquat; leek; lime; lotus root; lychee; macadamia nut; mulberry; mustard greens; palm heart, leaves; parsnip; passion fruit; persimmon; pine nut; plantain; pomegranate; quince; radish, oriental, roots; rhubarb; rutabaga; shallot; soursop; soybean, sprouts; starfruit; swamp cabbage; sweetsop; Swiss chard; turnip (roots and greens); and yam.

Some produce commodities did not appear in the NHANES/WWEIA at all; a commodity is added to NHANES/WWEIA partly based on the number of times the new food is reported and partly based on whether a new reported food has ***nutrient*** contents that are very different from the ***nutrient*** contents of a food that already exists in the database. In the remainder of this document we refer to these commodities as “produce commodities with no reported consumption.” Arrowroot and fiddleheads are examples of produce commodities with no reported consumption.

As we stated when we issued the produce safety final rule, we will consider updating the list of RCR commodities if new ***data*** become available (80 FR 74354 at 74390). We therefore invite interested persons to submit ***data***, information, and/or comment to support whether particular commodities with either no or low reported consumption in NHANES/WWEIA should be categorized as RCR. We seek commodity-specific ***data*** that would indicate whether that particular fruit or vegetable is consumed cooked by almost all consumers across the United States at this time. To be most useful, newly submitted ***data*** should be quantitative ***data*** of U.S consumption patterns that are sufficiently robust such that we could draw from them scientifically valid conclusions. The ***data*** should clearly indicate what proportion of the population consumes the commodity in the uncooked form and/or how often the commodity is consumed uncooked compared to the cooked form. Results of a well-designed consumer survey would be one possible type of ***data*** that may be submitted. Market ***data*** that closely parallels consumer consumption ***data*** may also be helpful. Another type of ***data*** that could be useful is ***data*** indicating that a commodity cannot safely be consumed uncooked, e.g , because in its uncooked state it contains toxic properties. We also request information on any kill steps other than cooking (e.g , fermentation that adequately reduces microorganisms of public health significance) that are always or almost always applied to produce commodities with no or low reported consumption and ***data*** on the extent to which this kill step is applied consistently across the industry.

For this Request for Information, FDA is requesting ***data***, information, and comments from all interested parties, including, but not limited to, academic and government researchers, industry, and any other source. When submitting information, please include details about how the ***data*** were ***collected***, including information on the study design and sample population, year(s) of ***data*** ***collection***, a detailed summary of the methods and measures used (e.g , any surveys utilized) and if available, the survey results (i.e , raw ***data***).II. References

The following references are on display in the Dockets Management Staff (see ADDRESSES) and are available for viewing by interested persons between 9 a.m and 4 p.m , Monday through Friday; they are also available electronically at [*https://www.regulations.gov*](https://www.regulations.gov) FDA has verified the website address, as of the date this document publishes in the Federal Register, but websites are subject to change over time.

1. Center for Disease Control and Prevention, National Center for Health ***Statistics***. “National Health and Nutrition Examination Survey/What We Eat in America (NHANES/WWEIA).” Available at [*https://www.cdc.gov/nchs/nhanes/wweia.htm*](https://www.cdc.gov/nchs/nhanes/wweia.htm) Last accessed July 23, 2020.

2. Environmental Protection Agency Office of Pesticide Programs and University of Maryland Joint Institute for Food Safety and Applied Nutrition. “What We Eat in America—Food Commodity Intake Database, 2005-2010 (WWEIA-FCID 2005-10).” Available at [*https://fcid.foodrisk.org/*](https://fcid.foodrisk.org/). Last accessed July 23, 2020.

3. Tijerina, M. J., J. Johanson, J. Spungen, and S. Briguglio, “Memorandum to the File—Produce Rarely Consumed Raw,” October 2015. Available in Docket No. FDA-2011-N-0921 at [*https://www.regulations.gov*](https://www.regulations.gov) Dated: July 28, 2020.Lauren K. Roth,Associate Commissioner for Policy.[FR Doc. 2020-16800 Filed 8-5-20; 4:15 pm]BILLING CODE 4164-01-P

**Load-Date:** August 15, 2020

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[***NEWS BULLETIN NO. 11077***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5Y87-76V1-JDKJ-13WP-00000-00&context=1516831)

HINA Digest

February 21, 2020 Friday

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**Length:** 6650 words

**Body**

Zagreb,Hrvatska21 February 2020 (Hina) -

**EU summit ends without agreement on 2021-27 budget**

ZAGREB, Feb 21 (Hina) - An extraordinary meeting of EU member states' leaders ended on Friday evening without agreement on the next EU budget.

The 27 leaders did not support the latest proposal that the 2021-27 budget be 1.069% of the gross national income.

Most of the summit, convened so that they could reach a compromise on the new Multiannual Financial Framework, passed in bilateral meetings, while the plenary kept being postponed all day.

After a new proposal was drawn up, with little changes made to European Council President Charles Michel's earlier draft, the EU leaders convened again but soon ended the meeting without reaching an agreement.

In the afternoon, the European Commission, which is providing Michelwith expert assistance, shared a document with a new proposal for the next EU budgetequivalent to 1.07% of the member states' GNI.

A technical document has been prepared, Michel's spokesman Barend Leyts told the press.However, he did not want to confirm the exact figure.

**Plenkovic says is trying to make sure MFF is favourable to Croatia**

ZAGREB, Feb21(Hina) -Prime Minister Andrej Plenkovic would not say on Friday morning whether the ongoing EU summit would result in a compromise on the 2021-2027 Multiannual Financial Framework (MFF).

The extraordinary summit, which began on Thursday afternoon in Brussels, continued for several hours until late Thursday evening and resumed on Friday morning.

On Thursday afternoon, European Council President Charles Michel held a series of bilateral meetings with heads of state or government of the 27 EU member states.

Commenting on his talks with Michel, Plenkovic said that he had highlighted the matters important for Croatia, such as cohesion policy and demographic revitalisation.

"We have tried to see to it that the final agreement brings about as good results as possible for Croatia" Plenkovic said.

**No agreement in sight for new EU budget**

Danish Prime Minister Mette Frederiksen, whose country is among those calling for cuts to the EU budget, said on Friday morning she did not believe EU member states would reach an agreement on the 2021-2027 Multiannual Financial Framework (MFF) this weekend.

We are still negotiating. Our position is clear. I am prepared to stay the whole weekend, but it is likely that a new extraordinary summit will be needed, Frederiksen said ahead of the second day of the extraordinary summit on the MFF. She added that she was not sure when the next summit could be convened.

Denmark, Austria, Sweden and The Netherlands, dubbed the frugal four, insist that allocations to the new EU budget should not exceed one percent of the Gross National Income.

**Friends of Cohesion meet**

ZAGREB, Feb 21 (Hina) - Member states of the informal group known as Friends of Cohesion met in Brussels on Friday asa plenary meeting of EU leaders, unable to reach a compromise on the next seven-year EU budget, was postponed until further notice.

The extraordinary summit on the Multiannual Financial Framework started on Thursday afternoon and, following the first plenary session, continued into the night with bilateral meetings between European Council President Charles Michel and all the leaders. A new plenary meeting was initially announced for 10am on Friday, then for 11am and for noon, and has now been postponed until further notice.

Michel obviously failed to reconcile the opposite views for now and hadnothing new to propose, so there was no point in the leaders meeting again at a plenary.

Meanwhile, the leaders of the countries known as Friends of Cohesion met to try to agree a common approach. Before them, the group nicknamed the Frugal Four did the same.

The Frugal Four countries Austria, Denmark, the Netherlands and Sweden insist that the 2021-2027 budget should be limited to one percent of Gross National Income, which means that the budget would be €75 billion smaller than the present one. The €75 billion is basically Britain's contribution to the EU budget. The four countries argue that the smaller Union means a smaller budget.

The four countries and Germany, which is somewhat more flexible, are entitled to a rebate, a sort of discount on payments into the EU budget to ensure that no member state has excessive allocations in relation to its wealth. The rebate was introduced in 1984 when Britain was allowed to reduce its contribution to the EU budget.

In its proposal for the next MFFthe European Commission thought that Britain's departure from the EU was an ideal opportunity to do away with the rebate altogether. This met with strong resistance from these countries, which led Michel to propose a gradual reduction of the rebate.

Michel has proposed that the MFFfor 2021-2027 amounts to €1,094.8 billion, which is equivalent to 1.074% of the 27 member states' GNI.

**Milanovic appoints staff,special advisers at President's Office**

ZAGREB, Feb 21 (Hina) - President Zoran Milanovic appointed his staff and special advisers on Friday.

Orsat Miljenic will serve as chief of staff and adviser on foreign and European policy, Nikola Jelic will be spokesman for the President's Office and Dragan Lozancic will become defence and national security adviser.

Melita Mulic advise the presidenton issues relating to human rights and civil society andJadranka Zarkovic will serve asadviser on education.

The president will have three special advisers: Marijan Marekovic on Homeland War veterans, Velibor Mackicon the economy and Julije Domac on energy and climate.

**President appoints Robert Hranj as armed forces' chief of staff**

ZAGREB, Feb 21 (Hina) - The President of the Republic and Commander in Chief of the Croatian Armed Forces, Zoran Milanovic, on Friday appointed Vice Admiral Robert Hranj as Chief of the General Staff of the Croatian Armed Forces.

The appointment came after the parliamentary Defence Committee unanimously supported the government's proposal to appoint Hranj to the post. The decision on the appointment enters into force on March 1.

The President's Office also said in a press release that Milanovic met with Defence Minister Damir Krsticevic, the outgoing Chief of the General Staff, General Mirko Sundov, and Hranj, who currently serves at Director of the General Staff. They informed the President about the situation in the Armed Forces and development plans.

Taking into account the existing short-term obligations of Croatia, Milanovic issued an order on the assignment of Croatian troops to NATO's Resolute Support peacekeeping mission in Afghanistan, under which up to 110 Croatian military personnel will be deployed for up to seven months, while medical staff will have tours of duty of up to four months.

"The future participation of Croatian military personnel in the peacekeeping mission in Afghanistan will be discussed with a view to ending Croatia's participation in the mission," the press release said.

**PM: New chief state prosecutor to be appointed by mid-April at latest**

ZAGREB, Feb 21 (Hina) -Prime Minister Andrej Plenkovic on Friday said that a new chief state prosecutor would be appointed by mid-April at the latest, without speculating on any names at the moment.

"You are awarethat we changed the law. Now we are in the phase of parliament relieving Drazen Jelenic of duty. After thatthe State ProsecutorialCouncilwill invite applications and then decisions will be made," Plenkovic told reporters in Brussels where he was attending an extraordinary EU summit on the new Multiannual Financial Framework.

He assessed that the new chief state prosecutor could be selected by mid-April at the latest, adding that "it would be a little pretentious now to just pull a name out of the hat."

Former chief state prosecutor Drazen Jelenic on Wednesday submitted his resignation after it was revealed that he is a member of a Masonic lodge.

Plenkovic also commented on requests by the Srebrnjak children's hospital for him to help resolve the problem at that hospital after itssteering committee annulled a selection procedure for the hospital's director, meaning that the entire process has been returned to square one.

"We are taking into account that there are some responsibilities at the national level while others are at the city level," he underscored and recalled that he personally attended a signing ceremony for the Children's Centre for Translational Medicine at the Srebrnjak hospital which is being financed by EU funds.

"I believe that what the experts and doctors have achieved, who worked on that for years, is essential for Croatian medicine, essential forpediatrics. In the end, I hope that this operational problem will be resolved and the programmerealised," said Plenkovic.

**Gov't adopts decision on establishing former president's office**

ZAGREB, Feb 21 (Hina) - The government adopted a decision at a telephone session on Friday on establishing the former president's office upon the end of Kolinda Grabar-Kitarovic's term, it was stated in a press release by the government's Office for Public Relations.

Grabar-Kitarovic, whose term of office ended on 18 February, submitted a request to the government to exercise her right to be assigned an office upon the end of her term.

Under the government's decision, the former president's office will be based in Zagreb. A state administration body is required to allocate a property for the office within the next 30 days.

The decision specifies that this year the former president's office will be financed from the 2020 state budget's reserves.

It also specifies that the office has to submit its financial plan and annual work programme to the Parliament, the government, and the Ministry of Finance within 30 days from the entry into force of the decision.

**Parliament: Vote on population census bill postponed until next Friday**

ZAGREB, Feb 21 (Hina) - The Croatian parliament has postponed until next Friday a vote on 20-odd items on its agenda, including a bill on the population census scheduled for the spring next year, which sparked a heated debate and led to three deputies of the Independent Democratic Serb Party (SDSS) leaving the chamber.

"My colleagues from the HDZ group have informed me that the group representing the ethnic minorities will hold additional consultations, so the vote will be next Friday," Speaker Gordan Jandrokovic said after a break which was preceded by a heated debate.

Things escalated during the debate on amendments to the census bill tabled bythe ethnic minorities group. The proposed amendments were first rejected by a government representative and then by MPs, after which Vladimir Bilek, MP for the Czech and Slovak minorities, requested a recess so that the group could agree on how to vote on the bill.

Rejected was the amendmentin which the minority MPs proposed that citizens be allowed to say that they have more than one mother tongue and the amendment concerning the appointment of census takers from among the ethnic minorities.

Zdravko Zrinusic, state secretary at the Ministry of Finance, said that everyone is free to declare their mother tongue and that the introduction of "two modalities" could lead to unreliable results and unclear answers, as a result of which ***data*** might not be comparable with previous census ***data***.

Speaking of census takers, Zrinusic said that before every census the National Bureau of ***Statistics*** prepares instructions specifying the criteria for census takers and that it will be so this time too.

"During the selection processcounty election commissions will be required to take into account the representation of members of ethnic minorities among census takers in areas populated by ethnic minorities," he said.

Branko Bacic of the ruling Croatian Democratic Union (HDZ) said that next year's census would be the fourth since 1991 and that the same rules had applied to all the previous censuses.

Parliament voted on four of 29 items planned and added 12 more items to the agenda, including a motion to relieve Drazen Jelenic of his duties as chief state attorney.

**Bernardic calls forelection overcrisis in parliament, prosecutor's office**

ZAGREB, Feb 21 (Hina) - Social Democratic Party (SDP) leader Davor Bernardic on Friday claimed in parliament that the key institutions in the country - the Sabor and the State Prosecutor's Office (DORH) - were in crisis and that it was necessary to immediately call a parliamentary election.

"A crisis exists in the country's key institutions and no one can control what is happening anymore, hence we are calling for an immediate election," Bernardic said after avote on about 20 items on the agendawas postponed and after the chief state prosecutor resigned earlier in the week.

He said he wascalling for an electionbecause this is the second Friday in a row that the ruling parties do not have a majority to vote and because of the fact that DORH has been left without a head following Drazen Jelenic's resignation.

**Esih comments on Jelenic affair**

MP Bruna Esih (Independents for Croatia) also commented on Jelenic's resignation, underscoring that no one will answer for the omission of a security check when Jelenic was appointed.

"For days we've been hearing analyses in parliament and in the media how Jelenic's membership to the Masons is a great danger for the independence of the judiciary, yet in the end he was'draconically' punished by being made the deputy to the chief state prosecutor," Esih said.

**Bulj: Election will show what it is like to live in Croatia**

MP Miro Bulj (Bridge) said that the ruling majority had performed anact todayregarding the vote on the population census billand that in 2021 it will be statistically seen what they have made of Croatia.

The unnatural coalition of the ruling majority has implemented a policy of emigration like that ofthe 1960s in Yugoslavia, only now entire families are emigrating, Buljsaid.

He added that the election will show how disastrously people are living in Croatia because of their policy.

The HDZ whip, Branko Bacic, said that despite the failed vote today, the ruling majority was not in question.

**Health minister decides toestablish quarantine unit at Zagreb hospital**

ZAGREB, Feb 21 (Hina) - Health Minister Vili Beros on Friday adopted a decision to establish a quarantine unit as a preventative safety measure to protect citizens from any possible threat of the coronavirus, at the Croatian Institute for Public Health's recommendation, the ministry said.

The quarantine unit has been set up at the Dr Fran Mihaljevic Infectious Diseases Hospital in Zagreb for anyone who is suspected of or is determined to have been in touch with infected or possibly infected persons while spending in time in areas considered to be the source of the disease.

Quarantine will last in line with health assessments. The decision enters into force today, the ministry underscored.

"To date, luckily, there aren't any people infected with the coronovirus in Croatia. However, we do not want to leave anything to chance in the protection of Croatian citizens from this health threat. The experience of neighbouring Italy and some other communities demand us to play it extra safe and, in addition to everything undertaken so far, I have decided to establish a quarantine unit as an additional preventative measure," said Minister Beros.

**GLAS calls for elective subject for pupils not attending Religious Education**

ZAGREB, Feb 21 (Hina) - GLAS MPsAnka Mrak Taritas andVesna Pusic on Friday said that the their caucus has sent a draft conclusion to parliament for the introduction of an elective subject in primary schools for pupils who do not attend Religious Education classes, warning that it is essential to introduce Civic Education as a subject in schools.

The two MPs called on the Ministry of Education and Science to adapt lesson plans and programmes for primary schools and to ensure conditions so that every pupil who does not attend Religious Education hasaccess to another elective subject during that time.

They told a press conference that the majority of schools in Croatia only provide Catholic Religious Education and pupils who do not wish to take that as an elective subject due to religious, worldview or other reasonsare disadvantaged. Those pupils are discriminated against and spend a certain number of hours in school without any educational content, the MPs said.

GLAS believes that "Religious Education does not belong in school but in the church which is why we called for a review of the Vatican agreements a year ago," Mrak Taritas said and added that fewer and fewer children chooseReligious Education and spend two hours a week inschooldoing nothing. "That is why we are proposing that an elective subject of their choice is provided. Apart from that, Religious Education was once either the first or last lesson of the day, which is no longer the case," they warned.

Mrak Taritas said that Education Minister Blazenka Divjak had absorbed HRK 27 million to introduce Civic Educationbut decided to re-allocate that money "to several other options," and in the end no one will getanything.

Pusic underscored that the minimum would be for schools and the ministry to ensure that instead of sitting in the corridor two hours a week, pupils are provided with some other elective subject. The other option, she added, is for Religious Education classes to be either the first or last lesson of the day.

She in particular emphasised the importance of introducing Civic Education in schools. "That is a lot more important than all the tablets and IT so that they can at least have a minimum preparation to be informed citizens, to know what theychoose, where they live and how,in thoseconditions, they can behave and realisetheir needs and interests," warned Pusic.

The fact that there is no Civic Education in schools is perhaps the biggest and poorest mistake this government has made, she concluded.

**Opposition seeks inquiry commission for organisations that dissuade women from abortion**

ZAGREB, Feb21(Hina) - Twenty-two MPs on Friday tabled a proposal to set up an inquiry commission into the financing, work and influence of organisations which consult pregnant women in Croatia in order to prevent quackery and disinformation about abortion.

Independent MP Bojan Glavasevic, Sabina Glasovac (SDP) and Vesna Pusic (GLAS) told the pressthataccording to reports in Croatian and foreign media, so-called pregnancy crisis centres were spreading in Europe and Croatia as part of a global coordinated project aimed at disinforming women about their reproductive rights and health as well as introducing additional obstacles to abortion.

Those centres are organisations that try to dissuade women who are thinking about abortingby providing incorrect information and advice on reproductive health and medical services, which denies women the legal right tomedical services and information based on scientific facts, they said.

There is evidence that some of those pseudo-medical institutions are receivingmore and more funds from foreign organisations and governments, notably from the USas part of its policy to deny the right to abortion around the world, the three MPs added.

Such practice is dangerous to women's reproductive rights and health, as warned by the European Parliamentary Forum for Sexual andReproductive Rights in a letter to the European Commission, the MPs said.

They recalled that underrecommendations bythe UN Committee on the Elimination of Discrimination against Womenpublishedin July 2015,Croatiashould stop retrograding with regard tosexual and reproductive health and that this included access to safe abortion.

The three MPs said the organisations that offered reproductive health advice and spread disinformation were exempt from mandatory oversight for institutions offering medical advice.

The proposal was signed by MPs from GLAS, IDS, HSS, HSU, Bridge, SDP, SDSS, SNAGA, Democrats, New Politics and independents Glavasevic and Marko Vucetic.

**Ex-*agriculture* minister fined €400 over discrepancies in declaration of assets**

ZAGREB, Feb 21 (Hina) - The Conflict of Interest Commission on Friday fined former ***agriculture*** minister Tomislav Tolusic HRK 3,000 (€400) because of discrepancies in his declaration of assets.

The Commission found that Tolusic did not declare the correct surface area of his house and surrounding grounds in Virovitica, 150 km east of Zagreb.

It did not find any favouritism between Tolusic and the Horvat construction company, which had built his house and with which he was in a business relationship as head of Podravina-Virovitica County, because all the accounts were settled.

Tolusic said that he filled in the declaration of assets form incorrectly, that it was not his intention, and asked the Commission to fine him.

**Croatia to start building 300 new socially-subsidised flats in H1**

ZAGREB, Feb 21 (Hina) - The Croatian Real Estate Agency (APN) director, Dragan Hristov, on Friday outlined activities of this state-owned agency concerning the POS socially-subsidised housing construction scheme in the first half of 2020.

Blocks of flats under this scheme are being built at about 30 locationsthroughout Croatia. Furthermore, the process of obtaining construction permits for 13 locations is under way, andthe process of selection of builders for POS flats at six locations has also begun. Plans are also in the pipeline for the construction ofPOS flats at 15 more locations.

The construction of 300 flats under the POS scheme is to start in the first half of 2020.

The Construction and Zoning Ministry's State Secretary, Zeljko Ulrih, presented programmes to provide accommodation for civil servants, notably teachers, doctors, healthcare professionals, cultural workers, police staff,on demand in some underdeveloped areas of Croatia.

**Butkovic signs HRK 99 mn agreement for integrated mobility project for Sibenik**

ZAGREB, Feb 21 (Hina) - Minister of the Sea, Transport and Infrastructure Oleg Butkovic signed an agreement on Friday for a HRK 99 million project aimed at increasing integrated mobility and the number of passengers using public transport in an around the central Adriatic city of Sibenik, HRK 73.7 million of which is a European grant.

This is a comprehensive integrated project that involves several activities and stages and is also a pilot project, Butkovic said at the signing ceremony in Sibenik.

The project involves preparing documentation on the organisation and integration of public transport in the city of Sibenik and the development of an app so that consumers are better informed and which will facilitate the use of various transport services.

The app will integrate various transport modes and information and will enable paying for tickets in public transport as well as payments in public parking lots. The project also envisages the purchase of 11 low-floor busses on 7 routes and the procurement of material and equipment to refurbish 17 bus stops with info-displays.

The project also includes the construction and equipping of a logistics centre which entails the construction of an underground parking lot, and reconstruction of the square above it.

"This project will completely change the face of Sibenik and significantly improve the infrastructure standard of the city," Mayor Zeljko Buric said.

The head of the Central Finance and Contracting Agency for EU funds, Tomislav Petric, said that HRK 420 million arrived in the city very quickly and that this is the 13th project agreement for Sibenik.

Minister Butkovic also signed agreements for the funding for the reconstruction of 3 ports in Sibenik-Knin County worth about HRK 13 million.

**DZS: Croatia's annual inflation reaches 2% in January**

ZAGREB, Feb 21 (Hina) - Croatia's annual inflation rate, as measured by the consumer price index, was 2.0% in January 2020, the National Bureau of ***Statistics*** (DZS) said on Friday.

The annual rise in consumer prices was mostly driven by the rise in transport prices (+4.9%), on the backof the rise in prices of fuels and lubricants for passengervehicles (+9.8%). This was the result of a considerable drop in prices of Brent crude oil at the end of 2018, analysts atRaiffeisen bank(RBA) said.

Compared with January 2019, prices of food and soft drinks increased by 3.4%, with prices of meat going up by 8.6% and those of fruit by 11.7%. Prices of housing, water, electricity and gas were 1.6% higher and those of hotel and restaurant services were up 2.7%.

Year on year, consumer prices rose, albeit at a slower rate, in all other categories except recreation and culture, which recorded a decrease of 0.4%.

Excluding energy, consumer prices increased by 1.6% overall, and without energy and food, they were 0.7% higher.

Compared with December 2019, consumer prices fell by 0.3% on average.

**January inflation picks up in EU,euro area;Croatia above EU average**

ZAGREB, Feb21(Hina) - Annual inflation picked up slightly in both the European Union and the euro area in January 2020,with Croatia exceeding the EU average, ***Eurostat*** said on Friday.

The EU28 annual inflation rate, as measured by the Harmonised Index of Consumer Prices (HICP), picked up to 1.7% (+0.1 percentage points,pp) in January.

The same increase was also observed in the euro area, where inflation reached 1.4%, aspredicted in ***Eurostat***'s preliminary assessment last month.

In the euro area, prices of food grew the most, by 2.3% compared to the same period in 2019. Energy prices increased by 1.9%.

In January, the highest contribution to the annual euro area inflation rate came from services (+0.68pp), followed by food, alcohol andtobacco (+0.40 pp), and energy industrial goods (+0.19 pp).

**Croatia above EU average**

The annual inflation rate in Croatia as measured by the HICP picked up to 1.8% in January 2020 from 1.3% in December 2019. In January 2019 the rate was three times lower, according toEurostat's report.

Among EU member states, the lowestannual inflation ratewasregistered in Italy (0.4%), the third largest euro area economy andone of Croatia's principal trading partners. It wasfollowed by Cyprus (0.7%), Denmark and Portugal (both 0.8%).

Germany, an important trading partner for Croatia and the biggest economy in the euro area, had an inflation rate of 1.6%. The annual inflation rate in Slovenia was 2.3%.

The highest annual inflation rates were recorded in Hungary (4.7%), Romania (3.9%), Czechia and Poland (both 3.8%).

Compared with December, in the first month of 2020 annual inflation fell in five member states, remained stable in five, and rose in eighteen.

**Union: Workers losing out because gov't not protecting *collective* bargaining**

ZAGREB, Feb21(Hina) - The latest ***data*** indicates that there are 120,000 fewer workersin Croatia than there were in 2000 benefiting from ***collective*** agreements, and the SSSH union federation is appealing to the government to stop appeasing demands by employers and to create a stimulating legislative framework for ***collective*** bargaining.

"***Collective*** agreements...contribute to a fairer division of newly created values and greater coverage of workers benefiting from ***collective*** agreements," SSSH leader Mladen Novosel said on Friday following a press releaseissued by the European Trade Union Confederation (ETUC).

ETUC, citing the latest figures,said on its website that "at least 3.3 million fewer workers are benefiting from a ***collective*** bargaining agreement across the European Union today compared to the beginning of the century."

"***Collective*** bargaining coverage is down in 22 of the EU’s 27 member states since 2000 as a result of deliberate policies implemented by member states and endorsed by the European Commission, often because of a mistaken idea that high levels of ***collective*** bargaining are bad for the economy," ETUC said.

The facts show that the opposite is true and that strong ***collective*** bargaining systems contribute to higher wages and better working conditions, as well as to a fairer society and to better economic performances.

The biggest fall in the percentage of workers covered was in Romania (100% to 23%), Greece (100% to 25%) and Bulgaria (56% to 23%), ETUC said, citing figures from the University of Amsterdam. In Croatia coverage fell from 64% to 45% or 120,000 fewer workers enjoying the benefits of ***collective*** bargaining.

There is now a huge disparity in coverage between countries across the EU, with just 7% of workers benefiting from ***collective*** bargaining in Lithuania compared to 98% in Austria.

**Pension fund receives ISO/IEC certification**

ZAGREB, Feb 21 (Hina) -The Croatian Pension Insurance Institute (HZMO) has received the ISO/IEC certificationfor its information security management system (ISMS) and has become the first state agencyto have implemented theISO 27001 standard.

HZMO director Ivan Serdar was presented with the certification on Friday by Dejan Grahovac, deputy director for international accreditation by Croatia's branch of Bureau Veritas, a world leader in testing, inspection and certification services.

HZMO implemented its entire information security management system according to the internationalISO/IEC 27001:2013 standard and has become the first state body to do so.

The certification confirms adherence of managing information security tothe standards in information technology such as managing human potential, supervision, strategic analysis and business-information security, HZMO said in a press release.

**INA can't exclude personal information leak during cyber attack**

ZAGREB, Feb 21 (Hina) - The INA Group on Friday saidthat it wasin the process of remedying its IT systems which were exposed to a cyber-attack last week, underscoringthat it cannot exclude the possibility of unauthorised access to personal ***data*** occurring during the attack.

"We have begun with the system recovery and are working to restore services that did not work from time to time," INA said on its website.

INAreported earlier that it had informed the relevant authorities and that it wasfully cooperating in that regard.

"The attack and possible unauthorized access to ***data*** is being investigated.As with any cyber-attack, we cannot at this point exclude the possibility of unauthorised access to personal ***data***," the leading oil and gas group added.

INA reassures the general publicthat market supply is secure and fuel sales at retail outlets are continuing without any interruptions.

"Also, all payments, whether in cash, INA card or bank card, are secured," INA assured.

On February 16, theINA Group statedthat it hadbeen the target of a cyber-attack since February 14.

**MEPs urge *agriculture* minister to stop illegal captivity of bears in Croatia**

ZAGREB, Feb 21 (Hina) -Fifteen members of the European Parliament Intergroup on the Welfare and Conservation of Animals have appealed in a letter to Croatian ***Agriculture*** MinisterMarijaVuckovic to ensure that Croatia implements the Animal Protection Act and puts an end to illegal captivity of the brown bear.

The Croatian association Friends of Animals said on Friday that the Dutch MEP and chairwoman of the Intergroup, Anja Hazekamp, recalled in the letter to Minister Vuckovic that in October 2017 Croatia adopted the Animal Protection Act which bans holding and showing bears outside registered zoological parks and shelters, which included a transition period until 31 December 2018, warning however that bears continue to be illegally held in captivity in Croatia.

Two brown bears are still being held captive as atourist attraction at the Macola restaurant in Korenica, on the road to the Adriatic coast, in a pound that is not registered either as a zoological park or as an animal shelter, which constitutesillegal captivity under the law, and the relevant authorities have not ordered their confiscation.

In addition to the two bears in Korenica, another bear is being kept by a family in Ruscica.

The Croatian association supported the MEPs and called for the immediate relocation of the bears toshelters.

The MEPs also warned of the need to protect other wildlife, including big cats.

**Zagreb hosting Festival of EU Archaeology**

ZAGREB, Feb21(Hina) - The Zagreb Archaeological Museum is hosting the Festival of EU Archaeology on the occasion ofCroatia's presidency of the Council of the EU in the first half of this year with the aim to showmember states'archaeological heritageand recall the common foundations which shaped the values of present-day Europeans.

From February through June, the festival will compriseover 50 exhibitions, lectures, symposia, workshops and round tables.

As of February 7, Slovakia and Malta areshowing the secrets from their past, to be followed in March, April and May by Austria, Bulgaria, Spain, the Netherlands, Greece, Lithuania, Belgium, Latvia, Romania, France, Finland, Hungary, Poland, Czechia, Estonia and Italy, while Ireland, Denmark, Sweden, Portugal, Luxembourg, Slovenia, Cyprus and Germany will do so in June.

The festival has been co-organised by theEuropean Association of Archaeologists and is being held under the auspices of the European Parliament, in cooperation with more than 100 European institutions and the embassies of all EU member states in Croatia.

**Zagreb National and University Librarycelebrates 413th anniversary**

ZAGREB, Feb21 (Hina) - The National and University Library (NSK) in Zagreb celebrates its 413th anniversary this year, and last year it registered more than 9 million viewsof its digital content, more than 160,000 individual user entries, while more than 60,000 itemswere added to the national ***collection*** Croatica.

"NSK is moving with the times, developing in all areas of librarianship and information services, and keeping up with the highest standards of librarianship," Culture Minister Nina ObuljenKorzinek said in the Croatian State Archives on Friday at a ceremony markingNSK Day, adding that this anniversarytestified to the effort to maintain Croatian identity, culture, and society.

NSK acts as the main partner in the realisation of aproject todigitalisecultural heritagefinanced by an EU grant worth more than HRK 40 million.

Since 1 January, the NSK building is one of the central locations for the Croatian presidency of the Council of the EU.

Last year, NSK registered more than 9 million views of its digital content, whilemore than 30,000 itemswere added to the digital ***collection*** Croatica. At theend of 2019, it contained117,235 library itemswith more than 150,000metadata records.

The day of the largest and the oldest of Croatia's libraries is celebrated in commemoration ofthe date whenthe first book in the Croatian language was printed in 1483 (Misal po zakonurimskogadvora). It is also the oldest book printed intheGlagolitic scriptand one of the most valuable worksof Croatian culturestored at the NSK. Only 11 incomplete copies of the bookhave been preserved, six of which are located in Croatia, and five abroad.

**Croatia's honorary consul in Barcelona under investigation for money laundering**

ZAGREB, Feb 21 (Hina) - Catalan police are investigating Croatia's honorary consul in Barcelona over possible money laundering for a local criminal gang, a source from Catalonia's autonomous police told Hina on Friday.

Consul Juli Barcena San Jose is suspected of receiving money from drug sales and investing it in real estate and luxury cars, thus covering up the trail of the illegally gains.

Also under investigation are the honorary consuls of Albania and Mali, Jose Maria Calmet Iglesias and Jose Luis Lopez Fernandez, respectively. Both are suspected of the same crime.

Catalonia's autonomous police Mossos d’Esquadra said on 18 September 2019 that they had arrested four members of a known family clan from Catalonia for money laundering and drug trafficking. An investigation uncovered their business ties to the consuls.

Three honorary consuls stationed in Barcelona are under investigation, the Catalan police said in a press release.

A police source told Hina today Croatia's consul was under investigation while a diplomat said Croatia would request his dismissal for damaging Croatia's reputation.

Neither Barcena San Jose nor the Croatian consulate in Barcelona have issued any statement.

Honorary consuls are usually not nationals of the state they represent but citizens of the territory they are on, in this case Catalonia, i.e. Spain. They are usually renowned in their communities and their main job is to encourage economic and cultural cooperation between the two countries and to help the citizens of the country they represent.

Barcena San Jose is an entrepreneur and has held the post of Croatia's honorary consul since May 2002.

**In other news:**

**Nine in ten Croats are milk consumers - survey**

ZAGREB, Feb21(Hina) - Nearly 90% of the Croatians consume milk and dairy products, according to findings of a survey conducted by theJa Trgovac magazine and Hendal market research agency.

The findings of the survey, conducted on a national representative sample last November, show that 89.7% of those polled said that they consumedmilk.

Of them, 22.8% use milk only in combination with coffee, and 66.9% consume milk otherwise.

Nearly one third, 64.1%, consume milk every day, and a quarter of the respondents drink milk a few times a week.

**Long-life milk more popular than fresh milk**

Also, ultra-high-temperature processed (UHT) milk seems to be more popular than fresh milk, since 71.6% of those polled said they consumed long-life milk.

**Cheese most favourable dairy product**

When it comes to dairyproducts, 89.2% of those polled eat cheese, and 82.4% say they consume yogurt.

Nearly three quarters (72%) like ice-creams,71.9% consume dairy spreads and 69.9% say they eat sour cream.

A mere 2.3% say they never consume dairy products.

**Croatia gets green light for WRC candidate race**

ZAGREB, Feb 21 (Hina) - TheWorld Rally Championship's (WRC) leaderOliver Ciesla visited Zagreb and made an official offer to Croatia to host theWRC2020 candidaterace.

Croatia has never been closer to organising a rally of the second most-watched octane sport in the world, Ciesla confirmed. Heheld a series of meetings with the President and the General Secretary of the Croatian Automobile and Karting Federation (HAKS), officials from the City of Zagreb, and potential promoters.

October was suggested as the potential date of the candidate race, and Zagreb got the opportunity to host the WRC already this year. Mayor Milan Bandicpledged his full support for the project and expressed his desire for Zagreb to appear on the map of a sport with a fan base of over80 million.

"We plan to come to the candidate rally, and if all goes well, by the end of the year all doors will open for Croatia to become a part of the World Rally Championship in the future," said Ciesla.

"After seven years of talks about hosting the WRC in Croatia, we have an official offer to undergo the final test, after which the WRC's door opens. The significance of this event for Croatia is confirmed by the support of the Croatian government, the City of Zagreb, and other institutions," said HAKS president DavorinStetner.

The World Rally Championship was established in 1973, and the current champions are the Estonian crewTanak/Jarveoja.

**ZSE indices close day in opposite directions**

ZAGREB, Feb 21 (Hina) - The Zagreb Stock Exchange (ZSE) index Crobex went up 0.04% to 2,021 points on Friday, while the Crobex10 dipped 0.08% to 1,201 points.

Regular turnover reached HRK 9.16 million, around HRK 6 million less than on Thursday, and another HRK 3.63 million was generated in block trading with HT telecom's shares.

The largest turnover was generated by the HT in regular trading as well, HRK 1.5 million in total, and the price of HT shares increased by 0.28% to HRK 151.5.

(€1 = HRK 7.441778)

**THIS BULLETIN INCLUDES ITEMS RELEASED BY 2100 HRS ON FRIDAY**

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Masthead Brief News Bulletin is published by the Croatian News Agency HINA Marulićev trg 1610 000 ZagrebCroatia web:[*www.hina.hr*](http://www.hina.hr) mail: [*hina@hina.hr*](mailto:hina@hina.hr) phone: (+385 1) 48 08 660; fax (+385 1) 48 08 822 Publisher: Branka Gabriela Valentić, DirectorEditor in Chief: Serđo Obratov Bulletin Editor: Marija Šestan

**Load-Date:** February 21, 2020

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[***UK Intellectual Property Office grants trade mark "Working Dog Food Co." to Jordan Szyndra***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6073-8Y21-F0YC-N3CN-00000-00&context=1516831)

Impact Financial News

June 26, 2020 Friday

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**Length:** 25722 words

**Body**

London:Jordan Szyndra , has been granted trademark (UK00003498812) titled as 'Working Dog Food Co.' from the UK Intellectual Property Office.

Status: Registered

Class/es: Class 31Abalones [live]; Abrasive liners for cat litter pans; ***Agricultural*** and aquacultural crops, horticulture and forestry products; ***Agricultural*** grains for planting; ***Agricultural*** produce (Unprocessed -); ***Agricultural*** seeds; Algae for human consumption; Almonds [fruits]; Aloe vera, fresh, for food; Aloe vera plants; Anchovy, live; Animal beverages; Animal embryos; Animal forage (Lime for -); Animal litter; Animal litter for cats; Animal litter made from hydrated calcium silicate; Animals (Live -); Animals (Menagerie -); Apple tree seeds; Apple trees; Apples (Fresh -); Apples (Unprocessed -); Aquarium fish; Ark-shells [live]; Aromatic sand for pets [litter]; Aromatic sand [litter] for pets; Arrangements of dried flowers for decorative purposes; Arrangements of fresh fruit; Arrangements of natural flowers; Artichokes, fresh; Artificial milk prepared for use as a feeding stuff for calves; Asparagus (Fresh -); Asparagus plant material (Fresh -); Asparagus plants; Asparagus (Unprocessed -); Baby corns, fresh; Bagasses of cane [raw material]; Bagasses of cane [raw materials]; Bait (Fishing -), live; Bait [live]; Bait, not artificial; Baled air-cured hay; Bark for mulches; Bark for use as animal litter; Bark for use in mulching; Bark mulches; Bark-based products for use as animal litter; Bark-based products for use in mulching; Barks (Raw -); Barley; Barley for use in brewing beer; Barley (Unprocessed -); Beans, fresh; Beans (Locust -); Bedding and litter for animals; Bedding material for fowl; Bedding materials for animals; Bee pollen being raw material for industrial use; Bee pollen (Raw -); Bee pollen (Unprocessed -); Beef cattle; Beer barley; Bees; Beet; Beet, fresh; Berries, fresh; Berries, fresh fruits; Berries (Raw -); Berries (Unprocessed -); Betel nuts, fresh; Beverages for animals; Beverages for cats; Biodegradable mulching plates made of wood fibres; Bird food; Bird seed; Boars for breeding purposes; Bouquets of dried flowers; Bouquets of fresh flowers; Bred stock; Breeder birds; Brine shrimp for fish food; Bulbs; Bulbs (Flower -); Bulbs for ***agricultural*** purposes; Bulbs for horticultural purposes; Bulbs for planting; Bulbs (Plant -); Bulbs (Plant -) for ***agricultural*** use; Bulbs (Plant -) for horticultural use; Bumblebees; Bushes; Bushes [shrubs]; Cake (Rape -) for cattle; Calamari, live; Cannabis plants; Cannabis, unprocessed; Canned foodstuffs for cats; Capelin, live; Capsicums; Carp [live]; Cat biscuits; Cat food; Cat litter; Cat litter and litter for small animals; Cat litters; Cat treats [edible]; Catnip; Catnip [fresh]; Cats; Cattle cake; Cattle feed; Cattle food; Cellulose for use as animal bedding; Cellulose sheets for use as animal bedding; Cherries (Fresh -); Cherries (Unprocessed -); Chestnuts, fresh; Chicks; Chicory, fresh; Chicory roots; Chicory [salad]; Chillies; Chillies (Unprocessed -); Chinese artichoke, fresh vegetable; Chinese roses; Chinese roses, natural; Chinese toon sprout, fresh vegetable; Chopped straw for animal bedding; Christmas trees; Citrus fruit; Citrus fruit, fresh; Climbing plants; Cocoa beans, raw; Cocoa beans (Unprocessed -); Cocoanut shell; Coconut fibre mulches; Coconut shell; Coconut shells; Coconuts; Cocoons for egg production; Cocoons for silkworm breeding; Cola nuts; Cones (Hop -); Cones (Pine -); Conifer trees; Copra; Cork (Rough -); Corms; Corn husks, dried, for decoration; Corn (Unprocessed -); Courgettes (Fresh -); Crabs [live]; Crabs, live; Crayfish, live; Crop seeds; Crustaceans, live; Cucumbers, fresh; Culinary herbs (Fresh -); Cut Christmas trees; Cut flowers; Cuttings (Plant -); Cuttle bone for birds; Cuttle bone [for cage birds]; Cuttlebones for birds; Cuttlefish bones; Decorative woodchip mulch; Digestible chewing bones and bars for domestic animals; Distillery waste for animal consumption; Dogs; Draff; Dried boutonnieres; Dried cattails for decoration; Dried corn husks for decoration; Dried corsages; Dried flower arrangements; Dried flower wreaths; Dried flowers; Dried flowers for decoration; Dried herbs for decoration; Dried plants; Dried plants for decoration; Durian saplings; Edible baits; Edible bird treats; Edible flaxseed, unprocessed; Edible flowers, fresh; Edible horse treats; Edible insects, live; Edible linseed, unprocessed; Edible nuts [unprocessed]; Edible sesame, unprocessed; Edible silvervine powder for pet cats; Egg laying poultry (Preparations for -); Eggplants; Eggs for hatching; Eggs for hatching, fertilised; Eggs for hatching, fertilized; Fattening preparations (Animal -); Feeding preparations for bees; Feeding substances for bees; Ferns; Fertilised eggs for hatching; Fertilized eggs for hatching; Fir trees for grafting purposes; Fir trees for propagation purposes; Fish eggs for hatching; Fish food; Fish, live; Fish meal [animal feed]; Fish spawn; Fishing bait, live; Flax [linseed] plant seeds; Flax [linseed] plants; Flax meal [fodder]; Flaxseed for animal consumption; Floral decorations [dried]; Floral decorations [fresh]; Floral decorations [natural]; Flounders, live; Flower bulbs; Flower corms; Flower seeds; Flowering plants; Flowers; Flowers, dried, for decoration; Flowers [natural]; Flowers, natural; Flowers (Wreaths of natural -); Fodder; Foliage plants; Food for aquarium fish; Food for birds; Food for cats; Food for fish; Food for goldfish; Food for hamsters; Food for rodents; Food for wild birds; Food preparations for cats; Foods containing beef for feeding cats; Foods containing chicken for feeding cats; Foods containing liver for feeding cats; Foods flavoured with beef for feeding cats; Foods flavoured with chicken for feeding cats; Foods flavoured with liver for feeding cats; Foods in the form of rings for feeding to cats; Foodstuffs for birds; Foodstuffs for calves; Foodstuffs for cats; Foodstuffs for cats based on or consisting of fish; Foodstuffs for cattle; Foodstuffs for chickens; Foodstuffs for dairy animals; Foodstuffs for ewes; Foodstuffs for farm animals; Foodstuffs for fish; Foodstuffs for horses; Foodstuffs for marine animals; Foodstuffs for pigs; Foodstuffs for poultry; Foodstuffs for sheep; Forage; Forage for animals; Formula animal feed; Freeze-dried fishing bait; Fresh adzuki beans; Fresh almonds; Fresh apple mangos; Fresh apples; Fresh apricots; Fresh artichokes; Fresh arugula; Fresh asparagus; Fresh avocados; Fresh balloon flower root (Doraji); Fresh bamboo fungus; Fresh bamboo shoots; Fresh bananas; Fresh basil; Fresh bean sprouts; Fresh beans; Fresh beetroots; Fresh beets; Fresh bell peppers; Fresh berries; Fresh black raspberry (Bokbunja); Fresh blackberries; Fresh blackcurrants; Fresh blood oranges; Fresh blueberries; Fresh bok choy; Fresh boysenberries; Fresh Brazil nuts; Fresh broad beans; Fresh brussel sprouts; Fresh brussels sprouts; Fresh burdock root; Fresh cabbage; Fresh carambolas; Fresh carrots; Fresh cashew apples; Fresh cashew nuts; Fresh champignons; Fresh chanterelles; Fresh cherries; Fresh cherry tomatoes; Fresh chervil; Fresh chestnuts; Fresh chick peas; Fresh chickpeas; Fresh chilies; Fresh Chinese yams; Fresh chives; Fresh cilantro; Fresh citrus fruit; Fresh citrus fruits; Fresh cloudberries; Fresh coconuts; Fresh cola nuts; Fresh corn; Fresh corni fructus (Sansuyu) in the nature of live plants; Fresh cranberries; Fresh cucumbers; Fresh culinary herbs; Fresh currant; Fresh cut garlands; Fresh cut wreaths; Fresh dates; Fresh dragon fruits; Fresh durians; Fresh edible aloe vera; Fresh edible black fungi; Fresh edible cacti; Fresh edible flowers; Fresh edible mushrooms; Fresh edible rootstocks; Fresh eggplants; Fresh fava beans; Fresh fern (Gosari); Fresh figs; Fresh finger limes; Fresh flavoring leaves of Japanese pepper tree (Sansho); Fresh flower arrangements; Fresh flowers; Fresh fruit; Fresh fruits; Fresh fruits and vegetables; Fresh fruits, nuts, vegetables and herbs; Fresh funghi; Fresh garden herbs; Fresh garlic; Fresh garlic scapes; Fresh ginger; Fresh gingko nuts; Fresh ginkgo nuts; Fresh ginseng; Fresh goji berries; Fresh golden berries; Fresh gooseberries; Fresh grape tomatoes; Fresh grapefruits; Fresh grapes; Fresh green garlic; Fresh green split-peas; Fresh guavas; Fresh hawthorn fruits; Fresh hazelnuts; Fresh herbs; Fresh horseradish root; Fresh ice cream beans; Fresh jackfruit; Fresh Japanese edible horseradishes (wasabi); Fresh Japanese leeks; Fresh Japanese persimmons; Fresh kale; Fresh kelps; Fresh khorasan wheatgrass; Fresh kiwi fruit; Fresh kohlrabi; Fresh kumquats; Fresh leafy Asian vegetables; Fresh leeks; Fresh legumes; Fresh lemons; Fresh lentils; Fresh lettuce; Fresh limes; Fresh loganberries; Fresh long net stinkhorn; Fresh longan; Fresh loquats; Fresh lotus roots; Fresh lychees; Fresh mandarin oranges; Fresh mandarins; Fresh mangos; Fresh mangosteens; Fresh melons; Fresh mint; Fresh mugwort (Yakssuk) in the nature of live plants; Fresh mulberries; Fresh mushrooms; Fresh napa cabbage (Baechu); Fresh naranjillas; Fresh noni fruit; Fresh nuts; Fresh oak mushroom; Fresh oats; Fresh okra; Fresh olives; Fresh onions; Fresh oranges; Fresh oregano; Fresh oriental melon (Cham-oe); Fresh palm fruits; Fresh papayas; Fresh parsley; Fresh parsnips; Fresh passion fruit; Fresh peaches; Fresh peanuts; Fresh peas; Fresh pecans; Fresh peppers; Fresh perilla leaves (Shiso); Fresh pine mushroom; Fresh pine nuts; Fresh pineapple guavas (feijoa); Fresh pineapples; Fresh pistachio nuts; Fresh plantains; Fresh plants; Fresh plum tomatoes; Fresh plums; Fresh pomegranates; Fresh potatoes; Fresh pulses; Fresh pumpkins; Fresh quince; Fresh radicchio; Fresh rambutans; Fresh raspberries; Fresh redcurrants; Fresh rosemary; Fresh sage; Fresh sapodillas; Fresh sapotes; Fresh scallions; Fresh seaweed; Fresh shallots; Fresh shiitake mushrooms; Fresh soursops; Fresh soy beans; Fresh soya beans; Fresh Spanish limes; Fresh spinach; Fresh star fruit; Fresh strawberries; Fresh strawberry guavas; Fresh string beans; Fresh sugar-apples; Fresh sweet potatoes; Fresh tangerines; Fresh thyme; Fresh tiger nuts; Fresh tomatoes; Fresh truffles; Fresh vegetables; Fresh walnuts; Fresh water chestnuts; Fresh wax apples; Fresh waxberries; Fresh wheat; Fresh wheatgrass; Fresh white carrots (arracacha); Fresh wine grapes; Fresh yams; Fresh yellow peaches; Fresh zucchini; Fruit bushes; Fruit, fresh; Fruit plants; Fruit residue [marc]; Fruit seeds; Fruit shrubs; Fruit trees; Fuller's earth for use as animal litter; Funeral wreaths; Fungi; Garden herbs, fresh; Garden salads; Garlands of natural flowers; Garlic [fresh]; Garlic, fresh; Germ grains; Germ (Seed -) for botanical purposes; Gift baskets of fresh fruits; Ginger, fresh; Goldfish; Grains [cereals]; Grains for animal consumption; Grains [seeds]; Grape vine trees; Grapefruits; Grapes, fresh; Grass; Grass seed; Grass seeds; Grasses [plants]; Gravel paper for bird cages; Groats for poultry; Ground bait [live or natural]; Hamster food; Hamsters; Hanging basket liners [moss]; Hay; Hazelnuts; Hazelnuts, fresh; Helichrysum [shrub]; Helichrysum (shrub); Herbs, dried, for decoration; Herbs (Fresh -); Herbs, fresh (Garden -); Herrings, live; Hop cones; Hop pellets; Hop saplings; Hops; Horse feed; Horticultural mulches; Horticultural mulches made from cocoa shell waste; House plants; Hovenia acerba, fresh; Hybrid wheat seeds; Hydroponic plants; Hydroponic seeds; Irish moss, other than for medical purposes; Juniper berries; Kitty litter; Koi carp, live; Kola nuts; Krill, live; Kumquats; Lawn/turf; Leaf mustard, fresh; Leeks, fresh; Leguminous plants; Lemons, fresh; Lentils, fresh; Lettuce, fresh; Lichees, fresh; Lime for animal forage; Linseed for animal consumption; Litter for animals; Litter for birds; Litter for cats; Litter for dogs; Litter for domestic animals; Litter for small animals; Litter peat; Live abalones; Live anchovies; Live animals; Live animals, organisms for breeding; Live aquarium coral; Live aquatic creatures; Live ark-shells; Live arthropods for the control of pests; Live bait; Live bait for fishing; Live bait for hunting; Live baits; Live bee pupae; Live birds; Live black-bone chickens; Live blue mussels; Live bullfrogs; Live bushes; Live butterflies; Live carp; Live carps; Live cattle; Live Christmas trees; Live Christmas trees [cut]; Live clams; Live codfishes; Live coral; Live corsages; Live cows; Live crabs; Live crayfish; Live crucian carps; Live cuttlefish; Live ducks; Live edible aquatic animals; Live eels; Live fish; Live fish for food purposes; Live fish for human consumption; Live fish [not for food]; Live fish, other than for human consumption; Live fishing bait; Live flower arrangements; Live flower wreaths; Live flowers; Live game; Live goats; Live goldfish; Live hamsters; Live hatching eggs; Live hens; Live horses; Live insects; Live laboratory animals; Live langoustines; Live lobsters; Live mammals; Live octopuses; Live oysters; Live perches; Live pigs; Live plaices; Live plants; Live plants used as aquarium landscapes; Live plants with symbiotic microorganisms; Live poultry; Live prawns; Live rootstocks; Live roses; Live salmon; Live sardines; Live sea basses; Live sea breams [red snappers]; Live seafood; Live sheep; Live shellfish; Live short-necked clams; Live shrimp; Live shrimps; Live silver carps; Live snails; Live topiaries; Live trees; Live trouts; Livestock; Livestock fattening preparations; Livestock feed; Living animals; Living christmas trees [cut]; Living flowers; Living fruit plants; Living natural flowers; Living plants; Living poultry; Living salad; Lobsters, live; Lobsters (Spiny -), live; Locust beans, raw; Loose hemp for use as animal bedding; Maize; Maize cake for cattle; Malt; Malt albumen for animal consumption [other than for medical use]; Malt for brewing; Malt for brewing and distilling; Malt for distilling; Malt germs; Malt grains [unprocessed]; Malted barley; Malts and unprocessed cereals; Mandarins [fruit, fresh]; Marc; Marrows; Marrows, fresh; Mash for fattening livestock; Meal for animals; Meal for consumption by animals; Melons; Menagerie animals; Milled peat; Mineral salt licking bricks for livestock; Mineral salts for cattle; Mint [fresh]; Mixed fruits [fresh]; Molluscs, live; Mollusks, live; Moss (Irish -), other than for medical purposes; Mulch; Mulch mats made of natural materials for use in suppressing weeds; Mulch (Straw -); Mulch (Straw -) for weed suppression; Mulches of natural materials for use in suppressing weeds in horticultural environments; Mushroom spawn for propagation; Mushrooms, fresh; Mushrooms, fresh, for food; Mussels, live; Mycelium for ***agricultural*** purposes; Natural bonsai trees; Natural edible plants [unprocessed]; Natural flowering plants; Natural flowers; Natural greenery for decoration; Natural plants; Natural plants and flowers; Natural plants [live]; Natural rice for use as animal fodder; Natural seeds; Natural turf; Nettles; Non-artificial turf; Non-debarked timber; Nursery plants; ***Nutrients*** [foodstuffs] for fish; Nuts being fresh; Nuts [fruits]; Nuts, unprocessed; Oats; Olives, fresh; Onions; Onions, fresh; Onions, fresh vegetables; Oranges; Oranges, fresh; Organic fresh fruit; Organic fresh herbs; Organic fresh vegetables; Oyster mushrooms, fresh; Oysters, live; Paddy; Palm fronds; Palm tree leaves [unworked or partly worked material]; Palm trees; Palms [leaves of the palm tree]; Paper for use as animal bedding; Peanuts, fresh; Peanuts, unprocessed; Pearl barley [in the husk]; Pears, fresh; Peas, fresh; Peat (Litter -); Peat litter for animals; Peat moss; Pennyroyal [plants]; Peppers [plants]; Pet animals; Pet beverages; Pet birds; Pet food for birds; Pet rabbit food; Pets (Aromatic sand for -) [litter]; Pets (Sanded paper for -) [litter]; Pig feed; Pigs; Pine cones; Pineapples [fresh]; Plant bulbs for horticultural use; Plant residues (raw materials); Plant seeds; Plants; Plants, dried, for decoration; Plants for aquaria [live]; Plants for ponds [live]; Plants (Live -); Pollen [raw material]; Pollen [raw materials]; Pomegranates; Pomelos, fresh; Potatoes, fresh; Potted dwarfed trees (bonsai); Potted fresh herbs; Potted plants; Poultry for breeding; Poultry grit; Poultry, live; Powdered milk for kittens; Prawns, live; Prawns [live]; Preparations for egg laying poultry; Preserved flowers; Preserved flowers for decoration; Propagation material [seeds]; Purslane, fresh vegetable; Pyrethrum [plants]; Quassia trees; Quebracho trees; Quinoa, unprocessed; Rabbit food; Rape cake for cattle; Raw ***agricultural*** products; Raw and unprocessed ***agricultural*** products; Raw and unprocessed aquacultural products; Raw and unprocessed forestry products; Raw and unprocessed grains; Raw and unprocessed horticultural products; Raw and unprocessed seeds; Raw apples; Raw apricots; Raw aquacultural products; Raw artichokes; Raw asparagus; Raw avocados; Raw bark; Raw barks; Raw beans; Raw beets; Raw blueberries; Raw cabbage; Raw cereals [unprocessed]; Raw cocoa beans; Raw coconuts; Raw corn; Raw dates; Raw forestry products; Raw fruit; Raw fruits; Raw garlic; Raw ginger; Raw grain; Raw herbs; Raw horseradish root; Raw horticultural products; Raw lemons; Raw mushrooms; Raw nut kernels; Raw nuts; Raw oats; Raw olives; Raw onions; Raw oranges; Raw peaches; Raw peppers; Raw potatoes; Raw quince; Raw red beans; Raw seeds; Raw sugar cane bagasses; Raw timber; Raw tomatoes; Raw vegetables; Raw wheat; Raw zucchini; Reinforced turf; Residual products of cereals for animal consumption; Residue in a still after distillation; Residues from malt treatment for use as an animal feed; Rhizomes; Rhubarb; Rhubarb, fresh; Rice bran [animal feed]; Rice meal for forage; Rice, unprocessed; Root vegetables [fresh]; Roots for animal consumption; Roots for food; Rose bushes; Roses; Roses [plants]; Rough cork; Round timber; Rye; Rye seed; Salad crops; Salad vegetables [fresh]; Salmon, live; Salt for cattle; Salt licks; Sanded paper for domestic animals (litter); Sanded paper for pets [litter]; Sanded paper for use in animal cages; Sanded paper for use in bird cages; Sanded paper [litter] for pets; Saplings; Sardines, live; Sardines [live]; Savory biscuits for animals; Sea basses [live]; Sea breams [red snappers, live]; Sea hares, live; Sea whelks, live; Sea-cucumbers, live; Seaweed for human or animal consumption; Seed germ for botanical purposes; Seed (Mats containing -) for laying lawns; Seed potatoes; Seedlings; Seedlings for planting; Seeds; Seeds, bulbs and seedlings for plant breeding; Seeds coated with a fertilizer; Seeds coated with an anti-parasitic preparation; Seeds for ***agricultural*** purposes; Seeds for ***agricultural*** use; Seeds for flowers; Seeds for fruit; Seeds for growing herbs; Seeds for growing plants; Seeds for horticultural purposes; Seeds for horticultural use; Seeds for planting; Seeds for sowing; Seeds for vegetables; Seeds in pellet form; Seeds of urushi; Seeds (Plant -); Seeds pre-sown in a propagation media for grassing between plants; Seeds pre-sown in a propagation media for grassing between trees; Seeds pre-sown in a propagation media for grassing drainage channels; Seeds pre-sown in fibrous propagation media for grassing banks; Seeds pre-sown in matted fibrous propagation media for grassing banks; Seeds pre-sown in matted fibrous propagation media for grassing fields; Seeds pre-sown in matted fibrous propagation media for grassing golf courses; Seeds pre-sown in matted fibrous propagation media for grassing lawns; Seeds pre-sown in matted fibrous propagation media for grassing paths; Seeds pre-sown in matted fibrous propagation media for grassing sports fields; Seeds pre-sown in matted fibrous propagation media for grassing tracks; Sheep; Shell (Cocoanut -); Shellfish, live; Short-necked clams [live]; Shrimp, live; Shrimps, [live]; Shrimps, live; Shrubs; Shrubs (Live -); Silkworm eggs; Silkworms; Small animal bedding made of recycled paper; Small animal litter; Smolt [live]; Snails [live]; Snakehead fish, live; Snow crabs, live; Sod; Soft-shelled turtles [live]; Soft-shelled turtles, live; Sole fish, live; Sowing seeds; Soy bean meal [animal feed]; Soy sauce cakes [animal feed]; Soya beans, fresh; Spanish mackerel, live; Spawn (Fish -); Spawn for ***agricultural*** purposes; Spinach, fresh; Spiny lobsters, live; Spores and spawn [for ***agricultural*** purposes]; Spores for ***agricultural*** purposes; Squashes; Squashes, fresh; Squid [live]; Squid, live; Stall food for animals; Starch pulp [animal feed]; Straw; Straw [forage]; Straw litter; Straw mulch; Strawberries [fresh]; Strengthening animal forage; Sugar cane; Sugarcane; Sunflower seeds; Sweet biscuits for consumption by animals; Sweet potato leaves, fresh; Sweetcorn [fresh]; Synthetic animal feed; Tangerines [fresh]; Timber (Undressed -); Timber (Unsawn -); Tomatoes [fresh]; Tree trunks; Trees; Trees and forestry products; Trees (Trunks of -); Tropical fruits [fresh]; Truffles, fresh; Trunks of trees; Tubers for plant propagation; Tuna, live; Turf [natural]; Turf, natural; Turkey hens [live]; Turkey [live]; Turkeys [live]; Undaria pinnatifida, fresh; Undressed timber; Unprocessed agar (Tengusa seaweed); Unprocessed ***agricultural*** products; Unprocessed algae for human consumption; Unprocessed apples; Unprocessed apricots; Unprocessed aquacultural products; Unprocessed artichokes; Unprocessed asparagus; Unprocessed avocados; Unprocessed barley; Unprocessed beans; Unprocessed beets; Unprocessed blueberries; Unprocessed brown algae (Hijiki seaweed); Unprocessed buckwheat; Unprocessed cabbage; Unprocessed cereal seeds; Unprocessed cereals; Unprocessed chia seeds; Unprocessed coconuts; Unprocessed corn; Unprocessed dates; Unprocessed edible laver; Unprocessed edible seaweeds; Unprocessed flax seeds; Unprocessed forestry products; Unprocessed foxtail millet; Unprocessed fruits; Unprocessed garlic; Unprocessed ginger; Unprocessed ginseng; Unprocessed grain; Unprocessed grains for eating; Unprocessed herbs; Unprocessed hops; Unprocessed horticultural products; Unprocessed Japanese barnyard millet; Unprocessed kelp (Kombu seaweed); Unprocessed laver; Unprocessed lemons; Unprocessed lychee fruit; Unprocessed mushrooms; Unprocessed nuts; Unprocessed oats; Unprocessed oil seeds; Unprocessed olives; Unprocessed onions; Unprocessed oranges; Unprocessed peaches; Unprocessed peppers; Unprocessed potatoes; Unprocessed proso millet; Unprocessed quince; Unprocessed quinoa; Unprocessed rice; Unprocessed sea lettuce (Aosa seaweed); Unprocessed seaweed (Wakame); Unprocessed seeds; Unprocessed seeds for ***agricultural*** use; Unprocessed shallots; Unprocessed sorghum; Unprocessed spirulina; Unprocessed sugar beets; Unprocessed sugar crops; Unprocessed sweet corn ears [husked or unhusked]; Unprocessed tea leaves; Unprocessed teff; Unprocessed tomatoes; Unprocessed vegetables; Unprocessed wheat; Unprocessed zucchini; Unsawn timber; Unseasoned timber; Urushi tree seeds; Vegetable marrows, fresh; Vegetable seeds; Vegetables, fresh; Vine plants; Waste (Distillery -) for animal consumption; Water chestnuts, fresh; Watermelon, fresh; Wheat; Wheat bran; Wheat germ for animal consumption; Wheat seed; Wild blueberries, fresh; Wildlife seed mixtures; Wood chips for the manufacture of wood pulp; Wood chips for use as ground cover; Wood shavings for use as animal bedding; Wood shavings for use as animal litter; Woodshavings for use as animal bedding; Woodshavings for use as animal litter; Wreaths of dried herbs for decoration; Wreaths of natural flowers; Yellow croakers, live; Young fresh soybeans in the pod (eda-mame).Class 35 Account auditing; Accountancy; Accountancy advice relating to tax preparation; Accountancy advice relating to taxation; Accountancy advice relating to the preparation of tax returns; Accountancy, book keeping and auditing; Accountancy services; Accountancy services relating to accounts receivable; Accounting; Accounting advisory services; Accounting consultancy relating to taxation; Accounting for third parties; Accounting, in particular book-keeping; Accounting services; Accounting services for mergers and acquisitions; Accounting services for pension funds; Accounting services relating to costs for farming enterprises; Accounting services relating to tax planning; Accounts (Drawing up of statements of -); Accounts (Preparation of -); Acquisition (Business -) searches; Acquisition of business information relating to company activities; Acquisition of business information relating to company status; Acquisition of commercial information; Acquisitions (Advice relating to -); Acquisitions (Business -) consulting services; Addressing envelopes; Addressing of envelopes; Administering medication reimbursement programs and services; Administering of professional competency testing; Administering of professional [vocational] certifications; Administering pharmacy reimbursement programs and services; Administration, billing and reconciliation of accounts on behalf of others; Administration (Business -) relating to statistical methods; Administration (Commercial -) of the licensing of the goods and services of others; Administration of a discount program for enabling participants to obtain discounts on goods and services through use of a discount membership card; Administration of business affairs; Administration of business payroll for others; Administration of businesses; Administration of competitions for advertising purposes; Administration of consumer loyalty programs; Administration of contests for advertising purpose; Administration of cultural and educational exchange programs; Administration of customer loyalty and incentive schemes; Administration of employee benefit plans; Administration of employee pension plans; Administration of employee welfare benefit plans; Administration of foreign business affairs; Administration of frequent flyer programmes that allow members to redeem miles for points or awards offered by other loyalty programmes; Administration of frequent flyer programs; Administration of frequent flyer programs that allow members to redeem miles for points or awards offered by other loyalty programs; Administration of incentive award programs to promote the sale of the goods and services of others; Administration of loyalty and incentive schemes; Administration of loyalty programs involving discounts or incentives; Administration of loyalty rewards programmes; Administration of loyalty rewards programs; Administration of loyalty rewards programs featuring trading stamps; Administration of membership schemes; Administration of newspaper subscription [for others]; Administration of patient reimbursement programs; Administration of preferred provider plans; Administration of prepaid health care plans; Administration of sales and promotional incentive schemes; Administration of sales promotion incentive programs; Administration of the business affairs of franchises; Administration of the business affairs of retail stores; Administration relating to business appraisal; Administration relating to business planning; Administration relating to marketing; Administration relating to sales methods; Administrative accounting; Administrative assistance in responding to calls for tenders; Administrative assistance in responding to requests for proposals [RFPs]; Administrative ***data*** processing; Administrative hotel management; Administrative loyalty card services; Administrative management of health care clinics; Administrative management of hospitals; Administrative order processing; Administrative processing and organising of mail order services; Administrative processing of computerized purchase orders; Administrative processing of orders; Administrative processing of purchase orders; Administrative processing of purchase orders placed by telephone or computer; Administrative processing of purchase orders within the framework of services provided by mail-order companies; Administrative processing of warranty claims; Administrative services for medical referrals; Administrative services for the relocation of businesses; Administrative services relating to credit card registration; Administrative services relating to customs clearance; Administrative services relating to dental health insurance; Administrative services relating to employee stock plans; Administrative services relating to hospital referrals; Administrative services relating to referrals for general building contractors; Administrative services relating to referrals for insurance agents; Administrative services relating to the management of legal dockets; Administrative services relating to the referral of clients to lawyers; Administrative services relating to the referral of patients; Administrative services relating to the relocation of personnel; Administrative services relating to warranty claims processing; Administrative support and ***data*** processing services; Advertisement and publicity services by television, radio, mail; Advertisement billboards (Rental of -); Advertisement for others on the Internet; Advertisement hoarding rental; Advertisement hoardings (Rental of -); Advertisement via mobile phone networks; Advertisements (Placing of -); Advertisements (Preparing of -); Advertising; Advertising agencies; Advertising agency services; Advertising analysis; Advertising and advertisement services; Advertising and marketing; Advertising and marketing consultancy; Advertising and marketing services; Advertising and marketing services provided by means of blogging; Advertising and marketing services provided by means of social media; Advertising and marketing services provided via communications channels; Advertising and promotion services; Advertising and promotion services and related consulting; Advertising and promotional services; Advertising and publicity; Advertising and publicity services; Advertising automobiles for sale by means of the Internet; Advertising business especially in the field of telematic and telephone networks; Advertising by mail order; Advertising by transmission of on-line publicity for third parties through electronic communications networks; Advertising consultation; Advertising copywriting; Advertising flyer distribution; Advertising flyer distribution for others; Advertising for motion picture films; Advertising for others; Advertising in periodicals, brochures and newspapers; Advertising in the field of tourism and travel; Advertising in the popular and professional press; Advertising, including on-line advertising on a computer network; Advertising, including promotion of products and services of third parties through sponsoring arrangements and licence agreements relating to international sports' events; Advertising, marketing and promotion services; Advertising, marketing and promotional consultancy, advisory and assistance services; Advertising, marketing and promotional services; Advertising material (Dissemination of -); Advertising material (Updating of -); Advertising matter (Dissemination of -); Advertising matter (Production of -); Advertising of business web sites; Advertising of cinemas; Advertising of commercial or residential real estate; Advertising of the goods of other vendors, enabling customers to conveniently view and compare the goods of those vendors; Advertising of the services of other vendors, enabling customers to conveniently view and compare the services of those vendors; Advertising on the Internet for others; Advertising particularly services for the promotion of goods; Advertising planning; Advertising, promotional and marketing services; Advertising, promotional and public relations services; Advertising relating to pharmaceutical products and in-vivo imaging products; Advertising relating to transport and delivery; Advertising research; Advertising research services; Advertising services; Advertising services by means of balloon displays; Advertising services by means of sandwich board; Advertising services by means of television screen based text; Advertising services for architects; Advertising services for promoting the brokerage of stocks and other securities; Advertising services for the literary industry; Advertising services for the promotion of beverages; Advertising services for the promotion of e-commerce; Advertising services of a radio and television advertising agency; Advertising services provided by a radio and television advertising agency; Advertising services provided by television; Advertising services provided for florists; Advertising services provided for others; Advertising services provided over the internet; Advertising services provided via a ***data*** base; Advertising services provided via the internet; Advertising services relating to books; Advertising services relating to clothing; Advertising services relating to cosmetics; Advertising services relating to ***data*** bases; Advertising services relating to esports events; Advertising services relating to financial investment; Advertising services relating to financial services; Advertising services relating to hotels; Advertising services relating to in vivo imaging apparatus; Advertising services relating to in vivo imaging products; Advertising services relating to jewelry; Advertising services relating to motor cars; Advertising services relating to newspapers; Advertising services relating to perfumery; Advertising services relating to pharmaceutical products; Advertising services relating to pharmaceuticals; Advertising services relating to pharmaceuticals for the treatment of diabetes; Advertising services relating to public works; Advertising services relating to real property; Advertising services relating to the commercialization of new products; Advertising services relating to the marine and maritime industry; Advertising services relating to the motor vehicle industry; Advertising services relating to the provision of business; Advertising services relating to the recruitment of personnel; Advertising services relating to the sale of goods; Advertising services relating to the sale of motor vehicles; Advertising services relating to the sale of personal property; Advertising services relating to the transport industries; Advertising services relating to the travel industries; Advertising services to create corporate and brand identity; Advertising services to promote public awareness in the field of social welfare; Advertising services to promote public awareness of environmental issues and initiatives; Advertising services to promote public awareness of environmental matters; Advertising services to promote public awareness of medical conditions; Advertising services to promote public awareness of medical issues; Advertising services to promote public awareness of nephrotic syndrome and focal segmental glomerulosclerosis [FSGS]; Advertising services to promote public awareness of social issues; Advertising services to promote public awareness of the benefits of shopping locally; Advertising services to promote the sale of beverages; Advertising space (Rental of -); Advertising space (Rental of -) on the internet; Advertising text publication services; Advertising the goods and services of online vendors via a searchable online guide; Advertising through all public communication means; Advertising via electronic media and specifically the internet; Advertising via the Internet; Advice and information concerning commercial business management; Advice concerning chemical product marketing; Advice for consumers (Commercial information and -) [consumer advice shop]; Advice in the field of business management and marketing; Advice in the running of establishments as franchises; Advice on tax preparation; Advice on the analysis of consumer buying habits and needs provided with the help of sensory, quality and quantity-related ***data***; Advice relating to barter trade; Advice relating to business management; Advice relating to business organisation; Advice relating to business organization; Advice relating to marketing management; Advice relating to personnel management; Advice relating to the acquisition of businesses; Advice relating to the business management of fitness clubs; Advice relating to the business management of health clubs; Advice relating to the business operation of fitness clubs; Advice relating to the business operation of health clubs; Advice relating to the organisation and management of business; Advice relating to the sale of businesses; Advising commercial enterprises in the conduct of their business; Advising industrial enterprises in the conduct of their business; Advisory and consultancy services relating to import-export agencies; Advisory and consultancy services relating to the procurement of goods for others; Advisory services and information in business organization and management; Advisory services (Business -) relating to the establishment of franchises; Advisory services (Business -) relating to the exploitation of inventions; Advisory services (Business -) relating to the management of businesses; Advisory services (Business -) relating to the management of public sector businesses; Advisory services (Business -) relating to the operation of franchises; Advisory services for business management; Advisory services for preparing and carrying out commercial transactions; Advisory services relating to advertising; Advisory services relating to business acquisitions; Advisory services relating to business administration; Advisory services relating to business analysis; Advisory services relating to business management; Advisory services relating to business management and business operations; Advisory services relating to business organisation; Advisory services relating to business organisation and management; Advisory services relating to business organization; Advisory services relating to business planning; Advisory services relating to business risk management; Advisory services relating to commercial planning; Advisory services relating to commercial transactions; Advisory services relating to corporate identity; Advisory services relating to ***data*** processing; Advisory services relating to electronic ***data*** processing; Advisory services relating to market research; Advisory services relating to marketing; Advisory services relating to personnel placement; Advisory services relating to personnel recruitment; Advisory services relating to promotional activities; Advisory services relating to public relations; Advisory services relating to publicity for franchisees; Advisory services relating to sales promotion; Advisory services relating to tax preparation; Advisory services relating to the corporate structure of businesses; Advisory services relating to the corporate structure of companies; Advisory services relating to the operation of franchises; Advisory services relating to the ordering of stationery; Advisory services relating to the purchase of goods on behalf of business; Advisory services relating to the purchase of goods on behalf of others; Affiliate marketing; Agency services for arranging business introductions; Agency services for promoting sports personalities; Airport administration services; Alcoholic beverage procurement services for others [purchasing goods for other businesses]; Analysis (Cost price -); Analysis of advertising response; Analysis of advertising response and market research; Analysis of business ***data***; Analysis of business information; Analysis of business management systems; Analysis of business ***statistics***; Analysis of business trends; Analysis of company attitudes; Analysis of company behaviour; Analysis of market research ***data***; Analysis of market research ***data*** and ***statistics***; Analysis of market research ***statistics***; Analysis of marketing trends; Analysis of markets; Analysis of the public awareness of advertising; Analysis relating to marketing; Announcement services for advertising purposes; Answering (Telephone -) for unavailable subscribers; Appointment reminder services [office functions]; Appointment scheduling services [office functions]; Appraisal of business opportunities; Appraisals (Business -); Arrangement of advertising; Arranging advertising and promotional contracts for others; Arranging advertising contracts for others; Arranging and concluding commercial transactions for others; Arranging and conducting auctions; Arranging and conducting business fairs; Arranging and conducting commercial trade shows; Arranging and conducting marketing promotional events for others; Arranging and conducting of advertising events; Arranging and conducting of art exhibitions for commercial or advertising purposes; Arranging and conducting of auctions and reverse auctions via computer and telecommunication networks; Arranging and conducting of auctions and reverse auctions via mobile telephones; Arranging and conducting of business meetings; Arranging and conducting of commercial exhibitions; Arranging and conducting of commercial exhibitions and shows; Arranging and conducting of demonstrations for advertising purposes; Arranging and conducting of displays for advertising purposes; Arranging and conducting of exhibitions for business purposes; Arranging and conducting of fairs and exhibitions for advertising purposes; Arranging and conducting of fairs and exhibitions for business and advertising purposes; Arranging and conducting of fairs and exhibitions for business purposes; Arranging and conducting of flea markets; Arranging and conducting of Internet auctions; Arranging and conducting of marketing events; Arranging and conducting of promotional events; Arranging and conducting of real estate auctions; Arranging and conducting of telephone auctions; Arranging and conducting of television auctions; Arranging and conducting recruitment fairs; Arranging and conducting sales events for cattle; Arranging and conducting sales events for livestock; Arranging and conducting sales events for others of livestock and registered and commercial cattle; Arranging and conducting trade fairs; Arranging and conducting trade show exhibitions; Arranging and conducting trade shows; Arranging and conducting trade shows relating to publishing; Arranging and conduction of auction sales; Arranging and placing of advertisements; Arranging business introductions; Arranging business introductions relating to the buying and selling of products; Arranging commercial transactions, for others, via online shops; Arranging for the provision of advertising space in newspapers; Arranging newspaper subscriptions; Arranging newspaper subscriptions for others; Arranging of advertising in cinemas; Arranging of auction sales; Arranging of auctions; Arranging of business introductions; Arranging of buying and selling contracts for third parties; Arranging of ***collective*** buying; Arranging of commercial and business contacts; Arranging of competitions for advertising purposes; Arranging of contracts for others for the buying and selling of goods; Arranging of contracts, for others, for the providing of services; Arranging of contracts for the purchase and sale of goods and services, for others; Arranging of contractual [trade]services with third parties; Arranging of demonstrations for advertising purposes; Arranging of demonstrations for business purposes; Arranging of demonstrations for commercial purposes; Arranging of demonstrations for trade purposes; Arranging of displays for advertising purposes; Arranging of displays for business purposes; Arranging of displays for commercial purposes; Arranging of displays for trade purposes; Arranging of exhibitions for advertising purposes; Arranging of exhibitions for business purposes; Arranging of exhibitions for commercial purposes; Arranging of exhibitions for trade purposes; Arranging of newspaper subscriptions for others; Arranging of presentations for advertising purposes; Arranging of presentations for business purposes; Arranging of presentations for commercial purposes; Arranging of presentations for trade purposes; Arranging of product launches; Arranging of subscriptions for the publications of others; Arranging of trade fairs; Arranging of trade shows; Arranging of trading transactions and commercial contracts; Arranging promotion of charitable fundraising events; Arranging subscriptions of the online publications of others; Arranging subscriptions to a television channel; Arranging subscriptions to electronic journals; Arranging subscriptions to information media; Arranging subscriptions to information packages; Arranging subscriptions to Internet services; Arranging subscriptions to media packages; Arranging subscriptions to publications for others; Arranging subscriptions to telecommunication services for others; Arranging subscriptions to telecommunication services [for others]; Arranging subscriptions to telephone services; Arranging the buying of goods for others; Arranging the distribution of advertising literature in response to telephone enquiries; Arranging the distribution of advertising samples; Arranging the distribution of advertising samples in response to telephone enquiries; Artists (Business management of performing -); Assessment analysis relating to business management; Assistance, advisory services and consultancy with regard to business analysis; Assistance, advisory services and consultancy with regard to business management; Assistance, advisory services and consultancy with regard to business organization; Assistance, advisory services and consultancy with regard to business planning; Assistance and advice regarding business management; Assistance and advice regarding business organisation and management; Assistance and advice regarding business organization; Assistance and advice regarding business organization and management; Assistance and consultancy relating to business management and organisation; Assistance and consultancy services in the field of business management of companies in the energy sector; Assistance (Business management -); Assistance in business management within the framework of a franchise contract; Assistance in franchised commercial business management; Assistance in management of business activities; Assistance in product commercialization, within the framework of a franchise contract; Assistance relating to business organisation; Assistance relating to recruitment and placement of staff; Assistance to commercial enterprises in the management of their business; Assistance to industrial enterprises in the conduct of their business; Assistance to industrial or commercial enterprises in the running of their business; Assistance to management in commercial enterprises in respect of advertising; Assistance to management in commercial enterprises in respect of public relations; Assistance with business management; Assistance with business planning; Auction and reverse auction services; Auction sales (Arranging of -); Auction services; Auctioneering; Auctioneering of property; Auctioneering provided on the internet; Auctioneering services; Auctioneering services provided via telecommunication networks; Auctioneering services relating to ***agriculture***; Auctioning of vehicles; Auctioning via telecommunication networks; Audience rating determination for radio and television broadcasts; Audio-visual displays for advertising purposes (Preparation or presentation of -); Auditing of accounts; Auditing of financial statements; Auditing utility rates for others; Auditioning of performing artists [selection of personnel]; Automated ***data*** processing; Automatic re-ordering service for business; Automobile registration services; Balance sheet accounting; Banner advertising; Benchmarking (evaluation of business organisation practices); Benchmarking services; Bidding quotation; Bill presentment services; Bill sticking; Billing; Billing services; Billing services in the field of energy; Billing services in the field of healthcare; Bill-posting; Blogger outreach services; Book club services retailing books to its members; Booking agent services for models; Bookkeeping; Book-keeping; Book-keeping and accounting; Book-keeping and accounting services; Bookkeeping for electronic funds transfer; Brand creation services; Brand creation services (advertising and promotion); Brand evaluation services; Brand positioning; Brand positioning services; Brand strategy services; Brand testing; Brokerage of name and address based lists; Business accounting advisory services; Business accounts management; Business acquisitions; Business acquisitions (Advice relating to -); Business acquisitions consultation; Business administration; Business administration and management; Business administration assistance; Business administration consultancy; Business administration for others; Business administration in the field of transport and delivery; Business administration of employee share schemes; Business administration services; Business administration services for processing sales made on the internet; Business administration services for the processing of sales made on a global computer network; Business administration services for the processing of sales made on the Internet; Business administration services in the field of healthcare; Business administration services in the field of transportation; Business administrative services for the relocation of businesses; Business administrative services for the relocation of personnel; Business advertising services relating to franchising; Business advice; Business advice and consultancy relating to franchising; Business advice, inquiries or information; Business advice relating to accounting; Business advice relating to acquisitions; Business advice relating to advertising; Business advice relating to disposals; Business advice relating to financial re-organisation; Business advice relating to franchising; Business advice relating to growth financing; Business advice relating to marketing; Business advice relating to marketing management consultations; Business advice relating to mergers; Business advice relating to restaurant franchising; Business advice relating to strategic marketing; Business advisory and consultancy services; Business advisory services; Business advisory services provided to determine pay and grading structures; Business advisory services relating to business liquidations; Business advisory services relating to company performance; Business advisory services relating to franchising; Business advisory services relating to franchising of a motor dealership; Business advisory services relating to product development; Business advisory services relating to product manufacturing; Business advisory services relating to the establishment and operation of franchises; Business advisory services relating to the establishment of motor dealership; Business advisory services relating to the running of restaurants; Business advisory services relating to the running of sandwich bars; Business advisory services relating to the selection of computers; Business advisory services relating to the setting up of restaurants; Business advisory services relating to the setting up of sandwich bars; Business advisory services relating to the use of computers; Business advisory services to determine pay and grading structures by job evaluation; Business analysis; Business analysis and information services, and market research; Business analysis of markets; Business analysis services; Business and commercial information services; Business and market research; Business appraisal; Business appraisal consultancy; Business appraisal services; Business appraisals; Business appraisals and evaluations in business matters; Business assistance; Business assistance, management and administrative services; Business assistance relating to business image; Business assistance relating to corporate identity; Business assistance relating to franchising; Business assistance relating to starting and running a franchise; Business assistance relating to the establishment of franchises; Business assistance relating to the formation of commercial undertakings; Business auditing; Business brokerage services; Business consultancy; Business consultancy and advisory services; Business consultancy, in the field of transport and delivery; Business consultancy (Professional -); Business consultancy relating to the administration of information technology; Business consultancy services; Business consultancy services relating to ***data*** processing; Business consultancy services relating to disaster planning and recovery; Business consultancy services relating to insolvency; Business consultancy services relating to management of fund raising campaigns; Business consultancy services relating to manufacturing; Business consultancy services relating to product development; Business consultancy services relating to the marketing of fund raising campaigns; Business consultancy services relating to the promotion of fund raising campaigns; Business consultancy services relating to the supply of quality management systems; Business consultancy to firms; Business consultancy to individuals; Business consultation; Business consultation relating to advertising; Business consultation services; Business consulting; Business consulting for enterprises; Business consulting services; Business consulting services in the ***agriculture*** field; Business ***data*** analysis; Business ***data*** analysis services; Business efficiency advice; Business efficiency expert services; Business efficiency studies; Business Enquiries; Business enquiries and investigations; Business enquiry services; Business examinations services; Business expertise; Business expertise services; Business feasibility studies; Business file management; Business information; Business information agency services; Business information and inquiries; Business information and research services; Business information (Compilation of -); Business information for enterprises; Business information for enterprises (Provision of -); Business information (Provision of -); Business information services; Business information services provided online from a computer database or the internet; Business information services provided on-line from a computer database or the internet; Business information services provided online from a global computer network or the internet; Business inquiries; Business intelligence services; Business intermediary and advisory services in the field of selling products and rendering services; Business intermediary services relating to the matching of potential private investors with entrepreneurs needing funding; Business introduction services; Business introductions (Arranging -); Business investigation; Business investigations; Business invoicing services; Business management; Business management advice; Business management advice and assistance; Business management advice relating to manufacturing business; Business management advisory services; Business management advisory services relating to commercial enterprises; Business management advisory services relating to franchising; Business management advisory services relating to industrial enterprises; Business management analysis; Business management and administration; Business management and consultancy; Business management and consultancy services; Business management and consultation; Business management and consultation services; Business management and consulting; Business management and consulting services; Business management and enterprise organization consultancy; Business management and organisation consultancy; Business management and organisation consultancy services; Business management and organization consultancy; Business management and organization consultancy services; Business management assistance; Business management assistance for industrial or commercial companies; Business management assistance in the establishment and operation of restaurants; Business management assistance in the field of franchising; Business management assistance in the operation of restaurants; Business management consultancy; Business management consultancy, also via the Internet; Business management consultancy and advisory services; Business management consultancy in the field of executive and leadership development; Business management consultancy in the field of transport and delivery; Business management consultancy services; Business management consultancy services provided via the Internet; Business management consultancy via the Internet; Business management consultation; Business management consulting; Business management consulting services; Business management consulting services in the field of information technology; Business management for a trade company and for a service company; Business management for freelance service providers; Business management for shops; Business management in the field of transport and delivery; Business management of actors; Business management of airports; Business management of an airline company; Business management of authors and writers; Business management of car parking facilities; Business management of conference centers; Business management of entertainers; Business management of entertainment venues; Business management of hospitals; Business management of hotels; Business management of hotels for others; Business management of insurance agencies and brokers on an outsourcing basis; Business management of models; Business management of musical performers; Business management of musicians; Business management of performing artists; Business management of petrol stations [for others]; Business management of professional athletes; Business management of reimbursement programmes for others; Business management of reimbursement programs for others; Business management of resort hotels; Business management of restaurants; Business management of retail outlets; Business management of sporting clubs; Business management of sporting facilities [for others]; Business management of sporting venues [for others]; Business management of sports people; Business management of sports personalities; Business management of swimming pool complexes; Business management of theaters; Business management of visitor attractions; Business management of wholesale and retail outlets; Business management of wholesale outlets; Business management organisation; Business management organisation consultancy; Business management planning; Business management services; Business management services for footballers; Business management services provided by theatrical agencies; Business management services relating to electronic commerce; Business management services relating to the acquisition of businesses; Business management services relating to the development of businesses; Business management supervision; Business marketing consultancy; Business marketing consultation services; Business marketing consulting services; Business marketing services; Business meeting planning; Business merchandising display services; Business merger consultation; Business merger services; Business mergers (Advice relating to -); Business networking; Business networking services; Business operation of shopping centers for others; Business operation of shopping malls; Business organisation; Business organisation advice; Business organisation and management consultancy; Business organisation and management consultancy in the field of personnel management; Business organisation and management consulting; Business organisation and management consulting services; Business organisation consultancy; Business organisation consulting; Business organization advice; Business organization and management consultancy including personnel management; Business organization and management consulting; Business organization and operation consultancy; Business organization consultancy; Business organization consulting; Business organizational consultation; Business planning; Business planning and business continuity consulting; Business planning consultancy; Business planning services; Business planning services for enterprises; Business process management; Business process management and consulting; Business process management consultancy; Business process re-engineering; Business profit analysis; Business project management; Business project management services; Business project management services for construction projects; Business promotion; Business promotion services; Business promotion services provided by audio/visual means; Business promotion services provided by telephone; Business promotion services provided by telex; Business record keeping services; Business records keeping; Business records management; Business recruitment consultancy; Business relocation consulting; Business relocation services; Business reports (Preparation of -); Business reports (Writing of -); Business representative services; Business research; Business research and advisory services; Business research and information services; Business research and survey services; Business research and surveys; Business research consulting; Business research for new businesses; Business research services; Business risk assessment services; Business risk management services; Business secretarial services; Business services relating to the arrangement of joint ventures; Business services relating to the establishment of businesses; Business statistical analysis; Business statistical information services; Business statistical studies; Business ***statistics*** information; Business strategic planning; Business strategic planning services; Business strategy and planning services; Business strategy development services; Business strategy services; Business studies; Business succession planning; Business supervision; Business supervision [on behalf of others]; Business surveys; Businesses (Relocation services for -); Businesses (supervision of -) [on behalf of others]; Career advisory services (other than education and training advice); Career information and advisory services (other than educational and training advice); Career networking services; Career placement; Career placement consulting services; Career planning consultancy; Carrying out auction sales; Casting [recruitment] of performing artists; Chamber of commerce services for the promotion of businesses; Chamber of commerce services for the promotion of commerce; Chamber of commerce services for the promotion of trade; Chartered accountancy business services; Cinema advertising; Cinematographic film advertising; Classified advertising; Classified advertising services; Clerical employment agency services; Clerical services for making appointments; Clerical services for the handling of enquiries; Clerical services for the taking of sales orders; Collating of ***data*** in computer databases; ***Collecting*** business information; ***Collecting*** business ***statistics***; ***Collecting*** information for business; ***Collection*** and systematisation of information into computer databases; ***Collection*** of commercial information; ***Collection*** of ***data***; ***Collection*** of information relating to advertising; ***Collection*** of information relating to market analysis; ***Collection*** of information relating to market research; ***Collection*** of information relating to market studies; ***Collection*** of market research information; ***Collection*** of personnel information; ***Collection*** of ***statistics*** for business; Commercial administration of the licensing of the goods and services of others; Commercial and industrial management assistance; Commercial assistance in business management; Commercial business management; Commercial consultancy; Commercial consultancy services; Commercial information; Commercial information agencies; Commercial information agencies [provides business information, e.g , marketing or demographic ***data***]; Commercial information agency services; Commercial information and advice for consumers [consumer advice shop]; Commercial information and advice for consumers in the choice of products and services; Commercial information and advice services for consumers in the field of beauty products; Commercial information and advice services for consumers in the field of cosmetic products; Commercial information and advice services for consumers in the field of make-up products; Commercial information (Compilation of -); Commercial information provided by means of a computer database; Commercial information (Provision of -); Commercial information research studies; Commercial information services; Commercial information services provided by access to a computer database; Commercial information services relating to wine; Commercial information services, via the internet; Commercial intermediation for business purposes; Commercial intermediation services; Commercial lobbying services; Commercial management; Commercial management assistance; Commercial or industrial management assistance; Communication media (Presentation of goods on -), for retail purposes; Company information (Searches relating to -); Company management [for others]; Company management, including consultancy in demographic matters; Company office secretarial services; Company record keeping [for others]; Company record-keeping; Comparison services (Price -); Comparison shopping services; Competitive intelligence services; Compilation and input of information into computer databases; Compilation and provision of trade and business price and statistical information; Compilation and systematisation of information in databanks; Compilation and systemisation of information into computer databases; Compilation and systemization of information into computer databases; Compilation and systemization of information used in electronic transmissions; Compilation and systemization of written communications and ***data***; Compilation of advertisements; Compilation of advertisements for use as web pages; Compilation of advertisements for use as web pages on the Internet; Compilation of advertisements for use on internet web pages; Compilation of advertisements for use on the internet; Compilation of business ***data***; Compilation of business directories; Compilation of business directories for publishing on the Internet; Compilation of business information; Compilation of business ***statistics***; Compilation of business ***statistics*** and commercial information; Compilation of commercial registers; Compilation of company information; Compilation of computer ***data*** bases; Compilation of computer databases; Compilation of ***data***; Compilation of ***data*** in computer databases; Compilation of direct mailing lists; Compilation of directories for publication on the internet; Compilation of directories for publishing on global computer networks or the internet; Compilation of directories for publishing on the internet; Compilation of indexed addresses; Compilation of information into computer databases; Compilation of information into computerised registers; Compilation of information onto computer databases; Compilation of lists of prospective customers; Compilation of mailing lists; Compilation of mathematical ***data***; Compilation of online business directories; Compilation of political ***statistics***; Compilation of registers relating to exporters; Compilation of registers relating to importers; Compilation of statistical ***data*** for use in scientific research; Compilation of statistical ***data*** relating to business; Compilation of statistical ***data*** relating to medical research; Compilation of statistical information; Compilation of statistical models for the provision of market dynamics information; Compilation of ***statistics***; Compilation of ***statistics*** [for business or commercial purposes]; Compilation of ***statistics*** for business or commercial purposes; Compilation of ***statistics*** relating to advertising; Compilation of ***statistics*** relating to health care utilization; Compilation, production and dissemination of advertising matter; Compiling indexes of information for commercial or advertising purposes; Compiling of information into computer databases; Compiling of ***statistics***; Composing advertisements for use as web pages; Composing advertisements for use as webpages; Computer assisted business information; Computer ***data*** processing; Computer database management; Computer database management services; Computer databases (Compilation of information into -); Computer databases (Systemization of information into -); Computer file management; Computerised accounting; Computerised accounting (Maintenance of -); Computerised accounting (Preparation of -); Computerised auditing; Computerised book-keeping; Computerised business information processing services; Computerised business information retrieval; Computerised business information services; Computerised business management [for others]; Computerised business promotion; Computerised business records keeping; Computerised business research; Computerised compilation of customer indexes; Computerised compilation of order lists; Computerised compilation of stock control records; Computerised ***data*** management; Computerised ***data*** processing; Computerised ***data*** verification; Computerised ***data***-base management; Computerised database management services; Computerised file management; Computerised information services to business opportunities appraisals; Computerised inventory control; Computerised inventory preparation; Computerised market research; Computerised office management; Computerised payroll preparation; Computerised point-of-sale ***data*** ***collection*** services for retailers; Computerised register management; Computerised stock management; Computerised stock ordering; Computerised tax assessments (preparation of -) [accounting]; Computerized accounting services; Computerized database management; Computerized database management services; Computerized file management; Computerized market research services; Computerized on-line ordering services; Computerized word processing; Condominium management; Conducting, arranging and organizing trade shows and trade fairs for commercial and advertising purposes; Conducting business and market research surveys; Conducting employee incentive award programs; Conducting interactive virtual auctions; Conducting market surveys; Conducting marketing studies; Conducting of auction sales; Conducting of business appraisals; Conducting of business feasibility studies; Conducting of business research; Conducting of internal business communication surveys; Conducting of market research; Conducting of market studies involving opinion polling; Conducting of marketing studies; Conducting of trade shows; Conducting online business management research surveys; Conducting public opinion polls; Conducting studies in the field of public relations; Conducting trade shows in the field of automobiles; Conducting virtual trade show exhibitions online; Conference call transcription services; Confirming scheduled appointments for others; Consultancy and advisory services for business management; Consultancy and advisory services in the field of business strategy; Consultancy and advisory services relating to business management; Consultancy and advisory services relating to personnel management; Consultancy and advisory services relating to personnel placement; Consultancy and advisory services relating to personnel recruitment; Consultancy and information services relating to accounting; Consultancy of personnel recruitment; Consultancy (Professional business -); Consultancy regarding advertising communication strategies; Consultancy regarding advertising communications strategy; Consultancy regarding business organisation and business economics; Consultancy regarding public relations communication strategies; Consultancy regarding public relations communications strategy; Consultancy regarding the organization or managing of a trade company; Consultancy relating to advertising; Consultancy relating to advertising and promotion services; Consultancy relating to auditing; Consultancy relating to business acquisition; Consultancy relating to business advertising; Consultancy relating to business analysis; Consultancy relating to business document management; Consultancy relating to business efficiency; Consultancy relating to business management; Consultancy relating to business management and organisation; Consultancy relating to business organisation; Consultancy relating to business planning; Consultancy relating to costing of sales orders; Consultancy relating to ***data*** processing; Consultancy relating to demographics for marketing purposes; Consultancy relating to management selection; Consultancy relating to marketing; Consultancy relating to personnel management; Consultancy relating to personnel recruitment; Consultancy relating to public relations; Consultancy relating to sales promotions; Consultancy relating to search engine optimisation; Consultancy relating to tax accounting; Consultancy relating to the establishment and running of businesses; Consultancy relating to the management of personnel; Consultancy relating to the organisation of promotional campaigns for business; Consultancy relating to the preparation of business ***statistics***; Consultancy relating to the selection of personnel; Consultancy services in the field of affiliate marketing; Consultancy services regarding business strategies; Consultancy services relating to advertising, publicity and marketing; Consultancy services relating to the administration and management of hotels; Consultancy services relating to the management of telephone call centers; Consultancy services relating to the management of telephone call centres; Consultancy services relating to the procurement of goods and services; Consultation in the field of business acquisitions; Consultations relating to advertising; Consultations relating to business acquisitions; Consultations relating to business advertising; Consultations relating to business disposals; Consultations relating to business mergers; Consultations relating to business promotion; Consulting and information concerning accounting; Consulting in sales techniques and sales programmes; Consulting services in business organization and management; Consulting services in the field of Internet marketing; Consulting services relating to marketing; Consulting services relating to publicity; Consumer market information services; Consumer profiling for commercial or marketing purposes; Consumer research; Consumer response analysis; Consumers (Commercial information and advice for -) [consumer advice shop]; Copying of documents; Copying of documents for others; Copying services; Copywriting; Copywriting for advertising and promotional purposes; Corporate communications services; Corporate identity services; Corporate image development consultation; Corporate image studies; Corporate management assistance; Corporate management consultancy; Corporate management consultancy services; Corporate planning; Cost accounting; Cost analyses; Cost analysis; Cost assessment services; Cost benefit analysis; Cost management accounting; Cost price analysis; Cost price analysis regarding waste disposal, removal, handling and recycling; Counselling on business matters; Coupon procurement services for others; Creating advertising material; Credit card registration services; Customer club services, for commercial, promotional and/or advertising purposes; Customer loyalty services for commercial, promotional and/or advertising purposes; Customer relationship management; ***Data*** ***collection*** [for others]; ***Data*** ***collection*** services; ***Data*** compilation for others; ***Data*** entry and ***data*** processing; ***Data*** file administration; ***Data*** inputting services; ***Data*** management; ***Data*** management services; ***Data*** processing; ***Data*** processing for businesses; ***Data*** processing for the ***collection*** of ***data*** for business purposes; ***Data*** processing management; ***Data*** processing services; ***Data*** processing services in the field of healthcare; ***Data*** processing services in the field of payroll; ***Data*** processing services in the field of transportation; ***Data*** processing, systematisation and management; ***Data*** processing verification; ***Data*** retrieval services; ***Data*** search in computer files for others; ***Data*** searches in computerised files for others; ***Data*** transcription; Database management; ***Data***-base management (Computerised -); Database management services; Database marketing; ***Data***-based stock control; ***Data***-based stock location services; Demonstration [for promotional/advertising purposes]; Demonstration of goods; Demonstration of goods and services by electronic means, also for the benefit of the so-called teleshopping and homeshopping services; Demonstration of goods for advertising purposes; Demonstration of goods for promotional purposes; Demonstration of photographic equipment [for advertising purposes]; Demonstration of products; Design of advertising brochures; Design of advertising flyers; Design of advertising logos; Design of advertising materials; Design of marketing surveys; Design of public opinion surveys; Developing promotional campaigns for business; Developing promotional campaigns for businesses; Development and implementation of marketing strategies for others; Development of advertising concepts; Development of concepts for business economy; Development of hospital management systems; Development of marketing strategies and concepts; Development of promotional campaigns; Digital advertising services; Digital marketing; Direct mail advertising; Direct mail advertising services; Direct mail advertising services provided by lettershops; Direct mail advertising to attract new customers and to maintain the existing customer base; Direct market advertising; Direct marketing; Direct marketing consulting; Direct marketing services; Directories (Compilation of business -); Display services for merchandise; Displaying advertisements for others; Dissemination of advertisements; Dissemination of advertisements and of advertising material [flyers, brochures, leaflets and samples]; Dissemination of advertisements via the Internet; Dissemination of advertising and promotional materials; Dissemination of advertising for others; Dissemination of advertising for others via an on-line communications network on the internet; Dissemination of advertising for others via the Internet; Dissemination of advertising, marketing and publicity materials; Dissemination of advertising material; Dissemination of advertising material [leaflets, brochure and printed matter]; Dissemination of advertising material [leaflets, brochures and printed matter]; Dissemination of advertising materials; Dissemination of advertising matter; Dissemination of advertising matter by mail; Dissemination of advertising matter online; Dissemination of advertising via online communications networks; Dissemination of business information; Dissemination of commercial information; Dissemination of ***data*** relating to advertising; Dissemination of ***data*** relating to business; Dissemination of information relating to the recruitment of graduates; Dissemination services of advertisement matter; Distribution and dissemination of advertising materials [leaflets, prospectuses, printed material, samples]; Distribution of advertisements and commercial announcements; Distribution of advertising announcements; Distribution of advertising brochures; Distribution of advertising leaflets; Distribution of advertising mail and of advertising supplements attached to regular editions; Distribution of advertising, marketing and promotional material; Distribution of advertising material; Distribution of advertising material by post; Distribution of advertising materials; Distribution of advertising matter; Distribution of advertising samples; Distribution of flyers, brochures, printed matter and samples for advertising purposes; Distribution of printed advertising matter; Distribution of printed promotional material by post; Distribution of products for advertising purposes; Distribution of promotional leaflets; Distribution of promotional material; Distribution of promotional matter; Distribution of prospectuses and samples; Distribution of prospectuses and samples for advertising purposes; Distribution of prospectuses for advertising purposes; Distribution of publicity leaflets; Distribution of publicity materials (flyers, prospectuses, brochures, samples, particularly for catalogue long distance sales) whether cross border or not; Distribution of publicity materials, namely, flyers, prospectuses, brochures, samples, particularly for catalogue long distance sales [whether crossborder or not]; Distribution of publicity texts; Distribution of samples; Distribution of samples for advertising purposes; Distribution of samples for publicity purposes; Document preparation; Document reproduction; Document reproduction [photocopying services]; Drafting of publicity material; Drawing up of business statistical information; Drawing up of statements of accounts; Drawing up statements of account; Duplication of documents; Economic analysis for business purposes; Economic forecasting; Economic forecasting analysis for business purposes; Economic forecasting and analysis; Economic forecasting for business purposes; Economic forecasting services; Economic information services for business purposes; Economic studies for business purposes; Editing of publicity texts; Efficiency (Business -) expert services; Efficiency expert services; Efficiency experts; Electricity meter reading for billing purposes; Electronic billboard advertising; Electronic ***data*** processing; Electronic order processing; Electronic publication of printed matter for advertising purposes; Electronic stock management services; Employee leasing; Employee record services; Employee relocation services; Employment agencies; Employment agency services; Employment agency services for people skilled in the use of computers; Employment agency services for personnel in general office positions; Employment agency services for temporary work assignments; Employment agency services provided for nannies; Employment agency services relating to au pairs; Employment agency services relating to bilingual staff; Employment agency services relating to nurses; Employment agency services relating to placement of medical and nursing personnel; Employment agency services the provision of staff for the manning of show houses; Employment booking services for film television technicians; Employment booking services for performing artists; Employment bureau services; Employment consultancy; Employment consultancy services; Employment consultancy services relating to ***data*** processing personnel; Employment counselling; Employment counselling and consultancy services; Employment counselling services; Employment management services for film television technicians; Employment outplacement services; Employment placement services for butlers; Employment placement services for housekeepers; Employment placement services for personal assistants; Employment recruiting consultancy; Employment recruiting services; Employment recruitment; Energy price comparison services; Estimations for marketing purposes; Evaluating the impact of advertising on audiences; Evaluation of business opportunities; Evaluation of personnel requirements; Evaluations relating to business management in commercial enterprises; Evaluations relating to business management in industrial enterprises; Evaluations relating to business management in professional enterprises; Evaluations relating to commercial matters; Event marketing; Execution of stenographic work to order; Executive placement services; Executive recruiting services; Executive recruitment services; Executive search and placement services; Executive search and selection services; Executive search services; Executive selection services; Exhibitions (Arranging -) for advertising purposes; Exhibitions (Arranging -) for business purposes; Exhibitions (Arranging -) for commercial purposes; Exhibitions (Arranging -) for trade purposes; Exhibitions (Conducting -) for advertising purposes; Exhibitions (Conducting -) for business purposes; Exhibitions (Conducting -) for commercial purposes; Exhibitions (Conducting -) for trade purposes; Exhibitions for commercial or advertising purposes; Expert evaluations and reports relating to business matters; Export agency services; Export and import agencies; Export promotion services; Export-import agency services; Fashion show exhibitions for commercial purposes; Fashion shows for promotional purposes (Organization of -); File management (Computerized -); Filing documents or magnetic-tapes [office functions]; Financial auditing; Financial marketing; Financial records management; Financial statement preparation and analysis for businesses; Forecasting (Economic -); Forecasting (Economic -) for business purposes; Foreign trade consultancy services; Foreign trade information and consultation; Foreign trade information (Provision of -); Foreign trade information (Services for the provision of -); Forensic accounting services; Franchising (Business advice relating to -); Franchising (Business advisory services relating to -); Franchising services providing business assistance; Franchising services providing marketing assistance; Gas meter reading for billing purposes; Gift registry services; Goods import-export agencies; Goods or services price quotations; Grain market analysis; Graphic advertising services; Handbill distribution; Headhunting services; Health care cost management; Health care cost review; Help in the management of business affairs or commercial functions of an industrial or commercial enterprise; Hire of advertising aids; Hire of advertising billboards; Hire of advertising equipment; Hire of advertising hoardings; Hire of office equipment; Hire of office machinery; Hiring of advertising materials; Hiring of machines or apparatus for offices; Hiring of office equipment; Hiring of publicity materials; Hiring of typewriters; Hospital management; Hotel management for others; Hotel management service [for others]; Hotels (Business management of -); Human resources consultancy; Human resources consultation; Human resources management; Human resources management and recruitment services; Import agency services; Import and export agencies; Import and export agencies services; Import and export agency services; Import and export services; Import-export agencies; Import-export agencies in the field of energy; Import-export agency services; Income tax returns (Preparation of -); Industrial management assistance (Commercial or -); Industrial management consultation including cost/yield analyses; Information about sales methods; Information agencies (Commercial -); Information and ***data*** compiling and analyzing relating to business management; Information and expert opinions relating to companies and business; Information (Business -); Information in business matters; Information or enquiries on business and marketing; Information services relating to advertising; Information services relating to business matters; Information services relating to businesses; Information services relating to ***data*** processing; Information services relating to jobs and career opportunities; Initiating telephone calls for others; Inquiries (Business -); Inserting printed matter into envelopes; Interim business management; Intermediary services relating to advertising; Intermediary services relating to the rental of advertising time and space; Internet marketing; Internship placement services; Interpretation of market research ***data***; Interviewing for market research purposes; Interviewing for qualitative market research; Interviewing services [for personnel recruitment]; Inventories (Preparation of -); Inventory control; Inventory management; Inventory management of parts and components for manufacturers and suppliers; Inventory management services; Inventorying merchandise; Investigations (Business -); Investigations of marketing strategy; Invoicing; Invoicing services; Issuing and updating of advertising texts; Issuing of publicity leaflets; Job agency services; Job agency services for medical personnel; Job agency services for para-medical personnel; Job and personnel placement; Job matching services; Job placement; Job placement consultancy; Key return registration; Keypunching [office functions]; Labor exchanges; Labour exchange services; Layout services for advertising purposes; Leasing of advertising billboards; Leasing of advertising hoardings; Leasing of advertising space on pamphlets; Leasing of advertising space on railway properties; Leasing of advertising space on trains; Leasing of billboards; Leasing of office machines; Leasing of typewriters; Licensing of the goods and services of others (Commercial administration of the -); Lifecycle costing for business purposes; Literary agency services consisting of the negotiation of contracts; Loyalty, incentive and bonus program services; Loyalty scheme services; Magazine advertising; Mail order retail services connected with clothing accessories; Mail order retail services for clothing; Mail order retail services for clothing accessories; Mail order retail services for cosmetics; Mail order retail services related to alcoholic beverages (except beer); Mail order retail services related to beer; Mail order retail services related to foodstuffs; Mail order retail services related to non-alcoholic beverages; Mail sorting, handling and receiving; Mail sorting, handling and receiving [office functions]; Mailing list preparation services; Mailing lists (Compilation of -); Mail-order advertising; Maintaining a registry of animal breeds; Maintaining a registry of certified aerospace technicians; Maintaining a registry of certified medical technical professionals; Maintaining a registry of dog breeds; Maintaining a registry of information; Maintaining a registry of professional vocational evaluators; Maintaining files and records concerning the medical condition of individuals; Maintaining personal medical history records and files; Maintenance of asset registers [for others]; Maintenance of personnel records [for others]; Maintenance of registers [for others]; Management accounting; Management administration of commercial undertakings; Management advice; Management advice relating to the placing of staff; Management advice relating to the recruitment of staff; Management (Advisory services for business -); Management advisory services related to franchising; Management and compilation of computerised databases; Management and operation assistance to commercial businesses; Management assistance; Management assistance (Commercial or industrial -); Management assistance for industrial organisations; Management assistance for promoting business; Management assistance in business affairs; Management assistance in the establishment of commercial undertakings; Management assistance services; Management assistance to commercial companies; Management assistance to commercial firms; Management (Computerized file -); Management consultancy (Personnel -); Management consultancy services; Management consulting; Management of a retail enterprise for others; Management of an airline company; Management of business [for others]; Management of business offices for others; Management of business projects [for others]; Management of computer databases; Management of computer files; Management of computerised files; Management of customer loyalty, incentive or promotional schemes; Management of health care clinics for others; Management of hotel incentive programs of others; Management of performing artists; Management of professional athletes; Management of telephone call centers for other; Management of telephone call centers for others; Management on behalf of industrial and commercial enterprises in terms of supplying them with office requisites; Market analysis; Market analysis and research; Market analysis and research services; Market analysis reports; Market analysis services; Market analysis services relating to the availability of antiques; Market analysis services relating to the availability of goods; Market analysis services relating to the sale of antiques; Market analysis services relating to the sale of goods; Market analysis studies; Market assessment consultancy; Market assessment services; Market campaigns; Market canvassing; Market forecasting; Market information services relating to index levels; Market information services relating to market ***statistics***; Market information services relating to trade reports; Market intelligence services; Market investigation via the telephone; Market opinion polling studies; Market prospecting; Market reporting consultancy; Market reporting services; Market reports and studies; Market research; Market research and analysis; Market research and analysis services; Market research and business analyses; Market research and market analysis; Market research and marketing studies; Market research by means of a computer ***data*** base; Market research by means of a computer database; Market research consultancy; Market research ***data*** analysis; Market research ***data*** ***collection*** services; Market research ***data*** retrieval services; Market research for advertising; Market research for compiling information on readers of publications; Market research for compiling information on viewers of television; Market research services; Market research services for publishers; Market research services regarding customer loyalty; Market research services regarding Internet usage habits; Market research services relating to broadcast media; Market research studies; Market segmentation consultation; Market studies; Market study and analysis of market studies; Market study services; Market survey analysis; Market surveys; Market surveys conducted by telephone; Marketing; Marketing, advertising and promotion services; Marketing, advertising, and promotional services; Marketing advice; Marketing advisory services; Marketing agency services; Marketing analysis; Marketing analysis services; Marketing assistance; Marketing (Business advice relating to -); Marketing by telephone; Marketing consultancy; Marketing consultation services; Marketing consulting; Marketing forecasting; Marketing in the framework of software publishing; Marketing information; Marketing management advice; Marketing research; Marketing research and analysis; Marketing research in the fields of cosmetics, perfumery and beauty products; Marketing research or analysis; Marketing research services; Marketing services; Marketing services in the field of dentistry; Marketing services in the field of restaurants; Marketing services in the field of travel; Marketing services provided by means of digital networks; Marketing services relating to esports events; Marketing studies; Marketing the goods and services of others; Marketing the goods and services of others by distributing coupons; Matching skilled volunteers with non-profit organisations; Media buying services; Media relations services; Mediation and conclusion of commercial transactions for others; Mediation of advertising; Mediation of agreements regarding the sale and purchase of goods; Mediation of contracts for purchase and sale of products; Mediation of trade business for third parties; Medical billing; Medical billing services for doctors; Medical billing services for hospitals; Medical cost management; Medical transcription services; Merchandising; Merchandizing; Message transcription; Model recruitment agencies; Modeling agency services; Modeling for advertising or sales promotion; Modeling services for advertising or sales promotion; Modelling agency services for advertising purposes; Modelling agency services for sales promotion purposes; Modelling agency services relating to advertising; Modelling agency services relating to sales promotions; Modelling and models for advertising or sales promotion; Modelling for advertising or sales promotion; Nanny placement services; Negotiating and concluding commercial transactions for others; Negotiation and conclusion of commercial transactions for third parties; Negotiation and conclusion of commercial transactions for third parties via telecommunication systems; Negotiation and settlement of commercial transactions for third parties; Negotiation of advertising contracts; Negotiation of business contracts for others; Negotiation of commercial transactions for performing artists; Negotiation of commercial transactions for third parties; Negotiation of contracts relating to the purchase and sale of goods; Negotiation of contracts with health care payors; News and current affairs clipping services; News clipping services; Newspaper advertising; Newspaper subscription services; Newspaper subscription services for others; Newspaper subscriptions; Newspaper subscriptions (Arranging -) for others; Obtaining business ***statistics*** [for others]; Office administration services [for others]; Office equipment rental services; Office functions; Office functions services; Office machine rental services; Office machines and equipment rental; Office machines (Rental of -); Office management services [for others]; Office services for electronically collating ***data***; Office services for electronically ***collecting*** ***data***; Office services for electronically manipulating ***data***; Office support staff recruitment services; Online advertisements; Online advertising; On-line advertising; On-line advertising and marketing services; Online advertising network matching services for connecting advertisers to websites; Online advertising on a computer network; On-line advertising on a computer network; On-line advertising on computer communication networks; Online advertising on computer networks; On-line advertising on computer networks; Online advertising services; Online advertising via a computer communications network; On-line advertising via a computer communications network; On-line auction bidding for others; On-line auctioneering; On-line auctioneering services via the Internet; Online business networking services; Online community management services; Online ***data*** processing services; On-line ***data*** processing services; Online marketing; Online ordering services; On-line ordering services in the field of restaurant take-out and delivery; On-line promotion of computer networks and websites; Online retail services for downloadable and pre-recorded music and movies; Online retail services for downloadable digital music; Online retail services for downloadable ring tones; Online retail services relating to clothing; Online retail services relating to cosmetics; Online retail services relating to handbags; Online retail services relating to jewelry; Online retail services relating to luggage; Online retail services relating to toys; Online retail store services in relation to clothing; Online retail store services relating to clothing; Online retail store services relating to cosmetic and beauty products; On-line trading services in which seller posts products to be auctioned and bidding is done via the Internet; Operation of a telephone switchboard for others; Operation of businesses [for others]; Operation of commercial businesses [for others]; Operational business assistance to enterprises; Opinion polling; Ordering services [for others]; Ordering services for third parties; Organisation and conducting of product presentations; Organisation and holding of fairs for commercial or advertising purposes; Organisation and management of business incentive and loyalty schemes; Organisation and management of customer loyalty programs; Organisation for a third party of telephone welcoming services and of telephone receptionist services; Organisation of customer loyalty programs for commercial, promotional or advertising purposes; Organisation of events for commercial and advertising purposes; Organisation of exhibitions and events for commercial or advertising purposes; Organisation of exhibitions and trade fairs for business and promotional purposes; Organisation of exhibitions and trade fairs for commercial and advertising purposes; Organisation of exhibitions and trade fairs for commercial or advertising purposes; Organisation of exhibitions for business or commerce; Organisation of exhibitions for commercial and advertising purposes; Organisation of exhibitions for commercial or advertising purposes; Organisation of exhibitions of flowers and plants for commercial or advertising purposes; Organisation of exhibitions or trade fairs for commercial or advertising purposes; Organisation of fashion shows for commercial purposes; Organisation of internet auctions; Organisation of prize draws for advertising purposes; Organisation of promotions using audiovisual media; Organisation of promotions using audio-visual media; Organisation of trade fairs; Organisation of trade fairs and exhibitions for commercial or advertising purposes; Organisation of trade fairs for advertising purposes; Organisation of trade fairs for commercial or advertising purposes; Organisation, operation and supervision of an incentive scheme; Organisation, operation and supervision of customer loyalty schemes; Organisation, operation and supervision of loyalty and incentive schemes; Organisation, operation and supervision of loyalty schemes and incentive schemes; Organisation, operation and supervision of sales and promotional incentive schemes; Organisational consultancy regarding customer loyalty programmes; Organising and conducting job fairs; Organising exhibitions for commercial or advertising purposes; Organization of art exhibitions for commercial or advertising purposes; Organization of events, exhibitions, fairs and shows for commercial, promotional and advertising purposes; Organization of exhibitions and trade fairs for commercial or advertising purposes; Organization of exhibitions for commercial or advertising purposes; Organization of fairs and exhibitions for commercial and advertising purposes; Organization of fairs for commercial and advertising purposes; Organization of fashion shows for promotional purposes; Organization of trade fairs; Organization of trade fairs for commercial or advertising purposes; Organization, operation and supervision of loyalty and incentive schemes; Organization, operation and supervision of sales and promotional incentive schemes; Organizing exhibitions for commercial or advertising purposes; Organizing of trade shows; Outdoor advertising; Outsource service provider in the field of customer relationship management; Outsourced administrative management for companies; Outsourcing services [business assistance]; Outsourcing services in the field of business analytics; Outsourcing services in the field of business operations; Outsourcing services in the field of customer relationship management; Outsourcing services in the nature of arranging procurement of goods for others; Outsourcing services in the nature of arranging service contracts for others; Pay per click advertising; Payroll advisory services; Payroll assistance; Payroll preparation; Payroll processing services [for others]; Permanent staff recruitment; Personal management consultancy services; Personality testing for recruitment purposes; Personality testing for the selection of personnel; Personnel agency services relating to the electronics industry; Personnel consultancy; Personnel management; Personnel management advice; Personnel management and employment consultancy; Personnel management assistance; Personnel management assistance services; Personnel management consultancy; Personnel management consultancy services; Personnel management consultation; Personnel management consulting; Personnel management for advertising purposes; Personnel management of marketing personnel; Personnel management of sales personnel; Personnel management services; Personnel placement; Personnel placement and recruitment; Personnel placement consultancy; Personnel placement services; Personnel recruitment; Personnel recruitment advertising; Personnel recruitment agency services; Personnel recruitment consultancy; Personnel recruitment services; Personnel recruitment services and employment agencies; Personnel relocation; Personnel resources management; Personnel selection [for others]; Personnel selection using psychological testing; Personnel services; Photocopying; Photocopying services; Placement of design staff; Placement of permanent personnel; Placement of staff; Placement of temporary personnel; Placing advertisements for others; Planning and conducting of trade fairs, exhibitions and presentations for commercial or advertising purposes; Planning and conducting of trade fairs, exhibitions and presentations for economic or advertising purposes; Planning concerning business management, namely, searching for partners for amalgamations and business take-overs as well as for business establishments; Planning of marketing strategies; Planning services for advertising; Planning services for marketing studies; Political advertising services; Political opinion polling; Polling (Opinion -); Preparation and compilation of business and commercial reports and information; Preparation and completion of income tax returns; Preparation and presentation of audio visual displays for advertising purposes; Preparation and realization of media and advertising plans and concepts; Preparation of accounts; Preparation of advertisements; Preparation of advertising campaigns; Preparation of advertising material; Preparation of advertising matter; Preparation of annual returns for business undertakings; Preparation of audio and/or visual displays for businesses; Preparation of business balances; Preparation of business reports; Preparation of business statistical ***data***; Preparation of business ***statistics***; Preparation of business surveys; Preparation of commercial reports; Preparation of custom advertisements for others; Preparation of documents relating to business; Preparation of documents relating to taxation; Preparation of economic reports; Preparation of expert evaluations and reports relating to business matters; Preparation of income tax returns; Preparation of inventories; Preparation of invoices; Preparation of mailing lists; Preparation of mailing lists for direct mail advertising services [other than selling]; Preparation of market analysis reports; Preparation of market reports and studies; Preparation of marketing plans; Preparation of marketing surveys; Preparation of pay packets; Preparation of payrolls [for others]; Preparation of project studies relating to business matters; Preparation of public opinion surveys; Preparation of publicity columns; Preparation of publicity documents; Preparation of publicity leaflets; Preparation of publicity material; Preparation of publicity publications; Preparation of reports for marketing; Preparation of résumés for others; Preparation of statements of accounts; Preparation of ***statistics*** [business]; Preparation of tax declarations; Preparation of tax returns; Preparation of trade publicity texts; Preparation of wage slips; Preparing advertisements for others; Preparing and placing advertisements for others; Preparing and placing of advertisements; Preparing and placing outdoor advertisements for others; Preparing audiovisual presentations for use in advertising; Preparing audio-visual presentations for use in advertising; Preparing business reports; Preparing promotional and merchandising material for others; Presentation of companies and their goods and services on the Internet; Presentation of companies on the Internet and other media; Presentation of financial products on communication media, for retail purposes; Presentation of goods and services; Presentation of goods on communication media, for retail purposes; Presentation of goods on communications media, for retail purposes; Press advertising consultancy; Press advertising services; Price analysis services; Price comparing services; Price comparison rating of accommodations; Price comparison services; Pricing analysis; Pricing surveys; Prize draws (Organising of -) for advertising purposes; Prize draws (Organising of -) for promotional purposes; Processing (Administrative -) of purchase orders; Processing of business survey results; Processing telephone inquiries regarding advertised goods and services; Processing warranty registration documents for others; Processing (Word -); Procurement of contracts concerning energy supply; Procurement of contracts [for others]; Procurement of contracts for others relating to the sale of goods; Procurement of contracts for the purchase and sale of goods and services; Procurement of contracts for the purchase and sale of goods and services for others; Procurement of goods on behalf of other businesses; Procurement services; Procurement services for others [purchasing goods and services for other businesses]; Procurement services for others relating to office requisites; Procuring of contracts for the purchase and sale of goods; Producing promotional videotapes, video discs, and audio visual recordings; Product demonstration services in shop windows by live models; Product demonstrations and product display services; Product launch services; Product launches; Product marketing; Product merchandising; Product merchandising for others; Product sales information; Product sales rankings information; Product sampling; Production and distribution of radio and television commercials; Production of advertising films; Production of advertising material; Production of advertising materials; Production of advertising matter; Production of advertising matter and commercials; Production of cinema commercials; Production of commercials; Production of infomercials; Production of radio advertisements; Production of radio commercials; Production of sound recordings for advertising purposes; Production of sound recordings for marketing purposes; Production of sound recordings for publicity purposes; Production of teleshopping programmes; Production of teleshopping programs; Production of television and radio advertisements; Production of television commercials; Production of video recordings for advertising purposes; Production of video recordings for marketing purposes; Production of video recordings for publicity purposes; Production of visual advertising matter; Professional business consultancy; Professional business consultancy services; Professional business consultation relating to the operation of businesses; Professional business consultation relating to the setting up of businesses; Professional business consultations; Professional business consulting; Professional consultancy relating to business management; Professional consultancy relating to marketing; Professional consultancy relating to personnel management; Professional recruitment services; Profit surveys; Prognosis on economical affairs; Project studies for businesses; Project studies relating to business matters (Preparation of -); Promoting a series of films for others; Promoting and conducting trade shows; Promoting services for baseball game; Promoting the artwork of others by means of providing online portfolios via a website; Promoting the designs of others by means of providing online portfolios via a website; Promoting the goods and services of others; Promoting the goods and services of others by arranging for sponsors to affiliate their goods and services with awards programs; Promoting the goods and services of others by arranging for sponsors to affiliate their goods and services with sporting activities; Promoting the goods and services of others by arranging for sponsors to affiliate their goods and services with sports competitions; Promoting the goods and services of others by distributing coupons; Promoting the goods and services of others by means of a loyalty rewards card scheme; Promoting the goods and services of others by means of a preferred customer program; Promoting the goods and services of others over the Internet; Promoting the goods and services of others through advertisements on Internet websites; Promoting the goods and services of others through discount card programs; Promoting the goods and services of others through infomercials; Promoting the goods and services of others through the administration of sales and promotional incentive schemes involving trading stamps; Promoting the goods and services of others through the distribution of discount cards; Promoting the goods and services of others via a global computer network; Promoting the goods and services of others via computer and communication networks; Promoting the music of others by means of providing online portfolios via a website; Promoting the sale of fashion goods through promotional articles in magazines; Promoting the sale of goods and services of others by awarding purchase points for credit card use; Promoting the sale of goods and services of others through promotional events; Promoting the sale of goods and services of others through the distribution of printed material and promotional contests; Promoting the sale of the services [on behalf of others] by arranging advertisements; Promotion, advertising and marketing of on-line websites; Promotion [advertising] of business; Promotion [advertising] of concerts; Promotion [advertising] of travel; Promotion of fairs for trade purposes; Promotion of financial and insurance services, on behalf of third parties; Promotion of goods and services for others; Promotion of goods and services through sponsorship; Promotion of goods and services through sponsorship of international sports events; Promotion of goods and services through sponsorship of sports events; Promotion of insurance services, on behalf of third parties; Promotion of musical concerts; Promotion of special events; Promotion of sports competitions and events; Promotion services; Promotion services relating to esports events; Promotional advertising carried out via the telephone; Promotional advertising for exploration projects; Promotional advertising relating to philosophical instruction; Promotional advertising relating to philosophical training; Promotional advertising services; Promotional and advertising services; Promotional management for sports personalities; Promotional management of celebrities; Promotional marketing; Promotional marketing services using audiovisual media; Promotional services; Promotional services provided by telephone; Providing a directory of third party web sites to facilitate business transactions; Providing a searchable online advertising guide featuring the goods and services of online vendors; Providing a searchable online advertising guide featuring the goods and services of other on-line vendors on the internet; Providing academic course administration services for academic institutions; Providing academic course administration services relating to online course registration; Providing academic course administration services relating to on-line course registration; Providing administrative assistance to pharmacies for managing drug inventories; Providing advertising services; Providing advertising space; Providing advertising space in periodicals, newspapers and magazines; Providing advice and information relating to commercial business management; Providing advice in the field of business management and marketing; Providing advice relating to sales methods and techniques; Providing advice relating to the analysis of consumer buying habits; Providing advice relating to the marketing of chemical products; Providing advice relating to the organisation and management of businesses; Providing an on-line commercial information directory on the internet; Providing and rental of advertising space; Providing and rental of advertising space on the internet; Providing assistance in the field of business management; Providing assistance in the field of business management and planning; Providing assistance in the field of business management within the framework of a franchise contract; Providing assistance in the field of business organisation; Providing assistance in the field of business promotion; Providing assistance in the field of product commercialization; Providing assistance in the field of product commercialization within the framework of a franchise contract; Providing assistance in the management of business activities; Providing assistance in the management of franchised businesses; Providing assistance in the management of industrial or commercial enterprises; Providing business directory information via a global computer network; Providing business efficiency advice; Providing business information; Providing business information, also via internet, the cable network or other forms of ***data*** transfer; Providing business information by way of computer terminals; Providing business information directory services, via a global computer network; Providing business information in the field of social media; Providing business information via a web site; Providing business information via a website; Providing business intelligence services; Providing business management and operational assistance to commercial businesses; Providing business management start-up support for other businesses; Providing business marketing information; Providing commercial and business contact information; Providing commercial directory information via the Internet; Providing commercial information and advice for consumers in the choice of products and services; Providing commercial information relating to companies; Providing commercial information to consumers; Providing consumer information relating to goods and services; Providing consumer product advice; Providing consumer product advice relating to cosmetics; Providing consumer product advice relating to laptops; Providing consumer product advice relating to software; Providing consumer product information; Providing consumer product information relating to cosmetics; Providing consumer product information relating to food or drink products; Providing consumer product information relating to laptops; Providing consumer product information relating to software; Providing consumer product information via the Internet; Providing employment counseling services; Providing employment information; Providing employment information via a global computer network; Providing hotel rate comparison information; Providing information about commercial business and commercial information via the global computer network; Providing information concerning commercial sales; Providing information in the field of marketing; Providing information in the field of time management; Providing information relating to employee relocation services; Providing information relating to employment recruitment; Providing information relating to personnel recruitment; Providing information via the Internet relating to the sale of automobiles; Providing market information in relation to consumer products; Providing market intelligence services; Providing market research ***statistics***; Providing marketing consulting in the field of social media; Providing marketing information via websites; Providing office functions; Providing on-line auction services; Providing online commercial directory information services; Providing online marketplaces for sellers of goods and or services; Providing recruitment information via a global computer network; Providing searchable online advertising guides; Providing temporary office support staff; Providing trade information; Providing transportation documentation for others [administrative services]; Providing user rankings for commercial or advertising purposes; Providing user ratings for commercial or advertising purposes; Providing user reviews for commercial or advertising purposes; Provision and rental of advertising space; Provision and rental of advertising space, time and media; Provision of administrative staff; Provision of advertising information; Provision of advertising space; Provision of advertising space by electronic means and global information networks; Provision of advertising space on a global computer network; Provision of advertising space on electronic media; Provision of advertising space, time and media; Provision of advice relating to marketing; Provision of advice relating to the recruitment of graduates; Provision of an online marketplace for buyers and sellers of goods and services; Provision of an on-line marketplace for buyers and sellers of goods and services; Provision of assistance [business] in the establishment of franchises; Provision of assistance [business] in the operation of franchises; Provision of business advice relating to franchising; Provision of business and commercial contact information via the Internet; Provision of business and commercial information; Provision of business assistance; Provision of business ***data***; Provision of business ***data*** in the form of mailing lists; Provision of business information; Provision of business information relating to franchising; Provision of business information relating to joint ventures; Provision of business information relating to the ***agricultural*** industry; Provision of business information via global computer networks; Provision of business management assistance; Provision of business management information; Provision of business statistical information; Provision of business statistical information relating to medical matters; Provision of clerical and secretarial services; Provision of commercial and business contact information; Provision of commercial business information by means of a computer database; Provision of commercial information; Provision of commercial information [business]; Provision of commercial information from online databases; Provision of commercial information via the Internet; Provision of commission sales staff; Provision of computerised advertising services; Provision of computerised business information; Provision of computerised business information ***data***; Provision of computerised business management information; Provision of computerised business ***statistics***; Provision of computerised ***data*** relating to business; Provision of computerised information relating to business records; Provision of contract sales forces; Provision of foreign trade information; Provision of information and advice to consumers regarding the selection of products and items to be purchased; Provision of information and advisory services relating to e-commerce; Provision of information concerning commercial sales; Provision of information relating to accounts [accountancy]; Provision of information relating to advertising; Provision of information relating to business; Provision of information relating to commerce; Provision of information relating to ***data*** processing; Provision of information relating to marketing; Provision of information relating to recruitment; Provision of initial company secretarial services on company formation; Provision of market research information; Provision of marketing advisory services for manufacturers; Provision of marketing information; Provision of marketing reports; Provision of models for advertising; Provision of models for promotional purposes; Provision of nominee company directors; Provision of on-line business and commercial information; Provision of online financial services comparisons; Provision of online price comparison services; Provision of reports relating to accounting information; Provision of sales analyses; Provision of sales staff; Provision of secretarial services; Provision of space on websites for advertising goods and services; Provision of space on web-sites for advertising goods and services; Provision of statements of accounts; Provision of statistical information relating to business; Provision of trade information; Psychological testing for the selection of personnel; Psychometric testing for the selection of personnel; Public opinion polling; Public opinion polling services; Public opinion polls (Conducting of -); Public opinion polls (Operating of -); Public opinion surveys; Public relations; Public relations agency; Public relations consultancy; Public relations services; Public relations studies; Publication of advertising literature; Publication of advertising matter; Publication of advertising texts; Publication of printed matter for advertising purposes; Publication of printed matter for advertising purposes in electronic form; Publication of publicity material; Publication of publicity materials; Publication of publicity materials and texts; Publication of publicity materials on-line; Publication of publicity texts; Publicity; Publicity (Advisory services relating to -); Publicity agencies; Publicity agency services; Publicity agents; Publicity and advertising; Publicity and promotional services; Publicity and sales promotion; Publicity and sales promotion services; Publicity brochure distribution; Publicity bureau services; Publicity column preparation; Publicity columns preparation; Publicity leaflets (Issuing of -); Publicity material (Preparation of -); Publicity material rental; Publicity material (Rental of -); Publicity personnel management services; Publicity publication services; Publicity services; Publicity texts (Publication of -); Publicity texts (Writing of -); Purchase orders (Administrative processing of -); Purchasing agency services; Purchasing of goods and services for other businesses; Purchasing services; Radio advertising; Radio advertising and commercials; Radio and television advertising; Real estate marketing; Real estate marketing analysis; Records management services, namely, document indexing for others; Recruiting of office support staff; Recruitment advertising; Recruitment and personnel management services; Recruitment and placement services; Recruitment [casting] of actors; Recruitment consultancy for lawyers; Recruitment consultancy for legal secretaries; Recruitment consultancy services; Recruitment consultants in the financial services field; Recruitment of airline personnel; Recruitment of airport ground staff; Recruitment of computer staff; Recruitment of executive staff; Recruitment of flight personnel; Recruitment of high-level management personnel; Recruitment of personnel; Recruitment of political operatives; Recruitment of political volunteers; Recruitment of temporary personnel; Recruitment of temporary technical personnel; Recruitment (Personnel -); Recruitment services; Recruitment services for sales and marketing personnel; Referral marketing; Registration and transcription of written communications; Registration of written communications and ***data***; Relocation services (Employee -); Relocation services for business; Relocation services for businesses; Rental of advertisement billboards; Rental of advertisement hoardings; Rental of advertisement space; Rental of advertisement space and advertising material; Rental of advertising material; Rental of advertising matter; Rental of advertising space; Rental of advertising space on the internet; Rental of advertising space on the Internet for employment advertising; Rental of advertising space on web sites; Rental of advertising space on-line; Rental of advertising space, time and materials; Rental of advertising time in cinemas; Rental of advertising time on communication media; Rental of all publicity and marketing presentation materials; Rental of billboards; Rental of billboards [advertising boards]; Rental of card-operated vending machines; Rental of coin-operated vending machines; Rental of copying apparatus; Rental of digital billboards; Rental of electronic point of sale (EPOS) equipment; Rental of office equipment; Rental of office equipment in co-working facilities; Rental of office machinery and equipment; Rental of office machines; Rental of office machines and equipment; Rental of photocopiers; Rental of photocopying machines; Rental of publicity equipment; Rental of publicity material; Rental of publicity matter; Rental of sales stands; Rental of signs for advertising purposes; Rental of typewriters; Rental of typewriters and copying machines; Rental of vending machines; Rental [Office machines and equipment -]; Rental (Publicity material -); Renting of advertising spaces; Reproduction (Document -); Reproduction of advertising material; Reproduction of drawings; Reproduction of files [paper]; Reproduction of records [paper]; Reproduction services (Document -); Reprographic services; Research and analysis in the field of market manipulation; Research (Business -); Research for business purposes; Research (Market -); Research of business information; Research services relating to advertising; Research services relating to advertising and marketing; Research services relating to business; Response advertising; Restaurant management for others; Retail of third-party pre-paid cards for the purchase of clothing; Retail of third-party pre-paid cards for the purchase of entertainment services; Retail of third-party pre-paid cards for the purchase of multimedia content; Retail of third-party pre-paid cards for the purchase of telecommunication services; Retail or wholesale services for pharmaceutical, veterinary and sanitary preparations and medical supplies; Retail purposes (Presentation of goods on communication media, for -); Retail services connected with stationery; Retail services connected with the sale of clothing and clothing accessories; Retail services connected with the sale of furniture; Retail services connected with the sale of subscription boxes containing beers; Retail services connected with the sale of subscription boxes containing chocolates; Retail services connected with the sale of subscription boxes containing cosmetics; Retail services connected with the sale of subscription boxes containing food; Retail services for computer software; Retail services for pharmaceutical, veterinary and sanitary preparations and medical supplies; Retail services for works of art provided by art galleries; Retail services in relation to ***agricultural*** equipment; Retail services in relation to alcoholic beverages (except beer); Retail services in relation to animal grooming preparations; Retail services in relation to art materials; Retail services in relation to articles for use with tobacco; Retail services in relation to audio-visual equipment; Retail services in relation to bags; Retail services in relation to baked goods; Retail services in relation to bakery products; Retail services in relation to beauty implements for animals; Retail services in relation to beauty implements for humans; Retail services in relation to bedding for animals; Retail services in relation to beer; Retail services in relation to bicycle accessories; Retail services in relation to bicycles; Retail services in relation to building materials; Retail services in relation to car accessories; Retail services in relation to chemicals for use in ***agriculture***; Retail services in relation to chemicals for use in forestry; Retail services in relation to chemicals for use in horticulture; Retail services in relation to chocolate; Retail services in relation to cleaning articles; Retail services in relation to cleaning preparations; Retail services in relation to clothing; Retail services in relation to clothing accessories; Retail services in relation to cocoa; Retail services in relation to coffee; Retail services in relation to computer hardware; Retail services in relation to computer software; Retail services in relation to confectionery; Retail services in relation to construction equipment; Retail services in relation to cookware; Retail services in relation to cooling equipment; Retail services in relation to cups and drinking glasses; Retail services in relation to cups and glasses; Retail services in relation to cutlery; Retail services in relation to dairy products; Retail services in relation to desserts; Retail services in relation to dietary supplements; Retail services in relation to dietetic preparations; Retail services in relation to disposable paper products; Retail services in relation to diving equipment; Retail services in relation to domestic electrical equipment; Retail services in relation to domestic electronic equipment; Retail services in relation to downloadable electronic publications; Retail services in relation to downloadable music files; Retail services in relation to earthmoving equipment; Retail services in relation to educational supplies; Retail services in relation to fabrics; Retail services in relation to fashion accessories; Retail services in relation to festive decorations; Retail services in relation to floor coverings; Retail services in relation to fodder for animals; Retail services in relation to food cooking equipment; Retail services in relation to food preparation implements; Retail services in relation to foodstuffs; Retail services in relation to footwear; Retail services in relation to fragrancing preparations; Retail services in relation to freezing equipment; Retail services in relation to frozen yogurts; Retail services in relation to fuels; Retail services in relation to furnishings; Retail services in relation to furniture; Retail services in relation to games; Retail services in relation to gardening articles; Retail services in relation to gardening products; Retail services in relation to hair products; Retail services in relation to hand-operated implements for construction; Retail services in relation to hand-operated tools for construction; Retail services in relation to headgear; Retail services in relation to hearing protection devices; Retail services in relation to heaters; Retail services in relation to heating equipment; Retail services in relation to horticulture equipment; Retail services in relation to horticulture products; Retail services in relation to hygienic implements for animals; Retail services in relation to hygienic implements for humans; Retail services in relation to ice creams; Retail services in relation to information technology equipment; Retail services in relation to jewellery; Retail services in relation to kitchen appliances; Retail services in relation to kitchen knives; Retail services in relation to lighting; Retail services in relation to litter for animals; Retail services in relation to lubricants; Retail services in relation to luggage; Retail services in relation to meats; Retail services in relation to medical apparatus; Retail services in relation to medical instruments; Retail services in relation to metal hardware; Retail services in relation to mobile phones; Retail services in relation to musical instruments; Retail services in relation to navigation devices; Retail services in relation to non-alcoholic beverages; Retail services in relation to paints; Retail services in relation to pet products; Retail services in relation to pharmaceutical preparations; Retail services in relation to physical therapy equipment; Retail services in relation to preparations for making alcoholic beverages; Retail services in relation to preparations for making beverages; Retail services in relation to printed matter; Retail services in relation to pushchairs; Retail services in relation to recorded content; Retail services in relation to refrigerating equipment; Retail services in relation to saddlery; Retail services in relation to safes; Retail services in relation to sanitary installations; Retail services in relation to sanitation equipment; Retail services in relation to seafood; Retail services in relation to sewing articles; Retail services in relation to sex aids; Retail services in relation to smartphones; Retail services in relation to smartwatches; Retail services in relation to sorbets; Retail services in relation to sporting articles; Retail services in relation to sporting equipment; Retail services in relation to stationery supplies; Retail services in relation to sun tanning appliances; Retail services in relation to tableware; Retail services in relation to teas; Retail services in relation to threads; Retail services in relation to time instruments; Retail services in relation to tobacco; Retail services in relation to toiletries; Retail services in relation to toys; Retail services in relation to umbrellas; Retail services in relation to vehicles; Retail services in relation to veterinary apparatus; Retail services in relation to veterinary articles; Retail services in relation to veterinary instruments; Retail services in relation to veterinary preparations; Retail services in relation to wall coverings; Retail services in relation to water supply equipment; Retail services in relation to weapons; Retail services in relation to wearable computers; Retail services in relation to works of art; Retail services in relation to yarns; Retail services relating to accumulators; Retail services relating to alcoholic beverages; Retail services relating to audiovisual equipment; Retail services relating to automobile accessories; Retail services relating to automobile parts; Retail services relating to bakery products; Retail services relating to batteries; Retail services relating to candy; Retail services relating to clothing; Retail services relating to delicatessen products; Retail services relating to fake furs; Retail services relating to flowers; Retail services relating to food; Retail services relating to food preparation implements; Retail services relating to fragrancing preparations; Retail services relating to fruit; Retail services relating to furniture; Retail services relating to furs; Retail services relating to home textiles; Retail services relating to horticultural equipment; Retail services relating to horticultural products; Retail services relating to jewelry; Retail services relating to kitchen knives; Retail services relating to live animals; Retail services relating to sporting goods; Retail services via catalogues related to alcoholic beverages (except beer); Retail services via catalogues related to beer; Retail services via catalogues related to foodstuffs; Retail services via catalogues related to non-alcoholic drinks; Retail services via global computer networks related to alcoholic beverages (except beer); Retail services via global computer networks related to beer; Retail services via global computer networks related to foodstuffs; Retail services via global computer networks related to non-alcoholic beverages; Retail shop window display arrangement services; Retail store services in the field of clothing; Risk management consultancy [business]; Sales account management; Sales administration; Sales demonstration [for others]; Sales management services; Sales promotion; Sales promotion for others; Sales promotion for others by means of privileged user cards; Sales promotion for others provided through the distribution and the administration of privileged user cards; Sales promotion for others through trading stamp schemes; Sales promotion for third parties; Sales promotion services; Sales promotion services for third parties; Sales promotion through customer loyalty programs; Sales promotion using audiovisual media; Sales promotions at point of purchase or sale, for others; Sales volume tracking for others; Sample distribution; Samples (Distribution of -); School fee accounting services; School fee cost accounting services; Scriptwriting for advertising purposes; Search engine marketing services; Search engine optimisation; Search engine optimisation for sales promotion; Search engine optimisation services; Search engine optimization; Search engine optimization for sales promotion; Secretarial and clerical services; Secretarial employment agency services; Secretarial employment services; Secretarial services; Secretarial services provided by hotels; Secretariat services; Selection of executive personnel; Selection of personnel; Selection of staff; Services comprising the composition of statistical ***data***; Services comprising the recording of statistical ***data***; Services comprising the transcription of statistical ***data***; Services for provision of foreign trade information; Services of advertising agencies; Services rendered by a franchisor, namely, assistance in the running or management of industrial or commercial enterprises; Services with regard to product presentation to the public; Serving as a human resources department for others; Shareholder record keeping services; Shop retail services connected with carpets; Shop window display arrangement services; Shop window dressing; Shop window dressings; Shorthand; Shorthand secretarial services; Shorthand services; Shorthand typing; Shows (Arranging trade -); Shows (Conducting business -); Shows (Conducting trade -); Sponsorship search; Sponsorship search consultancy services; Staff placement services; Staff recruitment; Staff recruitment consultancy services; Staff recruitment services; Staff utilisation planning; Statements of account (Drawing up of -); Statements of accounts (Drawing up of -); Statistical analysis and reporting; Statistical analysis and reporting services for business purposes; Statistical evaluations of marketing ***data***; Statistical information (Provision of business -); Statistical studies (Business -); ***Statistics*** (Compilation of -); ***Statistics*** (Preparation of business -); Stenographic transcription; Stenography; Stenotyping; Stock control services; Stock management services; Stocktaking; Strategic business analysis; Strategic business consultancy; Strategic business planning; Street dissemination of advertising materials; Subscription to a television channel; Subscription to an information media package; Subscriptions (arranging -) to a telematics, telephone or computer service [internet]; Subscriptions (Arranging -) to telecommunication services for others; Subscriptions (Arranging newspaper -) for others; Subscriptions (arranging of) to books, reviews, newspapers or comic books; Subscriptions for newspapers (Arranging of for others -); Subscriptions to electronic journals; Subscriptions to telecommunications database services; Supervision of businesses on behalf of others; Supply chain management services; Support for employees with regard to business matters; Surveys (Business -); Surveys for business purposes; Surveys (Market -); Systematization of ***data*** in computer databases; Systemisation of information into computer databases; Systemization of information into computer databases; Talent agency services [business management of performing artists]; Targeted marketing; Tariff information and advisory services; Tax advice [accountancy]; Tax assessment [accounts] preparation; Tax assessment preparation; Tax consultancy [accountancy]; Tax consultations [accountancy]; Tax declaration procedure services; Tax filing services; Tax planning [accountancy]; Tax preparation; Tax preparation and consulting services; Tax return advisory [accountancy] services; Tax return preparation; Tax returns (Preparation of -); Taxation [accountancy] advice; Taxation [accountancy] consultancy; Taxation [accountancy] consultation; Telecommunication services (Arranging subscriptions to -) for others; Telemarketing; Telemarketing services; Telephone and television auctions; Telephone answering and message handling services; Telephone answering [for others]; Telephone answering for unavailable subscribers; Telephone answering service; Telephone billing; Telephone marketing services [not selling]; Telephone order-taking services for others; Telephone switchboard services; Telephone welcoming services for third parties; Television advertising; Temporary assignment of employees; Temporary assignment of personnel; Temporary employment agencies; Temporary personnel employment services; Temporary personnel placement services; Temporary personnel services; Temporary placement of employees (Services for the -); Testing (Psychological -) for the selection of personnel; Testing to determine employment skills; Testing to determine job competency; Testing to determine professional competency; Texts (Publication of publicity -); Texts (Writing of publicity -); The bringing together, for the benefit of others, of a variety of insurance services, enabling consumers to conveniently compare and purchase those services; The bringing together, for the benefit of others, of a variety of telecommunications services, enabling consumers to conveniently compare and purchase those services; Theatrical casting agency; Tracking and monitoring energy consumption for others for account auditing purposes; Tracking and monitoring fluctuation in gasoline prices for others for account auditing purposes; Trade fair (Organization of -) for commercial or advertising purposes; Trade fairs (Organization of -) for commercial or advertising purposes; Trade information; Trade information (Provision of -); Trade marketing [other than selling]; Trade promotional services; Trade show and commercial exhibition services; Trade show and exhibition services; Trade show management services; Trade shows (Arranging of -); Trade shows (Conducting of -); Transcription; Transcription of communications; Transcription of communications [office functions]; Transcription of ***data***; Transcription of messages; Transcription of recorded communications; Transcription services; Transportation fleet (business management of -) [for others]; Typewriters (Rental of -); Typewriting; Typewriting agency services; Typing; Typing agency services; Typing services; Unmanned retail store services relating to drink; Unmanned retail store services relating to food; Updating advertising material; Updating and maintenance of ***data*** in computer databases; Updating and maintenance of information in registries; Updating of advertising information on a computer ***data*** base; Updating of advertising material; Updating of business information on a computer ***data*** base; Utility meter reading for billing purposes; Vehicle fleet (business management of a -) [for others]; Vehicular registration and title transfer; Vending machine rental services; Vending machines (Rental of -); Veterinary practice business management; Video recordings for advertising purposes (Production of -); Video recordings for marketing purposes (Production of -); Video recordings for publicity purposes (Production of -); Wage payroll preparation; Wage-packets (Preparation of -); Water meter reading for billing purposes; Web indexing for commercial or advertising purposes; Web site traffic optimisation; Web site traffic optimization; Website traffic optimization; Wholesale ordering services; Wholesale services for pharmaceutical, veterinary and sanitary preparations and medical supplies; Wholesale services in relation to ***agricultural*** equipment; Wholesale services in relation to alcoholic beverages (except beer); Wholesale services in relation to animal grooming preparations; Wholesale services in relation to art materials; Wholesale services in relation to articles for use with tobacco; Wholesale services in relation to audio-visual equipment; Wholesale services in relation to bags; Wholesale services in relation to baked goods; Wholesale services in relation to beauty implements for animals; Wholesale services in relation to beauty implements for humans; Wholesale services in relation to bedding for animals; Wholesale services in relation to beer; Wholesale services in relation to chemicals for use in ***agriculture***; Wholesale services in relation to chemicals for use in forestry; Wholesale services in relation to chemicals for use in horticulture; Wholesale services in relation to chocolate; Wholesale services in relation to cleaning articles; Wholesale services in relation to cleaning preparations; Wholesale services in relation to clothing; Wholesale services in relation to cocoa; Wholesale services in relation to coffee; Wholesale services in relation to computer hardware; Wholesale services in relation to computer software; Wholesale services in relation to confectionery; Wholesale services in relation to construction equipment; Wholesale services in relation to cookware; Wholesale services in relation to cooling equipment; Wholesale services in relation to cups and glasses; Wholesale services in relation to cutlery; Wholesale services in relation to dairy products; Wholesale services in relation to desserts; Wholesale services in relation to dietary supplements; Wholesale services in relation to dietetic preparations; Wholesale services in relation to domestic electrical equipment; Wholesale services in relation to domestic electronic equipment; Wholesale services in relation to earthmoving equipment; Wholesale services in relation to educational supplies; Wholesale services in relation to fabrics; Wholesale services in relation to festive decorations; Wholesale services in relation to floor coverings; Wholesale services in relation to fodder for animals; Wholesale services in relation to food cooking equipment; Wholesale services in relation to food preparation implements; Wholesale services in relation to foodstuffs; Wholesale services in relation to footwear; Wholesale services in relation to fragrancing preparations; Wholesale services in relation to freezing equipment; Wholesale services in relation to frozen yogurts; Wholesale services in relation to fuels; Wholesale services in relation to furnishings; Wholesale services in relation to furniture; Wholesale services in relation to games; Wholesale services in relation to hand-operated implements for construction; Wholesale services in relation to hand-operated tools for construction; Wholesale services in relation to headgear; Wholesale services in relation to heaters; Wholesale services in relation to heating equipment; Wholesale services in relation to horticulture equipment; Wholesale services in relation to horticulture products; Wholesale services in relation to hygienic implements for animals; Wholesale services in relation to hygienic implements for humans; Wholesale services in relation to ice creams; Wholesale services in relation to information technology equipment; Wholesale services in relation to jewellery; Wholesale services in relation to kitchen appliances; Wholesale services in relation to kitchen knives; Wholesale services in relation to lighting; Wholesale services in relation to litter for animals; Wholesale services in relation to lubricants; Wholesale services in relation to luggage; Wholesale services in relation to meats; Wholesale services in relation to medical apparatus; Wholesale services in relation to medical instruments; Wholesale services in relation to metal hardware; Wholesale services in relation to navigation devices; Wholesale services in relation to non-alcoholic beverages; Wholesale services in relation to pharmaceutical preparations; Wholesale services in relation to preparations for making alcoholic beverages; Wholesale services in relation to preparations for making beverages; Wholesale services in relation to printed matter; Wholesale services in relation to refrigerating equipment; Wholesale services in relation to saddlery; Wholesale services in relation to sanitary installations; Wholesale services in relation to sanitation equipment; Wholesale services in relation to seafood; Wholesale services in relation to sewing articles; Wholesale services in relation to sorbets; Wholesale services in relation to sporting articles; Wholesale services in relation to sporting equipment; Wholesale services in relation to stationery supplies; Wholesale services in relation to tableware; Wholesale services in relation to teas; Wholesale services in relation to threads; Wholesale services in relation to tobacco; Wholesale services in relation to toiletries; Wholesale services in relation to toys; Wholesale services in relation to umbrellas; Wholesale services in relation to vehicles; Wholesale services in relation to veterinary apparatus; Wholesale services in relation to veterinary articles; Wholesale services in relation to veterinary instruments; Wholesale services in relation to veterinary preparations; Wholesale services in relation to veterinary preparations and articles; Wholesale services in relation to wall coverings; Wholesale services in relation to water supply equipment; Wholesale services in relation to weapons; Wholesale services in relation to works of art; Wholesale services in relation to yarns; Wholesale services relating to automobile accessories; Wholesale services relating to automobile parts; Wholesale services relating to candy; Wholesale services relating to clothing; Wholesale services relating to cups and glasses; Wholesale services relating to electronic household appliances; Wholesale services relating to fake furs; Wholesale services relating to flowers; Wholesale services relating to furniture; Wholesale services relating to furs; Wholesale services relating to jewelry; Wholesale services relating to kitchen appliances; Wholesale services relating to sporting goods; Window display arrangement services; Window dressing; Window dressing and display arrangement services; Window dressing services for advertising purposes; Word processing; Word processing and typing services; Word processing services; Work analysis to determine worker skill sets and other worker requirements; Writing of business project reports; Writing of business project studies; Writing of business reports; Writing of curriculum vitae for others; Writing of publicity texts; Writing of résumés for others; Xerography.

Filing Date:9 June 2020

Date of registration: 19 June 2020

Representative name: N/A

**Load-Date:** June 27, 2020

**End of Document**



[***Uniting remote sensing, crop modelling and economics for agricultural risk management***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H851-F129-P0CV-00000-00&context=1516831)

Nature Reviews Earth Environment

January 2021

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**Section:** Pg. 140-159; Vol. 2; No. 2; ISSN: 2662-138X

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**Body**

Introduction

Risk is a pervasive part of ***agricultural*** life, and farmers and herders have developed many ways to manage it, from savings to ***agricultural*** or occupational diversification. These methods can buffer against unexpected losses affecting one household, known as idiosyncratic shocks–. However, especially in the context of developing countries, these strategies are often insufficient for managing shocks that affect an entire community, such as drought. The risk of poor weather — and its ensuing bad harvests — can profoundly affect rural households. Adverse weather has resulted in low-income farmers and herders rationing meals, withdrawing children from school, postponing medical care and either selling off or forgoing investments in seeds, fertilizer and other inputs that could otherwise increase future income,–.

The two principal approaches to managing community-wide weather shocks are relief services and insurance. When these tools work well, they can help farmers avoid the most severe coping strategies, should harvests fail. For example, in an experiment within a Kenyan livestock insurance programme, insured herder households reduced their use of painful coping strategies, such as skipping meals and selling off productive assets, by 40–80% after a drought relative to comparable uninsured households. A well-designed insurance programme can also encourage farmers to make productive investments, such as in seeds and fertilizer that can increase their income in typical conditions but that are sensitive to poor weather. For example, insurance coverage for Chinese hog farmers, Ghanaian rainfed farmers, Indian and Bangladeshi rice producers and Malian cotton cooperative members either encouraged adoption of practices that were more weather sensitive but with higher expected returns, or increased investments by 20–30% relative to comparable uninsured counterparts,–. Figure  depicts the benefits of effective risk management before and after a shock.

The benefits of effective risk management before and after a shock.

Adverse weather leading to reduced production can result in costly coping strategies that have long-term implications for human capital and income generation. The possibility of adverse weather also has behavioural effects, restricting the types of investments farmers may be willing to make to avoid the worst possible outcomes if adverse weather strikes. Effective risk management thus delivers benefits after a shock, as it helps farmers manage the consequences of weather-induced production losses, and benefits before a shock, by encouraging productive investment.

Given the social benefits that insurance can have, why is it not more prevalent, especially in low-income, rainfed regions whose inhabitants may benefit the most? A primary impediment is that, under conventional, , the costs for administering and verifying claims of many small farmers in remote areas often exceed the value of the policies themselves,. However, if an insurer does not verify losses and determine their causes, conventional insurance becomes prone to ,. Conventional insurance also suffers from when insurers have insufficient information to estimate risk for each individual and, instead, must estimate the average risk for farmers within a given region. As with moral hazard, adverse selection implies that the losses of the insured will exceed expected levels. In this case, insurers will repeatedly lose money and potentially exit the market, as they are unable to sustain their business model. Even among insurers that persist with an updated risk model, the new, higher prices they offer will reflect higher levels of risk than before, further diminishing the number of people who find the product valuable.

Index insurance aims to address these two information-based challenges by linking payouts to an index that closely tracks the underlying loss risk in a region — an ‘’ — but that is difficult for individuals to influence. For example, an index can be based on weather conditions, such as the amount of rainfall or the number of hot, dry days during the growing season; regional crop yield estimates based on a representative sample of fields; or earth-observation ***data*** on vegetation greenness or soil moisture. As individuals generally cannot affect these measures over large areas, an index also preserves the incentive to put full effort into crop or herd management. Furthermore, as contract pricing is a function of an observable index rather than unobservable conditions about the insured, index insurance minimizes the consequences of adverse selection. An exception to this claim is when conditions from the prior season (for example, drought) influence the probability of pay-offs in the subsequent years in ways that are known to the insured but not priced in the insurance contract, as seen in ref.. Finally, calculating an index is typically less expensive than venturing out into remote, rural areas to verify individual claims. All else equal, reducing such administration costs translates into a lower and, thus, higher value for the insured.

An essential challenge of index insurance programmes is ensuring that they deliver on their promise of detecting and protecting against large-scale, community-wide shocks,–. Delivering on this promise requires that these programmes use an index that mirrors the losses the insured zone experiences, has fair pricing that appropriately reflects the area’s risk distribution and makes timely payments to farmers. Early index insurance programmes often relied on ***data*** ***collected*** from the ground, either weather ***data*** from meteorological stations or . Over the past decade, the use of satellite remote sensing ***data*** in ***agricultural*** insurance has become increasingly common. This trend is likely to continue as the quality of remote sensing ***data***, coupled with advances in analytical methods to interpret the raw ***data***, promise greater accuracy than previous approaches and at much lower cost than ground-based indices. However, it is essential to evaluate the capabilities and limitations of these new ***data*** products in the context of their proposed use.

This Review builds on recent work in remote sensing and economics that can be harnessed to improve index insurance in developing countries. We first discuss the key features of reliable indices, followed by the evolution of index insurance programmes and the quest to reduce field costs with remotely sensed indices. We then outline advances in crop modelling and remote sensing that can support the development of a reliable index and provide a case study that evaluates the performance of multiple remotely sensed indices. We conclude by synthesizing emerging opportunities to enhance the design of ***agricultural*** index insurance programmes, with a focus on applications for developing regions.

The value of index insurance

Fundamentally, all insurance serves to stabilize livelihoods against possible but unexpected losses. Of the possible negative variations (that is, shocks) that a given insurance programme covers, index insurance compensates only for variation that is common to a given insurance zone and that the index successfully captures (Fig. ). This Review focuses on insurance intended to protect rural households against production variation (where VT is the total random variation in output; Fig. ). Index insurance compensates for only the fraction of total production risk common to all insured individuals in a given insurance zone (that is, the covariate risk). The remainder of the total risk (VI; Fig. ) is specific to an individual and, therefore, uninsurable by index insurance. A well-designed index accurately reflects the common loss events averaged across the insurance zone. The portion of the potentially insurable risk that is not detected by the index indicates an index design failure, which we term (VD).

Insurable and uninsurable production risks under index insurance.

a | Insured and uninsured production risks under index insurance. Only a portion of the total production risk (VT) a household faces is covered by index insurance: the part that is common to the insured zone and that the index accurately detects. Idiosyncratic deviations from the zone (VI) and poor detection of the true average variation of the zone (design risk, VD) are not compensated. b | Quality evaluation process and opportunities to improve contract design. In the process depicted, an index insurance contract is assessed based on whether it is net beneficial for transferring risk from ***agricultural*** households. Various opportunities exist for innovations in remote sensing, crop modelling and programme design to improve the value of the contract in reliably transferring risk. Payouts refer to how much an insurer pays to their policyholders when losses are detected. Markup includes how much the insurer charges to cover the payouts from the programme (the actuarially fair price) and any additional percentage for administrative and marketing costs. Premiums reflect the price the insurer charges for coverage. This framework outlines the evaluation process featured in the case study in the section titled ‘Illustrating index insurance quality evaluation’. Panel a adapted with permission from ref., Wiley © 2013 International Association of ***Agricultural*** Economists.

In the following sections, we discuss how advances in remote sensing, crop modelling and ***data*** processing can improve how well a given index captures loss events when they occur, reducing VD. We also discuss how these advances can help delineate more homogeneous insurance zones, reducing the magnitude of idiosyncratic variation (VI). First, we consider the question of index insurance quality, which can be framed as how small VD and VI must be for the insurance to offer risk-reduction value to farmers and induce them to invest more in their farm.

An economic perspective on index quality

Index insurance can only help mitigate the poverty created and perpetuated by uninsured risk if it reliably protects producers, issuing payouts for important income sources when most needed. However, how should reliability be measured? And how can one determine when an index insurance contract is reliable enough to enhance the economic well-being of contract holders? Building on previous evaluations and discussions,–, we propose an approach to addressing reliability using core economics concepts about decision-making and well-being under risk.

Index insurance has the potential to offer cost-effective protection to low-wealth households because it relies on a single index that covers many individuals and does not require the costly assessment and verification of individual losses. However, this advantage is also its weakness: a household is only compensated for a loss if the index registers a loss in their insurance zone, and ‘’ and ‘’ can occur. Together, false negatives and false positives are frequently known in the literature as . Although uncompensated losses from false negatives are generally considered more important, false positives can also hurt the insured, as the payouts are still priced into the insurance, meaning that farmers pay for expensive insurance to issue payments when they are not needed. By ‘expensive’, we mean that, under competitive market pricing, every US$1 of payout received by the farmer costs them, in unsubsidized terms, at least $1.30 (ref.). Receiving a dollar in times of severe need can be valuable, and the insured pays a premium in good times, when money is less scarce, to have insurance,. However, receiving that ‘expensive dollar’ in good times is not as valuable.

Altogether, poorly performing contracts can reduce welfare while contaminating the idea of index insurance as a whole. These accuracy issues are non-trivial. For example, although the Malawian government paid millions of dollars to the African Risk Capacity for drought coverage, when a severe drought induced widespread crop failure in 2016, millions of farmers remained unpaid for months because the insurance index failed to trigger a payout.

More generally, how should one measure improvements in the reliability of an index insurance programme? Although predictive skill is often used in remote sensing literature to gauge the accuracy of crop yield estimates, a conceptually sound measure of insurance quality should be built around farmers’ concerns of losses. Programme designers seeking to improve farmer welfare should, therefore, measure quality on the basis of an asymmetric loss function that is especially sensitive to prediction errors that occur at the lower tail of the yield distribution. Such a quality measure decomposes into three main factors relating to false negatives: first, the probability they occur; second, the level of the farmer’s desperation when they happen; and, third, the gap between the farmer’s income with and without insurance when they happen.

The economics concept of can be used to define a minimum quality standard (MQS) for index insurance reliability that is consistent with these criteria (see section S.1 of the ). As proposed in ref., a contract meets the standard if the insured’s expected utility (or the risk-adjusted, or , income; see section S.2 of the for further discussion of these terms) is higher with insurance than without (Fig. ). Importantly, we define ‘with insurance’ to mean a household’s income from insured ***agricultural*** activity plus insurance payments minus the full, unsubsidized market cost of the insurance (Fig. ). Ideally, these calculations would be done with full household income, allowing assessment of the insurance value while taking into consideration other risks beyond those affecting ***agricultural*** production. In practice, ***data*** limitations make historical measurements of full household income impractical, although simulation methods can be used to consider how other correlated and uncorrelated risks influence the value of insurance.

The MQS evaluation process allows comparisons across alternative insurance index options and provides a way to gauge the insurance value of alternative approaches to predicting yields and yield losses. Because low-quality insurance can reduce expected farmer well-being, new index insurance products ought to demonstrate their value to policyholders through evaluations like the MQS prior to implementation. In addition, many opportunities exist to improve the design of a given index contract and further enhance welfare (right side of Fig. ), whether by improved use of remotely sensed ***data*** and yield predictions or through programmatic design choices, and the MQS evaluation process can help identify those opportunities.

Subsidies for ***agricultural*** insurance do not change the logic of the MQS evaluation. Although many worthwhile reasons exist for subsidizing insurance exist, such as to relieve farmer liquidity constraints or reduce uncertainty, covering for low quality is not one of them. If a government pays an insurance premium, then the correct, budget-neutral comparison to make when assessing its value is the farmer’s economic well-being with ‘free’ insurance versus when the farmer is given a cash transfer of the amount of the insurance subsidy. Under this comparison, the farmer will be better off with insurance only if the contract passes the MQS, which happens when the certainty equivalent gain from insurance exceeds the full, unsubsidized cost of the premium. If the certainty equivalent gain does not exceed the premium, the farmer would be better off with the cash transfer for the value of the premium, rather than free, low-quality insurance.

Further requirements of a reliable index

In addition to being sufficiently reliable to pass the MQS, three other major features matter for developing an effective index and leveraging remote sensing ***data*** for managing risk and underwriting insurance–. First, the premise of index insurance hinges on issuing payouts on the basis of a trustworthy, externally observable index. If the index ***data*** source can be manipulated — as some ground-based, manually evaluated meteorological stations can — such tampering could result in higher-than-expected payouts and, ultimately, raise the cost of index insurance to participants. Although farmers cannot directly alter the ***data*** captured from satellite remote sensors, it is essential for insurers to use clear, consistent and verifiable processing procedures for calculating index values to guard against arbitrary payout protocols.

Second, index insurance payments must be timely, and, sometimes, programme designers must decide between speed and the quality of information used to issue payouts. A study comparing the value of different payout timings for herders in Kenya illustrates this issue,. The original insurance contract acquired and integrated ***data*** on biomass production from both the wet and the dry seasons to predict losses and determine payouts. A newer version of the contract estimated forage development directly from the seasonal evolution of the normalized difference vegetation index (NDVI), discarding the dry season information and potentially permitting earlier payments. Earlier evaluation resulted in minimal changes to accuracy while permitting payments 1–3 months earlier, allowing herders to purchase forage, sustain their herds and protect rather than replace their livestock. More generally, the additional accuracy that can be obtained with a longer evaluation time frame should also be weighed against the margins for action between when losses occur and when a farmer or herder anticipates they will be paid.

The third condition is adequate ***data*** of two types. The first type of ***data*** should allow computation of the probability that a given index will issue payouts so that insurers can price the index insurance contract. Although there are no fixed rules for how much ***data*** are required for this task, insurance providers routinely state that they prefer at least 15 years of historical ***data*** for constructing an index. Such a time series can be as simple as relying on sources with many years of observations. For example, ***Agriculture*** and Climate Risk Enterprise Ltd., frequently known as ACRE Africa, has used remotely sensed ***data*** extending back to 1983 as one of its key index ***data*** sources. However, without robust techniques to link newer and older ***data*** sources (such as those described in ref.), this requirement may limit the ability of insurers to base an index on ***data*** recorded by newer satellite sensors. Additionally, changes in land use and climate could make the signals extracted from older ***data*** less informative about the risk of adverse conditions in the future,. Therefore, using longer time series of satellite ***data*** in risk assessment may also require the use of complementary ***data*** sources and models to account for problems of nonstationarity. Alternatively, crop simulation models (henceforth, crop models) can be, and often are, used to simulate plausible outcomes and price risk–. However, the utility of these models is often constrained by the extent to which they reliably reflect plausible crop responses to poor agronomic conditions (discussed below in the section titled ‘Challenges and opportunities in estimating yields with crop models’).

Once an adequate time series on the insurance index is at hand, the second type of ***data*** required is a matching time series of actual, on-the-ground losses experienced by farmers. These ***data*** enable evaluation of the reliability and quality of the index insurance contract. Occasionally, government sources or other research projects make such ***data*** available,. When pre-existing ***data*** are unavailable, ‘recall surveys’ among farmers or farmer groups about their production in previous years have been used to assess historical yield and its variation. Although the reliability of self-reported historical production ***data*** has been questioned,, recent studies have suggested that repeated farmer focus group discussions about past yields correspond well with remotely sensed historical variation within a given region. How well and when recall surveys in an individual or group setting correspond with important farmer losses remains an important open area of research that new pilots and insurance programmes can help address during their design and implementation.

The quest to develop a reliable and inexpensive index

Although the idea of insurance contingent on regional indices dates back to a 1920 proposal of an ‘indirect’ insurance system for Indian farmers based on rainfall deficits, the first index insurance programme was not realized until four decades later. In 1961, Sweden began an indirect crop insurance programme based on estimated average yields in a given area; however, this programme was discontinued in the years just following the launch of Quebec’s area-yield programme in 1977 (ref.). The earliest index insurance programmes relied on field-based approaches to estimate regional average yield — the ‘area-yield index’ (Fig. ).

Timeline of selected index insurance programmes.

The timeline shows experiments by type of index, location and type of insured product. Labels indicate the location and programme name, where available, or another identifier used in the literature. Index labels are at the finest level of detail that could be discerned from programme documentation. In general, there is a transition from costly field-based loss-estimation approaches towards alternative or blended indicators. Satellite-derived ***data*** have been most frequently used for livestock programmes but have been increasingly used for weather-based crop insurance. Many of the programmes that rely on satellite-derived indices use a coarser spatial resolution than what is currently possible for assessing production conditions. Filled shapes at a line terminus indicate that the programme or experiment has ended; open lines indicate no documentation was found indicating the end point and that the programme is presumed to be ongoing. Distances in parentheses reflect the spatial resolution used for the index, where indicated. Admin, administrative; ET, evapotranspiration; EVI, enhanced vegetation index; exp, experiment; NDVI, normalized difference vegetation index; PVI, pasture vegetation index; temp, temperature. Additional abbreviations, programme names, all ***data*** and references are in the .

This field-based type of area-yield index insurance is often treated as the most reliable, but it is also potentially the most expensive form of index insurance because it requires a sufficient number of farm-level measurements every season to reliably estimate average yields in each insurance zone. Inexpensively implementing this type of index insurance might be possible when commercial organizations in tight value chains already ***collect*** production ***data*** from farmers as part of their commercial operations. Examples include the Kenyan sugarcane contract farming operation described in ref. and Burkina Faso’s monopsonistic (single-buyer) cotton production environment featured in refs,. Outside of these environments, however, area-yield insurance based on field measurements quickly becomes expensive to implement, with the cost increasing as the size of the insurance zone decreases and the total number of farm-level measurements increases. Technological advances promise to reduce some of these costs. For example, an index insurance pilot in Mozambique and Tanzania used photo-based methods to estimate maize dry weight without threshing, drying and weighing, which is estimated to account for half the cost of maize crop cuts. ‘Phenocams’ that capture field conditions might also help to reduce the need for costly field visits by insurers (discussed further below in the section titled ‘Innovations in programme design’).

Pending further development of these approaches to measure production, the high cost of area-yield insurance has spurred the exploration of alternatives that minimize the need for field visits. In one approach, several index insurance programmes, including Mexico’s ***Agricultural*** Fund for Natural Disasters (CADENA) and Peru’s catastrophic insurance programme (Seguro Agrícola Catastrófico), opted to conduct field assessments in only the most extreme situations. However, both programmes are heavily subsidized, with seemingly high markups, and the actuarial basis for their product is unclear. In another process-focused approach, the Kenya ***Agricultural*** Insurance and Risk Management Program recently began using satellite ***data*** to discern where maize was grown to develop a maize . Introducing this procedure reportedly reduced the programme’s field costs by 70% through eliminating the need for the extensive preliminary round of field visits previously used to determine where to conduct subsequent crop-cut-yield assessments.

Others have also begun to explore how remotely sensed ***data*** can be used to optimize insurance zone boundaries and, thus, reduce costs. For practical reasons, programmes have often used existing administrative boundaries to define insurance zones. However, administrative boundaries do not always correspond with agroecological conditions, introducing the possibility of avoidable idiosyncratic variation. Combining satellite ***data*** with crop yield ***data***, for example, can generate agroecological zones in which yield and weather patterns exhibit similar statistical properties. In an early effort, a recent study explored how dividing US counties into two agroecological units could influence the quality of an index-based insurance product otherwise based on county-level boundaries. Using a version of the MQS evaluation, the study finds positive but modest gains within the US corn and soy context. In another example, a non-governmental organization and a private insurance company documented a ***data***-driven approach to redraw insurance zone boundaries in Kenya and Nigeria for a crop-cut-based area-yield product. This experiment found that using satellite-derived information to demarcate areas with common yield distributions generated larger zones than the previous zones based on administrative units, in turn halving the number of crop cuts required for assessing yields and determining payouts. Similarly, another group based out of the University of Maryland applied machine learning techniques to satellite ***data*** to optimize the number and location of crop cuts in Ukraine, with early results suggesting a 20% cost reduction over previous methods. Determining the optimal size of a crop-cut-based index insurance product can involve serious cost and accuracy trade-offs, and none of these studies has reported if and how these larger zones offer better insurance value under the welfare metric of the MQS. Unifying these innovative approaches with a consistent quality standard offers a promising approach to reducing associated with the definition of insurance zones.

Beyond experimenting with ways to optimize and reduce the cost of field-based approaches, many newer programmes have begun to use alternative sources of information to detect adverse conditions linked to ***agricultural*** losses. Irrespective of the source of loss, one of the crucial factors that influences the likelihood of an index insurance programme achieving the development goals discussed in the introduction is that the index addresses an important risk to the livelihood of the insured.

In the quest to develop a reliable index that provides value to the insured, several different sources of information have been used for developing the indices, including weather ***statistics***, satellite-derived vegetation indices or a combination of different sources (Fig. ). Although many of the existing index insurance programmes emphasize crop production, forage and rangelands for livestock are often a target (Fig. ). Finally, many of these remote sensing measures are of increasingly high spatial and temporal resolution, meaning that, unlike area-yield insurance, there should be no, or limited, cost barriers to creating more homogeneous and, likely, smaller insurance zones. However, to date, there has been limited systematic exploration of this possibility and its welfare implications.

Uses of remote sensing ***data***

Newer programmes are increasingly using remotely sensed ***data*** to detect adverse conditions and estimate losses — that is, to construct the index and the thresholds for issuing payouts (). The evolution of indices used in insurance programmes (as mentioned in refs,– and the Index Insurance Forum, among other sources indicated in the ) reveals a surge of interest in improving the indicators used to assess vegetation conditions and, ultimately, ***agricultural*** losses, and ideally in ways that can be accessed automatically and remotely.

Four additional observations emerge from the timeline in Fig. . First, the earliest generation of alternatives (to crop-cut or administrative ***statistics***) for developing indices often used weather ***data*** (such as rainfall or temperature) observed at a nearby meteorological station to determine payouts. Subsequent weather-based programmes have increasingly used more and automated stations, as well as gridded weather products often partially derived from satellite ***data***. Second, the ***data*** used to detect stress or estimate crop losses within operational index insurance programmes have generally been moving towards higher spatial and temporal resolution, for example, moving from sensors with a multi-kilometre resolution towards 250 m. Third, although some programmes are evolving to take advantage of higher-resolution sensors, few programmes have deployed the most recent advances. This limited uptake of new products among existing programmes may be due to the requirement for a long time series on the index to price the insurance contract, although some work has demonstrated scope for extending the operational record of satellite-derived indices by linking ***data*** from sensors with different lengths of historical records. Fourth, many of the earliest programmes using satellite ***data*** focused on detecting rangeland and forage conditions for livestock. However, interest has grown in using remotely sensed ***data*** to develop indices correlated with crop production.

The benefits of enhanced spatio-temporal resolution

In general, satellite sensors are either passive (the sensor records reflected or emitted energy from the earth, such as optical sensors) or active (the sensor sends out signals and receives backscatter, such as radar and lidar). The ***data*** can be characterized by their spatial resolution (the pixel size), temporal resolution (the time difference between observations of the same location) and the spectral resolution (which, and how many, bands of the electromagnetic spectrum are observed). The spatial and temporal resolution of satellite ***data*** have generally increased over time (Fig. ). For example, the LANDSAT satellites have ***collected*** 30-m spatial resolution ***data*** roughly every 2 weeks since the mid-1980s, but since 2017, the Sentinel-2 programme (a constellation of two satellites) has ***collected*** spectrally similar ***data*** at a 10-m spatial resolution with a return time of 5 days at the equator (2–3 days in the mid-latitudes).

Timeline of selected sensors, measurement missions and gridded products used for evaluating indicators of ***agricultural*** conditions.

The timeline is indicative, emphasizing selected products previously used for ***agricultural*** index insurance or products that capture similar features. The timeline demonstrates the availability of a diverse set of records with increasing spatio-temporal resolution. A cross (+) indicates privately operated, an underscored T (\_T) signifies a thermal product and an asterisk (\*) denotes a gridded reanalysis product. ET, evapotranspiration; SIF, solar-induced fluorescence. ***Data*** available in the . Adapted with permission from ref., Wiley © 2019 The Authors. New Phytologist © 2019 New Phytologist Trust.

Typically, increasing one form of resolution comes at the expense of another. For example, the two MODIS satellites have a revisit period of 1 day and a spatial resolution starting at ~250 m (500 m and 1 km for some bands). The relatively new PlanetScope constellation from Planet, a private company, has a very high spatial (~3 m) and temporal resolution (daily) but lower spectral resolution (four spectral bands, including the near-infrared band). In contrast to MODIS and Sentinel ***data***, Planet ***data*** are not freely available. Generally, the sensors with highest spatial resolution are private, and their use can be costly. For example, prices from Apollo Mapping range from $2 to $25 per square kilometre for sub-2-m-resolution imagery. In addition, to obtain the highest spatial and temporal resolution, these sensors must often be tasked, meaning they image an area for a well-defined and often time-bound purpose (for example, assessing natural disaster damage). Although some taskable sensors regularly revisit the same areas, their regular, non-tasked observations tend to occur less frequently, limiting their use for ***agricultural*** analyses that require more within-season ***data***. Higher temporal resolution results in more observations per growing season and, in turn, can increase analytical power. Higher-spatial-resolution ***data*** can help distinguish the relevant rangelands and croplands from non-target areas, such as forests, roads, houses and water bodies, that could otherwise influence the observed response of the insured vegetation, through crop-masking techniques. Nevertheless, even if the resolutions of available remote-sensing ***data*** have increased, their use still relies on a model that connects the patterns observed in the ***data*** to ***agricultural*** responses. The subsequent sections review approaches to discerning crop status, stressors and production with these ***data***.

Satellite-derived indicators for assessing crop conditions

Satellite ***data*** across the spectral range contain information that can be used to estimate above-ground biomass and crop production,. Satellite-***data***-guided interpolations of temperature and rainfall observed at weather stations can also be used to infer environmental stress during the growing season. Furthermore, vegetation indices combine ***data*** from multiple spectral bands to provide information about vegetation health.

Among the most common vegetation indices are the NDVI, the enhanced vegetation index (EVI) and the green chlorophyll vegetation index (GCVI) that extract information from the near-infrared and red, blue and green spectral bands. The NDVI combines information from the red and near-infrared bands, and is a ‘workhorse’ index with a history of estimating green biomass dating back to the late 1970s,. NDVI measures often suffer from value saturation in the presence of even moderate above-ground biomass. The EVI includes the red, near-infrared and blue bands, and has atmospheric corrections that allow better management of the NDVI’s background saturation problem. EVI measures therefore tend to be more sensitive to variations in biomass conditions in areas with dense vegetation. The GCVI uses the near-infrared and green bands, and is considered to be more sensitive to variation in leaf chlorophyll concentrations compared with indices that use the red bands,. Capturing variations in chlorophyll content is also thought to help gauge ***nutrient*** deficiencies associated with low yields, and, indeed, GCVI measures have outperformed other vegetation indices featuring the red band for assessing crop conditions in a ***nutrient***-constrained (low-nitrogen) environment in Western Kenya.

Newer indices have experimented with different spectral bands, including the red edge or parts of the electromagnetic spectrum beyond the visible (for example, thermal and microwave) to assess crop conditions and production. Detailed summaries of the merits and drawbacks of different vegetation indices can be found in refs,–. Here, we briefly characterize recent advances of yield assessment techniques in the context of index insurance, focusing on when and where satellite ***data***, and especially vegetation indices and satellite-derived weather indicators, tend to work well. We also summarize some of the measures that can be gleaned from remotely sensed ***data*** sources and how they relate to crop status, stressors or productivity in Fig. .

Strength of various remotely sensed ***data*** used to indicate crop health, productivity and environmental stressors.

Summary of the information that can be estimated from remotely sensed ***data*** for evaluating indicators of crop health, productivity and environmental stressors. The scale reflects the authors’ approximation of how the indicator captures each feature (where 0 is not applicable and 3 is highly relevant), based on knowledge of existing indicator resolutions and their ability to provide low-noise information during the growing season for smallholder fields. fPAR, fraction of absorbed photosynthetically active radiation; GPP, gross primary productivity; LAI, leaf area index; LUE, light use efficiency.

How well vegetation indices correspond with ***agricultural*** production can vary over space and time. Various vegetation indices that measure leaf ‘greenness’ tend to outperform meteorological variables in humid areas–. However, in arid areas, moisture indicators (such as rainfall, soil moisture and evaporative stress indices) can outperform vegetation indices–. In addition, meteorological ***data*** can sometimes generate insight into crop health that satellites cannot detect. For example, some crops are especially sensitive to heat and drought stress during growth periods, such as flowering or grain filling. However, reduced productivity due to stress may not be directly observable from the crop canopy, which can remain green and healthy looking. Satellite-derived indices can also help discern crop growth stages, such that meteorological variables can be better interpreted (for example, temperature during flowering). Thus, the combination of different sources of remote sensing ***data*** can improve yield prediction,,,, generally by generating better predictor variables that capture variation during sensitive growth stages. Furthermore, capturing production variability well may depend not only on which ***data*** source is used but also on how the ***data*** are processed, that is, over what time period and how it is integrated to reveal crop status and conditions.

The newest generation of satellite sensors has also started to ***collect*** ***data*** beyond traditional visible–near-infrared reflectance ***data*** and the vegetation indices derived from them. For example, solar-induced fluorescence (SIF) emission signals — the active emission from chlorophyll often considered a good proxy of photosynthesis — can be observed with the GOME-2 (ref.), OCO-2 (ref.) and TROPOMI satellite sensors. The use of SIF has improved crop yield predictions through better estimation of gross primary productivity–, especially during periods of environmental stress. In addition, microwave sensors are attractive ***data*** sources for assessing crop conditions, because they can provide consistent observations irrespective of cloud coverage (discussed below). To date, backscatter signals derived from microwave sensors have been used to generate yield estimates in a few applications, including for rice in Vietnam and wheat in Canada. Microwave-derived vegetation optical depth (VOD) has also been used to estimate maize and soybean yields in the USA. However, to our knowledge, no studies have used satellite-derived SIF or VOD to assess the conditions of smallholder ***agricultural*** systems, probably owing to the coarse spatial resolutions of these products (currently ranging from 3 to 40 km). Developing approaches to effectively use these new types of satellite ***data*** for assessing crop production characteristics is likely to remain an active field of research in the near future. However, owing to the coarse spatial resolution of even these newest products, it will probably be necessary to pair them with other ***data*** sources, at least some of which would be at higher spatial resolution, for smallholder-relevant applications.

Challenges in observing smallholder ***agriculture*** with satellite ***data***

Several atmospheric conditions, including clouds and cloud shadows, can interfere with the signals perceived by satellite-based sensors, limiting the utility of remotely sensed ***data*** for yield estimation,. Frequent cloud cover during the growing (rainy) season poses an especially large challenge for ***agricultural*** applications,. For example, the share of usable Sentinel-2 pixels in Kenya during the long maize-growing season (April–September) in 2018 and 2019 varies between 10% and 70%, depending on the region and year (Fig. ).

Illustrating the effects of cloud cover on image quality.

The percentage of Sentinel-2 observations that are usable, defined as pixels that are not classified as clouds or cloud shadows, varies widely by location and over time, as shown by this example for Kenya during the long rainy season (April–September) in 2018 (panel a) and 2019 (panel b). Sentinel-2 has a 5-day return time, but there are narrow regions in which ***data*** are ***collected*** in two passes. These regions are clearly visible because the ***data*** ***collection*** is effectively doubled (if at least one of the two observations were useful, it was counted as a single usable observation). Water bodies appear as white pixels, and a regression tree was used to detect cloud and cloud shadows, as described in ref..

One approach to overcome the cloud contamination problem involves fusing ***data*** from multiple optical sensors to increase the chance of constructing a time series of cloud-free imagery with high temporal frequency–. However, well-performing ***data*** fusion requires relationships to first be established between selected ***data*** products using relatively clear imagery from earlier in the growing season. Accessing such ***data*** to establish this relationship can be especially challenging in tropical regions characterized by frequent cloud cover.

The use of active sensing platforms, such as synthetic aperture radar (SAR), are also being increasingly explored as an approach to overcome the cloud-cover challenge, as the longer microwave wavelengths used by active sensors are not blocked by clouds. Although SAR ***data*** can be used alone,,, many analysts frequently combine SAR with optical ***data***, and they are increasingly using machine learning techniques to capture the subtle connections between optical and SAR ***data***. These combined products have been used to classify crops– and predict yields–. For example, the privately developed CropSAR product fuses a cloud-interrupted time series of Sentinel-2 fAPAR (fraction of absorbed photosynthetically active radiation) and uninterrupted Sentinel-1 backscatter to support crop mapping and yield prediction. CropSAR has been deployed at the field level and will be expanded to capture sub-field variability, which is especially relevant for precision farming applications. Similarly, an earth-observation company, UrtheCast, plans to launch a constellation of satellites with integrated multispectral optical and radar sensors (the OptiSAR Constellation), which is expected to facilitate new lines of research using ***data*** fusion products.

Advances in yield assessment

This section reviews approaches to estimating production and developing an insurance index using remote sensing ***data***, crop models or both. The first approach uses increasingly sophisticated techniques to predict on-the-ground measures of yield outcomes and losses using remote sensing ***data***. Reliable predictors can then be used as the basis for an insurance index. A second approach uses new methods in crop yield simulation that incorporate remote sensing ***data*** to predict crop yields. After reviewing these methods, we provide a case study evaluating the quality of several insurance indices as an example of how to approach the process for many different yield-estimation techniques. A crucial component of generating economically meaningful indices for insurance depends on a thorough understanding of site-specific or stage-specific factors that can result in important economic losses for farmers and herders. Improved modelling paired with assessments of relevant on-the-ground conditions can help improve the reliability of an index and, thus, the contract’s risk-reduction value to the insured.

Machine learning with remotely sensed ***data*** to detect yield variation

The increase in the volume and accessibility of remotely sensed ***data*** has facilitated experimentation with new machine learning approaches to assess crop conditions and production. Recent applications of machine learning techniques on satellite ***data*** have demonstrated potential to detect yield variation across various contexts–. In one example, mainstream machine learning methods (such as random forests, support vector machines and neural networks) outperformed a well-known regularized regression method (LASSO) in assessing wheat yields across Australia. The improvements obtained with machine learning techniques largely stem from their ability to fit non-linear predictive models to large volumes of input ***data***. Furthermore, the best-performing machine learning approaches for ***agricultural*** prediction often explicitly account for the spatial and/or temporal patterns in the ***data***: models such as long short-term memory (LSTM) or attention-based neural networks have shown particular promise in discerning yield variation,,.

The accessibility and quality of ground ***data*** for training, calibrating and validating models can, however, strongly influence performance. Typically, predictions generated in relatively homogeneous (for example, flat areas with a consistent production approach and little, if any, intercropping) and ***data***-rich production areas can capture 70–80% of the yield variability (R2 ≈ 0.7–0.8) with errors of ~10–15% of reported yield,,,,. However, predictions tend to perform worse (for example, R2 ≈ 0.1–0.5) in small, mixed-crop fields that predominate in ***data***-sparse regions such as sub-Saharan Africa. Improving the performance of these models for insurance would be accelerated with systematic coordination of ***collecting***, archiving and sharing of ground-reference information across a range of productivity levels.

Challenges and opportunities in estimating yields with crop models

Crop models have been used in various applications, including assessing the impact of weather on crop yields (see refs, for reviews). Process-based crop models simulate crop growth and development based on inputs such as environmental ***data*** (for example, weather and soil), crop cultivar and management. For the purposes of risk management and insurance, crop models can be used to estimate reasonable ranges of historical variability that underpin risk assessment and premium pricing (discussed above and featured in Fig. ). Given a series of up-to-date inputs, crop models can also be used to estimate production. However, two considerations affect how well crop models reflect conditions on the ground and, thus, their applicability for index insurance.

First, crop models tend to capture yield responses well for a defined range of expected conditions but often do not perform well with abnormal conditions, in part, because the model developer may not have had sufficient ***data*** reflecting such conditions,,. This issue is especially relevant for insurance applications: most crop models characterize yields well in normal weather conditions but can fail to capture crop responses to extreme weather events–. Even using a simple mean of a multimodel ensemble — a common approach to managing errors from a single model– — will not necessarily resolve this problem, as it will likely reproduce the problem observed in many individual models. An alternative approach is Bayesian model averaging, whereby individual models that capture the key limiting process are assigned a greater weight in determining yields than the models that do not feature the key limiters,. In a variation on this approach but applied specifically for ***agricultural*** insurance, others have suggested avoiding the use of multimodel ensembles in favour of selecting or adapting select crop models that feature the key agronomic conditions and limiting processes for the insured crop in the relevant location(s) where the insurance would apply.

Second, estimates from crop model simulations are only as finely spatially and temporally resolved as the input ***data***. Thus, crop models tend to estimate yield response functions well when detailed and up-to-date information about management practices and environmental conditions are available, such as at the experimental sites where most current crop models are developed. However, in many developing country contexts, the gridded weather and soil products currently available to describe soil properties (including texture, pH and organic matter content) and management practices (***data*** products such as AgMIP or SoilGrids) are generally of coarser resolution than required to reflect the heterogeneity of farming conditions relevant for assessing risk and detecting yield variability. This is important, as even small variations in soil properties and land management decisions, including sowing dates,, planting densities,, fertilizer rates and irrigation,, can significantly change the simulated yield output. Models paired with on-the-ground information can, therefore, help discern key sources of local variability that may not be observed in production figures estimated by satellite remote sensing or crop cuts alone. In this way, crop models could help provide a structured framework for creating insurance zones, with the zones determined based on their likely homogeneity in response to changing conditions. Recent research has begun to examine how satellite ***data*** can provide insight into soil properties and management practices, such as land preparation, planting dates and irrigation (for summaries of these studies, see refs,,). Increasing the spatial resolution of these input ***data*** sets could result in crop models that better reflect the on-the-ground variation in heterogeneous landscapes. A small but growing number of studies have attempted to discern management practices in developing countries using satellite ***data*** (summarized in ref.), but many of these studies focus on larger plots rather than heterogeneous smallholder plots.

Integrating crop modelling and remote sensing

Recent approaches for yield estimation leverage both crop modelling and remote sensing. ***Data*** assimilation, for example, uses satellite-***data***-based estimates of crop features (such as leaf area index and evapotranspiration) to constrain crop models in efforts to improve yield prediction–. Although common ***data*** assimilation procedures for yield estimation have been reviewed in detail elsewhere, here, we briefly summarize a few key approaches under development. One ***data*** assimilation procedure is the ensemble Kalman filter (EnKF), which sequentially adjusts crop model simulations by updating intermediate variables (such as leaf area index and evapotranspiration) based on satellite observations. EnKF procedures have been shown to reduce wheat yield prediction errors in relatively small regions when the leaf area index was assimilated and to work reasonably well when estimating US maize yield at the county level. However, using the EnKF did not appreciably improve accuracy when both the leaf area index and the surface soil moisture were assimilated, probably because surface-level soil moisture observations did not capture the extent of water stress occurring deeper in the soil. Moreover, as satellites rarely capture all the relevant factors affecting crop yields (including cultivars, pathogens and soil types), constraining model simulations to match satellite observations may distort model state variables,. ***Data*** assimilation approaches also tend to be computationally costly, limiting their use in larger-scale applications.

Another approach to leverage the advantages of both remote sensing ***data*** and crop modelling is the recently developed scalable satellite-based crop yield mapper (SCYM), a computationally efficient yield prediction framework that systematically links crop models and remote sensing–. SCYM first uses crop models to simulate several hundred pseudo-observations of daily crop attributes (such as leaf area index and yield) that would arise from a realistic combination of the possible growing conditions in the study region (including varying soil, weather, cultivar, fertilizer applications and sowing date). Next, these simulations are used to train statistical models that relate simulated end-season yield to weather and satellite-observable vegetation indices. Finally, these statistical models ingest satellite observations and gridded weather ***data*** to generate pixel-by-pixel yield estimates. Although ground-reference ***data*** are required to validate SCYM’s performance in a given region, the SCYM approach does not require the ***collection*** of costly ground ***data*** to generate yield estimates, owing to its reliance on crop models for training. In this way, the SCYM approach requires much less ground-reference ***data*** compared with other empirical prediction approaches that depend on this information to train their models. This feature is important because, as discussed in the introduction, ground calibration ***data*** are often unavailable in smallholder-dominated regions and costly when they are. Although SCYM has been shown to capture 75% of crop variability for maize in the USA, in developing country contexts to date, the SCYM approach has captured one-third to about half of the variation exhibited in ground-based measures for winter wheat in northern India, maize in Uganda and Kenya,, and sorghum in Mali.

In a similar approach to SCYM, Leroux et al. used a crop model to generate above-ground biomass, water stress and attainable yield measures to then train a remote sensing model that estimates yield. When applied to maize growing in Burkina Faso, this approach captured 46% of the yield variability reported in ground surveys among farmers. Although these studies for smallholder farming systems rarely find that satellite estimates explain more than half of the variability of ground-based measures, even ground-based measures such as crop cuts are themselves noisy estimates of field-scale yields. Crop cuts are better estimates for the fields where they were measured, but averaging crop cuts to estimate regional crop yield can be worse than estimating it with remote sensing. Regardless, none of the previous studies assessing yield variability was designed for use in index insurance. Therefore, further work evaluating these approaches, once tailored to the context, the application and the goal of improving farmer welfare, would reveal more about their performance and suitability for index insurance.

Finally, ‘theory-guided’ or ‘physics-guided’ ***data*** science is a new approach to improving predictions based on integrating scientific knowledge embodied in process-based models with state-of-the-art machine learning models. In a study simulating lake temperature, a physics-based deep learning model trained with theory-based feedback (that is, with penalties for violating conservation of energy) informed by a physics-based energy balance model resulted in a smaller root-mean-square error than traditional deep learning and process-based modelling. Similar techniques have been applied to reduce prediction errors for several atmospheric and hydrological variables,–. Although we are currently unaware of applications of theory-guided deep learning for crop yield predictions, recent funding directed at this research area (see, for example, ref.) suggests that we can anticipate more work using these techniques in the years ahead.

Illustrating index insurance quality evaluation

How much do advances in techniques to assess ***agricultural*** conditions address the fundamental challenges of reducing design and idiosyncratic risk, and, in turn, translate into (unsubsidized) value to the insured? A key approach to measuring the quality of index insurance design involves ascertaining how reliably a given index captures the intensity of poor conditions when they occur. In this section, we illustrate how the MQS evaluation framework (Fig. ) helps assess the relative performance of several weather and yield measures derived from simple applications of the methods discussed herein.

Ideally, we would use farmer-level ***data*** to illustrate how the choice of zone boundaries and index can influence the value to the insured. However, here, we use available ***data*** on maize yields estimated from a series of crop cuts conducted in 71 Kenyan sub-counties in each year from 2016 to 2019 (see ref. for a more detailed description of the area and procedures for the crop cuts). For illustration purposes, we consider each sub-county as a single, synthetic individual who represents the aggregate of all crop cuts conducted in that sub-county. Risk is less of a problem for this synthetic individual, as yields for the sub-county will fluctuate much less than for a real person. Nonetheless, we can learn about the performance and quality of remote sensing insurance measures by constructing and evaluating a sample set of six different index insurance contracts for all synthetic individuals over the 2016–2019 period. All contracts were set up to compensate the insured by $1 for every $1 that the predicted yield falls below its mean value. We assume that the synthetic individuals are modestly (see section S.2 of the ).

To benchmark the analysis, we first examine the workings of a ‘perfect’ individual insurance contract, in which design and idiosyncratic variation are zero. This contract perfectly compensates each synthetic individual for their losses (Fig. ). For example, the largest loss in the ***data*** set is ~$1,000, and the synthetic individual who suffered that loss receives a $1,000 insurance payout. This insurance boosts the risk-adjusted (certainty equivalent) value of income for the synthetic individual by $55 per hectare compared with the no-insurance case (Fig. ). This individual contract easily passes the MQS.

Illustrating index insurance quality evaluation.

a | Payouts versus losses for six different indices at the county and sub-county levels, including crop cuts, a vegetative index (green chlorophyll vegetation index (GCVI)) and cumulative growing season (spring) precipitation amounts. The lower halves of the plots indicate how each index would issue payouts compared against the ‘true’ income loss. b | The certainty equivalent of a given insurance contract establishes the maximum risk-reduction value that the contract offers for the moderately risk-adverse individuals in this case study, relative to the case of no insurance. c | Predicted versus observed performance. Each index is compared against ground-reference-based yield estimates (sub-county crop cuts) using the symmetric performance measures of R2 and root-mean-square error (RMSE) common in the remote sensing literature. The dashed vertical lines indicate the trigger value to issue payouts, which, here, equals the average production estimated at the synthetic individual level (sub-county). The comparison of sub-county-level and county-level aggregates of each index type indicates the idiosyncratic risk; the difference between various types of indicators for a given zone indicates variation in design risk. FN, false negative; FP, false positive; NP, no payout; TP, true payout. ***Data*** available in the .

Individual-level contracts for real smallholder farmers are not viable, however, owing to moral hazard, adverse selection and the high cost of loss verification. As a more viable alternative, we consider an area-yield contract that defines the county as the insurance zone. Because this contract is based on crop cuts, it is expected to have no (or trivial) design risk, but it does introduce idiosyncratic risk, as all individuals receive the same payout as their county average, despite their underlying production differing from the county average.

This contract generally issues payouts for losses, although both false negatives and false positives occur (Fig. ). For one individual who, in one year, experienced a $1,000 loss, the payout was only ~$250. The risk-adjusted income under this area-yield contract exceeds the no-insurance option by ~$35 per hectare (Fig. ), but offers only about two-thirds of the insurance value of the individual contract. This drop in insurance value reflects the magnitude of idiosyncratic risk at the county level. ***Data*** acquisition and other administrative costs are not included in the cost of this contract and would further reduce its certainty equivalent value. As these costs are largely fixed, their magnitude depends on the number of contracts sold. In real life, ***data*** acquisition through crop cuts can easily add $2–5 to the per-hectare cost of insurance (see section S.3 in the for supporting assumptions), meaning that the certainty equivalent value of this contract would be ~$2–$5 less than the $35 shown in Fig. .

We next consider what happens when the insurance area is fixed at the county level, but crop-cut ***data*** are replaced with satellite observations used to estimate average yields. Production estimates are based on a satellite vegetation index (based on the GCVI) and cumulative spring precipitation amounts extracted from the Climate Hazards Group InfraRed Precipitation with Station ***data*** (CHIRPS) ***data*** product (Fig. ). At the county level, these indices are subject to idiosyncratic and design risk, the latter arising from the imperfect ability of the indices to predict average losses at this level.

The county-level GCVI index appears to mimic the area-yield index, although there are higher rates of false negatives and positives (Fig. ). By contrast, with the county-level spring precipitation index, there is little discernible relationship between individual losses and payouts under the contract. The rainfall-based contract renders the moderately risky individual worse off than if they had no insurance, as the change in certainty equivalent income is $4 lower than the no-insurance alternative (Fig. ). This contract thus fails the MQS. However, the county-level GCVI index passes the MQS, as its certainty equivalent income is $20 per hectare. Its insurance value falls below that of the area-yield contract, showing the importance of design risk.

In addition, we assess what happens to insurance value when we exploit satellite observations to create smaller insurance zones at minimal additional cost, while potentially reducing idiosyncratic risk. For both the GCVI and precipitation contracts, the insurance zone was shrunk to the sub-county level (Fig. ). These new contracts slightly outperform the county-level contracts (Fig. ). The rainfall contract still fails the MQS, whereas the certainty equivalent income gain increases by ~$2 when the zone size of the GCVI contract is reduced to the sub-county level. Although additional research is needed to determine which conditions using the smaller zones proves beneficial, this first exercise illustrates the potential.

The loss measures commonly used to assess predictive skill in the remote sensing literature (R2 values and root-mean-squared error) appear similar at the sub-county and county levels for both the GCVI and precipitation indices (Fig. ). Despite the similarity when using these measures that equally weight positive and negative deviations, the asymmetric loss function reflected through the certainty equivalent calculation shown in Fig.  reveals subtle differences in the risk-reduction value of these two indices, with the GCVI index at the sub-county level, for example, restoring $2 of risk-reduction value beyond that of the more aggregated zone. Although the measure of predictive skill for the county-level crop cuts outperforms the other indices, the focus on unweighted predictive skill obscures the important additional weighting of uncompensated losses (false negatives) that a certainty equivalent approach (featured in Fig. ) enables.

This example case reflects a short time series and uses simple approaches to generate sample indices. Although further improvements can and should be made before any variation on these indices are deployed for insurance purposes, the case illustrates how examining the relationship between the predicted and observed values, as well as the certainty equivalent measure, offer diagnostics for evaluating and, subsequently, improving, the value of insurance indices to rural households.

Innovations in programme design

Several additional opportunities exist beyond the construction of an index that can improve the fit of an insurance programme to the conditions a farmer faces.

For example, a picture-based insurance programme was recently piloted among more than 750 smallholder wheat farmers in north-west India. This pilot used a custom phone-based application with which farmers captured a georeferenced time-lapse of the insured crop throughout the growing season from a fixed vantage point and orientation, fixed-view angle and at a similar time of day. These ‘phenocams’ can ***collect*** information about crop growth stages, which can improve the algorithms that use satellite ***data*** to estimate crop yields. Phenocams can also allow for low-cost ground-***data*** ***collection*** to detect problems (such as hail damage) that are easily observable in a photo but not as easy to observe in satellite images. Citizen science approaches could be further developed with phenocams to ***collect*** large samples of relevant ***data***, including phenology, stress and crop production. The size of such ***data*** sets can compensate for the lack of precision therein, and even ordinal ***data***, as in ‘high’, ‘medium’ and ‘low’, can be used to understand yield variation in ways that could outperform more formally ***collected*** ***data*** that intensively samples smaller areas or shorter time frames.

Interest in using unmanned aerial vehicles (drones) for crop insurance purposes has also increased. The MetLife Corporation, for example, has submitted a patent request for their use of drones for various risk-assessment and auditing purposes. Drones may also enable ***agricultural*** stress to be detected over a wide and inaccessible area, and, in early 2020, the UN Food and ***Agriculture*** Organization reported that it had begun experimenting with drones to detect and manage locust infestations in Eastern Africa. However, current commercial drones still suffer from limited battery life (constraining flight time and areal coverage), complex ***data*** processing requirements and regulatory challenges that may impede their widespread adoption in developing country contexts. The relative cost advantages of operating drones compared with conventional, ground-based approaches is also not yet clear. However, ongoing experiments, will likely provide additional insight into their value. Either drones or ground-based phenocams could plausibly be used as a supplementary ***data*** source for auditing systems to cover larger territories during field visits or supplement yield estimates derived from satellite ***data***.

Another opportunity to enhance the value of an index insurance programme is to deploy a limited number of crop cuts when groups of farmers indicate that the satellite or weather-based indices have failed them. Such a conditional audit system was applied in a pilot index insurance project among Tanzanian rice farmers. To ensure incentive compatibility, that is, to ensure that the field visits are deployed only when most needed, a small fee can be assessed to at least partially cover the cost of the audits. The lower cost associated with satellite-based approaches mixed with conditional audits generated higher risk-reduction value for the farmers relative to field-based or satellite-based approaches alone,, using the same measures discussed above (Fig. ). Using emerging technologies that lower the cost of field-based crop measurements might further enhance the feasibility of this approach.

Finally, another approach to enhance the value of index insurance involves allowing farmers to select what they perceive to be the riskiest time periods to insure their crops. In contrast to focusing on cost reduction, this approach introduces a modicum of flexibility to better fit the losses of greatest concern to farmers.

Future perspectives

Index insurance can increase the resilience and income of rural communities, although several programmes have failed, owing to high costs or farmers not being compensated when payment was warranted and most needed. However, improving index insurance has been hampered by the lack of a conceptually sound standard for measuring and recognizing the quality of index insurance. In this Review, we have built on ideas in ref., showing how a measure can not only be used to evaluate a given contract (versus the alternative of no insurance) but also to measure the progress that can be made as rapidly advancing remote sensing tools are applied to the problem of small-farm risk reduction and resilience. As much remains to be learned about which innovations work best and under which conditions, we close this Review by summarizing the key emerging opportunities relating to advances in ***data*** availability, production estimation techniques and programme design that can enhance the value of index insurance to the insured.

First, the influence of using higher-resolution ***data*** in determining which areas to use to evaluate production (crop masking) should be examined. Better understanding of where relevant crops are can help reduce the signal-to-noise ratio of satellite-based estimations, especially in heterogeneous landscapes for which reflectance ***data*** may be contaminated by other types of land uses. Such crop masks can be used to improve the index by eliminating pixels that have a small share of the target crops and, therefore, help identify relevant areas to conduct field-based assessments. Additional research can help discern how to best apply such methods and how much they help.

Second, we recommend applying improved techniques to detect losses, drawing on advances in modelling, new ***data*** sources and using the metric of farmer welfare as evaluated with unsubsidized insurance prices. The idea of improving loss detection builds on techniques discussed above and implies the use of an asymmetric loss function focused on production shortfalls. In particular, modelling approaches that account for responses to poor conditions, relatively new ***data*** products that can each help assess the state of production (such as SIF or VOD), techniques such as physics-guided ***data*** science and ***data*** fusion approaches are ripe for exploration.

Third, strategically ***collecting*** ground-based ***data*** that span the yield distribution can help improve production estimates for insurance. Evaluating the performance of remote sensing and crop modelling methods requires reliable ground-reference ***data***. The amount of ground-reference ***data*** needed depends on the heterogeneity of the target area over space and time, and having ***data*** that reflect shocks, especially low-yield states, is particularly important. Farmer recall surveys can be noisy: improved understanding of how to best ***collect*** and use such ***data*** could provide insight over a longer time period for which no other ***data*** exist and for the type of large and noteworthy events that index insurance seeks to cover. The utility of any survey may depend on the type and severity of shock, along with the community’s responses or composition.

Fourth, insurance zones can be optimized to reflect areas with high response homogeneity. As index insurance pays out farmers based on group-level indices so as to avoid moral hazard, delineating groups with common production trends and variances helps reduce the risk of uncompensated losses. Although seemingly convenient, large-scale administrative boundaries are unlikely to reflect optimal insurance zoning. To address concerns about the clarity of zone boundaries on the ground, a zone-optimization process could be constrained to follow well-defined boundaries, such as lower-level administrative boundaries or major landscape features. Fundamentally, however, if idiosyncratic risk is high, meaning that individuals within a given insurance zone do not experience common shocks or have common production responses to those shocks, index insurance will be of little value and other risk management approaches would be more appropriate.

Finally, contracts can be designed to accommodate heterogeneous needs and inevitable index failure. Although many of the above approaches focus on reducing the costs of providing reliable index insurance, two additional programmatic innovations can help enhance the value of index insurance in diverse smallholder contexts. One is to tailor specific index insurance contract parameters (for example, providing flexible windows for insurance coverage) to help account for heterogeneous conditions that farmers perceive but that a standardized contract offered over a single time period may not accommodate. In addition, contracts must be designed for when even the most advanced model or remote-sensing-based production estimation techniques err. To account for these inevitable errors at the outset, providing incentive-compatible, secondary audits for farmers to present their loss claims that the index failed to detect serves as an important recourse to minimize the extent of uncompensated losses. Smartphones, drones and other technological advances may offer further possibilities to reduce the cost of these field audits.

Overall, evaluating and designing programmes to successfully manage risk is a problem with both technical and social dimensions. Although index insurance instruments will not solve all ***agricultural*** risk-related problems, they offer a useful form of protection against severe, community-wide shocks when done well. Techniques to systematically evaluate the quality of a given insurance design offer an important lens to evaluate, diagnose and enhance the value of current and future programmes to insurers and the insured.

**Acknowledgements**

This work has benefited from research conducted under the auspices of the United States Agency for International Development (USAID) Feed the Future Innovation Lab for Markets, Risk and Resilience (grant no. 7200AA19LE00004), which M.R.C. directs and from which M.R.C., E.B. and A.H. have previously received funds. The contents are the responsibility of the authors and do not necessarily reflect the views of the USAID or the United States Government.

**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s43017-020-00122-y.Peer*](https://doi.org/10.1038/s43017-020-00122-y.Peer) review informationNature Reviews Earth & Environment thanks K. Takahashi, A. Vrieling, L.M. Robles and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s noteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.Related linksIndex Insurance Forum:[*https://www.indexinsuranceforum.org/about-siteOptiSAR*](https://www.indexinsuranceforum.org/about-siteOptiSAR):[*https://directory.eoportal.org/web/eoportal/satellite-missions/o/optisar*](https://directory.eoportal.org/web/eoportal/satellite-missions/o/optisar)

**Load-Date:** September 6, 2023

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[***A longitudinal association between the traditional Japanese diet score and incidence and mortality of breast cancer—an ecological study***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2C1-JCWX-C1V9-00000-00&context=1516831)

European Journal of Clinical Nutrition

January 2021

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**Section:** Pg. 929-936; Vol. 75; No. 6; ISSN: 0954-3007,1476-5640

**Length:** 3890 words

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**Body**

Introduction

Japanese traditional food culture, known as “washoku”, is considered to contribute Japanese health and longevity [, ]. The basic composition of “washoku” is cooked rice as a staple food, one soup, and three side dishes (“ichi-ju san-sai”) [], and foods often used for side dishes are soybeans/soybean-derived products, seafood, and vegetables []. Previous meta-analyses reported that high intake of soy isoflavones or soy-based foods [, ], marine n-3 polyunsaturated or omega-3 fatty acids in fish [, ], and high intake of fruits and vegetables combined [] were associated with a lower risk of breast cancer. Because soybeans, fish, and vegetables are often used in the traditional Japanese diet, “washoku” may reduce breast cancer risk. However, a cohort study and a case-control study reported that the typical Japanese diet pattern was not associated with breast cancer risk in Japanese women [, ].

Breast cancer is the most commonly diagnosed cancer and the leading cause of cancer death among women globally, but the incidence of breast cancer among Asians, including Japanese, is lower than in Western countries []. Studies involving only Japanese women have shown no clear association between traditional Japanese dietary patterns and breast cancer. In addition, factor analysis was used to create Japanese dietary patterns in previous studies, but traditional Japanese food patterns were not necessarily obtained and analyzed. In order to clarify whether the traditional Japanese diet is globally associated with breast cancer, a Japanese food score that can be commonly used in international comparative studies is required.

We created a traditional Japanese diet score (TJDS) that can be used for international comparative studies, and reported that TJDS was significantly associated with decreased obesity rates and incidence of ischemic heart disease, and extended healthy life expectancy using international databases []. There have been no international comparative studies that examined the relationship between the Japanese diet and breast cancer. The purpose of this study was to clarify the long-term association between TJDS and breast cancer incidence and mortality using international databases.

Methods

Variables

TJDS

We previously created TJDS to reflect the dietary pattern of traditional Japanese food culture with reference to the scoring system of the Mediterranean diet []. TJDS is calculated from nine food groups as well as the Mediterranean diet score []. Briefly, TJDS has two components, with each component divided into tertiles (+1, 0, −1). The first component is the beneficial food group (rice, fish, soybeans, vegetables, eggs, seaweed), and a score of positive 1 point is given for high consumption (g/day/capita/1000 kcal) of this component. The second component is foods not commonly used in the traditional Japanese diet (wheat, milk, and red meat), and a score of negative 1 point is given for high consumption (g/day/capita/1000 kcal) of this component. The total score ranges from −9 to 9, with higher scores indicating greater adherence to the traditional Japanese diet.

The food supply excluding losses between production and households and reflecting consumption was obtained from the Food and ***Agriculture*** Organization of the United Nations ***Statistics*** Division database (FAOSTAT) [] and TJDS was calculated by country. The FAOSTAT provides food and ***agricultural*** ***data*** for over 245 countries and regions. It covers all regional groups of the FAO of the United Nations [].

Incidence and mortality of breast cancer

Age-standardized incidence and mortality per 100,000 people of breast cancer by country was obtained from the Global Burden of Disease (GBD) 2017 database from 1990 to 2017 []. The GBDs, Injuries, and Risk Factors Study 2017 includes a comprehensive assessment of incidence, prevalence, and years lived with disability for 354 causes in 195 countries and territories from 1990 to 2017 [], and was used in the present study.

Covariables

Socio-economic variables were population (million), gross domestic product per capita (gross domestic product [GDP] 1000 US$/capita), percentage of the population over 65 (aging rate) obtained from the World Bank database [], and years of education obtained from the GBD database []. Lifestyle variables were current smoking rates (%), mean body mass index (BMI kg/m2), physical activity (1000 MET min/week) obtained from the GBD database, and energy supply (kcal/day/capita) obtained from the FAOSTAT database. These covariates are internationally available socio-economic and lifestyle indicators that have the potential to confound breast cancer.

Statistical analysis

The 1990–2017 ***data*** were used for the analyses. All analyses were conducted for 139 countries with a population of over 1 million without missing ***data*** from 1990 to 2017. The association between TJDS and incidence and mortality of breast cancer was examined using 2017 ***data***. The distribution of variables is shown by mean, standard deviation (SD), and percentile for 2017 ***data***. The relationship between TJDS and breast cancer incidence or mortality is shown by value plotting with regression lines. The trend in breast cancer incidence and mortality over time is shown spaghetti lines about countries.

The effects of TJDS on incidence and mortality of breast cancer over time were evaluated using a linear mixed-effect model, which takes into account the dependence of repeated observations within countries. Linear mixed-effect models can handle missing ***data*** more appropriately than traditional regression analysis and repeated measures analysis. The within-country correlation structure was specified as a compound symmetry structure corresponding to a constant correlation. Additionally, the models included random intercepts and time effects, which captured country-specific deviations from the intercept and slope by fiscal year. In the analysis, the restricted maximum likelihood approach was used, which can produce unbiased estimates of variance and covariance parameters []. The models used in this study included fixed effects for the intercept, TJDS, fiscal year, and the interaction between TJDS and fiscal year. GDP, aging rate, education, smoking, BMI, physical activity, and energy supply were included as covariables. To make the model fitting, all the variables except TJDS and fiscal year were log-transformed. Model 0 was a linear mixed-effect model with the intercept and fiscal year as the fixed effects. Model 1 was a linear mixed-effect model with the intercept, TJDS, fiscal year, interaction between TJDS and fiscal year as the fixed effects. Model 2 was a linear mixed-effect model in which GDP was added to Model 1 as a fixed effect. Model 3 was a linear mixed-effect model in which all socio-economic and lifestyle variables were added as fixed effects. In all models, random effects were fiscal year and country. SD of the random intercept and slope, correlation between the intercept and slope, and residuals showed the initial incidence or mortality in each country in 1990 and TJDS over time. The main outcome of this study was the interaction between TJDS and fiscal year. We used Akaike information criterion (AIC) and Bayesian information criterion (BIC) for model fit.

All ***data*** were analyzed using R version 3.6.1 []. The linear mixed-effect models were fitted by the “lme” function of “nlme” package version 3.1.140 []. p < 0.05 was considered statistically significant. The R code and the final dataset used in the analysis are available as supplementary information in the Tsu city college repository [].

Results

Table shows TJDS, incidence and mortality of breast cancer, socio-economic and lifestyle variables of 138 countries by mean, SD, and percentile in 2017. The 5th to 95th percentile of TJDS ranged from −2 to 6, with a mean of 1.6 and median of 1.5. The countries with the highest TJDS were Nigeria, Republic of Korea and Thailand (eight points) and the country with the lowest TJDS was Mongolia (−4 points). TJDS of Japan was five points, the third highest score of the countries examined. Figure shows the plot of the relationship between TJDS and breast cancer incidence and mortality in 2017. The slopes of the regression lines were −2.786 ± 0.760 (p < 0.001) for incidence of breast cancer and mortality of breast cancer was not significant (−0.290 ± 0.160; p > 0.05). Figure shows the trend in breast cancer incidence and mortality over time about countries (Color version is available in Supplementary Fig. ). Although there are some exceptions, many countries with high scores on TJDS have lower distributions of breast cancer incidence and mortality, and many countries with low scores have a high distribution of breast cancer incidence and mortality in 1990–2017.

Mean value, standard deviation, and percentiles of breast cancer incidence and mortality, socio-economic variables, lifestyle variables, and TJDS in 138 countries.

| **Variables** | | **Mean** | **SD** | **Percentile** | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **5** | **25** | **50** | **75** | **95** |
| Breast cancer |  |  |  |  |  |  |  |  |
| Incidence (/100,000/year) | 46.1 | 23.6 | 20.4 | 26.8 | 39.0 | 60.7 | 90.8 |  |
| Mortality (/100,000/year) | 16.2 | 4.8 | 9.4 | 12.6 | 16.1 | 18.4 | 24.2 |  |
| Socio-economic variables |  |  |  |  |  |  |  |  |
| Population (million) | 52.5 | 167.5 | 2.0 | 5.6 | 12.5 | 38.2 | 168.6 |  |
| GDP (1000 US$/capita) | 12.8 | 17.2 | 0.6 | 1.5 | 5.2 | 15.6 | 49.0 |  |
| Aging rate (%) | 9.1 | 6.5 | 2.5 | 3.4 | 6.5 | 14.8 | 20.0 |  |
| Education (years) | 9.2 | 3.4 | 3.4 | 6.4 | 9.2 | 12.5 | 13.8 |  |
| Lifestyle variables |  |  |  |  |  |  |  |  |
| Smoking (%) | 15.1 | 7.3 | 5.0 | 9.3 | 14.3 | 20.8 | 27.6 |  |
| BMI (kg/m2) | 25.4 | 2.0 | 22.1 | 23.7 | 25.9 | 26.8 | 28.1 |  |
| Physical activity (1000 MET min/week) | 5.7 | 1.8 | 3.2 | 4.3 | 5.7 | 7.5 | 8.5 |  |
| Energy supply (1000 kcal/capita/day) | 2.6 | 0.4 | 2.0 | 2.3 | 2.7 | 3.0 | 3.2 |  |
| TJDS |  | 1.6 | 2.5 | ?2.0 | 0.0 | 1.5 | 3.0 | 6.0 |

The figures in this table are the results for 2017.

GDP gross domestic product, BMI body mass index, TJDS traditional Japanese diet score, SD standard deviation.

Relationship between TJDS and breast cancer in 2017.

a Aging-standardized incidence of breast cancer. b Aging-standardized mortality of breast cancer. Bubble size resents the GDP/capita of 138 countries with a population of over 1 million.

Trend in breast cancer over time about countries.

a Incidence of breast cancer. b Mortality of breast cancer. The darker the line, the higher TJDS.

Longitudinal analyses were conducted in all 139 countries with a population of over 1 million, for 27 years from 1990 to 2017. In the longitudinal analyses, the number of countries was not always the same in all fiscal years because the country name was changed, or ***data*** was missing. The longitudinal analyses used ***data*** from a total of 3715 countries, with all ***data*** from one country used for at least 12 years. Table shows the effects of interaction between TJDS and fiscal year, and covariables on the incidence of breast cancer in the four linear mixed-effect models. In Model 0, the variance of the intercept and fiscal year differed by country (β ± standard error; intercept, 3428.786 ± 53.815, p < 0.001; fiscal year, 11.581 ± 0.997, p < 0.001). In Model 1, the interaction between TJDS and fiscal year was significantly negatively associated with incidence of breast cancer (−0.717 ± 0.146, p < 0.001). In Model 2 controlled for GDP, the interaction between TJDS and fiscal year was significantly negatively associated with incidence of breast cancer (−0.716 ± 0.146, p < 0.001). In Model 3 controlled for all socio-economic and lifestyle variables including GDP, aging rate, years of education, smoking rate, physical activity, and energy supply, the interaction between TJDS and fiscal year was still significantly negatively associated with incidence of breast cancer (−0.453 ± 0.138, p < 0.01).

Main effects of the interaction between TJDS and fiscal year, and log-transformed covariables on incidence of breast cancer in the four linear mixed-effect models: longitudinal analysis.

| **Incidence of breast cancer** | **Model 0** | | **Model 1** | | **Model 2** | | **Model 3** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **?** | **(SE)** | **?** | **(SE)** | **?** | **(SE)** | **?** | **(SE)** |
| Fix effects |  |  |  |  |  |  |  |  |
| ?(Intercept) | 3428.786 | (53.815)\*\*\* | 3418.574 | (54.605)\*\*\* | 3397.662 | (61.012)\*\*\* | 2488.733 | (925.955)\*\* |
| ?Year | 11.581 | (0.997)\*\*\* | 12.449 | (1.059)\*\*\* | 12.277 | (1.082)\*\*\* | ?2.445 | (1.286) |
| ?TJDS |  |  | 9.254 | (2.433)\*\*\* | 9.278 | (2.434)\*\*\* | 5.906 | (2.334)\* |
| ?TJDS×Year |  |  | ?0.717 | (0.146)\*\*\* | ?0.716 | (0.146)\*\*\* | ?0.453 | (0.138)\*\* |
| ?GDP |  |  |  |  | 2.925 | (3.890) | 3.414 | (3.904) |
| ?Aging rate |  |  |  |  |  |  | 134.051 | (21.266)\*\*\* |
| ?Education |  |  |  |  |  |  | 571.012 | (49.509)\*\*\* |
| ?Smoking |  |  |  |  |  |  | ?24.613 | (19.061) |
| ?BMI |  |  |  |  |  |  | 1643.262 | (181.294)\*\*\* |
| ?Physical activity |  |  |  |  |  |  | ?640.007 | (73.408)\*\*\* |
| ?Energy supply |  |  |  |  |  |  | ?5.431 | (25.722) |
| Random effects |  |  |  |  |  |  |  |  |
| ?SD of intercept | 633.971 | 642.643 | 639.111 | 459.470 |  |  |  |  |
| ?SD of slope | 11.659 | 12.220 | 12.210 | 10.693 |  |  |  |  |
| ?Correlation intercept and slope | ?0.606 | ?0.636 | ?0.638 | ?0.733 |  |  |  |  |
| ?Residua | 53.710 | 53.478 | 53.499 | 51.302 |  |  |  |  |
| AIC | 41819.325 | 41799.228 | 41796.123 | 41296.847 |  |  |  |  |
| BIC | 41862.862 | 41855.199 | 41858.311 | 41396.322 |  |  |  |  |

All variables except TJDS and year were log-transformed.

TJDS: Traditional Japanese Diet Score, GDP: Gross Domestic Product, BMI: Body Mass Index, AIC: Akaike Information Criterion, BIC: Bayesian Information Criterion, SE: Standard Error, SD: Standard deviation.

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

Table shows the effects of the interaction between TJDS and fiscal year, and covariables on the mortality of breast cancer in the four linear mixed-effect models. In Model 0, the variance of the intercept differed by country (intercept, 2773.401 ± 35.652, p < 0.001). In Model 1, the interaction between TJDS and fiscal year was significantly negatively associated with mortality of breast cancer (−0.640 ± 0.136, p < 0.001). In Model 2 controlled for GDP, the interaction between TJDS and fiscal year was significantly negatively associated with mortality of breast cancer (−0.650 ± 0.136, p < 0.001). In Model 3 controlled for all socio-economic and lifestyle variables including GDP, aging rate, years of education, smoking rate, physical activity, and energy supply, the interaction between TJDS and fiscal year was still significantly negatively associated with mortality of breast cancer (−0.455 ± 0.135, p < 0.001).

Main effects of the interaction between TJDS and fiscal year, and log-transformed covariables on mortality of breast cancer in the four linear mixed effect models: longitudinal analysis.

| **Mortality of breast cancer** | **Model 0** | | **Model 1** | | **Model 2** | | **Model 3** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **?** | **(SE)** | **?** | **(SE)** | **?** | **(SE)** | **?** | **(SE)** |
| Fixed effects |  |  |  |  |  |  |  |  |
| ?(Intercept) | 2773.401 | (35.652)\*\*\* | 2763.762 | (36.345)\*\*\* | 2901.196 | (45.460)\*\*\* | 4714.121 | (938.893)\*\* |
| ?Year | ?0.523 | (0.969) | 0.236 | (1.023) | 1.370 | (1.048) | ?6.161 | (1.228)\*\*\* |
| ?TJDS |  |  | 8.908 | (2.283)\*\*\* | 8.804 | (2.272)\*\*\* | 6.040 | (2.238)\*\* |
| ?TJDS×Year |  |  | ?0.640 | (0.136)\*\*\* | ?0.650 | (0.136)\*\*\* | ?0.455 | (0.135)\*\*\* |
| ?GDP |  |  |  |  | ?19.228 | (3.570)\*\*\* | ?18.157 | (3.714)\*\*\* |
| ?Aging rate |  |  |  |  |  |  | 134.440 | (21.749)\*\*\* |
| ?Education |  |  |  |  |  |  | 313.911 | (44.806)\*\*\* |
| ?Smoking |  |  |  |  |  |  | ?16.151 | (18.681) |
| ?BMI |  |  |  |  |  |  | 309.298 | (179.599) |
| ?Physical activity |  |  |  |  |  |  | ?447.254 | (77.425)\*\*\* |
| ?Energy supply |  |  |  |  |  |  | 33.255 | (24.488) |
| Random effects |  |  |  |  |  |  |  |  |
| ?SD of intercept | 419.669 | 426.999 | 442.083 | 403.592 |  |  |  |  |
| ?SD of slope | 11.337 | 11.819 | 11.871 | 10.48 |  |  |  |  |
| ?Correlation intercept and slope | ?0.715 | ?0.734 | ?0.749 | ?0.471 |  |  |  |  |
| ?Residual | 50.163 | 49.962 | 49.734 | 48.530 |  |  |  |  |
| AIC | 41192.449 | 41174.892 | 41144.102 | 40945.294 |  |  |  |  |
| BIC | 41235.986 | 41230.864 | 41206.290 | 41044.769 |  |  |  |  |

All variables except TJDS and year were log-transformed.

TJDS: Traditional Japanese Diet Score, GDP: Gross Domestic Product, BMI: Body Mass Index, AIC: Akaike Information Criterion, BIC: Bayesian Information Criterion, SE: Standard Error, SD: Standard deviation.

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

For random effects of both breast cancer incidence and mortality, Model 3 controlled for all socio-economic and lifestyle variables showed the lowest SD of the intercept, SD of the slope, and residuals. Both models on breast cancer incidence and mortality had the lowest AIC and BIC for Model 3 controlled for all socio-economic and lifestyle variables.

Discussion

This study investigated the longitudinal association between TJDS and incidence and mortality of breast cancer using international databases. TJDS was negatively associated with incidence of breast cancer in 2017 (Fig. ) and most countries with high TJDS had a low distribution of breast cancer incidence and mortality (Fig. ). Longitudinal analyses controlled for all socio-economic and lifestyle variables indicated that the interaction between TJDS and fiscal year was significantly negative associated with incidence and mortality of breast cancer. The β value of interaction between TJDS and fiscal year in the fully controlled model in the longitudinal analysis was smaller than that of other models, but that model showed the least statistical variability and error. These results suggest that in recent years, a traditional Japanese diet may reduce the incidence and mortality of breast cancer worldwide. This study provides the first evidence that a traditional Japanese diet pattern might suppress the incidence and mortality of breast cancer on a global scale.

Previous meta-analyses reported that a high intake of foods often used in the traditional Japanese diet was associated with a lower risk of breast cancer [–]. However, there is a complex interaction between ***nutrients*** in the diet, and it is important to investigate the association between dietary patterns as a whole (i.e., not a single food) and breast cancer. A previous systematic review suggested that dietary patterns that contain vegetables and limit red and processed meats and saturated fat may reduce breast cancer risk []. A previous dose-response meta-analysis suggested that higher soy food and skim milk intake may lower breast cancer risk whereas higher total red meat, fresh red meat, and processed meat intake may increase breast cancer risk []. In TJDS, beneficial food groups such as vegetables and soy products are given a positive score and food groups that are not used for traditional Japanese food such as meat and milk (not skim milk) are given a negative score []. Since diets with more vegetables and soy products and less meat score higher in TJDS, the traditional Japanese diet may reduce the incidence and mortality of breast cancer.

In this study, there was a significant negative association between TJDS and breast cancer incidence, however, an association between TJDS and breast cancer mortality was not a significant in cross-sectional analysis. In general, survival rates for breast cancer have improved because access to medical care is improving in many countries and the majority of breast cancer cases are diagnosed at an earlier and localized stage []. Therefore, the effect of diet on breast cancer mortality appears to have weakened. Breast cancer incidence varies by region in the world. Incidence is higher in Australia/New Zealand, Western Europe, and Northern Europe, and lower in South Central Asia, Central Africa, and East Africa []. Asian women have been reported to have an increased incidence of breast cancer after migrating to the United States of America []. These regional variations in breast cancer incidence may be attributed to differences in lifestyle including dietary patterns. In regions with a high incidence of breast cancer, dietary patterns based on TJDS may further reduce incidence of breast cancer.

Previous studies have reported on the mechanisms of soy foods, omega-3 fatty acids in fish, vegetables and fruits on breast cancer risk. Soy foods contain dietary isoflavones that are similar in structure to 17-β-estradiol, which may prevent breast cancer as an estrogen antagonist []. Omega-3 fatty acids in fish decrease cell proliferation and induce apoptotic cell death in human breast cancer cells []. Various biochemical compositions in vegetables and fruits induce apoptosis of breast cancer cells and prevent and inhibit breast cancer progression in animal models []. Ecological studies such as this study cannot mention where TJDS affect the cancer process, but TJDS might reduce the incidence of breast cancer due to the complex interactions of these food compositions. Our results showed that the interaction between TJDS and fiscal year on breast cancer incidence and mortality was negative, and that as the year progresses, TJDS has a negative effect on breast cancer incidence and mortality. The reasons for this are that TJDS may reduce breast cancer incidence and mortality by curbing obesity [] (we include obesity as an adjustment factor, however because of an ecological study, individual results may not be adequately adjusted), people with high TJDS are associated with better lifestyle habits (e.g., smoking) [], the effects of TJDS on breast cancer incidence and mortality have become more apparent in recent years as health care disparities have decreased [].

TJDS of Japan was five points, which was not first among the 138 countries investigated in 2017 (Fig. ). TJDS represents a traditional Japanese diet and it does not reflect current Japanese diet styles. It is thought that TJDS of Japan was low because the current Japanese diet is westernized compared to the traditional Japanese diet []. The incidence/mortality of breast cancer in Mongolia was low (Fig. ). Mongolia relies almost on meat and dairy products for its energy, and has a diet pattern closer to Western countries than to other Asian countries []. The detailed reason is unknown, but other dietary factors not included in TJDS may play a role []. Moreover, early detection of breast cancer may be difficult because Mongolia’s population is sparsely distributed. The ***data*** quality of Mongolia is not clear since ***data*** ***collection*** depends on factors such as population coverage and the ***collection*** methods used []. However, the models adjusted for socio-economic and lifestyle covariates did not show significant outliers in the incidence and mortality of breast cancer in Mongolia (results not shown).

This study has methodological limitations for an ecological study. First, ***data*** were ***collected*** from international databases by country, without considering individual differences such as age, gender, and lifestyle. Therefore, the results cannot be considered evidence of causal relationships at the individual level. Second, breast cancer is generally categorized into estrogen receptor (ER)-positive and ER-negative types. However, breast cancer in the GDB database did not separate these types, so it was not possible to analyze these types separately in this study. Third, because this study used age-standardized breast cancer incidence, it was not possible to analyze the difference between before and after menopause. A systematic review of Japanese studies suggested that soy products lower breast cancer risk in postmenopausal women compared to premenopausal women []. Further international comparative studies would be needed to analyze these ***data***, such as before and after menopause. Forth, adjusting for more unmeasured variables (such as race or oral contraceptive use) may result in lower TJDS β values, as we have adjusted only limited covariates of the available international ***data***. Fifth, ecological studies can be subject to inference errors of association due to the aggregation process []. Sixth, we used a mixed-effects model that allowed both negative and positive values; however, the incidence/mortality ***data*** will never be negative. Therefore, the values for the outcomes must be interpreted carefully.

In conclusion, this longitudinal analysis in an ecological study suggested that the traditional Japanese diet, which is thought to contribute to the longevity of Japanese people, has been associated with lower incidence and mortality of breast cancer worldwide in recent years. Future research should aim to improve the quantity and quality of ***data*** ***collected*** according to globally uniform standards.

**Acknowledgements**

We would like to thank Forte Science Communications (Tokyo, Japan) for carefully English proofreading the manuscript.

**Notes**

Supplementary informationThe online version contains supplementary material available at [*https://doi.org/10.1038/s41430-020-00847-5.Publisher’s*](https://doi.org/10.1038/s41430-020-00847-5.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***High adherence to a mediterranean diet at age 4 reduces overweight, obesity and abdominal obesity incidence in children at the age of 8***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2N1-F0C0-33W1-00000-00&context=1516831)

International Journal of Obesity

March 2020

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**Section:** Pg. 1906-1917; Vol. 44; No. 9; ISSN: 0307-0565,1476-5497

**Length:** 6122 words

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**Body**

Introduction

Childhood obesity is one of the most crucial health challenges of this century. According to the latest global estimates from a pooled analysis of 2416 studies with 128.9 million participants aged 5 years and older, the trends in mean body mass index (BMI) and obesity prevalence increased worldwide from 1975 to 2016 []. In European countries, Spain presented one of the highest rates of childhood obesity in 2016, with prevalence of 10.5% for obesity and 33.7% for overweight, in children and adolescents aged 5–19 years [].

Obesity at early ages is characterized by an increase in the number and size of adipocytes (adipose tissue cells); a process known as hyperplasia. By contrast, in adults, the most common obesity process is hypertrophy, which is distinguished by a large accumulation of fat in the adipocytes without an increment in the number of cells []. Importantly, the massive formation of adipocytes in infancy may become an irreversible process that results in obesity in adulthood, increasing the potential risk of developing multiple concomitant health problems such as glucose tolerance, hyperlipidaemia, cardiovascular diseases, and certain types of cancer [–]. Since obesity in adolescence and adulthood is very difficult to reverse, it is important to identify modifiable environmental factors such as diet, at early ages, in order to prevent obesity and noncommunicable diseases later in life.

Few studies have explored the relationship between diet and childhood obesity, and the main findings suggest that a greater consumption of vegetables and a lower intake of sugary drinks are associated with a lower risk of childhood obesity [–]. An alternative to studying the effect of specific foods and ***nutrients*** is to explore dietary patterns such as the traditional Mediterranean diet (MD), which has shown a beneficial effect on many chronic diseases and longevity in adults []. The traditional MD is a dietary pattern characterized by abundance of plant-based foods such as vegetables, legumes, fruits, nuts and cereals, the use of olive oil as main source of dietary fat, moderate-to-high intake of fish, low or moderate intake of dairy products, and a low consumption of meat []. Regarding ***nutrients***, MD is characterized by a high intake of carbohydrates of low glycemic index, dietary fiber and antioxidants, monounsaturated fatty acids, vegetable proteins, and a balanced ratio between omega-6 and -3 fatty acids [, ]. Thus, MD has high antioxidant and anti-inflammatory properties that play a preventive role against overweight and obesity [–], as corroborated by several systematic reviews mostly in adult populations [–]. However, the evidence of potential beneficial effects of MD on child health is still insufficient and not fully consistent. In a recently published systematic review based on 17 studies, an inverse association was reported between adherence to MD and BMI in children or adolescents, although there were differences by sex and age []. More prospective cohort studies may better elucidate the relationship of the MD adherence in the obesity in children.

In the light of the research cited above, this study had the following aims: first, to explore the cross-sectional association between adherence to MD and its components at age 4 and the prevalence of overweight, obesity, and abdominal obesity at the age of 4; and, second, to examine the prospective association between adherence to MD at age 4 and the incidence of overweight, obesity, and abdominal obesity at the age of 8.

Methods

The INfancia y Medio Ambiente (Environment and Childhood) project (INMA, [*www.proyectoinma.org*](http://www.proyectoinma.org)) is a population-based multicenter prospective birth cohort study established in seven Spanish regions that uses a common protocol []. For the present analysis, we used the ***data*** from the INMA study areas of Valencia, Sabadell, Asturias, and Gipuzkoa ***collected*** between 2003 and 2008. At the outset, there were 2644 women who agreed to participate, of which 2506 delivered a live infant. At the 4-year follow-up assessment 1801 children participated and 1527 children participated at the 8-year interview. Figure shows the flowchart of the population sample in our study. All participant parents provided informed consent, and the ethical committees of the centers (Hospital La Fe, Valencia; Sabadell Hospital, Sabadell; Central University Hospital of Asturias, Asturias; Zumarraga Hospital, Gipuzkoa) involved in the study approved the research protocol.

Flowchart of the mothers and their children from the INMA study.

Flowchart of the study population describing the selection process.

Dietary assessment

A semiquantitative food frequency questionnaire (FFQ) of 105 food items was used to assess the child’s usual daily intake of foods and ***nutrients*** (available at [*http://epinut.edu.umh.es/cfa-105-inma-infancia/*](http://epinut.edu.umh.es/cfa-105-inma-infancia/)) []. The FFQ was derived from an adult version of FFQ previously validated among the mothers from the Valencia-INMA cohort []. The FFQ was modified to include food items and portion sizes appropriate for children ages 4–5. It was validated in a sample of 169 children from the INMA study and showed moderately good reproducibility with an average correlation coefficient of 0.41 for ***nutrients*** and 0.43 for food groups. The average correlation coefficients for validity of daily ***nutrient*** intakes, as compared with three 24-h dietary recalls and blood concentration of vitamins, were 0.44 and 0.21, respectively [].

Parents were asked to report the dietary intake of their children as the average frequency of consumption for the specified serving or portion size of each food item over a previous 9-month period. The questionnaire included nine possible frequencies of consumption, ranging from “never, once, or less than once a month” to “six or more times a day”. ***Nutrient*** values and total energy intake were obtained from the United States Department of ***Agriculture*** food composition tables [] and other published sources as cultural reference for specific Spanish food and portion sizes [, ]. In order to calculate average daily ***nutrient*** intakes from the diet for each child, we multiplied the frequency of consumption of each food item by the ***nutrient*** content of the portion indicated in the FFQ and added the results across all foods.

Adherence to a MD

Adherence to MD was measured by the relative Mediterranean Diet Score (rMED) after excluding alcohol consumption, since our study population was made up of children []. This dietary index was composed of eight components of MD, and the total score range was from 0 (minimal adherence) to 16 (maximum adherence). The rMED components were: vegetables (excluding potatoes), fruit (including nuts, seeds, and fruit juices), legumes, cereals (including whole grains and bread), fish (including seafood), meat (including processed meat), dairy products (including low-fat and high-fat products), and olive oil. Each rMED component was calculated in grams per 1000 kcal/day and divided into tertiles of intake. A score of 0, 1, and 2 was assigned to the first, second, and third tertiles of intake, respectively; higher intakes scored positively, with the exception of meat and dairy products for which the scoring was inverted. The rMED scores were categorized into low (0–6 points), medium (7–10 points), and high (11–16 points) adherence to MD based on Buckland’s cutoff points after excluding the score for alcohol [].

Anthropometric measures

The body weight, height, and waist circumference (WC) of children were measured at the age 4 and 8 interviewed by trained personnel using standard protocols (in light clothing and without shoes). BMI was obtained as weight in kilograms divided by the square of height in meters, and we calculated BMI according to the specific cutoffs proposed by the International Obesity Task Force []. WC in centimeters was measured using an inelastic tape (SECA 201) at the midpoint between the lower rib margin and the superior anterior iliac spine, in a standing position and after a gentle expiration. The values of WC within the 90th percentile or above of the sample distribution were used to determine abdominal obesity []. Since the Gipuzkoa-INMA cohort did not perform this follow-up assessment, the analyses of WC results did not include ***data*** from this study area.

Incident cases of overweight, obesity, and abdominal obesity were defined as those participants without that condition at age 4 and were classified as having overweight, obesity, and abdominal obesity at the age of 8 using the aforementioned criteria.

Other variables

Mother’s sociodemographic and lifestyle factors considered were age (years), study area (Asturias; Gipuzkoa; Sabadell; Valencia), social class (I/II, high; III, medium; IV/V, low), prepregnancy BMI (normal weight; overweight; obesity), smoking during pregnancy (no; yes), second-hand smoking (no; yes), parity (0; ≥1), and breastfeeding duration (<4 months; ≥4 months). We also ***collected*** information about children. At birth: sex (female; male), small for gestational age by weight (no; yes); and at 4-year follow-up interview: age (years), sleep (hours per day), television watching (hours per day), and sweetened beverages consumption (<1 drink/week; ≥1 drinks/week). The sweetened beverages consumption was estimated from the ***data*** ***collected*** by the FFQ.

Statistical analysis

The distribution of sociodemographics and lifestyle characteristics by the rMED score categories were compared using the chi-square test for categorical variables and ANOVA for continuous variables.

To evaluate the association between adherence to MD at 4 years as measured by rMED and prevalence of overweight, obesity, and abdominal obesity at the age of 4, we used multiple Poisson regression models with robust variance based on the Huber sandwich estimate [, ] to obtain prevalence ratios (PR) and their 95% confidence interval (CI). A robust Poisson regression model was used instead of log-binomial regression model due to it did not converge []. We used Cox regression analysis to estimate hazard ratios (HR) to evaluate the association between adherence to MD at 4 years and incidence of the overweight, obesity, and abdominal obesity from age 4 to 8. Both the cross-sectional and longitudinal analyses were also performed using the rMED as a continuous variable to explore the associations per two-point increase in the rMED score. Furthermore, to explore the associations in more detail, we replicated these analyses for each component of the rMED per one-point increase in the component score.

We fitted several models, initially adjusting for location, age (continuous), and sex, and secondly, adjusting for maternal characteristics (social class, BMI, smoking, second-hand smoking, and parity) and child characteristics (breastfeeding duration, small for gestational age by weight, television watching, sleep, and sweetened beverage consumption at age 4). When we carried out the analysis of the components of the rMED, we also included the variable rMED score in the adjusted model excluding the component specifically assessed. All of the covariates with P < 0.20 and those that changed the magnitude of the main effects by 10% after a backward elimination procedure were included in the multiple model.

We also analyzed the associations separately for each study area to quantify the heterogeneity using I2 ***statistics*** []. Due to the fact that all I2 values for the outcome associations were <50%, we performed the analyses adjusting all the models for the study area.

Statistical analyses were conducted with R statistical software version 3.4.2 (R Foundation for Statistical Computing).

Results

Table presents the baseline characteristics of mothers and children according to categories of adherence to MD. Mothers whose children had the highest scores of rMED (i.e., high adherence to MD) tended to be older, belonged to a high social class, and were also more likely to be nonsmokers. Regarding children’s characteristics, a greater adherence to MD was observed in girls, children with a longer mean sleep time per day, those who had lower energy intake on average, and those who consumed <1 drink/week of sweetened beverages. The mean rMED score at age 4 was 8 points, 29.9% of children were classified as low adherence and 19.3% as high adherence to MD.

Baseline participants’ characteristics of mothers and their children from the INMA study according to adherence to MD as assessed by relative Mediterranean Diet Score (rMED) at the age of 4 years.

|  | **All** | **rMED categories** | | | ***p* valuea** |
| --- | --- | --- | --- | --- | --- |
|  | **Low (0?6)** | **Medium (7?10)** | **High (11?16)** |  |
| % (*n*) | 1801 | 29.9 (539) | 50.8 (915) | 19.3 (347) |  |
| Maternal characteristics |  |  |  |  |  |
| ?Age at delivery, mean (SD) | 30.1 (4.08) | 30.3 (4.25) | 31.1 (4.04) | 31.6 (3.95) | <0.001 |
| ??Region, % (*n*) |  |  |  |  |  |
| ??Asturias | 21.5 (387) | 9.5 (51) | 24.3 (222) | 32.9 (114) | <0.001 |
| ??Gipuzkoa | 22.2 (399) | 21.7 (117) | 21.9 (200) | 23.6 (82) |  |
| ??Sabadell | 24.2 (435) | 23.7 (128) | 24.7 (226) | 23.3 (81) |  |
| ??Valencia | 32.2 (580) | 45.1 (243) | 20.2 (267) | 20.2 (70) |  |
| ?Social class, % (*n*) |  |  |  |  |  |
| ??I/II, high | 24.0 (433) | 17.8 (96) | 25.2 (231) | 30.5 (106) | <0.001 |
| ??III, medium | 27.0 (486) | 24.1 (130) | 27.1 (248) | 31.1 (108) |  |
| ??IV/+V, low | 49.0 (882) | 58.1 (313) | 47.7 (436) | 38.3 (133) |  |
| ?Prepregnancy BMI, % (*n*) |  |  |  |  |  |
| ??Normal weight | 73.7 (1327) | 77.6 (418) | 70.7 (647) | 75.5 (262) | 0.018 |
| ??Overweight | 18.8 (338) | 14.7 (79) | 21.2 (194) | 18.7 (65) |  |
| ??Obesity | 7.6 (136) | 7.8 (42) | 8.1 (74) | 5.8 (20) |  |
| ?Smoking in pregnancy, % (*n*) |  |  |  |  |  |
| ??No | 69.8 (1234) | 63.1 (332) | 72.4 (651) | 73.0 (251) | <0.001 |
| ??Yes | 30.2 (535) | 36.9 (194) | 27.6 (248) | 27.0 (93) |  |
| ?Second-hand smokingb, % (*n*) |  |  |  |  |  |
| ??No | 39.1 (688) | 32.6 (170) | 39.3 (351) | 48.7 (167) | <0.001 |
| ??Yes | 60.9 (1071) | 67.4 (352) | 60.7 (543) | 51.3 (176) |  |
| ?Parity, % (*n*) |  |  |  |  |  |
| ??0 | 57.8 (1040) | 54.3 (292) | 59.5 (544) | 58.8 (204) | 0.136 |
| ???1 | 42.2 (759) | 45.7 (246) | 40.5 (370) | 41.2 (143) |  |
| Child characteristics |  |  |  |  |  |
| ?Age at 4 years, mean (SD) | 4.42 (0.18) | 4.40 (0.15) | 4.42 (0.18) | 4.44 (0.20) | 0.018 |
| ?Age at 8 years, mean (SD) | 7.58 (0.63) | 7.50 (0.60) | 7.59 (0.64) | 7.67 (0.63) | <0.001 |
| ?Sex, % (*n*) |  |  |  |  |  |
| ??Female | 48.0 (864) | 44.3 (239) | 47.9 (438) | 53.9 (187) | 0.021 |
| ??Male | 52.0 (937) | 55.7 (300) | 52.1 (477) | 46.1 (160) |  |
| ?SGA according to weight, % (*n*) |  |  |  |  |  |
| ??No | 90.1 (1620) | 89.1 (480) | 89.6 (818) | 93.1 (322) | 0.115 |
| ??Yes | 9.9 (178) | 10.9 (59) | 10.4 (95) | 6.9 (24) |  |
| ?Breastfeeding duration, % (*n*) |  |  |  |  |  |
| ??<4 months | 53.8 (929) | 59.0 (306) | 53.2 (468) | 47.0 (155) | 0.003 |
| ???4 months | 46.2 (799) | 41.0 (213) | 46.8 (411) | 53.0 (175) |  |
| ??Sleep (h/d), mean (SD) | 10.4 (0.90) | 10.2 (0.99) | 10.4 (1.01) | 10.6 (0.87) | <0.001 |
| ?Television viewing (h/d), % (*n*) |  |  |  |  |  |
| ??<1 | 29.7 (534) | 24.7 (133) | 28.5 (261) | 40.3 (140) | <0.001 |
| ??1?2 | 52.1 (938) | 49.7 (268) | 54.3 (497) | 49.9 (173) |  |
| ??>2 | 18.3 (329) | 25.6 (138) | 17.2 (157) | 9.8 (34) |  |
| ?Energy intake (kcal/d), mean (SD) | 1582 (339.0) | 1648 (346.8) | 1589 (353.7) | 1458 (316.6) | <0.001 |
| ?Sweetened beverages, % (*n*) |  |  |  |  |  |
| ??<1 drink/week | 34.7 (625) | 28.4 (153) | 34.6 (317) | 44.7 (155) | <0.001 |
| ???1 drinks/week | 65.3 (1176) | 71.6 (386) | 65.4 (598) | 55.3 (192) |  |

MD Mediterranean diet, rMED relative Mediterranean Diet Score, SD standard deviation, BMI body mass index, SGA small for gestational age.

ap value was calculated by Chi-square for categorical variables, and ANOVA for continuous variables.

bSecond-hand smoking was defined as being exposed to tobacco at least twice a week in any of the following environments: at work, at home, or in leisure time.

Table presents the results of the association between adherence to MD at age 4 and overweight, obesity, and abdominal obesity prevalence at the age of 4, and incidence of overweight, obesity, and abdominal obesity at the age of 8. The prevalence of overweight, obesity, and abdominal obesity in the children in our study at age 4 was 14.5%, 6%, and 9%, respectively. Regarding incidence from 4 to 8 years, 15% of children with normal weight at age 4 became overweight at age 8 and 6% who were not obese at age 4 (normal weight or overweight) developed obesity at age 8. Overall, no association was observed in cross-sectional analyses between adherence to MD and overweight, obesity, or abdominal obesity in children at the age of 4. By contrast, in the longitudinal analyses, those children who had high adherence to MD at the age of 4 showed lower risk of developing overweight (HR = 0.38; 95% CI, 0.21–0.67), obesity (HR = 0.16; 95% CI, 0.05–0.53), and abdominal obesity (HR = 0.30; 95% CI, 0.12–0.73) at the age of 8, compared with those children with a low adherence to MD. When exploring the incidence at the age of 8 per every two-point increase in rMED at age 4, we observed a lower risk of overweight (HR = 0.88; 95% CI, 0.78–1.00), obesity (HR = 0.80; 95% CI, 0.66–0.97), and abdominal obesity (HR = 0.82; 95% CI, 0.68–0.99).

Association between adherence to MD at age 4 using rMED score and overweight, obesity and abdominal obesity prevalence at the age of 4 and incidence risk at age 8 in children from the INMA cohort study.

|  | **Low (0?6)** | **Medium (7?10)** | | **High (11?16)** | | **2-unit increase** | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Prevalence at 4 years** |  | **PR (95% CI)** | ***p* value** | **PR (95% CI)** | ***p* value** | **PR (95% CI)** | ***p* value** |
| Overweight |  |  |  |  |  |  |  |
| ?Cases/total | 76/539 | 128/915 |  | 57/347 |  | 261/1801 |  |
| ?Model 1 | Ref. | 1.00 (0.97?1.03) | 0.926 | 1.02 (0.97?1.06) | 0.462 | 1.00 (0.99?1.01) | 0.758 |
| ?Model 2 | Ref. | 0.99 (0.96?1.02) | 0.549 | 1.01 (0.96?1.05) | 0.806 | 1.00 (0.99?1.01) | 0.995 |
| Obesity |  |  |  |  |  |  |  |
| ?Cases/total | 35/539 | 54/915 |  | 17/347 |  | 106/1801 |  |
| ?Model 1 | Ref. | 0.99 (0.97?1.01) | 0.401 | 0.98 (0.95?1.01) | 0.118 | 0.99 (0.98?1.00) | 0.055 |
| ?Model 2 | Ref. | 0.99 (0.97?1.02) | 0.451 | 0.99 (0.96?1.02) | 0.493 | 1.00 (0.99?1.00) | 0.412 |
| Abdominal obesitya |  |  |  |  |  |  |  |
| ?Cases/total | 47/515 | 60/719 |  | 21/150 |  | 128/1384 |  |
| ?Model 1 | Ref. | 0.97 (0.95?1.00) | 0.079 | 1.01 (0.95?1.06) | 0.807 | 0.99 (0.98?1.00) | 0.192 |
| ?Model 2 | Ref. | 0.98 (0.95?1.01) | 0.403 | 1.01 (0.96?1.08) | 0.686 | 0.99 (0.98?1.01) | 0.320 |
| Incidence from 4 to 8 years |  |  |  |  |  |  |  |
| Overweight |  |  |  |  |  |  |  |
| ?Incident cases | 56 | 91 |  | 36 |  | 183 |  |
| ?Person-years | 1087.36 | 1994.99 |  | 784.38 |  | 3866.73 |  |
| ?Model 1 | Ref. | 0.86 (0.61?1.22) | 0.398 | 0.37 (0.21?0.65) | <0.001 | 0.87 (0.78?0.98) | 0.025 |
| ?Model 2 | Ref. | 0.79 (0.55?1.13) | 0.200 | 0.38 (0.21?0.67) | 0.001 | 0.88 (0.78?1.00) | 0.047 |
| Obesity |  |  |  |  |  |  |  |
| ?Incident cases | 28 | 45 |  | 10 |  | 83 |  |
| ?Person-years | 1270.14 | 2332.79 |  | 952.51 |  | 4555.44 |  |
| ?Model 1 | Ref. | 0.85 (0.52?1.39) | 0.514 | 0.08 (0.02?0.31) | <0.001 | 0.74 (0.62?0.88) | <0.001 |
| ?Model 2 | Ref. | 0.92 (0.53?1.59) | 0.776 | 0.16 (0.05?0.53) | 0.002 | 0.80 (0.66?0.97) | 0.026 |
| Abdominal obesitya |  |  |  |  |  |  |  |
| ?Incident cases | 24 | 54 |  | 19 |  | 97 |  |
| ?Person-years | 922.99 | 1689.58 |  | 662.40 |  | 3274.97 |  |
| ?Model 1 | Ref. | 0.93 (0.56?1.55) | 0.795 | 0.26 (0.12?0.59) | 0.001 | 0.78 (0.66?0.92) | 0.004 |
| ?Model 2 | Ref. | 1.01 (0.58?1.73) | 0.982 | 0.30 (0.12?0.73) | 0.008 | 0.82 (0.68?0.99) | 0.041 |

Model 1 was adjusted for region (Asturias; Gipuzkoa; Sabadell; Valencia), child age (in years), and sex (female; male). Model 2 was adjusted with the same variables than model 1 plus maternal social class (I/II, high; III, medium; IV/+V, low), mother’s prepregnancy body mass index (normal weight; overweight; obesity), smoked during pregnancy (no; yes), second-hand smoking (no; yes), parity (0; ≥1), breastfeeding duration (<4 months; ≥4 months), small child for gestational age according to weight (no; yes), child television watching at 4 years (hours per day), sleep at 4 years (hours per day), and child sweetened beverages consumption at 4 years (<1 drinks/week; ≥1 drinks/week).

MD Mediterranean diet, rMED relative Mediterranean Diet Score, PR prevalence ratio, HR hazard ratio, 95% CI 95% confidence interval.

aChildren from Gipuzkoa were excluded because the information on the waist circumference was not ***collected***.

The results of the association between the consumption of rMED components at the age of 4 and overweight and obesity prevalence at 4 years and the incidence at the age of 8 are shown in Table . Regarding overweight, no association was observed in the cross-sectional analysis for the prevalence at age 4. In longitudinal analysis for overweight at age 8, a lower risk was observed for a one-point increase in rMED score of fruits (HR = 0.79; 95% CI, 0.64–0.97) and olive oil (HR = 0.65; 95% CI, 0.52–0.82). A lower risk of overweight was observed for a lower consumption of meat (HR = 0.70; 95% CI, 0.56–0.87). On the other hand, we observed a higher risk of overweight for a higher intake of fish (HR = 1.23; 95% CI, 1.00–1.51) and for a lower intake of dairy products (HR = 1.38; 95% CI, 1.11–1.70). Regarding obesity, no association was observed for the prevalence at age 4. A one-point increase in the rMED score of fish (HR = 1.49; 95% CI, 1.08–2.06) was associated with a higher risk of obesity at the age of 8, while a lower intake of meat (HR = 0.63; 95% CI, 0.46–0.88) was associated with a lower risk of obesity at this age.

Association between one-point increase in the components of the rMED score and overweight and obesity prevalence at 4 years and incidence risk.

| **Components of rMED (one-point increase)** | **Overweight** | | | | **Obesity** | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Prevalence at 4y** | | **Incidence risk until 8y** | | **Prevalence at 4y** | | **Incidence risk until 8y** | |
| **Cases = 261** | | **Incident cases = 183** | | **Cases = 106** | | **Incident cases = 83** | |
| **Total = 1801** | | **Person-years = 3866.73** | | **Total = 1801** | | **Person-years = 4555.44** | |
| **PR (95% CI)** | ***p* value** | **HR (95% CI)** | ***p* value** | **PR (95% CI)** | ***p* value** | **HR (95% CI)** | ***p* value** |
| Vegetables |  |  |  |  |  |  |  |  |
| Model 1 | 1.00 (0.98?1.02) | 0.779 | 0.76 (0.62?0.93) | 0.007 | 1.00 (0.99?1.02) | 0.609 | 0.63 (0.47?0.85) | 0.003 |
| Model 2 | 1.00 (0.98?1.02) | 0.825 | 0.78 (0.64?0.96) | 0.020 | 1.01 (0.99?1.02) | 0.359 | 0.72 (0.53?0.99) | 0.428 |
| Model 3 | 1.00 (0.98?1.02) | 0.800 | 0.80 (0.65?1.00) | 0.048 | 1.01 (0.99?1.02) | 0.201 | 0.76 (0.55?1.06) | 0.106 |
| Fruits |  |  |  |  |  |  |  |  |
| Model 1 | 1.00 (0.99?1.02) | 0.687 | 0.82 (0.68?1.00) | 0.048 | 1.00 (0.99?1.01) | 0.958 | 0.89 (0.67?1.18) | 0.427 |
| Model 2 | 1.00 (0.98?1.02) | 0.939 | 0.78 (0.63?0.95) | 0.015 | 1.00 (0.99?1.02) | 0.541 | 0.88 (0.65?1.18) | 0.401 |
| Model 3 | 1.00 (0.98?1.02) | 0.935 | 0.79 (0.64?0.97) | 0.025 | 1.01 (0.99?1.02) | 0.399 | 0.92 (0.68?1.25) | 0.605 |
| Legumes |  |  |  |  |  |  |  |  |
| Model 1 | 0.99 (0.98?1.01) | 0.492 | 0.91 (0.74?1.12) | 0.387 | 0.98 (0.97?0.99) | 0.006 | 0.83 (0.61?1.14) | 0.254 |
| Model 2 | 1.00 (0.98?1.02) | 0.825 | 0.97 (0.78?1.20) | 0.766 | 0.99 (0.97?1.00) | 0.039 | 0.94 (0.68?1.31) | 0.729 |
| Model 3 | 1.00 (0.98?1.02) | 0.816 | 0.99 (0.80?1.23) | 0.954 | 0.99 (0.97?1.00) | 0.040 | 1.00 (0.72?1.40) | 0.984 |
| Fish |  |  |  |  |  |  |  |  |
| Model 1 | 1.02 (1.00?1.03) | 0.082 | 1.18 (0.98?1.43) | 0.087 | 1.00 (0.99?1.01) | 0.827 | 1.16 (0.87?1.55) | 0.321 |
| Model 2 | 1.02 (1.00?1.03) | 0.092 | 1.17 (0.96?1.44) | 0.122 | 1.01 (0.99?1.02) | 0.296 | 1.35 (0.99?1.84) | 0.060 |
| Model 3 | 1.02 (1.00?1.04) | 0.065 | 1.23 (1.00?1.51) | 0.047 | 1.01 (1.00?1.02) | 0.197 | 1.49 (1.08?2.06) | 0.014 |
| Cereals |  |  |  |  |  |  |  |  |
| Model 1 | 0.99 (0.98?1.01) | 0.409 | 1.05 (0.86?1.27) | 0.643 | 0.98 (0.97?0.99) | 0.003 | 0.66 (0.49?0.89) | 0.007 |
| Model 2 | 0.99 (0.97?1.01) | 0.383 | 1.12 (0.91?1.37) | 0.275 | 0.99 (0.98?1.00) | 0.068 | 0.78 (0.57?1.06) | 0.114 |
| Model 3 | 0.99 (0.97?1.01) | 0.369 | 1.13 (0.92?1.38) | 0.248 | 0.99 (0.98?1.00) | 0.072 | 0.77 (0.57?1.06) | 0.111 |
| Meata |  |  |  |  |  |  |  |  |
| Model 1 | 1.00 (0.98?1.02) | 0.843 | 0.68 (0.55?0.83) | <0.001 | 1.00 (0.99?1.02) | 0.456 | 0.71 (0.53?0.96) | 0.028 |
| Model 2 | 1.00 (0.98?1.02) | 0.851 | 0.72 (0.58?0.89) | 0.002 | 1.00 (0.99?1.02) | 0.468 | 0.66 (0.48?0.92) | 0.014 |
| Model 3 | 1.00 (0.98?1.02) | 0.854 | 0.70 (0.56?0.87) | 0.001 | 1.00 (0.99?1.02) | 0.541 | 0.63 (0.46?0.88) | 0.007 |
| Dairy productsa |  |  |  |  |  |  |  |  |
| Model 1 | 1.00 (0.98?1.02) | 0.926 | 1.29 (1.06?1.57) | 0.012 | 0.98 (0.97?1.00) | 0.015 | 0.89 (0.67?1.20) | 0.449 |
| Model 2 | 1.00 (0.98?1.02) | 0.766 | 1.27 (1.03?1.55) | 0.024 | 0.99 (0.97?1.00) | 0.037 | 0.93 (0.68?1.26) | 0.647 |
| Model 3 | 1.00 (0.98?1.02) | 0.740 | 1.38 (1.11?1.70) | 0.002 | 0.99 (0.97?1.00) | 0.037 | 1.01 (0.74?1.38) | 0.953 |
| Olive oil |  |  |  |  |  |  |  |  |
| Model 1 | 1.00 (0.98?1.02) | 0.888 | 0.68 (0.55?0.85) | <0.001 | 1.00 (0.99?1.02) | 0.915 | 0.72 (0.52?1.01) | 0.055 |
| Model 2 | 1.00 (0.98?1.02) | 0.789 | 0.65 (0.51?0.81) | <0.001 | 1.00 (0.98?1.01) | 0.909 | 0.77 (0.55?1.07) | 0.118 |
| Model 3 | 1.00 (0.98?1.02) | 0.775 | 0.65 (0.52?0.82) | <0.001 | 1.00 (0.99?1.02) | 0.980 | 0.82 (0.58?1.16) | 0.262 |

Model 1 was adjusted for region (Asturias; Gipuzkoa; Sabadell; Valencia), child age (in years), and sex (female; male). Model 2 was adjusted for the variables in the model 1 plus maternal social class (I/II, high; III, medium; IV/+ V, low), mother’s prepregnancy body mass index (normal weight; overweight; obesity), smoked during pregnancy (no; yes), second-hand smoking (no; yes), parity (0; ≥1), breastfeeding duration (<4 months; ≥4 months), small child for gestational age according to weight (no; yes), child’s television watching at 4 years (hours per day), sleep at 4 years (hours per day), and child sweetened beverages consumption at 4 years (<1 drinks/week; ≥1 drinks/week). Model 3 was adjusted for the variables included in the model 2 plus total rMED score excluding the component assessed.

rMED relative Mediterranean Diet Score, y years, PR prevalence ratio, HR hazard ratio, 95% CI 95% confidence interval.

aIn meat and dairy products, a higher score indicates lower consumption.

The associations between rMED components and the abdominal obesity prevalence at age 4 and the abdominal obesity incidence at age 8 are displayed in Table . Lower risks of abdominal obesity were observed for a one-point increase in the score of vegetables (HR = 0.70; 95% CI, 0.52–0.95) and meat (HR = 0.61; 95% CI, 0.44–0.83), whereas a higher incidence of abdominal obesity at the age of 8 was found for one-point increase in the score of fish (HR = 1.62; 95% CI, 1.19–2.20).

Association between one-point increase in the components of rMED score and abdominal obesity at 4 years and incidence risk from 4–8 years in children from the INMA cohort study.

| **Components of rMED (one-point increase)** | **Abdominal obesitya** | | | |
| --- | --- | --- | --- | --- |
| **Prevalence at 4y** | | **Incidence risk until 8y** | |
| **Cases = 128** | | **Incident cases = 97** | |
| **Total = 1384** | | **Person-years = 3274.97** | |
| **PR (95% CI)** | ***p* value** | **HR (95% CI)** | ***p* value** |
| Vegetables |  |  |  |  |
| Model 1 | 1.03 (0.99?1.06) | 0.565 | 0.61 (0.46?0.81) | <0.001 |
| Model 2 | 1.02 (0.99?1.05) | 0.630 | 0.69 (0.51?0.92) | 0.012 |
| Model 3 | 1.03 (1.00?1.06) | 0.366 | 0.70 (0.52?0.95) | 0.022 |
| Fruits |  |  |  |  |
| Model 1 | 1.00 (0.98?1.02) | 0.923 | 0.81 (0.62?1.06) | 0.129 |
| Model 2 | 1.00 (0.98?1.02) | 0.802 | 0.80 (0.60?1.06) | 0.122 |
| Model 3 | 1.00 (0.99?1.02) | 0.643 | 0.82 (0.62?1.09) | 0.175 |
| Legumes |  |  |  |  |
| Model 1 | 0.99 (0.97?1.01) | 0.203 | 0.88 (0.66?1.19) | 0.411 |
| Model 2 | 0.99 (0.97?1.01) | 0.345 | 0.96 (0.70?1.31) | 0.787 |
| Model 3 | 0.99 (0.97?1.01) | 0.399 | 0.99 (0.72?1.35) | 0.940 |
| Fish |  |  |  |  |
| Model 1 | 1.00 (0.98?1.02) | 0.945 | 1.47 (1.12?1.94) | 0.005 |
| Model 2 | 1.00 (0.99?1.02) | 0.583 | 1.50 (1.11?2.04) | 0.008 |
| Model 3 | 1.01 (0.99?1.02) | 0.430 | 1.62 (1.19?2.20) | 0.002 |
| Cereals |  |  |  |  |
| Model 1 | 0.98 (0.97?1.00) | 0.055 | 0.77 (0.59?1.02) | 0.066 |
| Model 2 | 0.99 (0.97?1.01) | 0.220 | 0.88 (0.65?1.18) | 0.388 |
| Model 3 | 0.99 (0.97?1.01) | 0.233 | 0.88 (0.65?1.19) | 0.410 |
| Meatb |  |  |  |  |
| Model 1 | 0.99 (0.98?1.01) | 0.506 | 0.62 (0.47?0.81) | <0.001 |
| Model 2 | 0.99 (0.97?1.01) | 0.462 | 0.63 (0.46?0.86) | 0.004 |
| Model 3 | 0.99 (0.97?1.01) | 0.395 | 0.61 (0.44?0.83) | 0.002 |
| Dairy productsb |  |  |  |  |
| Model 1 | 0.98 (0.97?1.00) | 0.030 | 1.14 (0.87?1.48) | 0.343 |
| Model 2 | 0.98 (0.96?1.00) | 0.017 | 1.11 (0.83?1.48) | 0.476 |
| Model 3 | 0.98 (0.96?1.00) | 0.017 | 1.18 (0.89?1.58) | 0.252 |
| Olive oil |  |  |  |  |
| Model 1 | 1.01 (0.99?1.02) | 0.525 | 0.73 (0.54?0.98) | 0.035 |
| Model 2 | 1.01 (0.99?1.02) | 0.558 | 0.73 (0.53?1.01) | 0.060 |
| Model 3 | 1.01 (0.99?1.03) | 0.432 | 0.77 (0.55?1.07) | 0.115 |

Model 1 was adjusted for region (Asturias; Gipuzkoa; Sabadell; Valencia), child age (in years), and sex (female; male). Model 2 was adjusted for the variables in the model 1 plus maternal social class (I/II, high; III, medium; IV/+ V, low), mother’s prepregnancy body mass index (normal weight; overweight; obesity), smoked during pregnancy (no; yes), second-hand smoking (no; yes), parity (0; ≥1), breastfeeding duration (<4 months; ≥4 months), small child for gestational age according to weight (no; yes), child’s television watching at 4 years (hours per day), sleep at 4 years (hours per day), and child sweetened beverages consumption at 4 years (<1 drinks/week; ≥1 drinks/week). Model 3 was adjusted for the variables included in the model 2 plus total rMED score excluding the component assessed.

rMED relative Mediterranean Diet Score, y years, PR prevalence ratio, HR hazard ratio, 95% CI 95% confidence interval.

aChildren from Gipuzkoa were excluded because the information on the waist circumference was not ***collected***.

bIn meat and dairy products, a higher score indicates lower consumption.

Discussion

This study supports that higher adherence to MD in children at the age of 4 is associated with a lower risk of overweight, obesity, and abdominal obesity at the age of 8. The analysis of the specific rMED components revealed that the protective effect of overweight, obesity, and abdominal obesity was mainly due to a greater intake of vegetables and olive oil, as well as a reduction in the consumption of meat. We also observed a lower risk of overweight due to a greater intake of fruits. Our findings are consistent with those from previous prospective studies in adults and may also suppose good evidence to reinforce the role of MD in preventing overweight and obesity in children at early ages.

On the balance of the available evidence, the role of adherence to MD in child adiposity indicators still remains controversial []. As far as we know, only three studies have explored the association between adherence to MD and adiposity markers in children aged 4 or younger [–], and only one study found no association between adherence to MD and prevalence of childhood overweight and obesity [].

The results of the cross-sectional analyses showed no associations between adherence to MD and prevalence of adiposity outcomes at 4 years of age. A possible explanation may be attributed to the fact that early childhood is a critical period of adaptation in feeding style and eating habits, in which children are especially responsive to changes in dietary intake []. However, although eating habits during childhood may vary resulting in different dietary patterns, it has been suggested that they tend to be stable throughout this stage []. This may indicate that the absence of an association with adherence to MD at age 4 could be likely due to the lack of time to produce an effect on child adiposity at this age, whereas the maintenance of the MD pattern for several years could explain the detectable effect that we observed on adiposity outcomes at age 8. Thus, although in the present study we did not track the changes in the diet from age 4 to 8, the association observed between a high adherence to MD at age 4 and a lower incidence of overweight, obesity, and abdominal obesity at age 8 might be understood as indicative of a potential stability in healthy eating habits over this period of time. Nevertheless, we are aware that this association should be not interpreted as a result of a cumulative effect of children’s diet on the risk of adiposity outcomes.

To date, only one prospective study has reported that adherence to MD was inversely associated with overweight and obesity among children at early ages []. As suggested in adult populations [, ], our findings also support that MD may exert a long-term protective effect against overweight, obesity, and abdominal obesity throughout childhood. The beneficial effect of MD on obesity has been explained by the potential influence of some components of this dietary pattern, such as dietary fiber, dietary fat, and energy density, on satiation and satiety []. Dietary fiber has been associated with reduced risks of obesity, overweight, and high waist-to-hip ratio [], which may be particularly due to its effect on the regulation of the short-term subjective appetite and acute energy intake, and the long-term energy intake and body weight []. Hence, our results suggest that foods rich in dietary fiber such as fruits and vegetables may be associated with a lower incidence risk of overweight and abdominal obesity at 8 years of age.

Contrary to expectations, a higher intake of fish at age 4 was associated with higher incidence of obesity at the age of 8. A recent randomized controlled trial conducted in Spain showed that fish consumption could be a protective factor for obesity in children aged 7–8 []. Although our findings seem to contradict the beneficial effects of fish, the observed inverse association might be explained by the fact that the fish intake in the children of our study could indicate a different pattern of food consumption within a context of a healthy diet such as MD. In fact, children at these ages commonly consume breaded or battered fried fish from frozen coated fish products, which could lead to excess weight gain [].

One of the main features of MD is low consumption of meat. Our results would support that a lower consumption of meat would prevent weight gain. Although weight gain is the result of a very complex process, specific foods such as red and processed meats have been suggested to play an important role in metabolic syndrome in adults, particularly in the incidence of central obesity []. Actually, a recent systematic review and meta-analysis of observational studies with adult populations established that red and processed meat consumption were directly associated with the risk of obesity, higher BMI, and higher WC []. Importantly, in our study, we observed that children with overweight, obesity, and abdominal obesity had an overall higher intake of meat, especially of red and processed meats, compared with normal-weight children.

Regarding dairy food products, a recently published meta-analysis suggested that its consumption might have a protective effect on childhood adiposity [], although the accumulated evidence remains still insufficient and inconclusive. On the basis of the available ***data***, it may be hypothesized that dairy food products may exert a beneficial effect on adiposity through lipolysis, lipogenesis and fatty acid absorption, suggesting a positive impact on appetite regulation and food intake []. Our results showed that lower dairy consumption at age 4 was associated with a higher incidence of overweight at the age of 8, which would support the assumption accepted so far about the potential beneficial impact of dairy on disease prevention. However, in light of the apparently controversial results, further prospective research is recommended to clarify the role of the different types of dairy in child adiposity markers and obesity risk.

Unlike the rest of rMED components, olive oil is recognized as the hallmark of the traditional MD. Our results of a beneficial effect of olive oil on childhood overweight are consistent with the strong evidence available from prospective studies in adults []. To the best of our knowledge, only one small clinical trial among Spanish children ages 1–13 (n = 92) has shown that the consumption of olive oil reduced the risk of weight gain over 1-year follow-up [].

The present study has limitations. We adjusted for a wide range of potential confounding factors, although the effect of unmeasured variables, residual confounding, or modifiers cannot be ruled out. In terms of the scoring system to measure adherence to MD, the rMED score has not been previously developed for the child population; however, supported by strong evidence from prospective studies [], we confirmed our hypothesis that adherence to MD as measured by rMED categories and several of their components are related to a protective effect on the development of obesity at early ages in childhood. Another potential limitation might be that parents’ and children’s caregivers may misreport a child’s diet, particularly in children with obesity, thereby causing a potential differential bias. Although some underreporting of diet has been described among adults and elderly populations with obesity, it seems more unlikely to occur in younger parents with children at age 4 when reporting their children diet by the nutritional status. Thus, if any misclassification of diet occurred, it should be nondifferential, which would reinforce the associations found in our study. Also, the FFQ used in our study was previously validated and showed acceptable reproducibility and validity for assessing dietary intake among children ages 4–5 in the same study [].

Strengths of this study include the accuracy of the ***data*** on child anthropometry, which was measured by trained personnel using standard protocols and not self-reported. Moreover, the multicenter structure of this population-based cohort study located in different Mediterranean areas of Spain ensured the representativeness of the results. These results can be extrapolated to a wide range of situations with similar characteristics. The longitudinal design of the study permitted us to detect a long-term effect in children age 8 through specific assessments conducted at the age of 4, thereby confirming the strength of our findings. The prospective follow-up of the INMA project study should enable us to analyze the persistence of the effects on child and adolescent health outcomes and to identify potential changes over time in further assessments.

In summary, this observational prospective study shows that having a higher adherence to MD at age 4 may prevent overweight, obesity, and abdominal obesity at the age of 8. Our findings also suggest that the associations observed in terms of high adherence to MD in children at age 4 can be attributed to a greater intake of vegetables and olive oil, as well as to a reduction in the consumption of meat. Taking into account that the current diet of children in Spain is most likely affected by the phenomenon known as “Westernization” [], or an abandonment of the traditional Mediterranean dietary pattern, further research efforts are required to ascertain potential determinants of adherence to MD and to explore the association with child health outcomes. Our findings may be of help for developing dietary recommendations and designing public health programs to enhance healthy lifestyle habits at early ages.

**Acknowledgements**

We like to acknowledge Emily Felt for providing assistance with the English revision of the paper; she received compensation.

**Notes**

Supplementary informationThe online version of this article ([*https://doi.org/10.1038/s41366-020-0557-z*](https://doi.org/10.1038/s41366-020-0557-z)) contains supplementary material, which is available to authorized users.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***Significant stream chemistry response to temperature variations in a high-elevation mountain watershed***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2K1-JCWX-C0J3-00000-00&context=1516831)

Communications Earth & Environment

November 2020

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**Section:** Vol. 1; No. 1; ISSN: 2662-4435

**Length:** 6592 words

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**Body**

Introduction

High-elevation mountains (HEM) are “water towers for humanity”. More than one-sixth of the Earth’s population relies on glaciers and seasonal snowpacks for water supply. In the western United States, mountain snowpack is estimated to provide nearly three-quarters of the freshwater supply for >60 million people. HEMs are experiencing faster warming than low-elevation places–. Warming shifts precipitation from snow to rain; shrinking snowpack induces early snowmelt and prolonged summer droughts–.

These hydrological alterations can have profound impacts on ecosystems and water quality,. Droughts can alter biogeochemical transformation and water chemistry,, whereas large snow-melt events often flush out disproportionally large pulses of “stored” solutes,. It however has remained poorly understood how and by how much soil biogeochemical processes and weathering respond to warming to ultimately modify water quality in HEMs. Alpine lakes and watersheds have observed paralleled increase in sulfate and cations–. Crawford et al. suggested that this increase may arise from a lowered groundwater water table that exposes sulfide-containing minerals (e.g., pyrite) to oxic conditions and accelerates sulfate mobilization. In Alaska, Yukon River Basin underlain by discontinuous permafrost has seen elevated concentrations of sulfate and divalent cations but has seen no changes in Dissolved Organic Carbon (DOC). DOC however has been observed to gradually increase in Europe, North America, and Asia, which has been attributed to changing climate or recovery from acid rain–. These observations suggest that different solutes and biogeochemical reactions respond to warming and environmental drivers distinctively. By and large, however, we do not understand the impacts of warming on stream chemistry and how they will evolve as the pace of warming accelerates.

This work focuses on a HEM in Colorado and asks the following questions: (1) How do different soil biogeochemical processes and therefore solutes respond to temperature and hydrological variation distinctively? (2) How do solute variations in recent years compare to their long-term record? We present a rare, concurrent set of meteorological, hydrological, and geochemical ***data*** from Coal Creek, Colorado, a HEM watershed (elevation 2700–3700 m) in the central Rocky Mountains (Supplementary Fig. ). The air temperature has increased by about 2.0 °C since 1980, and the annual mean minimum temperature has just surpassed zero in 2018. We compare 4 years of high-frequency measurements (every other day) from 2016 to 2019 for >40 solutes spanning the entire periodic table of elements that have dissolved forms in water. The recent measurements show that solutes derived from distinct biogeochemical processes and source zones respond differently to inter-annual temperature variations. Solutes active in shallow soils have experienced concentration increases by a factor of more than three in recent years, whereas geogenic solutes derived from rock weathering in deeper subsurface have retained relatively similar inter-annual patterns. Juxtaposing recent frequent measurements with long-term bimonthly (once every 2 months) ***data***, however, cannot reach conclusive insights because of the inconsistent ***data*** frequency. We advocate that HEMs experiencing rapid warming should be established as “sentinel watersheds” that record early glimpses of Earth surface response to warming. They should be monitored persistently and consistently so as to document long-term responses to warming.

Results

Persistent warming from 1981 to 2019

***Data*** from the local Snow Telemetry (SNOTEL) station from 1981 to 2019 indicate the annual average minimum and maximum daily temperature have increased by ~1.6 and 2 °C, respectively (Fig. ). The daily ***data***, corrected for sensor bias, is comparable to an increase of ~ 2 °C in Colorado and <1 °C in the U.S., and <1 °C globally (National Oceanic and Atmospheric Administration, National Centers for Environmental information, [*https://www.ncdc.noaa.gov/cag/*](https://www.ncdc.noaa.gov/cag/)). The mean and maximum discharge were highly responsive to Snow Water Equivalent (SWE, Fig. ). Declines in SWE since 1981 have occurred (25 mm/decade, or 6% of average) but are not statistically significant (p = 0.20). Snow fraction (snowfall to total annual precipitation) appear to be declining on the order of ~1% per year, but the statistical significance is also poor (p = 0.46). Milly and Dunne found that without changing precipitation, Colorado River annual streamflow will drop 9% for ~2 °C temperature increase. From 2016 to 2019, the annual temperature in 2016 was near the average for the 1981–2019 period, 2017 and 2018 were warmer years, and 2019 was a cold year. In 2019, average daily maximum (Tmax) and minimum (Tmin) temperatures fell below the warming trend but near the average for the 1981–2019 period. Therefore, the temperature increase during 2015–2018, superimposed upon an already accelerated warming trend, likely exacerbated drought conditions in 2018. Maximum SWE was 34, 54, 26, and 49 cm in 2016, 2017, 2018, and 2019, respectively, compared to an average of 37 cm in the long-term record. Therefore, 2016 was an average water year, whereas 2017 and 2019 were wet and 2018 was dry compared to average. Indeed, 2018 SWE saw the 4th lowest value over the ***data*** record, after 1989, 1981, and 2012.

Climate record in the past 4 decades at a proximal Snow Telemetry (SNOTEL) station, Butte (ID#380, elevation 3097 m).

a Annual maximum and minimum daily temperature (Tmax and Tmin), b daily Tmax and stream discharge for water years 2015–2019; and c maximum and mean of discharge responding to peak and mean Snow Water Equivalent (SWE) for water years 2007–2019. The temperature of 1980–2004 relies on daily ***data*** corrected for bias due to sensor change. Annual temperature averages are for calendar years (Jan 1–Dec 31). Discharge ***data*** are from United States Geological Survey (USGS) site ID 09111250 with the regression infilling winter values and extending period of record. Years 2015–2019 are highlighted in a to illustrate warming in the last several years and that the average annual daily minimum in 2017 approaches 0 °C.

Water chemistry response in 2016–2019

Concentrations for representative solutes are in Fig.  (boxplots are in Supplementary Fig. ); concentrations of other solutes are in Supplementary Fig. . The most marked changes were observed for dissolved organic carbon (DOC). It remained within the range of the long-term record of 1–5 mg/L in 2016, escalated to as high as 15–20 mg/L in the warm years 2017 and 2018, and fell within the long-term range again in the cold year 2019. Other solutes (e.g., Fe, Al) that are known to be impacted by soil biogeochemistry and elemental cycling also increased. The timing of peak concentrations differed for different solutes. Al and Fe concentrations were high in 2016, the year high-frequency measurements started, decreased in 2017 and 2018, but increased again in 2019. In contrast, DOC peaked in 2018. Dissolved Inorganic Carbon (DIC) increased during snowmelt (minimum concentrations in Fig. ) in 2017 and 2018 by 50–100%, although its concentrations during low flow remained relatively similar. Some metals that are known to leach from mine tailings (e.g., Pb) also saw a substantial increase of approximately threefold. Other metals, including Zn and Cd (Fig.  and Supplementary File ), showed relatively small inter-annual variations and reached maximum concentration at the peak of snowmelt. Total nitrogen (TN, Fig. ) concentration remained within its historical range of 0.1–0.4 mg/L, somewhat surprising considering active nitrogen cycling in shallow soils. Other ***nutrients***, including P, PO4, and NO3, however, did vary from year to year (Fig.  and Supplementary File ).

Time-series concentration for a few representative solutes.

a Dissolved Organic Carbon (DOC). b Dissolved Inorganic Carbon (DIC). c Fe. d Al. e Pb. f Total nitrogen (TN). g Mg. h Ca. i Cd. j SO4. Stream concentration (left Y axis) and discharge (blue lines, right Y axis) for a few representative solutes that have seen concentration changes in recent years (left), and those still remained relatively similar year-to-year patterns in 2016–2019 (right). Note that the X axis (time) is shrunk for the 2000–2015 long-term ***data*** (black+, monthly or every other month, sampled USGS water quality site at the watershed outlet) to enable clear visualization of the short-term high-frequency ***data*** (red open square, this work, at Coal-11, sampled every other day at about 2/3 creek length toward the outlet) in 2016–2019. Time series for other solutes are in Supplementary Figs. and .

For solutes primarily derived from chemical weathering, such as Ca, Mg, SO4 (Fig. ), Na, Si, and Sr (Supplementary Fig. ), their high-frequency concentrations had similar year-to-year patterns. The Ca and Mg concentrations from the recent high-frequency measurements were consistently lower than the long-term USGS low-frequency measurements. This is because of the difference in sampling locations. The recent high-frequency sampling point is at about 2/3 of the creek length toward the outlet (at Coal-11, Supplementary Fig. ), whereas the long-term sampling point is at the watershed outlet (USGS water quality, Supplementary Fig. ). In between these two sampling locations, a water treatment plant often discharges lime-treated water to the stream, often elevating Ca and Mg concentrations at the stream outlet. Analysis of water treatment discharge indicates negligible addition of other solutes (e.g., Fe, Al). The concentration of SO4 has changed slightly from year to year, although without a consistent pattern.

Export patterns and loads

The concentration–discharge (C–Q) figures show how and how much solute concentrations varied as streamflow varies (Fig. ). DOC concentrations increased consistently with discharge (flushing patterns, maximum concentrations at the peak of snowmelt). The DOC C–Q patterns varied significantly in recent years but had maintained the flushing pattern. For Fe, however, the concentrations increased significantly under low discharge conditions (between August and November) such that their C–Q patterns transitioned from a pronounced flushing pattern in the long-term record to an almost chemostatic pattern, especially in 2018. In fact, concentrations of DOC, Fe, and Al have all elevated substantially in the low discharge drought period in 2018.

Concentration–discharge (C–Q) patterns.

a DOC. b Fe. c Al. d Pb. eC–Q slope b versus coefficient of variation of CVC/CVQ. Long-term measurements (LTM, +) vs. high-frequency measurements in the recent 4 years (dots in different colors). Note that 1 m3/s = 1.7 mm/day in Coal Creek. Notably, the concentrations of DOC, Fe, and Al at low discharge increased significantly in recent years, shifting the export patterns from flushing (concentration increase with discharge) to patterns with no apparent trend but with high variations. In contrast, Pb concentrations remained at relatively similar levels at low flow but decreased at high flow. The gray shaded region in (e) represents the range of b and CVC/CVQ that define chemostasis ( < 0.1 and CVC/CVQ < 0.2). All four solutes exhibit flushing patterns in the long-term record however transitioned to lower b values toward the b = 0 line, as indicated by the arrow, due to the concentration increase in the summer-fall droughts. Concentration-discharge figures for other solutes are in Supplementary Fig. .

The C–Q patterns are encapsulated in the slope b of the power-law relationship C = aQb, where C and Q are stream concentration and discharge, respectively; and a and b are fitting parameters. The slope b is a measure of the sensitivity of solute concentrations to streamflow changes. High absolute b values (negative or positive) indicate high sensitivity to changes in flow regimes, whereas close to zero b values indicate low sensitivity to hydrological changes (chemostatic). The ratios of the coefficient of variation (CV) compare the variation in concentration (CVc) and in discharge (CVQ) (Fig. ). For DOC, the b and CVc/CVQ values have largely remained at b values round 0.2–0.3, relatively similar to the long-term record. Fe has experienced the most significant changes in b values, transitioning from b value close to 0.5 in the LTM to near-zero b values in recent years. Pb, on the other hand, experienced significant variations with high CVc/CVQ in recent years.

The loads of solute export were largely controlled by the discharge pattern, in particular, the timing and magnitude of pronounced snowmelt peaks each year, as illustrated by the daily loads (Load = C\*Q) (Fig. ). The DOC loads were much higher in the wetter years 2017 and 2019 compared to the dry year 2018, whereas the peaks in 2016 and in long-term records were in between these values. Although the year 2019 had a higher discharge compared to 2017, DOC export in 2019 was nearly half of the 2017 export. For other solutes, however, the loads in 2016 were the highest, elevated by the higher concentrations that year. Flux analysis under different hydrological conditions indicates that during the 6–8 weeks of snowmelt, the watershed exported >70% of annual loads for most solutes. The annual loads depended significantly on the annual discharge for DOC and Al but the correlation was less significant for Fe and Pb.

Daily solute export (load) in recent years.

a DOC. b Fe. c Al. d Pb. e Annual load vs. annual discharge. The numbers in the legend are the annual exports (“MegaG” for “mega grams”, 106 grams, “kg” for kilogram) calculated from the area under load (C\*Q) curve. For the LTM ***data*** that was sparsely sampled (i.e., monthly or bimonthly), daily flux from different years was put together in the same year with their corresponding dates to maximize LTM flux points for load estimation.

Bimonthly averages indicate significant changes under post-snowmelt, dry conditions

Additional analysis for concentrations averaged in every 2 months shows that concentration peaks generally occurred during snowmelt, but the percentage increase maximized during post-snowmelt, the low flow period from August to November (Fig. ). Pb concentrations increased in 2016 and decreased to levels lower than the historical records, especially during snowmelt in 2017 and 2018. Its pre- and post-snowmelt concentrations however were still higher than long-term concentrations.

Bimonthly concentrations and their relative changes (%) compared to long-term records for representative solutes.

a DOC. b Fe. c Al. d Pb. Error bars are one standard deviation. Although the snowmelt period (i.e., light purple box) saw the largest jump in absolute concentration values, the percentage increase typically peaked at the low flow period from August to November.

Annual average concentrations

Annual flow-weighted average concentrations (Fig. ) showed that among all these solutes, DOC saw the most significant variations from 3.9 to 8.5 mg/L, with higher concentrations in the warmer years of 2017 and 2018 (Fig. a, c). These high concentrations however did not occur at the high Q year of 2019, indicating a stronger control of T compared to discharge. The annual average of DIC varied relatively little compared to DOC and peaked in 2018 when Tmin exceeded 0 °C.

Annual flow-weighted concentrations from 2016 to 2019.

As a function of a year, b annual mean Q, and c annual mean minimum temperature. Concentrations of DOC (red square), DIC (pink diamond), Ca+Mg (dark blue triangle), and SO4 (light blue circle) are in left Y axis, while the ratios of (Ca+Mg)/DIC (black+) are in the right Y axis. While other solutes did not change much, DOC concentrations highly depended on annual mean Tmin.

The flow-weighted sulfate concentrations increased from about 8.0 to 9.5 mg/L. It however did not have a clear correlation with temperature nor annual discharge. Ca and Mg mostly comes from rock weathering and exhibited similarly dilution patterns as sulfate. The ratio (Ca + Mg)/DIC is often used as a measure of recovery from acid rain or the influence of other chemicals such as those used in ***agricultural*** lands–. The ratio has varied between 3.5 to 5.0 in the past 4 years, with the wet years having lower ratios. The (Ca + Mg)/DIC, however, did not mirror the increasing temporal trend of sulfate, indicating recovery from acid rain may not be the dominant driver.

Extrapolation for long-term trend: Juxtaposing long-term, bimonthly ***data*** with short-term, frequent ***data***

The recent high concentrations of some solutes (e.g., DOC, Fe, Al) in Coal Creek were in stark contrast with the decades-long, low-frequency USGS ***data***. To analyze the long-term trend with consistent measurement frequency, we combined a machine learning approach to infer the full record of discharge from 2000 to 2019, and then used LOADEST and USGS bimonthly ***data*** to develop concentration time-series models for DOC and Mg as two representative solutes (details in “Methods” section). The predicted concentrations from the model had very similar dynamics as those of long-term bimonthly USGS ***data*** (Fig. ). However, this pattern contrasted the high-frequency ***data*** in 2016–2019 that exhibited high DOC concentrations at discharge peaks during snowmelt.

***Data***-model concentration comparison.

a DOC and b Mg. Comparison of USGS bimonthly ***data*** (black+) and recent high-frequency ***data*** (red square) with the model prediction of DOC and Mg at the high-frequency sampling point (gray lines). The predictions were from concentration time-series models developed using LOADEST, extended discharge record produced from a machine learning approach, and bimonthly USGS ***data*** (see the section of “Extrapolation for long-term trend” in Methods for details). The model did not use high-frequency ***data*** to avoid bias from inconsistent ***data*** frequency (or the problem of temporal aliasing) The predictions from models trained using bimonthly USGS ***data*** indicate that DOC and Mg should show very similar patterns as in the long-term record. This differed from the high-frequency ***data***.

Discussion

Persistent warming in Coal Creek and high elevation mountains

Global climate projection suggests a continued temperature increase in the coming century, in parallel with declining snowpack and freshwater storage,,,. HEMs generally warm at faster rates than other regions. Inter-comparison Project Phase 5 (CMIP5) predicts a global temperature increase of 1.5 °C could mean 2.1 °C in HEMs and an increase in warming rate by 0.2–0.4 °C/km. In the European Alps, the temperature has risen pervasively, mounting to a mean annual temperature increase of about 2 °C, twice as much as that of the northern-hemispheric average in the past century. The projected temperature increase in western US mountains is about 0.5 °C per decade for the twenty-first century. The temperature increase of 1.6 °C (Tmin) to 2.1 °C (Tmax) in Coal Creek over the past four decades is on par with other mountains across the globe. Warming regulates the timing and magnitude of snowmelt and summer droughts. Longer summer droughts have occurred across the US and particularly in the drainage area of Colorado River. Together with other environmental drivers such as acid deposition, changes in temperature and snow/water dynamics can have profound impacts on soil biogeochemical transformation, weathering, and solute export,. For example, Hirmas et al. showed that the Rocky Mountain regions have the largest increase in soil effective porosity in the US.

Solutes active in soil zones: large variation driven by warming or other drivers?

***Data*** from 2016 to 2019 in Coal Creek exhibited marked variations for some solutes but not as much for other solutes. They indicate that significant changes may be happening at least in the shallow soils and that different solutes (and therefore biogeochemical processes) diverge in their responses to warming. Solutes such as DOC, Fe, and Al (and many others in Supplementary Fig. , including P, PO4, NO3) are among those that have seen large variations. These solutes generally exhibited flushing C–Q patterns, indicating a more abundant presence in shallow soils–. Fe-containing minerals, including various forms of iron oxides, commonly exist in soils and play an essential role in biogeochemical cycles. Aluminum is a common element in organic matter that can stimulate or inhibit plant growth. It is often used as an indicator of soil response to acid rain, as soil buffers increased acid loads by releasing Al. Toxic levels of Al have been observed in areas impacted by acid rain–.

The lack of TN variation may be because N is tightly cycled in forests with a limited release of reactive nitrogen species. The co-occurrence of increased concentration (of Fe and Al, among other solutes) and sampling in 2016 may suggest changes have already taken place before 2016. The bimonthly ***data***, because of their low frequency, may have missed important spikes in the early years and therefore do not allow rigorous comparison with high-frequency ***data***. Without the presence of carbonate minerals at the site, DIC primarily originated from soil respiration and should also reflect changes if soil processes did alter. From Fig. , it appears that DIC did not change as much as DOC. However, a closer examination of time-series and C–Q figures revealed the DIC concentrations under high flow conditions in fact escalated in 2017 and 2018 (Fig.  and Supplementary Fig. ). These higher DIC may indicate higher soil CO2 in these 2 years during or right after snowmelt. The higher flow-weighted concentrations in 2018 and 2019 may reflect the overall “delayed” increase of DIC in 2019 responding to higher OM decomposition in 2017 and 2018.

Although concentrations have increased in both snowmelt and post-snowmelt seasons, the warm and dry post-snowmelt seasons have experienced a higher percentage increase compared to pre-snowmelt or snow-melt periods. This highlights the significant role of summer-fall drought on producing DOC, ***nutrients***, and other water quality measures,,. The high DOC percentage increase in post-snowmelt potentially indicates that DOC was produced in the warm, dry post-snowmelt period, stored in soil via sorption, and flushed out in the next snowmelt, as suggested in Wen et al.. The concerted increase in Fe and DOC, albeit in different years, may indicate a linkage between Fe and DOC mobilization. Destabilization or reductive dissolution of iron was suggested as potentially mobilizing sorbed solutes such as DOC and PO4 in ten mountainous sites. One may argue that the wet conditions in 2017 drove DOC production. However, snowpack and precipitation have been observed at similar levels in earlier years (for example, 2005 and 2008). These similarly wet years did not produce as much DOC as observed in 2017 and 2018. The annual average concentrations (Fig. ), although with only four ***data*** points, were much higher in high T years, especially in 2018 with average annual daily Tmin surpassing 0 °C. This alludes to the stronger influence of temperature for DOC increases compared to discharge. Whether temperature or precipitation is the major driver of organic matter decomposition is contentiously debated in literature,. The sensitivity of organic matter (OM) decomposition to temperature and hydrological conditions has been supported with extensive evidence of soil carbon loss and increased soil respiration in warming experiments–.

DOC increase has also been observed worldwide in recent decades, especially in Europe, North America, and Asia–. These places, however, typically observe a gradual increase, instead of the abrupt increase observed in Coal Creek. Multiple hypotheses have been put forth to explain the widespread DOC increase, including recovery from acid rain, changes in land use, and climate change. Coal Creek did not experience a land-use change in the past decades. One may also associate stream DOC increase with tree mortality. Various areas in Colorado have experienced the bark beetle epidemic under warm and drought conditions,. Their impacts on water quality however are typically significant in areas with >40% infested area, which is not the case in Coal Creek (US Forest Service; personal communication). Even in highly impacted areas, total organic carbon has exhibited a gradual increase over the decades, instead of abrupt escalation within a short period of time.

Geogenic solutes remaining relatively constant: is there influence of acid deposition?

Solutes derived from rock weathering typically exhibit dilution C–Q patterns, with high concentrations under low discharge condition reflecting mostly groundwater composition, and low concentrations under high discharge conditions signaling soil water composition. The relatively similar inter-annual dynamics of geogenic solutes (e.g., Ca, Mg, Na) from rock weathering in recent years may indicate that weathering minerals are not as influenced by hydroclimatic conditions because reactive, weathering minerals residing in deeper subsurface (e.g., bedrock) are not as easily influenced by surface temperature and hydrology conditions,.

Sulfate can come from both rock weathering and acid deposition. Its dilution pattern in concentration–discharge relationship, however, suggests higher concentrations in groundwater become diluted by shallow soil water during snowmelt. This indicates rock weathering is a more dominant source compared to atmospheric deposition. The annual averages of sulfate exhibited an increasing temporal trend that is consistent with observations in a nearby Colorado mountain site and other alpine waters–, pointing to the possibility of accelerated sulfate mobilization from pyrite oxidative dissolution as influenced by lower groundwater table under warming conditions. Ca and Mg, however, did not exhibit a paralleled increase as sulfate, as observed in other mountain sites.

Some areas in Colorado have experienced changes in water chemistry as a result of recovery from acid deposition. In Coal Creek, pH has remained within a relatively stable range between 7 and 8.5 (Supplementary Fig. ). Recovery from acid precipitation however may not express as increasing pH but as decreasing ratios of (Ca + Mg) to alkalinity, as watersheds gradually lose sulfuric acid as an additional acid source for weathering. The (Ca + Mg)/DIC ratios from 2016 to 2019 do not indicate a strong correlation with sulfate but decrease with discharge. This is possibly due to higher proportions of water from shallow soil zone with low Ca and Mg concentrations in wet years. Analysis for long-term trend line will require long-term ***data*** of sulfate, Ca, Mg, and alkalinity or DIC. In Coal Creek, the lack of these long-term ***data*** prevents such analysis such that we cannot fully rule out the possibility of acid rain impacts.

Quantifying the long-term trend: a call for establishing HEMs as sentinel sites for consistent and persistent monitoring

The contrasting variations across different solutes accentuate the complex response of Earth’s surface processes to warming. Comparison analysis for long-term and short-term ***data*** does not lead to decisive conclusions about the long-term response of stream chemistry to environmental conditions in this work. As highlighted in Fig. , the LOADEST model developed using long-term ***data*** captured the dynamics and concentration range exhibited in these ***data***, and projected the solute dynamics in very similar patterns as in long-term ***data***. In other words, models can only be as good as ***data***. It is important to keep in mind that the infrequent, bimonthly ***data*** typically recorded only one- or two-points during snowmelt, often missing the snowmelt peaks where the highest concentrations of DOC and lowest concentrations of geogenic solutes occur. The increase in Fe and Al in 2016 potentially indicates that variations observed in recent years have already occurred in earlier years. But low-frequency measurements cannot capture these dynamics. As such we cannot draw unequivocal conclusions about the long-term trend.

The concerted escalation of biogenic solute concentrations in topsoils may collaboratively suggest changes occur fastest and earliest in the top thin veneer of the Earth surface with abundant stores of OM. These marked increases may be also an early sign of a tipping point of climate change, above which the rates of soil carbon decomposition may increase substantially. However, this message will remain equivocal with the lack of long-term ***data*** at consistent, sufficient frequency. This work underscores therefore the needs for long-term ***data*** with sufficient sampling frequency that capture the full dynamics of stream solute variation, in particular under temperature and flow conditions where rapid changes occur. Such ***data*** can rule out the possibility of temporal aliasing, differentiate multiple mechanisms, and enable hypothesis testing.

Many HEMs are similarly in remote areas with limited accessibility for temporally dense sampling as in Coal Creek, such that we cannot understand the full magnitude and impact of climatic shifts and environmental perturbations. The present time is often labeled as an era of “big ***data***”. The past decades have witnessed rapid advances in technology and an unprecedented generation of earth surface ***data***. Detailed, high-resolution earth surface characteristics ***data*** have now become available at unprecedented rates and quantities. The availability of long-term, consistent observations that reflect the functioning of earth’s surface (e.g., water chemistry), however, remains to be the bottleneck for understanding earth system response to environmental perturbations. Large collaborative research networks have galvanized to ***collect*** consistent ***data*** for cross-site comparison,. Most of the available ***data*** however are still in easy-to-access places. Places such as HEMs that experience rapid changes are in dire need of earth system response ***data*** to understand ongoing changes. In places such as tropical glaciers in the Andes, the issue of ***data*** limitation is even more exacerbated.

Given the sensitivity of HEMs to warming, their water quality response to warming can offer early glimpses of climate change impacts. It is essential to establish watersheds such as Coal Creek as sentinel sites, defined as sites “charged to guard or keeps watch over an area and sounds an alarm if danger comes near.”. Extensive and multiple-perspective climate monitoring systems are urgently needed in HEMs in order to record long-term alteration of water quantity and quality in changing climate. Such monitoring has historically recorded many human-induced perturbations such as the discovery of ozone depletion and the response to acid rain. As the pace of climate change accelerates, we will need these sentinel sites that similarly identify early signals of thresholds and tipping points of climate change.

Methods

Field site

Coal Creek (~53 km2) is a representative high elevation watershed in the central Rocky Mountains of Colorado with an average slope of 16° (Supplementary Fig. ). The mean annual minimum and maximum daily temperatures are −1.5 and 9.0 °C, respectively. Annual rainfall and snowfall were ~612 mm and 551 cm, respectively, in 2016. The watershed is snow-covered from approximately November to June. The watershed consists primarily of evergreen forest (65%) and herbaceous vegetation (20%), followed by deciduous forest (9%), barren land (3%), and woody wetland (3%). The lithology includes primarily sandstone (39%) and mudstone (15%) that belong to the Mesaverde, Tertiary Wasatch, and Ohio Creek Formations,. Plutonic rock (15%) originated during the Middle Tertiary. A small area (10%) in the valley is covered by Quaternary Glacial Drift, which consists of surficial deposits including unsorted glacial till and associated sand and gravel deposits. The site was mined for metals between 1874 and 1974 at three primary mines (Supplementary Fig. ). Although mining has ceased, heavy metals continue to flush into Coal Creek. Coal Creek is part of the designated testbed of Lawrence Berkeley National Laboratory Watershed Function Science focus area ([*http://watershed.lbl.gov*](http://watershed.lbl.gov)) that explores how mountainous watersheds store and release water and solutes across perturbation gradients, and represents an active collaboration between local, federal partners and university partners.

SNOTEL climate ***data***

Precipitation, snow water (e.g., snowpack depth, snow-water-equivalent (SWE)), and temperature ***data*** were retrieved from the United States Department of ***Agriculture*** (USDA) Snow Telemetry (SNOTEL) database (CO #380, elevation 3100 m). Daily minimum and maximum temperature ***data*** were corrected for sensor bias following Oyler et al.. Warming trends were developed for calendar years (Jan 1–Dec 31). Correlation ***statistics*** of temperature to streamflow were on a water year basis (Oct 1–Sept 30). Annual precipitation and SWE ***data*** are from 1981 to the present.

Water chemistry and discharge ***data***

Stream chemistry has two sets of measurements. One is the long-term low-frequency measurements (LTM) by the United States Geological Survey (USGS) from November 2000 to November 2019, measured at the very outlet of the watershed (Supplementary Fig. ). The other is the high-frequency, every-other-day measurements (HFM, a total of >40 solutes) from April to October and every week from November to March from 2016 to 2019, measured at Coal-11, about 1/3 of the creek length into the watershed from the outlet (Supplementary Fig. ). The sampling location was chosen to reflect watershed chemical conditions. It does not coincide with the USGS sampling point because the USGS sampling point (with long-term ***data***) has a direct anthropogenic addition of Ca and Mg from the wastewater treatment plant discharge. The USGS daily streamflow ***data*** are for during ice-free periods (April to November) starting from October 2014 (site ID: 09111250). A regression was developed using a downstream USGS site (ID 385106106571000) to infill winter discharge and extrapolate the record back to Oct 1, 2006. The regression was done in two-parts to integrate low flow ***data*** from 2018 (flow ≤ 0.42 m3/s, r2 = 0.87; flow >0.42 m3/s, r2 = 0.92; RMSE for all flows = 5%). All water ***data*** were retrieved from the website ([*https://waterdata.usgs.gov/usa/nwis/*](https://waterdata.usgs.gov/usa/nwis/)).

Water chemistry analysis

Water samples for geochemical analysis were ***collected*** and filtered in the field using 0.45 μm Millipore filters. Anions samples were ***collected*** in no-headspace 2 mL polypropylene vials. DIC samples were ***collected*** in no-headspace 40 mL glass vials with polypropylene open-top caps and butyl rubber septa (VWR® TraceClean®). Cations samples were ***collected*** in high-density polyethylene 20 mL vials and acidified to 2% nitric acid with ultra-pure concentrated nitric acid. The samples were transported to the laboratory on ice and stored in 4 oC refrigerator until analysis. Anion concentrations were measured using a Dionex ICS-2100 Ion Chromatography (IC) system (ThermoScientific, USA), while cation concentrations were analyzed using an inductively coupled plasma mass spectrometry (ICP-MS) (Elan DRC II, PerkinElmer SCIEX, USA). DIC concentrations were measured using a TOC-VCPH analyzer (Shimadzu Corporation, Japan). Total dissolved nitrogen (TDN) was analyzed using a Shimadzu Total Nitrogen Module (TNM-1) combined with the TOC-VCSH analyzer (Shimadzu Corporation, Japan). TNM-1 is a non-specific measurement of TN. All nitrogen species in samples are combusted to nitrogen monoxide and nitrogen dioxide, then reacted with ozone to form an excited state of nitrogen dioxide. Upon returning to the ground state, light energy is emitted. Then, TN is measured using a chemiluminescence detector.

The method detection limits (MDLs) for ICP-MS and DIC and TDN are determined using the US EPA recommended method. Definition and procedures for the determination of the method detection limit, Revision 2. The MDLs for anions are cited from Thermo Fisher Scientific Application Note 154: Determination of inorganic anions in environmental waters using a hydroxide-selective column. Generally, the RSD or uncertainty for ICP-MS is <3% based on 5 replicate measurements for concentrations higher than MDLs. The DIC and DOC have an RSD < 3% for concentrations higher than MDLs based on 3–5 measurements. For measurement of anions (Cl−, NO3−, and SO42−), it generally has an RSD < 5% for concentrations higher than MDLs.

Annual export calculation

Daily loads (i.e., mass/time) were calculated as the product of daily discharge and solute concentration (Fig. ). For the recent 4 years (2016–2019), the annual export was calculated as the area under the load curve (from Jan to December) using the integral trapz function in Matlab. For the sparse LTM ***data***, daily loads from different years were put together in the same year with their corresponding dates to maximize ***data*** points for LTM load estimation.

Extrapolation for long-term trend

As an attempt to examine the long-term changes with consistent sampling frequency, we used a combination of a machine learning approach and the USGS tool LOADEST for two representative solutes, DOC and Mg. The bimonthly ***data*** were used to avoid sampling frequency bias. The discharge and DOC ***data*** are from 2006 to 2019. To infer the long record to 2000, we used the machine learning statistical approach Gaussian Process Regression (GPR), an approach commonly used to infer discharge ***data***–. We trained a discharge model using the odd years of climate and discharge ***data*** from 2006 to 2019, and tested the model using even year ***data***. The GPR uses time-series of precipitation, radiation, temperature, pressure, wind speed, SNOTEL ***data***, and discharge ***data*** as inputs to train the model (Matlab R2018a, Machine Learning Regression Toolbox, 5-fold cross-validation), and output missing discharge ***data*** in 2000–2006. The Nash–Sutcliffe Efficiency (NSE) values for the training and testing were 0.9 and 0.7, respectively, both are higher than the NSE satisfactory criteria of 0.5 and therefore are satisfactory.

With the full record of 2000–2019 discharge ***data*** and model output, the LOAD ESTimator (LOADEST, [*https://water.usgs.gov/software/loadest/*](https://water.usgs.gov/software/loadest/)) was used to develop temporal relationships between discharge and concentration for two representative species of DOC and Mg. LOADEST used decimal date, discharge, and concentration ***data*** to build linear regressions and automatically selected the best regression model. The training process used the ***data*** from 2006 to 2015 and then tested the model using 2016–2019 USGS bimonthly ***data*** with the same sampling frequency. The test models have a satisfactory performance (NSE > 0.8). The model was then used to infer concentrations in 2000–2005 with the provided decimal date and daily discharge. Continuous temporal predictions of DOC and Mg that were then inferred from the regression model from 2000 to 2019 (gray lines in Fig. ).

**Acknowledgements**

The U.S. Department of Energy (DOE), Office of Science, Office of Biological and Environmental Research funded the work under the contracts DE-SC0016221, DE-SC0020146 (To Penn State University, PI Li) and DE-AC02-05CH11231, (the Lawrence Berkeley National Laboratory’s Watershed Function Scientific Focus Area) EAR-2012669. We thank Ashley Bembenek and the Coal Creek Watershed Coalition (CCWC) for their ***data*** support. All ***data*** are available at the ***data*** portal for East River watershed in Colorado, managed by Lawrence Berkeley National Laboratory.

**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s43247-020-00039-w.Peer*](https://doi.org/10.1038/s43247-020-00039-w.Peer) review information Primary handling editors: Heike Langenberg.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***Review panel appointed as Overseer improvements continue***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YDD-9G31-F0YC-N4S3-00000-00&context=1516831)

Impact News Service

March 11, 2020 Wednesday

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**Length:** 1584 words

**Body**

Wellington: Ministry for Primary Industries, New Zealand has issued the following news release:

Eight independent experts have been appointed to lead a technical review of the Overseer environmental modelling software, the ministries for the environment and primary industries announced today.

The Overseer work is a major part of efforts to improve decision-making tools for use on-farm.

Panel members were selected based on their depth of knowledge and their ***collective*** range of skills and perspectives.

“The 8 independent and internationally-recognised environmental specialists will look ‘under the bonnet’ of Overseer to critically assess its modelling capability and explore potential improvements for its use,” says Ministry for the Environment deputy secretary – water and climate change, Cheryl Barnes.

“The panel’s conclusions and assessments will be critical to New Zealand’s future approach to land management. We must be confident that Overseer is the right tool to drive sound land management decisions and improve freshwater quality.”

The group was selected after a rigorous process involving New Zealand’s chief science adviser, Juliet Gerrard, and the chief scientists from the 2 ministries.

The review consists of 2 parts. The first will be an assessment of whether Overseer’s modelling approach is fit to use as a decision-making and regulatory tool and, if so, which aspects should be subject to a more in-depth review. Its inaugural meeting is on 30 March and its report back on this part is expected in late 2020. The review’s second part is dependent on these findings, and would take place over a year.

Related work to build knowledge to strengthen Overseer is also commencing, says Ministry for Primary Industries acting deputy director-general – policy and trade, Ruth Fairhall.

An additional $4 million per year has been allocated to a new contestable fund to commission longer-term research to develop and evaluate new technologies and systems to improve freshwater quality.

“More knowledge about different farming and growing technologies will enable us to fine-tune environmental models including Overseer to more accurately calculate potential impacts of different land management practices,” says Ms Fairhall.

In addition, funding has been allocated to extend the coverage of S-Map across New Zealand. S-Map is a digital soil map for New Zealand that collates a range of ***data*** and information. Produced by Manaaki Whenua – Landcare Research, S-Map is one of the underlying databases that Overseer draws on and is used by regional councils in environmental modelling.

“We want to support farmers and growers to have greater confidence in their decision-making,” says Ms Fairhall.

“The collaboration between government and industry, combined with leading-edge science, will ensure environmental models can be applied at the grassroots level for better freshwater management decisions.”

Plans to review and improve Overseer predate and complement recommendations of the Parliamentary Commissioner for the Environment to ensure Overseer is suitable as a regulatory tool.Science Advisory Panel members

The Science Advisory Panel comprises the following 8 members. Brief biographies follow.

Chair: Dr Ian Johnson – ***agricultural*** modeller (Australia) Dave Clark – dairy industry and research consultant Dr Brent Clothier – principal scientist at Plant and Food Research Dr Donna Giltrap – research priority area leader for ***Agricultural*** Greenhouse Gas Emissions and Mitigations at Manaaki Whenua – Landcare Research Dr Clint Rissmann – founder and director of Land and Water Science Ltd Dr Nick Roskruge – Atiawa ki Taranaki, Ngāti Tama-ariki and associate professor in horticulture at Massey University Dr Peter Thorburn – chief research scientist and research group leader at the Commonwealth Science and Industrial Research Organisation (Australia) Dr Robin White – associate professor of Integrated Beef Systems Management, Virginia Tech (USA).

Overseer is a management tool that supports farmers and growers to improve performance and reduce losses to the environment through better use of ***nutrients*** on-farm.Panel biographies

Dr Ian Johnson

Dr Johnson is a mathematician with experience in developing and writing biophysical computer simulation models incorporating environmental physics, plant, crop and pasture growth, soil hydrology, soil organic matter and ***nutrient*** dynamics, and animal growth and metabolism. Early in his career he was with the Biomathematics Department at the Grassland Research Institute in the UK and then the Department of Agronomy and Soil Science at the University of New England in Armidale, NSW. More recently, as director of IMJ Consultants, he has developed models in collaboration with universities and industry bodies in Australia and New Zealand.

He is widely published in the scientific literature, including as co-author of the textbook Plant and Crop Modelling (Thornley and Johnson, 1990, 2000).

Dave Clark

Dave Clark is a dairy industry and research consultant. Between 1991 and 2013, he was Principal Scientist at the Dairying Research Corporation/Dexcel/DairyNZ. His research during that time looked at the intersection of farm economics and environmental impact, and was underpinned by a philosophy that environmental protection and profitable dairy farming are not mutually exclusive.

In 2009 he was awarded the New Zealand Grassland Trust – Ray Brougham Trophy for services to New Zealand farming systems. He carried out mainly hill country research when he worked at Grassland Division, Department of Scientific and Industrial Research in the early stage of his career.

Dr Brent Clothier

Principal Scientist with Plant & Food Research, Dr Clothier has extensive experience in soil science, especially with the measurement and modelling of water and solute movement in soil. He has published more than 300 peer-reviewed publications.

He was elected a Fellow of the Royal Society Te Apārangi in 1994, and was the President of the New Zealand Society of Soil Science from 2008 to 2010. He is an Academician (Foreign) of the Chinese Academy of Engineering (***Agriculture*** Division).

Dr Donna Giltrap

Currently Research Priority Area Leader for ***Agricultural*** Greenhouse Gases Emissions and Mitigation at Manaaki Whenua – Landcare Research, Dr Giltrap is a modeller with a background in physics and mathematics. Her PhD is in physics and she also holds a Graduate Diploma in Applied ***Statistics***.

She was part of the team that reviewed the nitrous oxide component of Overseer in 2018. She is a member of the New Zealand Soil Science Society.

Dr Clint Rissman

Dr Rissmann is the founder and Director of Land and Water Science Limited. He is also a Senior Adjunct Fellow in the Waterways Centre for Freshwater Management – a partnership between the University of Canterbury and Lincoln University. He has more than 10 years’ experience in earth systems science, specialising in water quality, biogeochemistry, greenhouse gases and systems thinking. He has co-authored a number of peer-reviewed publications researching soil and water quality in New Zealand.

He is a leading proponent of the physiographic approach which involves understanding water quality outcomes based on an integrated understanding of landscape properties.

Dr Nick Roskruge

Dr Roskruge is of Atiawa ki Taranaki and Ngāti Tama-ariki descent. He is Associate Professor in Horticulture at Massey University, and since 2003, has been Chairperson of Tāhuri Whenua, which represents Māori interests in the horticulture sector. He is a member of the Māori Advisory Board for Resilience to Nature’s Challenges – a National Science Challenge - and is also a member of the HSNO Committee of the Environmental Protection Authority (EPA). Previously he was Chair of Ngā Kaihautū Tikanga Taiao, the EPA’s Māori advisory committee.

He holds a PhD in soil science with his doctoral thesis looking at Māori land development through traditional knowledge, and the soil and horticultural sciences. He has had sabbatical periods in Peru and Chile, where he worked on crop genetics and indigenous systems projects. He was the 2013 recipient of a Fullbright Scholarship, undertaken at Cornell University (USA).

Dr Peter Thorburn

Dr Thorburn is a Chief Research Scientist and Research Group Leader in the Commonwealth Science and Industrial Research Organisation (CSIRO) in Queensland. He is responsible for ***agricultural*** systems research and is internationally recognised for his expertise in crop systems modelling.

He represents CSIRO on the ***Agricultural*** Production Systems Simulator initiative, which owns the APSIM advanced farming systems model, and is co-lead for crop modelling in the international AgMIP program. He has extensive experience in scientific advisory groups, including as a member of groups on managing water quality in Great Barrier Reef catchments and reviewing or advising on Overseer in 2012 and between 2014 and 2017.

Dr Robin White

Dr White is Assistant Professor of Integrated Beef Systems Management at Virginia Tech in the United States. She is a member of the American Dairy Science Association, an editor for the Farm Systems Analysis and Economics and Resources and Environment sections of the Journal of Dairy Science, and an Editorial Board member of the Journal of Animal Science.Her research focuses on leveraging ***data*** analysis and animal nutrition to enhance the sustainability of food production systems. She graduated from Washington State University as a Doctor of Philosophy in Animal Sciences.

**Load-Date:** March 12, 2020

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[***The association of skipping breakfast with cancer-related and all-cause mortality in a national cohort of United States adults***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H7S1-JDK8-01CS-00000-00&context=1516831)

Cancer Causes Control

February 2021

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**Section:** Pg. 505-513; Vol. 32; No. 5; ISSN: 0957-5243,1573-7225

**Length:** 4532 words

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**Body**

Introduction

Globally and in the United States (US), cancer is the second leading cause of death []. About 40% of Americans will be diagnosed with cancer at some point in their lives []. One third to one half of cancers could be prevented by adoption of healthy lifestyle and dietary choices []. Certain cancers are known to be associated with dietary habits and patterns related to the circadian rhythm [].

Eating habits, including breakfast consumption, play significant roles in the prevention of chronic disease. Breakfast is often considered as the most important meal of the day due to its potential to contribute to better ***nutrient*** adequacy [, ]. Over the past decades, the proportion of Americans skipping breakfast has increased across all age groups. From 1965 to 1991, the intake of breakfast decreased among adults from 86% to 75% []. Currently, about 23% of American adults are reported to skip breakfast []. Breakfast, which is often taken after 8 h to 12 h of fast is an important source of energy and ***nutrients***. Some studies have reported that skipping breakfast affects the regulation of energy balance and that ***nutrients*** that are missed due to skipping breakfast are often not compensated for later in the day [–].

Numerous studies have reported positive associations between skipping breakfast and weight gain [], dyslipidemia [], hypertension [], insulin resistance [], diabetes [], and cardiovascular diseases [, ]. Despite the potential role of dietary habits in the development of cancer, investigations into the relation of breakfast consumption, regardless of dietary composition and cancer mortality are limited. Therefore, the aim of this study was to examine the association of skipping breakfast with all-cause and cancer-specific mortality in a national cohort of US Adults.

Methods

Study population

The National Health and Nutrition Examination Survey (NHANES) is a stratified, multistage, probability cluster survey conducted in the non-institutionalized US population. The survey comprises of interviewer-administered questionnaires, physical examination, and specimen ***collection*** performed in a set of specially-designed and equipped Mobile Examination Centers []. The National Center for Health ***Statistics***’ Institutional Review Board approved NHANES, and all participants provided written informed consent prior to the study.

The current analysis was limited to all participants aged 40 years and older who attended the 1988 to 1994 cycle of the survey (NHANES III). These survey years were selected because breakfast consumption was assessed and it also provided a long follow-up period to observe cancer-related mortality. Of the 9,737 participants aged ≥ 40 years who attended the health examination, the following exclusions were made: 1,142 persons with prevalent cancer, 6 with missing information on breakfast consumption, 3 women who were currently pregnant, 1,046 with prevalent cardiovascular disease (myocardial infarction, stroke or heart failure) and 4 participants with no follow-up information. Exclusion of participants with prevalent cardiovascular disease was undertaken to reduce the probability of reverse causation as changes in lifestyle pertaining to diet are often included in the management of the disease []. Similar to previous NHANES studies [], we excluded 460 participants who had daily total energy intake < 500 kcal or > 5,000 kcal. Additionally, we excluded 69 participants who died within 12 months of their NHANES III health examination as such individuals may have had an exceptionally high risk of death, and therefore, might have changed their habitual dietary intake and patterns. This resulted in an analytic sample of 7,007 participants.

Dietary assessment

Dietary information was gathered through 24-h recall interviews. The frequency of breakfast consumption was assessed by self-report. During the household interviews, participants were asked, “How often do you eat breakfast?” with possible responses of “every day”, “some days”, “weekends only”, “rarely”, and “never”. For this study, the frequency of breakfast was classified into three groups: (1) those who eat breakfast every day (response of “every day”); (2) those who eat breakfast some days (response of “some days” or “weekends only”) and (3) those who rarely consumed breakfast (response of “rarely” or “never”). Recalls for each dietary component (i.e., fruits and vegetables, fish, whole grain, sodium, and added sugar) were used to estimate the healthy diet index, which was created by the US Department of ***Agriculture***. Scores ranged from 0 to 100, with 100 being the best-quality diet. Total energy intake was calculated using the department’s automated multiple-pass method. Details of these procedures are described elsewhere [].

Mortality ascertainment

Deaths between the time of the NHANES III baseline survey through 31 December 2015 were ascertained based on a probabilistic match between personal identifiers of adult participants and the death certificate records from the National Death Index. Aggregate information on the underlying cause of death was obtained using codes from the International Classification of Diseases tenth version (ICD-10). Mortality outcomes of interest for the current study were all-cause mortality and cancer-related mortality (ICD-10 code: C00-C97).

Covariates

Information on age, sex, race/ethnicity, education, marital status, family income, smoking status, and physical activity were ***collected*** using standardized questionnaires during interviews. Race/ethnicity was classified as non-Hispanic white, non-Hispanic black, Mexican American, or other. Socioeconomic status was assessed using education and family poverty income ratio (PIR). This is the ratio of a family's income to the poverty threshold defined by the US Census Bureau appropriate to the family's composition []. Low income was defined as ratios that were less than 1.3.

Height, body weight, and waist girth were all measured using procedures previously described []. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. Central/abdominal obesity was defined as a waist circumference greater than 102 cm in men and 88 cm in women. The frequency of physical activity in the previous month was divided into 3 levels based on their distribution with participants in the lowest tertile considered to be sedentary. Hypertension was defined as systolic blood pressure above 130 mm Hg, diastolic blood pressure of above 80 mm Hg, or current medication use for elevated blood pressure. Fasting blood samples were ***collected*** for measures of serum lipids and glucose using standardized laboratory procedures []. Diabetes was defined by one or more of the following: a self-reported physician diagnosis, elevated fasting glucose levels ≥ 126 mg/dL, oral glucose tolerance test ≥ 200 mg/dL, or reported use of diabetes medications.

Statistical analysis

All statistical analyses accounted for the complex survey design (including oversampling of certain subpopulations) of NHANES by using primary sampling units, geographic strata, and sampling weights to provide estimates that are representative of the US population. Baseline characteristics were described according to frequency of breakfast consumption using analysis of variance for continuous variables and chi-square test for categorical variables.

In the analysis of time-to-event, the cumulative incidence of all-cause mortality was estimated using the Kaplan–Meier product-limit estimator with the log-rank test used to evaluate significant differences in survival curves according to the frequency of breakfast consumption. The Fine and Gray method [] was used to estimate the cumulative incidence of cancer-related mortality with deaths from all other causes considered as competing risk events. Cox proportional hazards regression models with progressive degrees of adjustment for potential confounders were used to evaluate the association of skipping breakfast with all-cause and cancer-related mortality. Covariates adjusted for were age, sex, race/ethnicity, education, marital status, PIR, smoking status, BMI, physical activity, hypertension, diabetes, total cholesterol, diet quality and total caloric intake. We tested and confirmed the validity of the proportional hazard assumption using interaction terms between categories of breakfast consumption frequency and the log of time. Formal interaction tests were performed to evaluate the potential modifying roles of sex, race/ethnicity and marital status on the association of skipping breakfast with all-cause and cancer mortality.

It is possible that the estimates reported may be influenced by residual confounding; therefore, we estimated E-values. E-value is defined as the minimum strength of association that an unmeasured confounder would need to have with both the exposure and the outcome, conditional on the measured covariates, to fully explain away the observed associations between the frequency of breakfast consumption and all-cause or cancer-related mortality []. E‐value ranges from 1 to infinity, with increasing values signifying higher degrees of unmeasured confounding needed to reduce the observed association to null. Analyses were performed using SAS software version 9.4 (SAS Institute, Inc., Cary, NC) with a two-tailed type 1 error of less than 0.05 considered to be statistically significant.

Results

The mean age of participants was 55.4 years, with 54.4% and 79% being women and non-Hispanic whites, respectively. Approximately 16% of participants rarely consumed breakfast, 23.0% consumed breakfast some days, and 61% consumed breakfast every day. Baseline characteristics of participants according to the frequency of breakfast consumption are shown in Table . Compared to participants who consumed breakfast every day, those who rarely consumed breakfast were younger, with a significantly greater proportion of them being non-Hispanic black, current smokers, divorced/separated, obese, and physically inactive. Participants who rarely consumed breakfast also had higher total cholesterol levels than participants who consumed breakfast every day. With regard to diet, although total caloric intake was similar among participants who consumed breakfast every day and those who rarely consumed breakfast, the latter had a lower percentage of their calories from proteins and carbohydrates but had a higher percentage of their calories from monosaturated fat, saturated fats and total fat. Overall, participants who rarely consumed breakfast had lower diet quality scores than those who ate breakfast every day.

Baseline characteristics of participants according to frequency of breakfast consumption, NHANES III 1988–1994

| **Characteristics** | **Frequency of breakfast consumptiona** | | | **P values** |
| --- | --- | --- | --- | --- |
| **Every day(n = 4421)** | **Some days(n = 1579)** | **Rarely(n = 1007)** |
| Age, years | 58.6 (0.4) | 49.9 (0.4) | 51.1 (0.5) | 0.001 |
| Sex, male % | 43.2 | 51.3 | 46.6 | 0.002 |
| Race/ethnicity, % |  |  |  | 0.001 |
| Non-Hispanic white | 80.8 | 75.7 | 77.5 |  |
| Non-Hispanic black | 7.8 | 14.6 | 11.9 |  |
| Mexican?American | 3.7 | 4.3 | 3.6 |  |
| Other | 7.7 | 5.4 | 6.9 |  |
| Some college degree or higher, % | 39.3 | 40.5 | 40.2 | 0.003 |
| Living at or below poverty line, % | 14.9 | 13.8 | 15.6 | 0.656 |
| Marital status, % |  |  |  | 0.001 |
| Single | 5.7 | 5.4 | 4.0 |  |
| Married | 70.3 | 73.6 | 71.1 |  |
| Divorced/separated | 11.4 | 13.5 | 16.1 |  |
| Widowed | 12.7 | 7.5 | 8.8 |  |
| Smoking status, current % | 15.9 | 32.7 | 38.4 | 0.001 |
| Body mass index, kg/m2 | 27.0 (0/3) | 27.9 (0.2) | 27.6 (0.3) | 0.001 |
| Obese, % | 23.6 | 28.7 | 30.6 | 0.004 |
| Abdominal obesity, % | 47.6 | 49.3 | 50.7 | 0.502 |
| Sedentary lifestyle, % | 21.9 | 27.3 | 25.7 | 0.006 |
| Hypertension, % | 38.6 | 33.3 | 36.5 | 0.051 |
| Diabetes, % | 11.4 | 9.3 | 9.9 | 0.427 |
| Total cholesterol, mg/dL | 217 (1.3) | 214 (1.6) | 223 (1.9) | 0.010 |
| High density lipoprotein cholesterol, mg/dL | 51.4 (0.5) | 50.0 (0.6) | 52.3 (0.7) | 0.022 |
| Total energy intake, kcal/day | 1954 (23) | 2078 (33) | 1921 (36) | 0.001 |
| Percent calories from fat, % kcal/day | 32.5 (0.3) | 35.2 (0.5) | 34.2 (0.4) | 0.001 |
| Percent calories from saturated fat, % kcal/day | 10.7 (0.1) | 11.7 (0.2) | 11.8 (0.2) | 0.001 |
| Percent calories from monosaturated fat, % kcal/day | 12.2 (0.1) | 13.2 (0.3) | 12.9 (0.2) | 0.001 |
| Percent calories from proteins, % kcal/day | 16.2 (0.1) | 15.3 (0.2) | 15.4 (0.3) | 0.001 |
| Percent calories from carbohydrates, % kcal/day | 51.4 (0.3) | 47.8 (0.6) | 47.3 (0.6) | 0.001 |
| Diet quality, healthy eating index | 68.4 (0.36) | 61.3 (0.61) | 59.7 (0.5) | 0.001 |

aValues are survey weighted mean (standard error) for continuous variables or survey weighted proportion for categorical variables

During a median follow-up of 22.2 years (IQR 16.6–24.4), there were 3,573 deaths of which 795 were attributed to cancer. The cumulative incidence of all-cause and cancer-related mortality was significantly highest among participants who consumed breakfast some days or rarely (Fig. ). In multivariable adjusted models Table , participants who rarely consumed breakfast had a higher risk of all-cause (HR = 1.69; CI: 1.42–2.02) and cancer-related mortality (HR = 1.52; CI: 1.06–2.18) compared to those who took breakfast every day. This risk was also higher among participants who consumed breakfast some days. Skipping breakfast was associated with a higher risk of all-cause (HR = 1.60, 95% CI: 1.42–1.79) and cancer-related mortality (HR = 1.59, CI: 1.23–2.06) Table . There was no significant interaction between the frequency of breakfast consumption and sex, race/ethnicity, or marital status on the risk of mortality outcomes. The E-values (and the lower limit of its 95% confidence interval) for the relation of skipping breakfast with cancer mortality was 2.56 (1.76), while those for the relation of skipping breakfast with all-cause mortality was 2.11 (1.87). These results show that a moderate amount of unmeasured confounding would be needed to explain away the observed associations of skipping breakfast with all-cause and cancer mortality outcomes.

Cumulative incidence curves for (a) cancer-related mortality and (b) all-cause mortality according to frequency of breakfast consumption, NHANES III 1988–1994. The p values for Gray's test for equality of cumulative incidence functions were all < 0.001

The association between the frequency of breakfast consumption and all-cause and cancer-related mortality, NHANES III 1988–2015

|  | **Model 1** | **Model 2** | **Model 3** | **Model 4** |
| --- | --- | --- | --- | --- |
|  | **HR (95% CI)** | **HR (95% CI)** | **HR (95% CI)** | **HR (95% CI)** |
| Cancer mortality |  |  |  |  |
| *Frequency of breakfast consumption* |  |  |  |  |
| Every day | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| Some days | 1.64 (1.26?2.14) | 1.51 (1.12?2.04) | 1.72 (1.26?2.34) | 1.65 (1.21?2.24) |
| Rarely | 1.58 (1.17?2.13) | 1.61 (1.19?2.18) | 1.57 (1.08?2.27) | 1.52 (1.06?2.18) |
| *Consume breakfast every day* |  |  |  |  |
| Yes | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| No | 1.61 (1.30?2.00) | 1.55 (1.24?1.94) | 1.65 (1.27?2.15) | 1.59 (1.23?2.06) |
| All-cause mortality |  |  |  |  |
| *Frequency of breakfast consumption* |  |  |  |  |
| Every day | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| Some days | 1.46 (1.24?1.71) | 1.51 (1.12?2.04) | 1.56 (1.33?1.82) | 1.52 (1.30?1.78) |
| Rarely | 1.66 (1.43?1.93) | 1.61 (1.19?2.18) | 1.71 (1.43?2.05) | 1.69 (1.42?2.02) |
| *Consume breakfast every day* |  |  |  |  |
| Yes | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| No | 1.55 (1.40?1.71) | 1.58 (1.42?1.75) | 1.63 (1.45?1.83) | 1.60 (1.42?1.79) |

Model 1: adjusted for age

Model 2: model 1 plus sex, race/ethnicity, education, marital status and poverty income ratio

Model 3: model 2 plus smoking status, sedentary lifestyle, BMI, hypertension, diabetes and total cholesterol

Model 4: model 3 plus total energy intake and Healthy Eating Index scores

BMI body mass index, CI confidence interval, HR hazard ratio

Discussion

In this nationally representative cohort study, we found that skipping breakfast was significantly associated with elevated risks of all-cause and cancer-related mortality. These associations were independent of sociodemographic, medical, behavioral, and lifestyle factors. To our knowledge, this is the first investigation of the relation of skipping breakfast and the risk of cancer mortality among US adults.

Several epidemiological studies report an association between diet and cancer. However, investigations into the important roles of dietary patterns such as skipping breakfast, which can accommodate the complex interplay of ***nutrients*** within a diet, in the etiology of cancer mortality are limited. Results from a recent study of 83,410 participants enrolled in the Japan Collaborative Cohort (JACC) Study with a median 19.4 years follow-up showed a positive association between skipping breakfast and cancer mortality in age-adjusted models []. However, this association disappeared with additional adjustment for potential confounders []; findings that were similar to a prior report from the JACC cohort []. These results are in contrast to the findings of the present study, despite both cohorts having similar years of breakfast intake assessment and follow-up duration.

There are several possible reasons for these diverging results. The dietary patterns and types of food consumed by participants in these two cohorts are largely different. The traditional Japanese diet is different in composition and portion size to the western-style diets of most Americans []. As evident from the JACC cohort and other studies [–], a growing proportion of Japanese are eating western-style diets. Traditional Japanese cuisines are often thought to be healthier than western-style diets of most Americans [–]. Accordingly, some studies [] have observed the traditional Japanese diet to be associated with a lower risk of gastrointestinal cancers among Japanese adults, although others have not observed such associations [, ]. Because the Japanese breakfast is reported to have a lower ***nutrient*** density than that of Americans [], it stands to reason, that skipping of breakfast among Americans may have more deleterious consequences on cancer compared to Japanese.

It is also possible that the discrepant results between JACC and NHANES highlight the methodical differences between these two cohorts. Unlike the current NHANES study, participants who consumed breakfast regularly in the JACC study [] were heterogeneous in the type of diet consumed (Japanese style, Western style, Chagayu style and others) which have been observed to have varying risk of mortality []. Additionally, there was a marked difference in the proportion of participants who rarely or never consumed breakfast among the two cohorts (16% in NHANES and 2% in JACC) as well as the proportion of cancer mortality among these two groups (9.5% in NHANES and 2.3% in JACC). The low proportion of events in participants who skipped breakfast in the JACC study could have led to low statistical power to detect significant associations. Finally, the JACC study did not make adjustments for dietary confounding factors due to the small proportion of participants who skipped breakfast.

Habitual skipping of breakfast has been suggested as a predictor of an unhealthy lifestyle. Similar to other reports [, –, , ], we observed unhealthy behaviors and lifestyles such as smoking, obesity, physical inactivity, high total cholesterol, and low-quality diet among participants who skipped breakfast. There are three plausible reasons why skipping breakfast may lead to the development of chronic diseases including cancer. First, skipping breakfast affects appetite and satiety leading to subsequent overeating, postprandial hyperglycemia, elevated free fatty acid levels after lunch and dinner, and impaired insulin response []. Second, skipping breakfast disrupts circadian rhythm and metabolism by altering the expression of certain genes that control circadian hormone secretions [, ]. Thus, the prolonged fasting due to skipping breakfast may be considered as a state of stress which leads to increased low-grade inflammatory response after lunch that is known to impair insulin sensitivity [, ]. Disturbance of the circadian rhythm as well as sustained hyperinsulinemia and hyperglycemia are important regulators in the etiology and treatment of cancer [, , ]. Third, skipping breakfast has been reported to be associated with weight gain, obesity, dyslipidemia, and physical inactivity [, , ]. Furthermore, skipping breakfast is associated with low dietary quality that entails a greater intake of fiber, vitamins, and minerals but lower intake of added sugars [, ]. Most cancers are known to be associated with adverse lifestyle and behavior factors, including dietary habits [, , ]. In the current study, we observed a positive association between skipping breakfast and all-cause or cancer mortality even after adjusting for several lifestyle and dietary factors, including total energy intake and overall diet quality. Taken together, the seemingly reduced all-cause and cancer mortality risk among persons who consume breakfast every day may simply be the reflection of habitual breakfast consumption being a proxy for a health-conscious lifestyle.

Whether skipping breakfast is causally related to cancer is unknown. Most studies on the role of skipping breakfast with the development of chronic conditions have been limited by the incomplete control of many interrelated and unmeasured confounders []. For instance, skipping breakfast is often incorporated in the various forms of intermittent fasting regimens []. However, most longitudinal studies did not distinguish whether skipping breakfast was part of an intermittent fast or not. Unlike several intermittent fasting regimens that involve skipping other meals such as late-night dinners, most individuals who skip breakfast are reported to often eat late-night dinners which raises their risk for chronic diseases and mortality []. It is unlikely that the association of skipping breakfast with chronic diseases reported in some observational studies is reflective of intermittent fasting since several lines of evidence suggest that eliminating nighttime eating and prolong nightly fasting intervals leads to improvement in metabolic health [, ]. Synchronizing food intake with daily circadian rhythms plays important roles in metabolism, hormonal secretion patterns, physical coordination, and sleep []. Accumulating evidence indicate that disruptions of the circadian clock is related to food intake occurring outside the normal feeding phase []. This, together with other factors, are reported to reset the body’s biological clock, disrupt energy balance and promote the development of cancer []. Late-night eating often results in shorter sleep duration and poor sleep quality resulting in suppression of nocturnal melatonin []. Melatonin, often referred to as the sleep hormone, plays major roles in inhibiting tumor growth through antioxidation, regulation of immunity and slowing down angiogenesis [–]. Accordingly, night shift-work has been reported to be associated with nighttime eating as well as elevated risk for several chronic diseases including hormone-dependent cancers such as prostate, breast and ovarian cancers [, , ].

Despite skipping breakfast being positively associated with cancer mortality, other studies report that short-term fasting up to 72 h enhances the efficacy and tolerability of cancer treatment modalities such as chemotherapy [–]. A recent trial which randomized 131 patients with HER2-negative early breast cancer to receive either a fasting mimicking diet as an adjunct to chemotherapy or their regular diet for 3 days prior to and during neoadjuvant chemotherapy observed lower toxicity among patients who fasted []. Furthermore, more radiologically complete or partial response to chemotherapy as well as less DNA damage in T-lymphocytes were observed in patients who were randomized to receive the fasting mimicking diet []. While these results are promising, it is worth noting that the higher number of noncompliance (about 50% of patients completed two fasting mimicking diet cycles and 34% used the fasting mimicking diet for at least 4 cycles) may have introduced selection bias. Therefore, further larger trials evaluating the role of short-term fasting on a wide range of cancer therapies outcomes are needed.

This study has notable strengths. This includes a long follow-up period to observe mortality outcomes and the use of a large population-based nationally representative sample who had a comprehensive assessment of potential confounders. Limitations of this study are worth noting. First, all ***data*** on diet were self-reported based on a single 24-h dietary recall and therefore direct information on regular breakfast consumption habits were not assessed. However, it has been shown that a single 24-h dietary recall produces reasonably robust estimates of dietary intake in several large population-based studies [, ]. Second, we did not evaluate the role of specific foods and beverages eaten at breakfast on the association of skipping breakfast and all-cause and cancer mortality. Although foods eaten for breakfast in the previous day were obtained, we did not use this information since we could not validate whether such diets were foods usually consumed at breakfast for all participants. Doing so could introduce potential confounding by means of reverse causality, as it would be unknown whether healthier people consumed certain diets at breakfast, rather than participants consuming such diets at breakfast in order to be healthier. Nevertheless, reports from other NHANES studies [, , ] suggest that consumption of breakfast, especially those that include cooked or ready-to-eat cereal, is associated with improved cardiometabolic risk profiles compared to persons who skip breakfast. Thus, breakfast consumption, regardless of the type of the food and the amount of calories it contains may have beneficial effects on long term health compared to no intake of breakfast []. Third, the presence of exposure misclassification bias cannot be ruled out due to dietary information being self-reported. However, such bias if present, will likely be non-differential with respect to the outcome (mortality) and will thereby possibly reduce the risk estimates toward the null. Fourth, information on other confounders on the relation of breakfast intake and cancer such as sleep duration or shift work involving circadian disruption were not ascertained. Fifth, the use of death certificates to identify cancer-related deaths may have resulted in some misclassification of the cause of death. In a validation study using mortality-linked ***data*** from the first NHANES study, 98.5% of participants in the cohort were correctly classified []. The consistent findings for all-cause and cancer-related mortality suggests that the influence of such misclassification on our results, if present, may be minimal. Finally, and perhaps most importantly, although we adjusted for an extensive array of potential confounders and had E-values that indicated that substantial unmeasured confounding would be needed to explain away the observed associations, residual confounding cannot be entirely excluded.

In conclusion, in this large nationally representative cohort of US adults, we found that skipping breakfast was significantly associated with elevated risk for all-cause and cancer-related mortality. Further investigations from different geographic locations are warranted to understand the various mechanisms underlying these associations to enhance targeted prevention of cancer. This study highlights the importance of regular breakfast consumption to reduce the risk of all-cause and cancer mortality.

**Notes**

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**Load-Date:** September 6, 2023

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[***Forecasting the red lentils commodity market price using SARIMA models***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2K1-JCWX-C1B2-00000-00&context=1516831)

SN Business & Economics

November 2020

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**Section:** Vol. 1; No. 1; ISSN: 2662-9399

**Length:** 2934 words

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**Body**

Introduction

Humans consume protein in different procedures, including animal sources as meat and plant sources as pulses (Lakkakula et al. ). Particularly, lentils are a rich source of Protein, Carbohydrates, Fiber, etc. Further, one major benefit of pulse consumption over meat consumption is that pulses contain only tiny amounts of fat compared to meat. Moreover, lentils also can be used for livestock feed. Table shows the nutrition value of 100 g of lentils. Lentils contain a greater amount of protein and carbohydrates, whereas Fat content is low in lentils.

Nutritional value for every 100 g of lentils

| **Nutrition** | **Content per 100 g of lentils** |
| --- | --- |
| Energy (kcal) | 324 |
| Protein (g) | 25.4 |
| Fat (g) | 1.5 |
| Fiber (g) | 17.0 |
| Carbohydrate (g) | 44.8 |

Source: Rawal and Navarro ()

Table exhibits the essential micronutrients and vitamin B9 for each 100 g of lentils. Lentils comprise higher amounts of Iron, Phosphorus, and Copper.

Essential micronutrients and B-9 vitamin for every 100 g of lentils

| ***Nutrient*** | **Content per 100 g of lentils** |
| --- | --- |
| Iron (mg) | 7.1 |
| Magnesium (mg) | 66 |
| Phosphorus (mg) | 291 |
| Potassium (mg) | 752 |
| Zinc (mg) | 3.55 |
| Copper (mg) | 0.41 |
| B9/folate (mg) | 150 |

Source: Rawal and Navarro ()

Canada is the major producer and exporter of lentils in the world as they export approximately 2.03 million metric tons of lentils in the year 2018/19 to over a hundred countries. They began the lentil production in the 1970s, and currently, there are over 5000 active lentil farmers in Canada. The province of Saskatchewan is the major contributor of 95% of the lentils production in Canada. Typically, lentils are planted in early May and harvested in mid-August in Saskatchewan.

However, the production of red lentils varies due to some influences such as weather, trade wars, and financial policies, etc. As a consequence, the red lentils price fluctuation is volatile, which causes a great impact on the growers, sellers, policymakers, and consumers. There are complex relationships among influential factors. Thus, precise forecasting is challenging. The current methods are mainly focused on qualitative analysis rather than the quantitative forecasting approach in the literature.

One of the most demanded and commonly used time series models is the ARIMA model (Alibuhtto and Ariyarathna ; Adebiyi et al. ; Esther and Magdaline ; Kaur and Ahuja ). ARIMA model has autoregressive (AR), moving average (MA), and autoregressive moving average (ARMA) subclasses. The seasonal ARIMA is the completely successful inequality of ARIMA models for forecasting seasonal time series (Box et al. ; Kihoro et al. ).

Furthermore, the GARCH family models, which are better for volatile ***data***, have a better forecast for price predictions. The GARCH, APARCH, TGARCH, and EGARCH can be used to forecast the linear and nonlinear effects. Moreover, hybrid models are also better for price forecasting (Kumari and Tan ; Shetty et al. ).

Some studies applied the artificial neural network and genetic algorithm without considering the period of production. Lately, Artificial Neural Networks (ANNs) have slightly increased concentrations in the usage of time series forecasting (Kaur and Ahuja ). There are different ANN models, such as multilayered perceptions (MLP), feed forward network (FNN), time lagged neural network (TLNN), and seasonal artificial neural network (SANN) (Hamzacebi ; Kamruzzaman et al. ).

The red lentils’ price is influenced by the season significantly. Hence, investigating the price fluctuation is needed for the SARIMA model which accounts for the seasonal effect in the time series. The ARIMA and SARIMA model have a stable layout and it is expressly designed for time series ***data***. The ANN needs to make modifications before applying it because it has been designed for cross sectional ***data***. Sometimes ANN is acceptable and does more accurate forecasts, but when adding more ***data***, ANN is ten to overfit. Since the red lentils price forecasting is very important, the researcher used the SARIMA model in this study. Subsequently, this study recommends a quantitative prediction method of red lentils price in Canada by applying the SARIMA model to produce a decision-making tool for each associate. R software was used for this analysis.

Literature review

Many of the studies have been conducted on forecasting future production and price of ***agricultural*** commodities specifically pulses based on the historical ***data*** by applying time series analysis.

Production of pulses in Kenya was forecasted using the ARIMA model by Esther and Magdaline (). The results indicated that ARIMA(1,1,2) model was the appropriate model to forecast the pulses production in Kenya and a decreasing trend in the predicted production by 2030. Therefore, due to the increasing tendency in population growth, the estimated results produce a clue that there won’t be enough pulses to feed the growing population in Kenya by 2030.

One of the ***agricultural*** commodities, which is consumed by most of the people can be identified as Cucumber. Forecasting vegetable prices is also a challenging task due to seasonal variation. Hence, Luo et al. () used the SARIMA model which considers the seasonal effect, to investigate an effective model of forecasting Cucumber price. SARIMA(1,0,1)(1,1,1)12 model was selected as the best-fitted model which provides feasible short-term warning of vegetable price.

Bisht and Kumar () focused on estimating the price volatility of major pulses including lentils in India using the GARCH model. The high fluctuation of the production of pulses led to high price variability in the market. Further, the results emphasized that the volatility of price in the current period depends on the previous period.

The ARIMA, SARIMA, and ARIMAX have used in the National Capital Region of the Philippines to identify the movements of fruits and vegetable commodities (Vibas and Raqueno ). For vegetables such as pechay and tomato had better forecast for the SARIMA model. That means their price values depend on their prices of the previous season of the same month.

SARIMA model was used to forecast the monthly percentage difference in the wholesale price index value in Nigeria (Otu et al. ). The volatility in inflation can be imputed to the money supply, exchange rates reduction, petroleum price rises, and substandard ***agricultural*** manufacturing. The predicted outcomes values for policymakers to gain insight into more proper economic.

The forecasting of tomato price is more valuable because tomatoes are highly perishable and seasonality. This forecasting can give essential information to tomato growers for making production and market decisions. Adanacioglu and Yarcan () analyzed the seasonal tomato price variation in Turkey and introduced a model to predict the monthly tomato price. The results specified that SARIMA(1,0,0)(1,1,1)12 was the most accurate model to forecast the tomato prices.

The monthly closing price of soybean has forecasted by Souza et al. () using the SARIMA model. They have mentioned the importance of those predictions for both producers and businesses. It can reduce the risks of soybean economics in the short, medium, and long term.

Mutwiri (), has built an analysis tool to give early warning massage of tomatoes wholesale price fluctuations of Nairobi in Kenya using SARIMA. This forecast information is valuable for stakeholders to make options regarding the manufacture, retail, trade, and storage as well as farmers to gain higher profit by storing tomatoes in a cool place and sell in a high market, make tomato paste, souse, and ketchup.

Methodology

Materials and methods

The study aimed to forecast the price of red lentils in Saskatchewan, Canada. The study was carried out using weekly time series ***data*** for the period of 2010 to 2018. The ***data*** on red lentils was ***collected*** from askatchewan.ca, AGR Market Trends, Government of Saskatchewan, Canada. There were 521 observations.

A total number of 469 observations were used for model building and 52 observations among those 469 ***data*** points were used for assessing the in-sample performance. Remained 52 observations were used for performing out-sample performance.

Model identification

In the identification stage, the ***data*** was tested for stationary and the augmented dickey fuller (ADF) test, and Phillips–Perron (PP) test were applied (Wang and Wu ). The seasonal index was calculated to identify the seasonal pattern. Decomposed plots were used to identify the time series components; seasonal, trend, cyclic, and random component in the ***data*** over the time. Seasonality is represented by the seasonal component at time. When a time series is influenced by seasonal factors there exists a seasonal pattern. The residual component describes the random or irregular influences at time t.

Non-Stationary time series ***data*** has statistical properties, which change with time. So, it is required to change the ***data*** into stationary time series ***data*** by obtaining the first difference of the time series, before building the predictive model.

SARIMA

The Seasonal ARIMA model (SARIMA) is formed by adding seasonal terms in the ARIMA models: where p is a non-seasonal autoregressive order, P is a seasonal autoregressive order, q is a non-seasonal moving average order, Q is a seasonal autoregressive order, d and D are the order of common difference and seasonal difference (Pepple and Harrison ).

SARIMA(p,d,q)(P,D,Q)[S] models are written as

is the non-seasonal parameter of autoregression and θ is the non-seasonal parameter of moving average, is the seasonal parameter of autoregression and Θ is the seasonal parameter of moving average, ω is frequency and B is the differential variable (Pepple and Harrison ).

The number of times the series is differenced determines the order of d. The AR and MA signatures are determined using non-seasonal and seasonal autocorrelation function (ACF) and partial autocorrelation function (PACF) plots. A theoretical AR model of order p has an ACF that decays and a PACF that cuts off at lag p while a theoretical MA model of order q consists of a PACF that decays and an ACF that cuts off at lag q. The model with the minimum AIC and BIC values is selected as the model that fits the ***data*** best (Pepple and Harrison ).

Estimation of parameters and diagnostic checking

Parameters of the best-fitted SARIMA model were estimated using the Akaike information criterion (AIC) and Bayesian information criterion (BIC). Then the significance of the model parameters was assessed using t test ***statistics***. The residuals from the estimated model were generated and tested whether they resemble a white noise series (uncorrelated and have zero mean) by investigating ACF, PACF plots, and performing Ljung–Box ***statistic*** test, respectively. Heteroscedasticity of the residuals was detected using the Autoregressive conditional heteroscedasticity Lagrange multiplier (ARCH-LM) test (Bisht and Kumar ).

If the parameter estimates were insignificant and the residual was not a white noise then the entire process of model identification, parameter estimation, and diagnostic checking was repeated until the appropriate model was attained.

Forecasting

After the selection of an appropriate model, future values of the time series were forecasted for in-sample and out-sample, and the confidence intervals for the forecasts were generated. Reliability of forecasted values based on the selected model was checked by computing sum of squared errors (SSE), mean absolute error (MAE), mean squared error (MSE), root mean square error (RMSE), and Theil’s inequality coefficient (TIC) (Kumari and Tan ): where n is the number of forecasts, and are the actual volatility and the volatility forecasts obtained from SARIMA models respectively.

Results and discussion

According to the summary ***statistics*** in Table , the maximum price of red lentils in Saskatchewan was dollar 52.28 per 100 lb in the 2nd week of, 2016 while the lowest red lentils price was dollar 14.25 per 100 lb in the 33rd week, 2018. On average red lentils price in Saskatchewan from 2010 to 2018 was dollar 24.75 per 100 lb. Though a significant increase in red lentils price was realized from the 47th week of 2015 to the 23rd week of 2016, afterward the price was declined as illustrated in Fig. . Further, the time series plot indicated that the lentils’ price is highly fluctuating over time.

Descriptive ***statistics*** of the lentils price during 2010 and 2018

|  |  |
| --- | --- |
| Minimum | 14.25 |
| Maximum | 52.28 |
| Median | 21.78 |
| Mean | 24.06 |
| Q1 | 18.16 |
| Q3 | 27.5 |
| Mode | 33.75 |

Red lentils price in dollars per 100 lb in Saskatchewan (2010–2019)

The seasonal indices for weekly red lentils’ price were calculated (Electronic supplementary maerial 1) and plotted. Figure  exhibits the maximum price in the 22nd Week and the minimum price in the 37th Week of the year. Further, seasonal indices were negative from 10th week to 14th week and 28th week to 48th week whereas within the first 10 weeks, from 15th week to 27th week and last four weeks in the year seasonal indices were positive. It emphasized that the lentils’ price exhibits seasonality since the price is low during the harvesting period while the price increases through the planting period.

Weekly seasonal index plot for red lentils price from 2010 to 2019

ACF and PACF plots for the original red lentils price ***data*** were shown in Fig. . The results implied that price ***data*** was not stationary since the ACF die off slowly. Further, the ADF test and PP test for red lentils price ***data*** were performed to confirm whether the ***data*** was stationary or not. The p values of ADF and PP tests which were 0.696 and 0.7212, respectively, were greater than 0.05. Therefore, the time series was not stationary at a 5% significance level. Hence, the ***data*** was differenced to make it stationary. The p values of the ADF and PP tests were 0.01 which was less than 0.05. It indicates that the differenced ***data*** was stationary at a 5% level of significance. The first differencing was sufficient to make the ***data*** stationary; hence price was integrated of order one (d = 1). Figure  shows a plot of the differenced red lentils price ***data*** against time.

ACF and PACF plots for red lentils price

Red lentils differenced ***data***

The plots of ACF and PACF for the non-seasonal and seasonal differenced price ***data*** were used to obtain the order of the non-seasonal and seasonal AR and MA. The results are shown in Figs.  and . There were insignificant spikes in all plots. Six parsimonious models were selected for the model building purpose using those plots.

ACF and PACF plots for non-seasonal differenced ***data***

ACF and PACF plots for seasonal differenced ***data***

Table indicates the selected best models according to AIC and BIC values. Accordingly, SARIMA (1,1,1)(0,1,1)[52] has the minimum AIC and BIC value.

AIC and BIC values of selected models

| **Model** | **AIC** | **BIC** |
| --- | --- | --- |
| SARIMA(1,1,1)(0,1,1)[52] | 2.94851 | 2.98303 |
| SARIMA(1,1,1)(0,1,2)[52] | 2.95270 | 2.99586 |
| SARIMA(1,1,2)(0,1,1)[52] | 2.95278 | 2.99593 |
| SARIMA(2,1,1)(0,1,1)[52] | 2.95278 | 2.99594 |
| SARIMA(2,1,2)(0,1,1)[52] | 2.95320 | 3.00498 |
| SARIMA(3,1,3)(0,1,2)[52] | 2.96419 | 3.04187 |

However, according to the in-sample and out-sample performance, SARIMA(2,1,2)(0,1,1)[52] which had the lowest SSE, MAE, MSE, RMSE, and TIC, was selected as the feasible model (Table ). Further ACF and PACF plots of residuals and Ljung–Box test ***statistics*** indicated that the residuals of the selected model were random, white noise, and independent. Then, the ARCH-LM test was performed to assess the heteroscedasticity of residuals. Since the p value was 0.999 which was greater than 0.05, residuals SARIMA(2,1,2)(0,1,1)[52] model was not heteroscedastic at 5% significance level.

Accuracy measurements of SARIMA(2,1,2)(0,1,1)[52]

| **Type** | **Model** | **SSE** | **MAE** | **MSE** | **RMSE** | **TIC** |
| --- | --- | --- | --- | --- | --- | --- |
| Out-sample | SARIMA(2,1,2)(0,1,1)[52] | 146.583 | 1.386 | 2.820 | 1.679 | 0.002 |
| In-Sample | 66.275 | 0.913 | 1.275 | 1.129 | 0.003 |  |

According to the parameter estimation results in Table , SARIMA(2,1,2)(0,1,1)[52] model can be expressed as following Eq. ():

Parameter estimation of SARIMA(2,1,2)(0,1,1)[52] model

|  | **Estimate** | **SE** | ***t* value** | ***p* value** |
| --- | --- | --- | --- | --- |
| ar1 | ? 0.0594 | 0.2873 | ? 0.2067 | 0.8364 |
| ar2 | 0.4882 | 0.1745 | 2.7981 | 0.0054 |
| ma1 | 0.2103 | 0.2849 | 0.738 | 0.4609 |
| ma2 | ? 0.4423 | 0.1625 | ? 2.7226 | 0.0068 |
| sma1 | ? 0.9998 | 0.201 | ? 4.9752 | 0 |

Lentils prices from January to December 2019 were predicted using best-fitted SARIMA (2,1,2)(0,1,1)[52]. The forecasted prices within 80% and 95% prediction intervals are shown in Fig. . Forecasted values in 2019 (Electronic supplementary maerial 2) were shown a fluctuating pattern and a decreasing trend concerning the price in the last week of December 2018.

The forecasted red lentils price using SARIMA(2,1,2)(0,1,1)[52] in Canada

Conclusion

Red lentils are one of the major pulses that comprise high nutritional value. Therefore, the consumer’s demand is high on lentils in many countries. However, due to the impact of many factors, the price of lentils is fluctuating. Hence, farmers, policymakers, and traders are interested in forecasting lentils prices to attain optimum marketing decisions and to cope with price risk. In this study, Seasonal ARIMA modeling was used to forecast the price of red lentils in Saskatchewan, Canada who is the major contributor in the lentils export market. The best-fitted model for price was identified as SARIMA(2,1,2)(0,1,1)[52]. Consequently, this model can be applied as a short-term decision-making tool on lentils’ price. Since the price is volatile, for long-term forecasting the model should be modified by adding new actual values, and regular monitoring of price should be done by the relevant authorities.

**Acknowledgements**

The authors are grateful to Mr. Chandika Jayawardane, Chief Analyst and Managing Director, Global Trade Finance and Quantitative Research|WISEWEL LLC, Kandy, Sri Lanka, for providing the ***data***.

**Load-Date:** May 3, 2023

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[***Covid-19 Demands Innovative Ideas for Financing the SDGs***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YVS-SHV1-JDG9-Y0W3-00000-00&context=1516831)

Impact News Service

May 8, 2020 Friday

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**Length:** 4420 words

**Body**

Washington: Center for Strategic and International Studies has issued the following press release:

The Covid-19 pandemic exacerbates the challenges to achieving the 17 Sustainable Development Goals (SDGs) and highlights the need for a shared framework for tackling global challenges. No country in the world is on track to meet all the goals by 2030, and ***collective*** action is needed to make real progress.1

Even before the current global pandemic, the financing gap to achieve the SDGs by 2030 was estimated to be $2.5 trillion per year.2 The bulk of this financing is expected to come from developing countries’ government revenue and savings, which can be increased through concerted domestic resource mobilization (DRM) efforts.

New sources of private capital could be used to fill the SDG financing gap but will require innovative and scalable approaches. Developing countries would benefit from mobilizing local pools of capital as well as from increased foreign direct investment (FDI), remittances, and investments from pension funds. Financial tools and approaches such as guarantees, green and infrastructure bonds, and advanced purchase agreements can be used to encourage participation from untapped private sources.

INTRODUCTION

Since 2000, the international community has designed two important development frameworks to improve the lives of millions of citizens around the world. The first framework, the Millennium Development Goals (MDGs), set out eight ambitious targets, including eliminating extreme poverty, hunger, and violence against women and promoting universal health services, quality education, clean water, and sanitation. Although the MDGs were not achieved overall by 2015, unprecedented progress was made toward many of the goals, particularly in poverty reduction. Another accomplishment of the MDGs was bringing together not only traditional development actors, such as bilateral donors and multilateral institutions, but also members of the private sector.

As a follow-on to the MDGs, the 193 UN member states adopted the second framework in 2015—the 2030 Agenda for Sustainable Development. At the heart of this framework are 17 Sustainable Development Goals (SDGs). Through the SDGs, leaders from around the world committed to ensuring that “no one is left behind.”3 While the MDGs focused on reducing poverty in all its forms, the SDGs have a broader agenda that incorporates the economic, environmental, and social aspects of sustainable development.4 The goals are all interrelated—action in one area will affect outcomes in others—and therefore call for integrated solutions.5 Each goal has specific action-oriented targets set to be achieved by 2030, with 169 sub-indicators in total.6 This year, 2020, marks the beginning of the “decade of action” and is a defining year for a more urgent phase of implementing the SDGs.7

THE RELEVANCE OF THE SDGS FOR THE GLOBAL COMMUNITY

If fulfilled, the 2030 agenda’s impact would be felt by everyone around the world—the poor and wealthy alike—but since the SDGs were launched in 2015, much more skepticism about multilateralism has emerged. Many countries are looking to finance individual economic development programs without engaging with multilateral institutions, such as the United Nations, World Bank, or International Monetary Fund (IMF). However, as seen through the Covid-19 pandemic, countries and societies are now more connected than ever before. Countries must make progress toward all the SDGs to combat the economic, social, and political consequences of Covid-19. It has become increasingly clear that countries cannot achieve the SDGs on their own. Pandemics, droughts, and locusts do not respect borders, and ***collective*** action around a shared framework is needed to improve the lives of all people. Most governments turn over every four years, and as a result, policies and programs adopted in countries tend to be short-lived.8 The SDGs promote a long-term approach to difficult problems that go beyond the political cycle and outlive the party holding power at the moment.9

Pandemics, droughts, and locusts do not respect borders, and ***collective*** action around a shared framework is needed to improve the lives of all people.

Achieving the goals in areas such as ***agriculture***, sustainable cities, energy, and health could unlock $12 trillion in business savings and revenue by 2030.10 Further, the SDGs are expected to stimulate economic growth in a number of countries by creating 380 million jobs by 2030.11 Marginalized populations, such as women and children, migrants, and low-income groups, in both developed and developing countries have been much more susceptible to the negative health and the economic effects of the Covid-19 crisis and would benefit greatly from progress toward the SDGs.12CHALLENGES IN ACHIEVING THE SDGS BY 2030

Since the 2030 Agenda was adopted in 2015, significant progress has been made toward achieving some of the stated goals. However, no country is on track to meet all the goals by 2030, and several challenges hamper forward progress.13 Chief among them is overcoming the Covid-19 pandemic. As of May 7, 2020, Covid-19 has infected more than 3.7 million people across at least 177 countries.14 The pandemic has already killed 264,000 people, and this number will grow over the coming months.15 Covid-19 also had a dramatic effect on economic activity around the globe. The International Labour Organization (ILO) estimates that 25 million people could become unemployed, and workers could lose an estimated $3.4 trillion in income.16 Millions of workers have already lost their jobs and suffered major financial setbacks, and developing countries are expected to bear the economic brunt of the pandemic.17 Since developing countries are most at risk to Covid-19, investments in emerging markets are rapidly declining.

The economic sectors that are likely to suffer the most from the pandemic include tourism, ***agriculture***, and creative industries, which collectively represent a large percentage of GDP for many developing countries in Southeast Asia and sub-Saharan Africa.18 Travel and tourism directly sustained 123 million jobs globally and contributed $2.8 trillion to global GDP in 2018.19 ***Agriculture*** will suffer from disrupted supply chains, leading to increased food insecurity since an estimated 80 percent of consumers in low-income countries rely on markets for food supplies.20 Estimates suggest that the film industry could lose as much as $5 billion this year from diminished box office revenue and impacted production due to the coronavirus outbreak.21 Since many theaters and concert venues have been effectively shut down for the last two months and will remain shut down for the foreseeable future, unemployment rates in creative industries have begun to skyrocket.

Even before the negative social and economic consequences of the current crisis, the financing gap to achieve the SDGs in developing countries by 2030 was estimated to be $2.5 trillion per year.22 The health, economic, and social consequences of Covid-19 make the implementation of all 17 SDGs even more difficult but also increase the importance of maintaining progress. Countries that have frameworks in place to support efforts to achieve the SDGs will be more resilient to the economic shocks caused by the pandemic and have a plan in place to respond to the economic disruption.

The financing gap to achieve the SDGs in developing countries by 2030 is estimated to be $2.5 trillion per year.

Another challenge is the absence of reliable ***data*** in developing countries, making it difficult for countries to design and implement appropriate policies and track progress.23 For example, of the 155 states in which the World Bank monitors poverty, half do not report poverty ***data***.24 In the developing world, national ***data*** systems are inadequately funded and can be run by poorly trained staff.25 The ***data*** is often compiled on paper or entered manually into old computers and is usually out of date, demonstrating the need for a “***data*** revolution.”26 Without reliable ***data***, technology, and institutional capacity, it becomes nearly impossible to monitor how much progress is being made and whether the policies instituted by countries are effective. The sheer numbers, 17 goals and 169 sub-indicators, complicates matters even more and exacerbates the daunting task of ***collecting*** ***data*** when even the most basic ***statistic*** may be unavailable.WHERE WILL THE FINANCING COME FROM TO ACHIEVE THE SDGS?

The bulk of funding required to achieve the SDGs will continue to come from countries themselves, through domestic resource mobilization (DRM) and reducing corruption. Governments must look to leverage new technologies to expand the tax base and cut down on corruption at borders.27 According to the IMF, tackling corruption in developing countries could increase total revenues globally by $1 trillion, or 1.25 percent of global GDP.28 Increasing tax revenue in low- and middle-income countries is an effective way of increasing the amount of funding available for social services in countries, but it takes time and political windows of opportunity.29 The majority of reforms take four years or more before ***collection*** is significantly impacted.30 In 2018, tax ***collection*** for countries in the Organization for Economic Cooperation and Development (OECD) was over $16 trillion with an average of 34.3 percent of GDP across the 36 countries; in low- and middle-income countries, taxes accounted for $3.2 trillion with an average of only 12 percent of GDP.31 For example, most infrastructure projects continue to be financed by the public sector through tax revenue.

In July 2015, the United Nations hosted the Third International Conference on Financing for Development in Addis Ababa, Ethiopia, which signified a turning point in the conversation regarding development finance.32 The resulting Addis Ababa Agenda and subsequent forums on financing the SDGs, such as the UN secretary-general’s “High-level Meeting on Financing the 2030 Agenda for Sustainable Development,” have guided countries in their pursuit of additional sources of financing to move from “billions to trillions” in terms of development finance.33 These discussions have proposed leveraging additional sources of private finance to close the $2.5 trillion financing gap, such as FDI, remittances, local savings, pensions, investments in equity or debt securities of privately held companies, and other private sources of funding.34 The sources of funds to meet the SDGs will come from two main channels: public finance and private capital (see Figure 1). Foreign aid levels are not expected to increase, but this money will play an increasingly important role in mobilizing other sources of finance.Figure 1: Potential Sources of Development Finance

The OECD estimates that FDI in 2019 was $1.4 trillion, an increase of 12 percent from 2018 but still not as high as the levels between 2010 and 2017.35 Due largely to Covid-19, FDI is expected to drop by more than 30 percent in 2020.36 Based on its track record, the involvement of the private sector is crucial for meeting the SDGs by 2030. The World Bank estimated that global GDP was $85 trillion in 2018, and global financial assets were estimated to be $294 trillion in 2015, demonstrating that financing for the SDGs is available.37 However, these resources are not being channeled toward sustainable development at the speed or scale required to meet the goals by 2030.

Many companies have already begun to take the lead on the SDGs by signing agreements to support their implementation and incorporating the goals into their corporate social responsibility strategies. Seventeen companies, referred to as the “Business Avengers,” have committed to play a significant role in achieving the goals. These companies represent over a million employees, more than $500 billion in revenue, and include Mars, Pepsico, RB, Avant, SAP, Diageo, Salesforce, Google.org, ARM, Unilever, NTT, Commvalut, Nike, Coca-Cola Company, Mastercard, Microsoft, and Salesforce.org.38 Many other companies are beginning to recognize the financial and reputational benefits of supporting the goals, but the next 10 years must be focused on turning these commitments into action.

New sources of capital for the SDGs could come from increased FDI or remittances as well as domestic pools of savings, such as pension funds, insurance companies, mutual funds, or sovereign wealth funds. The United Nations estimates that $6.5 trillion in international remittances will be sent to developing countries between 2015 and 2030.39 Remittances to low- and middle- income countries reached a record high of $528 billion in 2018, according to the World Bank’s latest Migration and Development Brief.40 Similarly, FDI and investments in emerging markets have been increasing in recent years, so much so that the IMF estimates that emerging markets account for 60 percent of the world economy.41 Creating greater transparency and a regulatory framework for remittances could help lower the costs of sending money across countries and increase the amount available to families to spend on improving living conditions.42 Moreover, domestic pools of savings have increased over the last 20 years and could potentially be matched to infrastructure investments if the right incentives, legal frameworks, and financing models are established. In developing countries, assets in pension funds and insurance amounted to $44.1 trillion in 2018.43

According to the UN Development Programme (UNDP), more than half of philanthropic institutions align their programs with the SDGs.44 They act as “development” venture capitalists and play a major role in leveraging private capital.45 An estimated $1.5 trillion in assets belong to philanthropy around the world, as does $150 billion in annual philanthropic expenditures.46 In 2018, the Ford Foundation committed $1 billion from its $12 billion endowment over the next 10 years in mission-related investments (MRIs).47 The Rockefeller Foundation, another innovator in impact investing, has been leveraging large-scale private investors to unlock private capital through its Zero Gap initiative.48 One of its projects, Africa GreenCo, aims to increase private-sector investment in green energy bonds in sub-Saharan Africa.49BEING MORE CREATIVE: FINDING INNOVATIVE APPROACHES TO MOBILIZE FUNDING FOR THE SDGS

With 10 years left to achieve the SDGs, developing country governments and multilateral organizations must think more creatively about how they mobilize private capital, especially as they respond to the Covid-19 crisis. Many domestic finance sources will be diminished or wiped out by the pandemic, making it harder for blended finance and other tools to leverage private capital. The good news is that there are many financing tools already in use by multilateral development banks (MDBs) and development finance institutions (DFIs) that could be introduced by additional institutions. For countries to successfully implement these new financing tools, national governments must first improve the quality of their capital markets.50 FDI and pension fund investment are likely wishful thinking until countries achieve macroeconomic stability and thriving capital markets that also have sufficient infrastructure to support the exit of these investments through trade sales or public listing. Asia has many examples of thriving capital markets such as Kuala Lumpur and Mumbai, which both ranked in the top-50 global financial centers in 2020.51 Mumbai jumped 27 spots to rank 45th out of the 108 financial centers observed.52

“These measures [stopping illicit financial flows and increasing domestic resource mobilization] will allow us to leverage the billions of dollars in official development assistance to trillions in investment of all kinds, whether private, national or global.” - Former World Bank Group President Jim Yong Kim53

One tool that could be scaled up is the use of financial guarantees to reduce investors’ exposure to risks and to attract private capital to these markets.54 A guarantee is a legally binding agreement under which the guarantor agrees to pay part or all the amount due on a loan, or another financial instrument, in the event of a non-payment.55 A recent survey by the OECD revealed that out of the six development finance instruments analyzed during 2012– 2017, guarantees mobilized the most private capital (over $62 billion, out of $152 billion mobilized in total).56 One example of this being implemented is WaterEquity’s WaterCredit Investment Fund 3 (WCIF3), where $5 million in first-loss guarantees was set aside in the unlikely scenario that the fund suffered a loss.57 The fund aims to finance progress toward SDG 6 (Clean Water and Sanitation) by investing in microfinance institutions in Asia that provide loans to families for clean drinking water or toilets in their homes.58 Guarantees can also help develop local capital markets by backing municipal bonds and corporate bond issuances.

Another tool for mobilizing additional financing for the SDGs is financial bonds. Last year, the International Capital Market Association put together a framework for issuers, investors, and bond market participants and shared the principles that bonds needed to meet to qualify as green, social, or sustainability bonds (see Box 1).59 In FY 2019 alone, the International Finance Corporation (IFC) issued 37 green bonds in 11 different currencies that total $1.6 billion and are expected to generate over 3 million hours of renewable energy, the equivalent of the energy consumption of 260,000 homes for one year.60 According to the Climate Bonds Initiative, worldwide green bond issuance since 2007 has been close to $521 billion.61 Similarly, the IFC launched its social bond program in 2017 and has since issued 33 social bonds that total over $2.8 billion.62 Even further, the World Bank has issued SDG equity-linked bonds amounting to $217 million.63 Almost all of these bonds are linked to national governments keeping the risks low and attractive to investors, especially those who seek to support a good cause while also earning financial returns.64

Blended finance is one of the most popular approaches to increase financing for SDGs. DFIs are best known for their use of blended finance because many are government- backed institutions that use public money to reduce the risk for private investors.65 An example would be the U.S Development Finance Corporation (DFC), which can provide first-loss guarantees on projects to encourage participation from private investors in countries.66 A similar approach by the World Bank is the “cascade framework,” which aims to maximize financing for development by encouraging reforms first, followed by subsidies and then public investments.67

BOX 1: DIFFERENT TYPES OF BONDS

GREEN BONDS are any type of bond instrument where the proceeds will be exclusively applied to finance or refinance projects with clear environmental benefits, such as projects that support renewable energy, energy efficiency, pollution prevention and control, clean transportation, and more.68 In February 2019, the IFC committed to investing $75 million in the first-ever listed $300 million green bond issued by AC Energy Finance International Limited and guaranteed by AC Energy.69 This is the first infrastructure-focused green bond to be publicly listed in Southeast Asia, and IFC’s investment will fund 360 megawatts of solar and wind farms.70

SOCIAL BONDS finance projects that directly aim to address or mitigate a specific social issue or seek to achieve positive social outcomes such as providing affordable basic infrastructure, housing, employment generation, food security, and more.71 For example, the IFC is using social bonds to combat the effects of the Covid-19 pandemic by using proceeds to fund research and the development of tests and to provide loans to small businesses negatively impacted by the economic slowdown.72

SUSTAINABILITY BONDS are any type of bond instrument where the proceeds will be exclusively applied to finance or refinance a combination of green and social projects, such as the ones mentioned above.73 In 2018, the government- owned Korea East-West Power Corporation raised $500 million from investors for its first sustainability bond.74

SDG EQUITY-LINKED BONDS are bonds that link returns to the stock price performance of 50 select companies that promote the SDGs.75 The World Bank first launched these new bonds in Hong Kong and Singapore in December 2018, raising $3.52 million.76

INFRASTRUCTURE BONDS are borrowings to be invested in government-funded infrastructure projects within a country.77 The maturity of these bonds is often between 10 and 15 years, and some can be used for income tax deductions in countries such as India.78 Kenya has been successfully issuing infrastructure bonds since 2009 when the first bond was issued to raise $18.2 million to fund transport, energy, water, and irrigation projects.79

In the field of health care, advanced purchase commitments for vaccines could help encourage development and research that directly benefits lower-income populations.80 Approximately $3 billion would be needed to persuade pharmaceutical companies to invest in vaccines that are desperately needed in the developing world.81 Advanced purchase agreements for ***agricultural*** products can also support smallholder farmers by guaranteeing their crops will be sold.82 For example, the World Food Program (WFP) signed a $100 million multi-year contract with Africa Improved Foods (AIF), a partnership between Dutch State Mines (DSM), WFP, the Rwandan government, and various stakeholders like the IFC, that aims to increase the amount of essential vitamins and ***nutrients*** in food aid.83

This is not an exhaustive list of the financing tools available. The UNDP shares even more financing tools, such as lotteries, biodiversity offsets, disaster risk insurance, and debt for nature swaps that may be applicable in some countries.84 The financing gap for the SDGs will not be filled by one individual financing tool but by the use of many of the options laid out in unison, tapping into a variety of new sources of finance.CONCLUSION

As the world embarks on the “decade of action,” the Covid-19 pandemic threatens to derail progress toward the SDGs even further. Most countries will have to finance the goals through increased DRM, which will be even more difficult due to the economic consequences of the coronavirus. As financial risks increase in emerging markets, getting private capital into countries with the poorest populations will become even more difficult, meaning global philanthropic funds will have a bigger role to play in supporting global development and health research during the crisis. For example, the Bill & Melinda Gates Foundation has a long history of supporting vaccines for developing countries and recently just committed over $250 million to expand testing and find a cure for Covid-19.85

Many countries have introduced significant stimulus packages that, if directed appropriately, can save jobs and businesses and support the SDGs around the world.86 In the United States, larger public companies, and private universities have come under fire for taking stimulus money that was intended for smaller businesses.87 The public backlash has led the companies to agree to return $170 million that can now be used to keep smaller businesses afloat.88 Civil society groups in other countries should look to keep companies accountable and make sure that stimulus packages are benefiting marginalized groups. It is also important now more than ever that governments in developing countries share and publicize information about unemployment benefits and available government services.

“The coronavirus pandemic is not just a medical crisis, but a social and economic one too. We have a chance to save millions of jobs and enterprises, if governments act decisively to ensure business continuity, prevent layoffs and protect vulnerable workers.” - ILO Director-General Guy Ryder on March 27, 2020

Similarly, multilateral organizations such as the World Bank and IMF are introducing economic programs to respond to Covid-19. On April 2, 2020, the World Bank approved a group of projects amounting to $1.9 billion that will assist 25 countries, with the goal of providing $160 billion in financing over the next 15 months.89 The IMF has received calls for emergency financing from 102 countries so far and has doubled access to its emergency facilities to provide $100 billion in financing.90 There is an opportunity to tailor these programs toward women, children, and people living below the poverty line so they are better prepared when the next pandemic, drought, or natural disaster hits. Government stimulus packages could be delivered by mobile payment to reach groups without access to traditional banks or directed to the female heads of households who are more likely to invest additional income to support the basic needs of their families than men.91

Furthermore, developing countries should use the “decade of action” to pursue new sources of capital from the private sector to support the goals and focus on implementing commitments. It is important that private companies continue to see the benefits of supporting the goals and remain engaged. Many financing instruments, such as bonds and guarantees, can be used in unison on the same projects to bring together different actors from the public and private sectors and reduce the financial risks for all parties involved. Advanced purchase agreements could also be expanded to strengthen global health and ***agricultural*** supply chains. The international community should focus less attention on trying to invent new financing tools to plug the gap and instead focus efforts on expanding the use of these financing instruments that have already demonstrated their ability to support the SDGs.

The MDGs taught the world that it is possible to see progress on global development challenges within a short timeframe. Investments in new technologies and ***data*** ***collection*** will be crucial in determining the most effective responses to the current crisis and measuring progress to the SDGs at the same time. Now is the time for countries to use the SDG framework as an opportunity to coordinate action to tackle the current pandemic and become more prepared for the next economic crisis, pandemic, or social disruption.

**Load-Date:** May 9, 2020

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[***Dietary patterns are associated with obesity in Mexican schoolchildren***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2C1-JCWX-C1HD-00000-00&context=1516831)

European Journal of Clinical Nutrition

March 2020

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**Section:** Pg. 1201-1209; Vol. 74; No. 8; ISSN: 0954-3007,1476-5640

**Length:** 4642 words

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**Body**

Introduction

Chronic diseases are considered one of the main public health problems around the world nowadays []. Overweight (Ow) and obesity (Ob) are the risk factors for the development of cancer, diabetes, and cardiovascular diseases [], and it is becoming a big concern in public health because of its complications and rapid increase. Since 1975, Ob has tripled worldwide. The World Health Organization (WHO) has reported that about 39% of adults (>18 year) globally were affected by Ow and 13% by Ob; on the other hand, over 340 million children and adolescents (5–19 year) were Ow/Ob in 2016 []. In Mexico, in the last three decades, the prevalence of Ow and Ob has increased; in schoolchildren (5–11 year) from 1988 to 2012, the prevalence increases from 26.6 to 33.6% []. ***Data*** from the National Health and Nutrition Survey 2016 (ENSANUT-MC 2016) showed that the combined prevalence (Ow/Ob) in this age group was 33.2% [], but, even the decrease in the percentage from 2012 to 2016 was not statistically significant.

Ow and Ob are conditions that emerge from the imbalance between calories consumed and calories expended, in which the high intake of energy-dense foods (high in sugar and fat, and low in healthy ***nutrients***) combined with physical inactivity, results as one of the main attributable factors [, ]. However, as a multifactorial disease, other conditions, such as social and economic development, public health policies in different areas (related to the food systems as: ***agriculture***, transport, food processing, urban planning, etc.), and the food environment (distribution and food availability, marketing, etc.) [, ] as well as education, are involved and determine food consumption. For a long time, most nutrition research has focused on the study of individual ***nutrients*** and their association with health; however, due to the interactions of diverse ***nutrients*** in the diet, the dietary pattern approach to assess diet has been used to study the relation of nutrition and chronic conditions []. Since ***nutrients*** are not consumed in isolation, and the study of an isolated ***nutrient*** underestimates possible interactions between ***nutrients***, food, and other diet composition [], the dietary pattern approach results appropriately to evaluate a diet as a whole.

In developing countries, it has been observed that consumption of high-calorie foods in schoolchildren and adolescents is associated with the development of adiposity and risk of being Ow or obese in adulthood [], and to develop noncommunicable diseases [].

A systematic review reported that, despite differences in the methodology to perform DP between studies, it has been identified that a similar DP was characterized by high-energy-dense, high-fat, and low-fiber foods, and it was found that this pattern predisposes young people to later Ow and Ob [].

The relation between dietary habits and chronic noncommunicable diseases (NCDs) has been well-documented through epidemiological studies, which have provided evidence of the potential causal relationship between specific dietary factors and NCDs [].

Given the relation of dietary habits and NCDs, the increase in the prevalence of Ow and Ob in Mexican children, and its implication on health later in life, our study aimed to analyze the association between DP of the Mexican schoolchildren and Ow and Ob. We hypothesized that children, who consume a DP characterized by foods with refined carbohydrates, added sugar, junk food, and food ready to eat, would be associated with Ob in Mexican schoolchildren.

Materials and methods

Design and study population

This cross-sectional study was performed with ***data*** from the National Health and Nutrition Survey 2012 (ENSANUT-2012) ***collected*** from October 2011 to May 2012. ENSANUT is a probabilistic survey with national, regional, and urban/rural strata designed to be nationally representative [].

The study population included a subsample of 2783 children (boys and girls) between 5 and 11 years of age with available information on diet and anthropometry. After the cleaning process that considered energy intake (EI) (below −3 SD of the log ratio of EI to the estimated energy requirement (EER), n = 29, and above +3 SD, n = 1), and two more children who reported the consumption of two foods or fewer, which were excluded from this study, the analytic sample comprised 2751 children for the analysis.

Sociodemographic characteristics

We obtained information about age (years), gender, and some demographic characteristics. Region of the country was categorized into three: North, Center and Mexico City, and the South. Area of residence was identified as rural, for towns with fewer than 2500 inhabitants, and urban for towns with 2500 or higher. Tertiles of socioeconomic status (SES), classified as low, middle, and high SES, were obtained through an index constructed by using factor analysis (factor scores were estimated by using a principal-component approach), with information on characteristics of the dwelling, and possession of household goods [].

To classify the education level of the child’s mother and head of the household, we considered the degree achieved or grade completed. Detailed information is published elsewhere [].

Anthropometry

Weight and height were measured by trained and standardized personnel to estimate the body mass index (BMI) for age. Weight was measured with an accuracy of 100 g with an electronic balance, and the height using a stadiometer with a precision of 2 mm. The classification of Ow and Ob was considering the WHO reference pattern [].

The Z score >+1 and ≤+2 standard deviations (SD) was considered to define Ow, while a Z score >+2SD was considered to define Ob. Validated ***data*** were considered a Z score between −5.0 and +5.0. Values outside the range between 10 and 38 of the BMI, and in all cases when the height/age Z score was located outside the valid ***data*** (<−6 and >+6), were eliminated [].

Dietary information

Dietary information was obtained through a 24-h recall using the multistep method, which captures the food intake of the interviewees more accurately. More details of this method were published in another article [].

Participants were randomly selected. The child in conjunction with the mother, caregiver, or person in charge of feeding the child, completed the recall. The questionnaire was administered by trained personnel to obtain information on foods and beverages consumed by the children the day before the interview, including those foods consumed out of the home.

Dietary patterns

The foods reported were classified into 33 groups according to ***nutrient*** similarity or common usage (Table ). We converted food quantity to EI by using a food-composition database compiled by the National Institute of Public Health [].

Food group classification.

| **Food groups** | **Example of included food** |
| --- | --- |
| Tortilla | Corn tortilla and flour tortilla |
| Legumes | Beans, chickpeas, and lentil |
| Egg | Egg of any species |
| Sugar-sweetened beverages | Juice made from any natural fruit, sports drinks, and Aguas Frescasa |
| Bread and other cerealsb | Oatmeal, whole-grain cereal, salty bread, and non-sweet whole-grain cereals |
| Milk drinks with sugar | Atolec, smoothies, flavored milk, and milk beverages with sugar |
| Snacks made from flour, corn, or potato | Chips, popcorn, and potato sticks |
| Fast food | Burrito, gringad, hamburger, hot dog, and pizza |
| Desserts, pastries, and sweets | Desserts, candies, ice cream, pastries, and cakes |
| Industrialized beverages | Industrialized juice and soft drinks of any flavor |
| Meals made of tortilla or corn dough | Mainly Mexican food as tacos, sopes, and quesadillas |
| Cereals with sugar | Mexican sweet bread and sugary cookies of any kind |
| Meat and sausage | Meat of any kind, organ meats/met other organs, and sausages |
| Dairy drinks | Modified milk fat content and/or sugar, soy milk, and formula |
| Fruits | Any kind of fruit |
| Rice and pasta | Rice of pasta of any preparation |
| Tortase and sandwich | Ham croissant, molletef, sandwich of any kind, and tortas of any kind |
| Breakfast cereal with sugar | Chococrispis, Zucaritas, Nesquik, and Zucoso |
| Vegetable-based stews | Stew made of any vegetables |
| Vegetables | Any kind of vegetables |
| Fish and seafood | Tuna fish, seafood, and fish |
| Yogurt | Solid yogurt of any kind and petite suisse |
| Drinkable yogurt | Dairy drink with sugar (not solid) |
| Cheeses | Cheeses of any kind and any fat |
| Juices | Natural fruit juices and vegetables |
| Soups and broths | Including industrialized, cream soups based on milk |
| Potato | Potato of any preparation |
| Seeds and oils | Peanut, nut, oils, margarine, and avocado |
| Miscellaneous | Sauce and seasonings, dressings, and creams |
| Drinking water | Plain water |
| Drinks, unsweetened | Coffee or tea without sugar |
| Diet sodas | Diet sodas of any flavor, flavored water (light), and mineral water |
| Supplements and dietary supplement | Any supplements and dietary supplement |

aTraditional Mexican beverages usually prepared with fruit, water, and sugar.

bExcludes corn, rice, pasta, and cereals with sugar.

cTraditional Mexican beverages made with ground-cooked corn, diluted in water or milk boiled.

dDish based on flour tortilla, pork meat, and cheese.

eMexican food elaborated with bread (telera or bolillo), it is flit into half and filled with different ingredients. It can be served hot or cold.

fA Mexican dish made of bread that could be salty (with beans and cheese) or sweet (jam or spreadable butter).

The percentage of EI of each food group to the total EI was obtained by multiplying the energy derived from the food group by 100 and dividing by the total EI. We transformed the percentage of EI to standardized values by subtracting the mean and dividing by the SD to use in cluster analysis, using k-means convergence to classify into nonoverlapping groups based on eating patterns. The detailed process to perform the DP is published elsewhere [].

Ethical considerations

Before the application of the questionnaire, parents or guardians of the children signed an informed consent form, and children were asked for their assent to participate. The Ethics Committee of the National Institute of Public Health approved the ENSANUT-2012 and the consent form.

Identification of plausible reporters of energy

We used a specified method that identifies plausible reporters [] through the estimation of the ratio of reported EI and the EER []. The EER was calculated according to the U.S. Institute of Medicine formula for children and adolescents (3–18 years) [], and the cutoff point of the ratio EI:EER considered was ±1SD. A low physical activity was assumed for this study population based on estimations from the Mexican population []. The plausibility range of energy reporting was defined as the value of EI/EER between 0.57 and 1.58 of this ratio; thus, under- and overreporters were classified using EI/EER <1SD and >1SD, respectively.

Statistical methods

We performed descriptive ***statistics***. Continuous variables are presented as means with the SD and percentage with the confidence interval for categorical variables.

Comparisons between portions were performed by differences of proportions for the independent population. Robust regression modeling was used to test differences in ***nutrient*** intake across DP []. To test for multiple comparisons, the Bonferroni method was used by multiplying the observed P value by the total number of comparisons.

To analyze the association between DP and Ow and Ob, a Poisson regression model was used. We performed two models, without adjusting for other potential confounding variables, and adjusting by age, sex, region, area of residence, SES, and for the design of the survey. It is argued that the total EI should be included in the model, so we tested a model by adjusting for the total EI since it influences BMI, to determine whether adjustment for EI would change our estimates. The final model did not include the education levels of the mother variable due to a high correlation with SES. As a sensibility analysis, we did a secondary analysis restricted just to the sample with plausible energy reporting.

The 95% confidence interval (CI) was estimated, and a p value < 0.05 was considered as statistically significant. All the analyses were performed by using the Stata statistical package version 14 [], with the use of the STATA SVY module for complex samples.

Results

Schoolchildren’s means of age, weight, and length was 8.7 (SD ± 2.01) years, 29.8 (SD ± 10.03) kg, and 1.3 (SD ± 0.13) m, respectively (***data*** not shown in the table). The characteristics of the schoolchildren are presented in Table . About a third of children (33%) were affected by Ow or Ob. Regarding the distribution by sex, approximately half of the population were male and half were female, and boys were more obese than girls (61.2%). Most of the population sample was concentrated in the Center region of the country where the population had the highest percentage of Ow. The highest percentage of the population was concentrated in urban areas where it was more prevalent than the Ow and Ob conditions.

Sociodemographic characteristics of school-aged children (5–11 years) by nutrition condition from the 2012 Mexican National Health and Nutrition Survey (ENSANUT-2012).

| **Variable** |  | **Normal1868 (67.1%)a** | **Overweight525 (21.3%)a** | **Obesity358 (11.5%)a** |
| --- | --- | --- | --- | --- |
|  | ***n*** | **% (C.I.)** | **% (C.I.)** | **% (C.I.)** |
| Sex |  |  |  |  |
| ?Boys | 1.404 | 49.1 (45.8?52.4) | 49.2 (42.5?55.8) | 61.2 (54.6?67.4) |
| ?Girls | 1.347 | 50.9 (47.5?54.1) | 50.8 (44.1?57.5) | 38.7 (32.5?45.3) |
| Regionb |  |  |  |  |
| ?South | 1.009 | 37.3 (34.5?40.1) | 31.1 (25.8?36.8) | 27.1 (22.0?32.7) |
| ?Center | 1.140 | 46.1 (43.1?49.2) | 51.3 (44.8?57.8) | 47.6 (40.9?54.4) |
| ?Northb | 602 | 16.5 (14.8?18.4) | 17.6 (13.9?21.9) | 25.3 (20.0?31.5) |
| Areac |  |  |  |  |
| ?Rural | 1.061 | 32.9 (30.3?35.6) | 20.1 (16.2?24.7) | 22.1 (17.3?27.7) |
| ?Urban | 1.690 | 67.1 (64.3?69.7) | 79.9 (75.3?83.8) | 77.9 (72.2?82.7) |
| Socioeconomic statusd |  |  |  |  |
| ?Low | 1.052 | 39.1 (36.0?42.2) | 28.6 (22.7?35.3) | 22.5 (17.4?28.5) |
| ?Middle | 963 | 33.9 (30.8?37.1) | 36.9 (30.7?43.6) | 36.9 (30.3?43.9) |
| ?High | 736 | 26.9 (23.8?30.3) | 34.4 (28.1?41.2) | 40.6 (34.1?47.5) |
| Mother?s educational levele |  |  |  |  |
| ?None | 125 | 6.5 (4.9?8.6) | 3.2 (1.8?5.8) | 1.3 (0.5?3.1) |
| ?Elementary school | 937 | 35.0 (31.7?38.4) | 36.7 (30.1?43.8) | 27.1 (22.4?34.5) |
| ?Middle school | 970 | 37.7 (34.2?41.3) | 36.6 (30.1?43.6) | 35.3 (28.6?42.6) |
| ?High school | 444 | 16.4 (13.7?19.5) | 18.1 (13.8?23.4) | 27.8 (21.4?35.2) |
| ?Bachelor?s or higher | 125 | 4.4 (3.3?5.8) | 5.3 (3.4?8.1) | 7.5 (4.6?12.1) |

an = 2751. The n shown is unweighted and the percentages are weighted.

bNorth: Baja California, Baja California Sur, Coahuila, Chihuahua, Durango, Nuevo León, Sonora, and Tamaulipas; Center: Aguascalientes, Colima, Estado de México, Guanajuato, Jalisco, Ciudad de México, Michoacán, Morelos, Nayarit, Querétaro, San Luis Potosí, Sinaloa, and Zacatecas; South: Campeche, Chiapas, Guerrero, Hidalgo, Oaxaca, Puebla, Quintana Roo, Tabasco, Tlaxcala, Veracruz, and Yucatán.

cRural, <2500 inhabitants; urban, ≥2500 inhabitants.

dCalculated with principal-component analysis; includes household characteristics, goods, and services.

en = 2601, 150 observations with ***data*** missing.

Four dietary patterns were identified in Mexican schoolchildren (Fig. ). According to the percentage of energy contribution of each food group to the total diet (detailed information of the percentage of energy contribution has been published elsewhere []), and having a statistical differences (p < 0.05), the food groups that characterized the first pattern were tortilla, legumes, egg, sugar-sweetened beverages, and bread and other cereals. This pattern was labeled as “Traditional”. Milk drinks with sugar, snacks made from flour, corn, or potato, fast food, desserts, pastries and sweets, and industrialized beverages, characterized the second pattern, which was labeled as “Industrialized”. A third pattern, which included meals made of tortilla or corn dough, cereals with sugar, meat, and sausages, dairy drinks, fruits, and rice and pasta food groups, was labeled as “Varied”, while the last pattern identified, which included tortas and sandwich, and breakfast cereal with sugar food groups, was labeled as “Modern”.

Energy contribution of food groups by dietary patterns in Mexican schoolchildren.

Four dietary patterns were identified in Mexican schoolchildren: traditional, industrialized, varied and modern. Each dietary pattern was characterized by a greater presence of some food groups compared to the other patterns. Analysis from the ENSANUT-2012 (n = 2751), adjusted for the survey design and considering a p value < 0.05, adjusted by Bonferroni method.

Table shows the nutritional characteristics (macronutrients, simple carbohydrates, saturated fat, cholesterol, and fiber) of each dietary pattern. Children with an “Industrialized” DP had significantly higher total EI and energy percentage from fat, compared with the “Traditional” and “Modern” pattern, as well as a higher percentage of saturated fat compared with the rest of DP (p < 0.05). Those with a “Modern” DP showed the highest energy percentage from protein and cholesterol. On the other hand, children in the “Varied” pattern had the lowest consumption of cholesterol, and those in the “Traditional” DP had the highest energy percentage from carbohydrates, the highest consumption of fiber, and the lowest percentage of fat with respect to the rest of DP (p < 0.05). Regarding the consumption of simple carbohydrate, the “Traditional” DP had the lowest intake (117.4 g) compared with the rest of the DP (p < 0.05). The pattern with the highest consumption was the “Industrialized” (195.2 g), followed by the “Varied” pattern (173.5 g).

Nutrimental characteristics of dietary patterns identified in school-aged children (5–11 years) from the 2012 Mexican National Health and Nutrition Survey (ENSANUT-2012).

| **Variables** | **Traditionala*n* = 752; 24.4%** | **Industrializedb*n* = 541; 19.4%** | **Variedc*n* = 1154; 43.9%** | **Modernd*n* = 304; 12.2%** |
| --- | --- | --- | --- | --- |
| Total energy (kJ) | 7041 ± 3709b,c | 8426 ± 3755a,d | 7916 ± 3575a | 7246 ± 2838b |
| ?(kcal/d) | (1,682 ± 886)b,c | (2,013 ± 897)a,d | (1,891 ± 854)a | (1,731 ± 678)b |
| Carbohydrates |  |  |  |  |
| ?% of total energy | 58.2 ± 12.3b,c,d | 52.0 ± 9.3a | 52.4 ± 10.9a | 53.5 ± 8.7a |
| ?Grams | 250.0 ± 142.0 | 265.3 ± 130.1 | 250.0 ± 117.0 | 232.4 ± 93.0 |
| Simple carbohydrates |  |  |  |  |
| ?% of total carbohydrates | 26.9 ± 15.4b,c.d | 38.6 ± 11.4a,c | 35.7 ± 12.7a,b,d | 33.2 ± 10.3a,c |
| ?Grams | 117.4 ± 91.2b,c,d | 195.2a,c | 173.5a,b | 169.2a |
| Protein |  |  |  |  |
| ?% of total energy | 13.6 ± 4.6b | 12.4 ± 4.1a,c,d | 13.5 ± 4.8b | 14.1 ± 3.4b |
| ?Grams | 58.0 ± 35.3 | 61.0 ± 27.4 | 64.0 ± 40.4 | 61.0 ± 27.7 |
| Fat |  |  |  |  |
| ?% of total energy | 28.1 ± 10.9b,c,d | 35.6 ± 8.5a,d | 34.2 ± 9.0a | 32.4 ± 7.4a,b |
| ?Grams | 55.0 ± 41.6b,c,d | 82.0 ± 44.4a,d | 75.0 ± 43.5a,d | 65.0 ± 33.7a,b,c |
| Saturated fat |  |  |  |  |
| ?% of total fat | 8.7 ± 4.9b,c,d | 14.0 ± 4.0a,c,d | 12.8 ± 4.2a,b | 11.8 ± 3.9a,b |
| ?Grams | 16.8 ± 13.4b,c,d | 32.0 ± 17.8a,c,d | 27.6 ± 16.9a,b,d | 23.7 ± 13.6a,b,c |
| Cholesterol |  |  |  |  |
| ?Grams | 301.9 ± 334.8 | 289.8 ± 235.8 | 254.5 ± 255.2 | 335.9 ± 349.8 |
| Fiber |  |  |  |  |
| ?Grams | 26.4 ± 22.0b,c,d | 18.2 ± 13.0a | 18.5 ± 11.8a | 18.0 ± 13.2a |

Values are presented as means ± SD.

a,b,c,dIndicate statistically significant differences between dietary patterns, adjusted for survey design. p < 0.05, adjusted by the Bonferroni method.

A total of 353 and 391 sub- and overreporters, corresponding to 27% of the total sample, were identified (***data*** not shown in the table). The results of the regression models to evaluate the association between DP and the nutrition condition are shown in Table . Considering the “Traditional” DP as the reference, in the model without adjustment, and taking into account only the plausible reporters, the “Modern” DP was associated with Ow and Ob than those in the reference pattern. When we adjusted the model for sociodemographic variables, the association remained, and children with a “Modern” DP showed a prevalence ratio of being affected by Ob of 1.7 (p < 0.05), compared with those in the “Traditional” pattern.

Association between dietary patterns with overweight and obesity in Mexican school-aged children, ENSANUT-2012.

| **Dietary patterns** | **Without adjustment** | | | | **Adjustment by sociodemographic variablesa** | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **OverweightbPR** | **CI,95%** | **ObesitycPR** | **CI,95%** | **OverweightbPR** | **CI,95%** | **ObesitycPR** | **CI,95%** |
| Traditional | Reference |  |  |  |  |  |  |  |
| Industrialized | 1.0 | 0.7?1.4 | 1.7d | 1.1?2.5 | 0.8 | 0.6?1.1 | 1.2 | 0.8?1.9 |
| Varied | 1.1 | 0.8?1.5 | 1.7d | 1.2?2.4 | 0.9 | 0.6?1.3 | 1.4d | 0.9?2.0 |
| Modern | 1.6d | 1.1?2.4 | 2.2d | 1.5?3.3 | 1.4 | 0.8?2.1 | 1.8d | 1.1?2.8 |
|  | Plausible reporterse |  |  |  |  |  |  |  |
| Traditional | Reference |  |  |  |  |  |  |  |
| Industrialized | 1.2 | 0.8?1.7 | 1.4 | 0.9?2.1 | 0.9 | 0.6?1.5 | 1.1 | 0.7?1.8 |
| Varied | 1.2 | 0.8?1.7 | 1.4 | 0.9?2.1 | 1.0 | 0.7?1.5 | 1.3 | 0.8?1.9 |
| Modern | 1.7d | 1.1?2.6 | 1.9d | 1.2?3.0 | 1.4 | 0.9?2.3 | 1.7d | 1.0?2.8 |

aAge, sex, region, area, and SES.

bn = 2393 observations.

cn = 2226 observations.

dStatistically significant, p < 0.05.

eModel restricted to plausible reporters (model to overweight n = 1741; model to obesity n = 1601).

Discussion

In this study, a DP characterized by “Tortas and Sandwich”, and “Breakfast cereal with sugar” compared with a DP characterized by “Tortilla”, “Legumes”, “Egg”, “Sugar-sweetened beverages”, and “Bread and other cereals” is associated with Ob (PR: 1.7, CI 1.0–2.8). In addition, we could not define a pattern as healthy due to the fact that the energy contribution of healthy foods was low.

The “Traditional” DP could be considered as the healthiest pattern due to its nutritional characteristics; however, it showed a high percentage of EI from sugar-sweetened beverages, which has been positively related to Ob []. Also, the “Varied” DP that showed the highest intake of fruit, does not reach the intake recommendation from the WHO [].

Few studies have analyzed the association of DP with Ob or other outcomes related to Ob as adiposity in schoolchildren [–]. Even though they have used different statistical methods to perform the patterns, as well as different questionnaires to evaluate diet consumption, and despite the methodological differences, cultural, and geographic characteristics, some similarities regarding the dietary patterns reported among schoolchildren have been found.

In Canadian children, three patterns were found, and children with a fast-food pattern were more likely to be Ow. This pattern was also positively associated with waist circumferences, body fat mass percentage, and adiposity []. A study that evaluated DP and childhood Ob in China reported three DPs, and found that those with a modern pattern (characterized by milk, fast foods, eggs, other livestock meat, poultry, and cake) were more likely to be obese []. Another study conducted in Brazil in children from 6 to 12 year, identified two DPs: the prudent and the obesogenic pattern, which was characterized by sugars, typical Brazilian dishes, pastries, fast food, oils, milk, cereals, cakes, and sauces, and showed a significant positive association with BMI [].

The association of childhood Ob with a DP with characteristics of a western diet (with high consumption of sugary foods, high-fat diets, and low-fiber content) has been reported [, ]. In this study, all the patterns had a high consumption of simple carbohydrate (including intrinsic as added sugar).

It has been recognized that a high intake of free sugars threatens the ***nutrient*** quality of diets by providing energy without specific ***nutrients***, and promotes positive energy balance. The recommendation for free sugar intake by WHO is <10% of the total energy; however, all the dietary patterns from this study showed more than double or triple than recommended [].

Furthermore, regarding food groups, it has been documented that the breakfast cereal industry is the second leading food advertiser to children under age 12 in the United States []. In Mexico, breakfast cereals and ready-made food are part of the foods most frequently advertised []. These food groups were characteristic of the “Modern” pattern, which showed the highest association with Ob in Mexican children, so the advertising of these foods could lead to the consumption in this population, and may influence Ob in children.

On the other hand, the WHO recommends an intake of less than 30% of total EI from fats to prevent unhealthy weight gain and <10% of saturated fat [], since this type of fat increases low-density lipoprotein and cholesterol concentration in plasma. In this study, the “Industrialized”, “Varied”, and “Modern” DP, which were associated with Ob, had a higher percentage than this recommendation.

The excess consumption of sugar, which is related to the apparition of NCDs and the risk of weight gain [], along with high consumption of fat and saturated fat, could be an explanation of the increases in the prevalence of Ow and Ob in Mexican children.

Many foods consumed by Mexican schoolchildren have high content of ***nutrients*** of concern, which promote an excess in EI, and hence the appearance of these health conditions []. In order to avoid increases in the prevalence of these diseases, quality and access to food must be improved. To achieve this goal, the participation of the food industry in the innovation and reformulation of products is essential in order to provide healthier food for healthier diets.

We are aware that this study has several limitations. This is a cross-sectional study design analysis, so we cannot infer causality between dietary patterns and the risk of Ob. Regarding the tool to assess diet, the use of a single 24-h recall is not adequate to account for the habitual intake, and it leads to systematic error; however, there is a suitable method to describe a population’s intake. Further, there were also national estimations so that they are nationally representative.

Moreover, a strength is that the questionnaire was administered by personnel trained by using the multistep method, and captured directly by decreasing capture errors []. Furthermore, this method is useful to obtain a more accurate recall with less systematic error, and with the Mexican 24-h instrument, is able to predict the expected dietary EI []. On the other hand, we obtained detailed information on food and beverage consumption, and the food reported was disaggregated in its ingredients, so we were able to have a better estimate of food group consumption to perform the patterns.

With respect to the methodology to perform dietary patterns, these are somewhat subjective when selecting the statistical method [], the number of clusters [], as well as in the food group conformation and the label assigned to each pattern. Diet information was obtained by self-report through a questionnaire, so the results may affect internal validity. Besides, the person in charge of feeding the child reported the diet of her/his child, so the person may not be fully aware of food consumed out of the home.

It has been reported that obese or Ow people tend to sub- or overreport foods [], or omit some others that they perceived as unhealthy [], so this should be considered since we are assessing diet in relation to children with these health conditions. Another limitation is that we did not account for physical activity and time the kid expends in front of a screen, which are important determinants of Ob [, ], so we could not know how these variables could influence the prevalence ratio.

Despite the limitations, this study has a large sample size, and it was designed to be representative of the Mexican population, allowing generalizing the results to the country.

Conclusions

In conclusion, a “Modern” pattern characterized by tortas and sandwiches, as well as breakfast cereals with sugar, was associated with Ob in Mexican children. Even though we did not identify a pattern as healthy, adopting a traditional DP by modifying the consumption of sugar-sweetened beverages (which was higher in this pattern) and replacing them by healthy foods such as vegetables and fruits, could protect against Ow and Ob in this population.

This study supports the evidence on the consumption of dietary patterns that are high in sugar, fat, and saturated fat content, which may lead to childhood Ow and Ob in Mexico.

Policymakers and public health advocates in Mexico should implement strategies to promote healthy food consumption. Also, to support actions such as product reformulation and regulation in marketing on food with high content of ***nutrients*** of concerns aimed at children, to improve food choices and access to healthier food, as an attempt to reverse the increasing prevalence of Ow and Ob in Mexican children.

**Notes**

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**Load-Date:** May 3, 2023

**End of Document**



[***Executive summary for the final impact assessment of the UK-Japan Comprehensive Economic Partnership (CEPA)***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6157-1B21-JDG9-Y3TR-00000-00&context=1516831)

Impact News Service

October 24, 2020 Saturday

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**Length:** 2701 words

**Body**

London: UK Government has issued the following news release:

This executive summary duplicates the executive summary in the Final impact assessment of the agreement between the United Kingdom of Great Britain and Northern Ireland and Japan for a comprehensive economic partnership pdf

The UK and Japan are the world’s fifth and third largest economies respectively, together accounting for 9.2% of global gross domestic product (GDP) in 2018 (source: World Bank Indicators, GDP, current $). Total trade between the UK and Japan was worth an estimated £31.6 billion in 2019, accounting for 2.2% of total UK trade (source: Office for National ***Statistics***, UK trade, quarterly trade in goods and services tables: October to December 2019). Japan was the sixth largest investor in the UK, with £89.2 billion invested in the UK in 2018 (source: Office for National ***Statistics***, foreign direct investment totals for inward and outward flows, positions and earnings: 2017 to 2018). The UK was the fourth largest investor in Japan in the same year, with US$23.3 billion (£17.5 billion) invested in Japan (source: Japan External Trade Organisation, Japan’s Inward foreign direct investment 2018).

Since February 2019, the UK and Japan have traded under the terms of the EU-Japan Economic Partnership Agreement (EPA). The EU-Japan EPA will cease to apply in the UK following the end of the UK’s transition period in January 2021.

The UK and Japan have negotiated the Agreement between the United Kingdom of Great Britain and Northern Ireland and Japan for a Comprehensive Economic Partnership (referred to as UK-Japan CEPA in this document) which, if ratified, will enter into force in January 2021. The agreement aims to ensure the continuity of the existing UK-Japan trading relationship following the end of the UK’s transition period and to enhance the UK and Japan’s trade and investment relationship further.

This impact assessment aims to provide parliament and the public with a comprehensive assessment of the implementation of the UK-Japan CEPA in the long run prior to ratification of the agreement (this impact assessment provides an update to the analysis undertaken in the scoping assessment published in May 2020. The long run is generally assumed to represent around 15 years from implementation of the agreement). The assessment draws upon a wide range of ***data*** and evidence, including a modelling exercise undertaken by Professor Joe Francois to generate quantitative predictions of the scale and distribution of trade and macroeconomic impacts. The impacts of the agreement are assessed against a baseline where the UK and Japan do not have a free trade agreement, as this represents the default situation (that is, what would happen without ratification).

The impacts of the agreement

The negotiated UK-Japan CEPA is a deep and comprehensive trade agreement, covering 24 chapters. The agreement builds upon the existing trading and investment relationship set out in the EU-Japan EPA in several areas of mutual interest. The UK-Japan CEPA goes further than the EU agreement in a number of key areas such as digital trade, financial services and rules of origin. The Parliamentary report highlights areas where there are material changes and enhancements to the existing EU-Japan EPA (DIT, ‘The United Kingdom’s Future Trading Relationship with Japan’, 2020).

The provisions of the UK-Japan CEPA offer substantial reductions in tariffs and the removal or reduction in non-tariff measures affecting trade in goods and regulatory restrictions applying to services trade (note that tariff reductions apply to goods that meet Rules of Origin requirements). The agreement also includes provisions which enhance economic cooperation between the UK and Japan, provide greater certainty to exporters and investors and encourage utilisation of the agreement by small and medium-sized businesses (SMEs).

Enhanced trade and investment

Reduced trade costs and increased trade

Trade costs are the costs associated with trading internationally across borders and can be significant. The UK-Japan CEPA is expected to reduce tariff and non-tariff trade costs between the UK and Japan. In line with the negotiated tariff schedules and the trade cost reductions associated with similar deep trade agreements in the past, the modelling exercise assumes that the agreement reduces trade costs by an average of around 2.8 percentage points for UK exporters to Japan and 2.3 percentage points for Japanese exporters to the UK in the long run (simple average of total average tariff and non-tariff cost reductions, external CGE modelling). The modelled trade cost reductions vary markedly across goods and services sectors reflecting the historical evidence of the sectoral impacts of FTAs as well as the provisions of the UK-Japan CEPA.

In the long run, the trade costs reduced by the UK-Japan CEPA are estimated to drive an increase in UK exports to Japan by 17.2% or £2.6 billion and UK imports from Japan by 79.9% or £13 billion when compared to 2019 levels. Therefore, in the long run overall bilateral trade between the UK and Japan is estimated to increase by 50% or £15.7 billion when compared to 2019 levels.

Although UK-Japan bilateral trade is estimated to increase significantly in the long run, total UK trade with all countries (including Japan) is expected to result in a more modest increase in trade given the share of UK-Japan trade (2.2% of total UK trade) with UK exports to and UK imports from all countries (including Japan) estimated to increase by 0.58% and 0.51% respectively in the long run. Overall, in the long run total UK exports and imports to the world are expected to result in a 0.5% or £7.8 billion increase when compared to 2019 levels.

Trade is an important source of jobs for UK workers. Latest available estimates suggest that around 167,000 jobs in the UK were supported by exports to Japan in 2015 (source: Organisation for Economic Co-operation and Development Trade in Employment database, last updated: March 2019). Increases in export opportunities are an important source of growth and economies of scale for UK businesses.

UK trade with Japan is important to the UK economy as:

* just over three quarters of UK imports from Japan are estimated to be intermediate or capital goods used in UK production (source: United Nations, Classification by Broad Economic Categories Rev.5, 2018: passenger motor vehicles have been included within the consumer goods category. Broad economic categories has limitations as a source for identifying goods for intermediate use).

1. increases in imports of intermediate goods help to drive increased business competitiveness, increase their integration in global supply chains and reduce prices.
2. increases in imports of final products could offer better quality and choice for consumers.

Reduced regulatory restrictions and increase trade in services and digital

Trade in services is important to both the UK and Japan. Services accounted for 80% of UK GDP in 2019 and 39% of the value of UK trade with the world in 2019 (source: Office for National ***Statistics***, GDP output approach – low-level aggregates). Services exports to Japan were worth £8.0 billion in 2019, which accounts for 52% of all UK exports to Japan (source: Office for National ***Statistics***, UK trade, quarterly trade in goods and services tables: January to March 2020).

The UK-Japan CEPA contains several chapters which aim to reduce unnecessary barriers to services trade arising from domestic regulations, including the ‘trade in services, investment, and electronic commerce’ and ‘intellectual property’.

From an economic perspective, the provisions reduce trade and investment costs for services through removing barriers and ensuring fair competition. For example, the agreement reaffirms commitments to non-discriminatory treatment of domestic and foreign businesses and removes several restrictions on businesses seeking to expand existing trade in Japan or enter the market for the first time. These include, for example, prohibiting restrictions on the number of UK service suppliers seeking to trade in Japan and removing the need for businesses to complete economic needs tests prior to establishing presence in Japan.

Several provisions reduce trade costs by providing greater certainty to service suppliers, such as through increased commitments on clarity and transparency of application and licensing procedures for service suppliers seeking to operate in each other’s countries. The agreement contains provisions on the movement of natural persons for business purposes, referred to as mode IV services trade. These provisions will help ensure that UK professionals have certainty of entering Japan through a number of routes to provide services or establish, with clearer and streamlined processing for temporary business visas.

Digital and ***data*** provisions in the UK-Japan CEPA go beyond the existing arrangements under the EU-Japan EPA to reduce costs by providing greater policy certainty for UK and Japanese service suppliers. For example, the agreement contains commitments to uphold the free flow of ***data***. These commitments provide business the assurances they need that they can ***collect***, process, and transfer ***data*** between the 2 countries, without facing unnecessary red tape while maintaining commitment to the UK’s ***Data*** Protection Act 2018. The free flow of ***data*** is essential in many industries and sectors to run operations smoothly.

In line with the scale of trade cost reductions associated with similar deep trade agreements in the past, the modelling exercise assumes that in the long run non-tariff costs facing services sectors are reduced by an average of 0.6 percentage points for Japanese exporters and 1.6 percentage points for UK exports, although the trade cost reductions vary markedly across services sectors.

As a result, trade in services between the UK and Japan is estimated to increase by 46% in the long run. The largest increases in exports are expected to be in Financial services, Insurance and Business services.

Increased certainty for investors

The UK and Japan have close investment ties, most notably in the UK’s automotive industry. Japan accounted for 5.9% of the total UK inward foreign direct investment (FDI) stock in 2018. Japanese ***data*** shows the UK was the 2nd largest destination for outward Japanese FDI (source: Japan External Trade Organisation, Japan’s Outward FDI 2018).

The agreement contains provisions aimed at securing the liberalisation of FDI between the UK and Japan. The agreement enables the establishment and operation of enterprises in each other’s country by committing to open market access as well as non-discriminatory treatment. The agreement ensures that UK and Japanese entrepreneurs and enterprises seeking to invest in each economy are able to do so on an equal footing via specific provisions on national treatment and most-favoured-nation treatment (Article 8.8 National Treatment and article 8.9 most-favoured-nation treatment). This means that the treatment of businesses is equal to domestic and third country businesses, which in turn underpins certainty for businesses seeking to invest. Furthermore, enterprises seeking to invest are not required to appoint individuals of any particular nationality as executives, managers or members of boards of directors (Article 8.10 Senior Management Board of Directors). Importantly, the agreement prohibits conditions on performance requirements before enterprises can invest. This includes requirements on the minimum export threshold, minimum domestic content and transfer of technology to domestic industry (Article 8.11 prohibition of performance requirements).

The modelling exercise does not explicitly model the impact of the agreement on FDI. Reflecting changes in relative rates of return and the wider impacts of the agreement, domestic business investment is estimated to increase by 0.02% in the long run (external CGE modelling).

Increased trade in goods

Trade in goods represented 61% of all UK trade and 53% of UK exports in 2019 (source: Office for National ***Statistics***, UK trade, quarterly trade in goods and services tables: January to March 2020). Of all UK exports to Japan in 2019, 48% were goods and around 9,500 UK businesses exported goods to Japan in 2018. All nations and regions of the UK traded goods with Japan in 2019.

Several chapters of the UK-Japan CEPA contain provisions aiming to remove or reduce barriers to trade in goods. These include chapters on tariffs and rules of origin, as well as non-tariff measures, such as customs facilitation and technical barriers to trade.

The agreement substantially reduces tariffs on UK exports to Japan which can generate opportunities for UK businesses through maintaining or increasing competitiveness, particularly when compared to businesses exporting to Japan from countries without an FTA. 39% of Japan’s tariff lines are duty free. The UK-Japan CEPA liberalises a further 45% of tariff lines at entry into force, with a further 11% being liberalised in the long run. This equates to 98% of UK goods exports being liberalised at entry into force, rising to 99% in the long run. This compares to 88% of UK goods exports entering duty free in a situation where the UK and Japan do not have an agreement.

Based upon 2019 trade flows, the estimates suggest that annual duties on UK exports to Japan could reduce by £30.4 million in the short term, with a £34.9 million reduction in the long term (DIT internal analysis. Japan trade ***statistics*** portal 2019. Short term is defined as tariff savings in 2021 and long term is tariff savings from 2038 onward). The largest reductions in export duties occur in the textiles, animal and animal products and chemical products. The export opportunities are estimated to benefit all nations and regions of UK, with particular benefits for London and Scotland which account for 9% and 8% of UK goods exports to Japan respectively but, based upon the pattern of Japanese tariffs and regional exports, are estimated to benefit from 17% and 16% of overall tariff reductions on UK exports.

Annual reductions in tariffs on UK imports from Japan are estimated to be £137.1 million, with £44.7 million on imported intermediate goods and £92.5 million on consumer goods in the long term (source: DIT internal analysis. ***Eurostat***, 2019. Short term is defined as tariff savings in 2021 and long term is tariff savings from 2038 onward). Consumers are expected to benefit most from tariff reductions on recreational goods and transport goods (such as cars), which accounted for 15% and 16% of household consumption baskets in 2018. If passed on, consumers could benefit from lower prices and increased choice.

The agreement contains substantive provisions, aimed at reducing non-tariff costs to trade, including measures which support the protection of the UK’s geographical indicators for ***agricultural*** goods such as Scottish farmed salmon and West Country farmhouse cheddar cheese and measures which support UK industry such as the commitments to apply relevant industrial standards which reduce the administrative costs associated with trading.

In line with the tariff schedules and the scale of trade cost reductions associated with similar deep trade agreements in the past, the modelling assumes tariff cost reductions in goods sectors of an average of around 2.9 percentage points for Japanese exporters and 3.3 percentage points for UK exporters. For non-tariff costs the modelling assumes an average reduction of 2.4 percentage points for Japanese exporters and 2.9 percentage points for UK goods exporters. The assumed trade cost reductions do however vary markedly across goods sectors. Under the UK-Japan CEPA, both parties have largely eliminated duties on most goods, particularly on ***agriculture***, forestry and fishery products, and on industrial products, the former being more relevant for the UK, and the latter for Japan.

Taking these factors into account, trade in goods between the UK and Japan is estimated to increase by 53% as a result of the agreement. The largest increases in exports are expected in ‘textiles and leather’, ‘***agriculture***’ and ‘processed foods’.

**Load-Date:** October 27, 2020

**End of Document**



[***Association between the 10-year predicted risk of atherosclerotic cardiovascular disease and dietary patterns among Canadian adults 40–79 years***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2C1-JCWX-C1R9-00000-00&context=1516831)

European Journal of Clinical Nutrition

October 2020

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**Section:** Pg. 636-644; Vol. 75; No. 4; ISSN: 0954-3007,1476-5640

**Length:** 4463 words

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**Body**

Introduction

Atherosclerotic cardiovascular diseases (ASCVD) are among the top causes of mortality in Canada []. This makes effective preventive strategies a priority in order to reduce the burden on the health sector. One approach is to identify people with high risk of developing ASCVD using cardiovascular health assessment tools such as the ASCVD risk equations or the cardiovascular age gap (CAG) tool []. In 2013, the American College of Cardiology/American Heart Association recommended assessing the 10-year risk of ASCVD for ages 40–79 years using pooled cohort based risk assessment equations []. In addition, CAG, which is the difference of the vascular age and chronological age, has been of interest to researchers in the field of ASCVD prevention []. This tool is a beneficial approach in conveying cardiovascular risk messages to the general population [].

Diet is an important factor in developing and preventing ASCVD. Accordingly its association with ASCVD is of interest to researchers. Dietary patterns present a holistic picture of the real life usual diet rather than the conventional approach of looking into one ***nutrient*** at a time []. This approach allows researchers to understand how foods that provide combinations of related ***nutrients*** and have synergistic effects on one another might influence ASCVD [–].

The Canadian Health Measures Survey (CHMS), conducted bi-yearly since 2007, is the only national survey that has ***collected*** ***data*** from children, adolescents and younger and older adults, which includes both objective health measures and dietary intake ***data*** []. It permits calculation of 10-year ASCVD risk and laboratory-based CAG. For the first time, we aimed to determine the 10-year ASCVD risk and CAG of Canadian adults within the age range of 40–79 years and across sociodemographic, lifestyle, metabolic and medication using factors; and to evaluate the associations of ASCVD risk and CAG and dietary pattern among this population.

Subjects and methods

Participants and study design

CHMS has been conducted by ***Statistics*** Canada in collaboration with Health Canada and the Public Health Agency of Canada. Health Canada’s Research Ethics Board provided ethics approval for this survey [, ]. Respondents’ consents were obtained before their participation [, ]. Cycles 1 and 2 were conducted from 2007 to 2011 and consisted of 5600 (age 6–79 years) and 6400 (age 3–79 years) respondents, respectively [, ].

This survey covers ~96% of the target population []. Those excluded in the survey include institutionalised residents, Canadians living on reserves, in remote regions, and the Canadian Forces full-time members []. ***Data*** from CHMS Cycles 1 and 2 was used but only for those participants aged 40–79 years who had a fasted blood sample [, ].

The combined fasted sub-sample response rate was 47.2% compared to the full sample response rate of 53.5% []. Further, pregnant women and those having cardiovascular disease (CVD) were omitted for descriptive analysis. For the analysis of the association of diet and ASCVD risk and CAG, additionally people with hypertension and diagnosed type 2 diabetes were excluded due to the likelihood of having a modified diet based on recommendations they received from health professionals []. The total number of respondents included in this study was 2088 participants, which were representative of 13,655,671 Canadians age 40–79 years.

Estimated 10-year ASCVD risk and CAG for ages 40–79 years

The estimated 10-year ASCVD risk is the probability of a first hard ASCVD within the next 10 years []. The estimated 10-year ASCVD risk of ages 40–79 years was determined using equations developed from a pooled cohort presented by American College of Cardiology/American Heart Association Guidelines in 2013 []. The outcome for this method is the first hard ASCVD that includes non-fatal myocardial infarction, coronary heart disease death and stroke (fatal or non-fatal). The risk factors included in these equations were age, total cholesterol level, high-density lipoprotein cholesterol level, systolic blood pressure, blood-pressure medication usage, diabetes and smoking status. The risk was calculated as 1 minus the baseline survival rate raised to the power of the exponential of the sum of ʻcoefficient × individual values’ minus the sum of the age and ethnic-specific value as indicated in Eq. 1 [].

where, ʻS’ is the survival rate at 10 years, ʻin’ is the individuals’ values and ʻm’ is the race- and sex-specific overall mean. The risk was used as continuous for descriptive analysis, and it was dichotomised into low and high categories with the cut-off of 7.5% (7.5% included as high risk) [] for regression analysis.

The CAG was determined using sex-specific score sheets presented in D’agostino et al. []. These score sheets included the following variables: age, high-density lipoprotein cholesterol level, total cholesterol, treatment of systolic blood pressure, smoking status and diabetes status []. Based on the range the value would fall in for each of the aforementioned variables, points were allocated and the sum of the points would be used to indicate the CAG.

Risk factors

Smoking was defined as ever smoker and non smoker. Diabetes was considered based on the fasting plasma glucose level of ≥7 mmol/L or self-reported diagnoses of diabetes by a health professional. For more information regarding the procedure of taking the objective measurement, refer to CHMS user guide [, ]. The unified criteria of metabolic syndrome [] and the ethnic/country specific cut-offs for waist circumference were used [].

Medication users

In CHMS each respondent was asked to report all the medications they were using. The medication ***data*** file was prepared based on the reported medication’s Anatomical Therapeutic Chemical code. Anatomical Therapeutic Chemical codes of C10A (excluding C10A) and C10B were categorised as blood lipid-lowering medication users []. Respondents that reported using ATC codes including C02, C03, C07, C08 and C09 (excluding C02KX01, C03BA08, C03CA01, C07AA07, C07AA12 and C07AG02) [] or self-reported using blood-pressure lowering medication in the past month were categorised as antihypertensive medication users.

Dietary assessment and dietary pattern analysis

The usual dietary intake ***data*** were ***collected*** using a food frequency questionnaire included in the CHMS household questionnaire [, ]. We used the response to 32 questions on food/food groups from the food frequency questionnaire that are indicated in Table of the . This tool was developed to complement the physical and laboratory measurements. It included questions on milk and dairy product; meat; grains, fruits, and vegetables; dietary fat; and water/soft drink consumption []. The 32 food groups were the input variables for the principal component analysis (PCA, PROC FACTOR). Using PCA, uncorrelated components were obtained from the 32 correlating food intake variables. Factors were retained based on a combination of scree plot, Kaiser criterion and interpretability. Eleven dietary patterns had eigenvalues of above 1 based on Kaisers criterion, which explained about 52% of the variation in the ***data***. For better interpretation, we retained only four dietary patterns to assess their association with ASCVD risk that explained 21.69% of the variance in the dietary intake ***data*** []. The Varimax rotation method was used to obtain more interpretable results []. The names of the dietary patterns reflect the content of those foods with a factor loading cut-off of ±0.3.

Mean 10-year atherosclerotic cardiovascular disease risk and vascular age gap across different factors, Canadians Health Measures Survey combined Cycles 1 and 2, 2007–11 (2088 respondents, which were representative of 13,655,671 Canadians aged 40–79 years).

|  | **10-y estimated ASCVD risk mean ± SE (95% CI)** | ***P* value** | **CAG estimated mean ± SE (95% CI)** | ***P* value** |
| --- | --- | --- | --- | --- |
| Total (40?79 y) | 6.91 ± 0.22 (6.46?7.36) |  | ?1.76 ± 0.53 (?2.84?0.67) |  |
| Sociodemographic and lifestyle factors |  |  |  |  |
| Age by 10 years (y) |  |  |  |  |
| ?40?49 ya | 2.10 ± 0.16 (1.76?2.44) |  | 1.39 ± 0.62 (0.10?2.68) |  |
| ?50?59 y | 5.09 ± 0.39 (4.29?5.90) | **<0.0001** | ?2.75 ± 1.16 (?5.15?(?0.35)) | **0.007** |
| ?60?69 y | 10.36 ± 0.35 (9.64?11.08) | **<0.0001** | ?3.63 ± 0.72 (?5.12?(?2.14)) | **<0.0001** |
| ?70?79 y | 26.29 ± 0.98 (24.28?28.30) | **<0.0001** | ?7.68 ± 1.10 (?9.95?(?5.40)) | **<0.0001** |
| Sex |  |  |  |  |
| ?Malea | 9.08 ± 0.34 (8.38?9.79) |  | ?4.11 ± 0.61 (?5.37?(?2.84)) |  |
| ?Female | 4.9 ± 0.24 (4.40?5.40) | **<0.0001** | 0.42 ± 0.67 (?0.95?1.80) | **<0.0001** |
| Immediate family member having premature cardiovascular diseases |  |  |  |  |
| ?Yesa | 6.46 ± 0.36 (5.71?7.22) |  | ?3.08 ± 0.86 (?4.86?(?1.29)) |  |
| ?No | 6.94 ± 0.24 (6.45?7.44) | 0.233 | ?1.02 ± 0.45 (?1.94?(?0.1)) | **0.008** |
| Education level |  |  |  |  |
| ?Less than secondarya | 13.35 ± 1.21 (10.86?15.84) |  | ?6.84 ± 1.18 (?9.28?(?4.39)) |  |
| ?Secondary | 7.43 ± 0.71 (5.96?8.90) | **<0.0001** | ?3.66 ± 1.55 (?6.86?(?0.46)) | 0.128 |
| ? Other post-secondary | 6.02 ± 0.77 (4.43?7.62) | **<0.0001** | ?1.14 ± 1.91 (?5.09?2.81) | **0.025** |
| ? Post-sec graduate level | 6.14 ± 0.29 (5.54?6.74) | **<0.0001** | ?0.67 ± 0.51 (?1.73?0.38) | **<0.0001** |
| Income level |  |  |  |  |
| ?Lowest-incomea | 8.71 ± 1.48 (5.65?11.77) |  | ?6.33 ± 1.73 (?9.90?(?2.76)) |  |
| ?Lower-middle income | 8.53 ± 0.73 (7.02?10.04) | 0.913 | ?3.83 ± 1.33 (?6.57?(?1.08)) | 0.896 |
| ?Upper-middle income | 8.33 ± 0.47 (7.36?9.31) | 0.811 | ?3.41 ± 0.88 (?5.22?(?1.60)) | 0.778 |
| ?Highest income | 5.48 ± 0.27 (4.92?6.03) | **0.043** | 0.12 ± 0.49 (?0.90?1.14) | **0.047** |
| Having a family doctor |  |  |  |  |
| ?Yesa | 7.08 ± 0.24 (6.58?7.57) |  | ?1.68 ± 0.56 (?2.83?(?0.54)) |  |
| ?No | 5.57 ± 0.65 (4.23?6.92) | 0.054 | ?2.33 ± 1.30 (?5.02?0.37) | 0.64 |
| Physical activity |  |  |  |  |
| ?Activea | 6.22 ± 0.52 (5.15?7.29) |  | 0.77 ± 0.86 (?1.01?2.54) |  |
| ?Moderately active | 6.70 ± 0.42 (5.84?7.56) | 0.531 | 0.53 ± 0.66 (?0.84?1.90) | 0.823 |
| ?Inactive | 7.30 ± 0.31 (6.67?7.93) | 0.082 | ?3.84 ± 0.66 (?5.20?(?2.48)) | **<0.0001** |
| Smoking status |  |  |  |  |
| ?Non smokera | 6.56 ± 0.25 (6.03?7.08) |  | 0.70 ± 0.44 (?0.21?1.61) |  |
| ?Smoker | 8.22 ± 0.60 (6.97?9.46) | **0.027** | ?10.75 ± 1.09 (?13?(?8.51)) | **<0.0001** |
| Drinking alcohol |  |  |  |  |
| ?Evera | 6.89 ± 0.28 (6.30?7.48) |  | ?1.73 ± 0.61 (?2.99?(?0.48)) |  |
| ?Never | 7.02 ± 0.66 (5.66?8.37) | 0.878 | ?1.87 ± 1.00 (?3.94?0.20) | 0.911 |
| Metabolic and medication use |  |  |  |  |
| Having at least one MetS component |  |  |  |  |
| ?Yesa | 8.64 ± 0.27 (8.09?9.20) |  | ?5.49 ± 0.65 (?6.83?(?4.16)) |  |
| ?No | 2.83 ± 0.19 (2.44?3.22) | **<0.0001** | 7.05 ± 0.28 (6.48?7.62) | **<0.0001** |
| Having at least two MetS components |  |  |  |  |
| ?Yesa | 10.59 ± 0.39 (9.78?11.40) |  | ?9.14 ± 0.71 (?10.61?(?7.67)) |  |
| ?No | 4.09 ± 0.18 (3.72?4.46) | **<0.0001** | 3.91 ± 0.40 (3.08?4.74) | **<0.0001** |
| Having at least three MetS components |  |  |  |  |
| ?Yesa | 13.54 ± 0.93 (11.63?15.45) |  | ?13.36 ± 0.95 (?15.32?(?11.39)) |  |
| ?No | 5.39 ± 0.23 (4.90?5.87) | **<0.0001** | 0.91 ± 0.46 (?0.03?1.86) | **<0.0001** |
| Having at least four MetS components |  |  |  |  |
| ?Yesa | 16.08 ± 1.44 (13.11?19.04) |  | ?21.01 ± 1.78 (?24.69?(?17.33)) |  |
| ?No | 6.43 ± 0.24 (5.95?6.92) | **<0.0001** | ?0.75 ± 0.50 (?1.78?0.28) | **<0.0001** |
| Abdominal obesity |  |  |  |  |
| ??Yesa | 8.32 ± 0.46 (7.37?9.27) |  | ?5.40 ± 0.80 (?7.06?(?3.74)) |  |
| ??No | 5.75 ± 0.36 (5.02?6.49) | **0.001** | 1.24 ± 0.55 (0.11?2.37) | **<0.0001** |
| Reduced high-density lipoprotein cholesterol level |  |  |  |  |
| ?Yesa | 7.79 ± 0.47 (6.82?8.76) |  | ?7.17 ± 0.84 (?8.9?(?5.45)) |  |
| ?No | 6.59 ± 0.28 (6.02?7.16) | 0.056 | 0.25 ± 0.50 (?0.78?1.28) | **<0.0001** |
| Elevated triglycerides levels |  |  |  |  |
| ?Yesa | 9.16 ± 0.43 (8.26?10.06) | **<0.0001** | ?9.27 ± 0.92 (?11.17?(?7.37)) | **<0.0001** |
| ?No | 6.02 ± 0.31 (5.38?6.65) |  | 1.24 ± 0.56 (0.08?2.39) |  |
| Elevated fasting plasma glucose |  |  |  |  |
| ?Yesa | 12.13 ± 0.57 (10.95?13.31) | **<0.0001** | ?9.49 ± 0.99 (?11.53?(?7.45)) | **<0.0001** |
| ?No | 5.06 ± 0.22 (4.6?5.52) |  | 0.98 ± 0.42 (0.11?1.86) |  |
| Elevated blood pressure |  |  |  |  |
| ?Yesa | 11.88 ± 0.37 (11.11?12.64) |  | ?10.13 ± 0.74 (?11.67?(?8.6)) |  |
| ?No | 3.92 ± 0.14 (3.62?4.22) | **<0.0001** | 3.29 ± 0.47 (2.33?4.25) | **<0.0001** |
| Antihypertensive medication use |  |  |  |  |
| ?Yesa | 14.07 ± 0.58 (12.88?15.25) |  | ?11.55 ± 0.86 (?13.33?(?9.77)) |  |
| ?No | 4.74 ± 0.18 (4.38?5.11) | **<0.0001** | 1.21 ± 0.51 (0.16?2.26) | **<0.0001** |
| Lipid-lowering medication use |  |  |  |  |
| ?Yesa | 14.37 ± 0.76 (12.81?15.94) |  | ?7.83 ± 1.43 (?10.79?(?4.88)) |  |
| ?No | 5.59 ± 0.23 (5.11?6.06) | **<0.0001** | ?0.68 ± 0.57 (?1.85?0.50) | **<0.0001** |

ASCVD atherosclerotic cardiovascular diseases, CI two-sided confidence interval, MetS metabolic syndrome, defined as the presence of at least three out of the following five factors: elevated triglycerides level (1.7 mmol/L), reduced high-density lipoprotein cholesterol level (1.0 mmol/L for men and 1.3 mmol/L for women), elevated blood pressure (systolic blood pressure ≥130 and/or diastolic ≥85 mmHg) and/or diagnosis by health professional and elevated fasting plasma glucose level (≥5.6 mmol/L), SE standard error, y year.

aReference level. Alpha = 0.05 significant level. Significant values are indicated in bold. For this analysis, binary logistic regression was used.

Socio-demographic and lifestyle characteristics

The following factors were included, age, sex, income, education, physical activity, smoking, alcohol intake, ethnicity and having a family physician. For the age variable, age at the clinic was categorised by 10-year intervals. The household income variable included four income levels: the lowest, lower-middle, upper-middle and highest-income levels []. The education variable had four levels: less than secondary, secondary, other post-secondary and post-secondary graduate levels []. The Physical Activity Index was a proxy for total daily leisure-time energy expenditure. Physical activity was categorised as inactive, moderately activate and active levels based on the daily leisure-time energy expenditure with cut-offs of 0, 1.5 and 3 total daily leisure-time energy expenditure []. Alcohol intake had two categories: ʻever’ drinker and ʻnever’ drinker. Self-reported ethnicity was categorised into two categories of white and non white []. Having a family physician was considered in the analysis as yes or no.

***Data*** analysis

Instructions from ***Statistics*** Canada on combining CHMS Cycles 1 and 2 [] were used, and followed by cleaning, grouping and creating the variables of interest to obtain the combined file that included the master, fasted-subsamples, and the medication files []. The prevalence of ASCVD risk and age gap was determined across different factors as mean of percent risk (±standard error, SE). The independent t test and ANOVA were applied to estimate the significant difference of ASCVD risk prevalence among different categories of the aforementioned variables. The significant difference between the prevalence of sociodemographic variables across quintiles of the dietary patterns was assessed using simple binary logistic regression. According to ***Statistics*** Canada’s recommendations, we used the degree of freedom of 24 for the combined ***data*** []. Participants, which had missing ***data*** on some of the variables of interest, were included in the descriptive analysis (non participation is explained in the CHMS User Guide []). Alpha was set at 0.05 to detect statistically significant differences. SAS for Windows software (release 9.4, SAS Institute, Cary, North Carolina, U.S) was used to perform all analysis.

For determining the association between the ASCVD 10 years risk and dietary patterns, logistic regression was used to obtain multivariable adjusted odds ratios (OR) and two-sided 95% confidence intervals (CI). For testing the trend analysis across quantiles of dietary pattern scores, the median score of each of the quantiles were assigned to the corresponding quantile. Linear regression adjusting for potential covariables was applied and the significance of interaction terms to determine the association of CAG and dietary patterns was tested. Weighting and bootstrapping calculations provided nationally representative results.

Results

Our results, using CHMS combined Cycles 1 and 2 (representative of 13,655,671 Canadians 40–79 years (males = 48%, mean age = 55 years) indicated that Canadian adults aged 40–79 years had a 10-year ASCVD estimated risk of 6.9%. Furthermore, 29% of this population was in the high-risk category for the 10-year ASCVD risk. A significantly higher 10-year ASCVD risk was observed among individuals that were older (50–79 years), males, less than secondary level educated, in the lowest level of income and smokers compared to younger ages (40–49 years, p < 0.0001), females (p < 0.0001), in higher education levels (p = <0.0001), in highest-income level (0.043) and non smokers (p = 0.027), respectively (indicated in Table ).

The Canadian adults aged 40–79 years had a mean CAG of −1.76 years that indicated the vascular system is aging almost 2 years faster than their biological age. A significantly higher CAG was observed among individuals that were older (50–79 years), males, having immediate family member with premature CVD, in less than secondary level education level, in the lowest level of income, physically inactive and smokers compared to younger ages (40–49 years, p < 0.0001), females (p < 0.0001), not having immediate family member with premature CVD (p = 0.008), in higher education levels (p = <0.0001), in highest-income level (0.043), physically active (p < 0.0001), and non smokers (p = 0.027), respectively (indicated in Table ).

Regarding the mean prevalence of 10-year ASCVD risk and CAG across metabolic and medication factors see Table .

Factor loadings from principal components analysis of dietary intakes among Canadians aged 40–79 years, Canadians Health Measures Survey combined Cycles 1 and 2, 2007–11.

| **Food/food groupsa** | **Dietary patterns emerged** | | |  |
| --- | --- | --- | --- | --- |
|  | **Factor 1b** | **Factor 2** | **Factor 3** | **Factor 4** |
| Other vegetables | **0.67** | ? | ? | ? |
| Fruit | **0.56** | ? | ? | ? |
| Nuts | **0.48** | ? | ? | ? |
| Yoghurt | **0.30** | ? | 0.21 | ? |
| Sport drinks | **?0.30** | ? | ? | ? |
| Chips | ? | **0.66** | ? | ? |
| French/home fries/hash brown potatoes | ? | **0.66** | ? | ? |
| Diet drinks | ? | **0.54** | ? | ? |
| Hot dogs | ?0.22 | **0.43** | ? | ? |
| Lettuce/green vegetables | 0.25 | ? | **0.73** | ? |
| Salad dressing/mayonnaise | ? | ? | **0.71** | ? |
| Tomato and tomato sauce | ? | ? | **0.50** | ? |
| Milk | ? | ? | ? | ? |
| Cereal | ? | ? | ? | ? |
| Baked/boiled/mashed potatoes | ? | ? | ? | **0.61** |
| Red meat | ? | **0.31** | ? | **0.56** |
| Sausage | **?0.33** | 0.24 | ? | **0.52** |
| Eggs | ? | ? | ? | **0.47** |
| Rice | 0.20 | ? | ?0.22 | ? |
| Pasta | ? | 0.25 | ? | ? |
| Beans | ? | ? | ? | ? |
| Spinach | **0.31** | ? | 0.28 | ? |
| White bread | ? | ? | ? | ? |
| Ice-cream/frozen yoghurt | ? | ? | ? | **0.30** |
| Brown bread | ? | ? | ? | ? |
| Organ meat | ? | ? | ? | ? |
| Liver | ? | ? | ? | ? |
| Soft drinks | ? | **0.30** | ? | ? |
| Flavoured drinks | ? | ? | ? | ? |
| Cheese | ?0.23 | ? | **0.30** | ? |
| Vegetable juice | ? | ? | ? | ? |
| Fruit juice | ? | ? | ? | ? |

Only factor loading scores below −0.2 and above 0.2 are shown in this table. Factor loadings in bold show foods have been used to define the pattern considering a factor loading cut-off of ± 0.3.

aDetailed description of the food/food groups are indicated in the Appendix Table .

bF1–4: Dietary patterns 1–4.

Dietary pattern analysis

The factor loadings resulted from the principle component analysis of the corresponding dietary patterns are indicated in Table . The first dietary pattern was called the ʻHealthy like’ dietary pattern with positive loadings of fruit, nuts, yoghurt, spinach and ʻother vegetables’ and negative loadings of sausage and sport drinks. The second dietary pattern was called the ʻFast food’ dietary pattern with positive loadings of chips, French/home/hash brown fries, diet drinks, hot dogs, red meat and soft drinks. The third dietary pattern named the ʻSalad, greens cheese and condiments’, which is positively loaded by lettuce/green vegetables, tomato/tomato sauce, salad dressing/mayonnaise and cheese. Finally, the fourth dietary pattern named the ʻhigh carbohydrate and protein’ pattern was positively loaded by baked/boiled, mashed potatoes, red meat, sausage, egg and ice-cream/frozen yoghurt.

Association between outcomes and dietary patterns

A significant positive association was found between the ʻHigh carbohydrate and protein’ dietary pattern and 10-year ASCVD risk for Canadians 40–79 years of age (Ptrend = 0.013) (Table ), after adjusting for potential covariates using logistic regression. The association between 10-year ASCVD risk and any other dietary pattern was not significant (p > 0.05).

Multivariate-adjusted odds ratios for the association of 10-year atherosclerotic cardiovascular disease risk and dietary patterns prevalent among Canadians aged 40–79 years, Canadians Health Measures Survey combined Cycles 1 and 2, 2007–11 (representative of 13,655,671 Canadians aged 40–79 years).

| **Pattern** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | ***P* trenda** | **Continuous factor scoresb** | ***P* value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Odds ratio (upper 95% confidence interval-lower confidence interval)c |  |  |  |  |  |  |  |  |
| ?Healthy? | 1 | 0.83 (0.51?1.36) | 0.60 (0.34?1.07) | 0.76 (0.42?1.38) | 0.68 (0.32?1.43) | 0.32 | 0.87 (0.61?1.22) | 0.41 |
| ?Fast food? | 1 | 0.90 (0.53?1.52) | 0.40 (0.26?0.62) | 0.64 (0.29?1.39) | 0.55 (0.29?1.05) | 0.13 | 0.86 (0.66?1.12) | 0.25 |
| ?Salad, greens, cheese and condiments? | 1 | 1.25 (0.63?2.51) | 1.10 (0.60?2.02) | 1.06 (0.51?2.20) | 1.03 (0.58?1.84) | 0.86 | 0.92 (0.76?1.12) | 0.39 |
| ?High carbohydrate and protein? | 1 | 1.24 (0.70?2.21) | 0.93 (0.49?1.75) | 1.45 (0.84?2.54) | 1.87 (1.070?3.28) | **0.01** | 1.43 (1.19?1.72) | **<0.00** |

ASCVD atherosclerotic cardiovascular diseases, Q quantile, y year. Alpha = 0.05 significant level. Significant values are indicated in bold.

aFor testing the trend analysis across quantiles of dietary pattern scores, we assigned the median score of each of the quantiles to the corresponding quantile.

bThe continuous factor scores were used in multivariate analysis logistic regression.

cModel adjusted for income, education, physical activity, alcohol intake, body mass index and other dietary patterns (continuous scores) between 1 and 4.

Our results showed that after adjusting for covariates, for every unit increase in the dietary factor scores of the ʻHealthy’ dietary pattern, vascular age was 2 years younger than chronological age (p < 0.0001) (Table ). In addition, for each unit increase of the ʻFast food’ dietary pattern, the vascular age was on average 1.34 years older than the chronological age (p = 0.005). Other dietary patterns were not significantly associated with CAG for this population (p > 0.05) (Table ).

Multivariate-adjusted beta coeffecient for the association of cardiovascular age gap and dietary patterns prevalent among Canadians aged 40–79 years, Canadians Health Measures Survey combined Cycles 1 and 2, 2007–11 (representative of 13,655,671 Canadians aged 40–79 years).

| **Pattern** | **CVA Estimate (SE), ya** | ***P* value** |
| --- | --- | --- |
| ?Healthy? | 2.00 (0.30) | **<0.000** |
| ?Fast food? | ?1.34 (0.47) | **0.005** |
| ?Salad, greens, cheese and condiments? | 0.45 (0.36) | 0.211 |
| ?High carbohydrate and protein? | ?0.30 (0.45) | 0.502 |

CVA cardiovascular age gap, SE standard error.

aModel adjusted for income, education, ethnicity, physical activity, alcohol intake, body mass index and other dietary patterns (continuous scores) between 1 and 4. Alpha = 0.05 significant level. Significant values are indicated in bold.

Discussion

The mean 10-year ASCVD risk of 40–79 years olds was 6.9%, with almost one-third of this population having a high risk of 10-year ASCVD. Our results indicate that for Canadian males 40–79 years, their cardiovascular system were aging on average 4 years more than their chronological age but females’ cardiovascular systems were aging at a similar rate to their chronological age. Dietary patterns seemed to make a significant difference to the risk of ASCVD and CAG.

Our result of the 10-year ASCVD risk (6.9%) were similar to the results from Hennessy et al. [] (6.6%), with only a small difference likely due to the study population age range difference (40–75 years for the latter study). The analysis of CAG for U.S. adults 30–75 years revealed that male and female cardiovascular system are aging 7.8 and 5.4 years more, respectively, than their chronological age []. The CAG reported in the U.S. was larger compared to our study, which is due to the difference in the type of variables incorporated into the equations. These researchers have indicated they have used risk factor variables that were ʻnon-laboratory’ risk factors in the equations, which [] produces larger CAG’s compared to the ʻlaboratory-based’ risk factor equations used in the present study.

We found the ʻHigh carbohydrate and protein’ dietary pattern to be significantly associated with high risk of ASCVD. This dietary pattern which is loaded with high intakes of baked/boiled mashed potatoes, red meat, sausage, eggs and ice-cream/frozen yoghurt was similar to the ʻWestern’ dietary pattern, which has been found to have a positive association with many chronic diseases [, ]. The significantly greater prevalence of ʻwhite’ and ʻnon-immigrant’ groups in the highest quantiles of this dietary pattern intake score may indicate that this dietary pattern could be a traditional North American dietary pattern. In agreement with our results, the Multi-Ethnic Study of Atherosclerosis [, ], the Health Professionals Follow-up Study [] and the Nurses’ Health Study [] have found similar dietary patterns to increase the risk of CVD and its risk factors cross-sectionally [] and prospectively [–] among the U.S. population. The foods that had a positive loading on this dietary pattern in our study have previously been shown to adversely affect CVD risk [–]. The processed foods and foods with a high glycemic index have been shown to contribute to the development of ASCVD [–].

Our findings for ASCVD risk assessment and CAG were similar in most part. However, the CAG results were more interpretable compared to ASCVD findings. This is consistent with the aim of producing the CAG score sheets, which was to have more understandable results [] that could be more useful for the public health and also relevant for our nationally representative study. For example, the 10-year ASCVD risk for smokers was 8.22% and for non smokers was 6.56%; however, the CAG for smokers was 10 years older than non smokers.

One limitation of the present study was the absence of a few foods from the food frequency questionnaire used by CHMS, especially from grains and meat and alternative groups []. Second, our study design was cross-sectional. Thus, results do not imply causation. However, the 10-year ASCVD risk assessment tool was recommended for prediction of CVD risk within the next 10 years based on established CVD risk factors.

This approach was recommended with the purpose of better quality of CVD care and prevention. Therefore, it is a helpful approach in cross-sectional design studies that include objective health measures such as CHMS. In addition, despite the usefulness of PCA method for generating dietary patterns in population-based studies, these alpha posteriori methods include researcher-based decisions made through the analysis thus may reduce the reproducibility of the analysis.

Our study is the first in Canada to investigate the prevalence of 10-year ASCVD risk and CAG of Canadians 40–79 years and their association with dietary patterns. To obtain our results, we used CHMS ***data*** that included blood measurements for a large representative sample of Canadians. Observing an association between CAG and ʻHealthy’ and ʻFast food’ dietary patterns, we would suggest long-term prospective studies of dietary interventions.

**Acknowledgements**

Authors of this study acknowledge Saskatchewan Research ***Data*** Centre at the University of Saskatchewan for providing opportunity to access the nationally representative CHMS datasets.

**Funding**

This paper is supported by University of Saskatchewan and a contribution from the Dairy Research Cluster Initiative (Dairy Farmers of Canada, ***Agriculture*** and Agri-Food Canada, the Canadian Dairy Network and the Canadian Dairy Commission) (grant number AIP-CL04). The funders had no contribution in any part of this research or any part of the preparation of this paper.

**Notes**

Supplementary informationThe online version of this article ([*https://doi.org/10.1038/s41430-020-00763-8*](https://doi.org/10.1038/s41430-020-00763-8)) contains supplementary material, which is available to authorized users.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

**End of Document**



[***Federal Register: National Primary Drinking Water Regulations: Lead and Copper Rule Revisions Pages 4198 - 4312 [FR DOC #2020-28691]***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61SY-21B1-JDG9-Y0X7-00000-00&context=1516831)

Impact News Service

January 15, 2021 Friday

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**Length:** 123164 words

**Body**

Washington: Office of the Federal Register has issued the following notice:Environmental Protection Agency-----------------------------------------------------------------------40 CFR Parts 141 and 142National Primary Drinking Water Regulations: Lead and Copper Rule Revisions; Final RuleFederal Register / Vol. 86, No. 10 / Friday, January 15, 2021 / Rules and Regulations[[Page 4198]]-----------------------------------------------------------------------ENVIRONMENTAL PROTECTION AGENCY40 CFR Parts 141 and 142[EPA-HQ-OW-2017-0300; FRL-10019-23-OW]RIN 2040-AF15National Primary Drinking Water Regulations: Lead and Copper Rule RevisionsAGENCY: Environmental Protection Agency (EPA).ACTION: Final rule.-----------------------------------------------------------------------SUMMARY: The Environmental Protection Agency (EPA) is publishing final regulatory revisions to the National Primary Drinking Water Regulation (NPDWR) for lead and copper under the authority of the Safe Drinking Water Act (SDWA). These revised requirements provide greater and more effective protection of public health by reducing exposure to lead and copper in drinking water. The rule will better identify high levels of lead, improve the reliability of lead tap sampling results, strengthen corrosion control treatment requirements, expand consumer awareness and improve risk communication. This final rule requires, for the first time, community water systems to conduct lead-in-drinking-water testing and public education in schools and child care facilities. In addition, the rule will accelerate lead service line replacements by closing existing regulatory loopholes, propelling early action, and strengthening replacement requirements.DATES: Effective date: This final rule is effective as of March 16, 2021. For judicial review purposes, this final rule is promulgated as of January 15, 2021. Compliance dates: The compliance date for the revisions to 40 CFR part 141, subpart I, is set forth in Sec. 141.80(a). The compliance date for the revisions to 40 CFR 141.2 is January 16, 2024, and the compliance date for 40 CFR 141.31 is January 16, 2024. The compliance date for changes made to 40 CFR part 141, subpart O (40 CFR 141.153(d)(4)(vi) and (xi) and 141.154(d)(1)), is January 16, 2024. The compliance date for changes made to 40 CFR part 141, subpart Q (Sec. 141.202 and appendices A and B), is January 16, 2024.ADDRESSES: EPA has established a docket for this action under Docket ID No. EPA-HQ-OW-2017-0300. All documents in the docket are listed on the [*http://www.regulations.gov*](http://www.regulations.gov) website. Although listed in the index, some information is not publicly available, e.g , Confidential Business Information or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the internet and will be publicly available only in hard copy form.FOR FURTHER INFORMATION CONTACT: Jeffrey Kempic, Standards and Risk Management Division, Office of Ground Water and Drinking Water, U.S Environmental Protection Agency, 1200 Pennsylvania Ave. NW, Mail Code 4607M, Washington, DC 20460; telephone number: (202) 564-4880 (TTY 800-877-8339); email address: [*Kempic.Jeffrey@EPA.gov*](mailto:Kempic.Jeffrey@EPA.gov) For more information visit [*https://www.epa.gov/dwreginfo/lead-and-copper-rule.SUPPLEMENTARY*](https://www.epa.gov/dwreginfo/lead-and-copper-rule.SUPPLEMENTARY) INFORMATION: I. General Information A. What are EPA's final revisions? B. Does this action apply to me?II. Background A. Health Effects of Lead and Copper B. Statutory Authority C. Regulatory HistoryIII. Revisions to 40 CFR Part 141, Subpart I, Control of Lead and Copper A. Lead Trigger Level 1. Proposed Revisions 2. 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As a result of multiple Federal laws and regulations, including the 1973 phase-out of lead in automobile gasoline (40 CFR part 80, subpart B), the 1978 Federal regulation banning lead paint for residential and consumer use (16 CFR part 1303), the 1991 LCR (40 CFR part 141, subpart I), and the 1995 ban on lead in solder in food cans (21 CFR 189.240), the median concentration of lead in the blood of children aged 1 to 5 years dropped from 15 micrograms ([micro]g) per deciliter in 1976-1980 to 0.7 [micro]g per deciliter in 2015-2016, a decrease of 95 percent (USEPA, 2019a). Although childhood blood lead levels have been substantially reduced as a result of these actions, exposure to lead in the environment continues to be a concern, especially for vulnerable populations such as children and pregnant women. ***Data*** evaluated by the National Toxicology Program (NTP, 2012) demonstrates that there is sufficient evidence to conclude that there are adverse health effects associated with low-level lead exposure. Moreover, no safe blood lead level in children has been identified ([*https://www.cdc.gov/nceh/lead/prevention/default.htm*](https://www.cdc.gov/nceh/lead/prevention/default.htm)). Sources of lead include lead-based paint, drinking water, and soil contaminated by historical sources. The Federal Action Plan (Action Plan) to Reduce Childhood Lead Exposures and Associated Health Impacts, issued in December 2018, provides a blueprint for reducing further lead exposure and associated harm through collaboration among Federal agencies and with a range of stakeholders, including states, tribes, and local communities, along with businesses, property owners, and parents. The Action Plan is the product of the President's Task Force on Environmental Health Risks and Safety Risks to Children (Task Force). The Task Force is comprised of 17 Federal departments and offices including the U.S Department of Health and Human Services (HHS) and the U.S Department of Housing and Urban Development, which co-chaired the development of the Action Plan with EPA. Through this plan, EPA committed to reducing lead exposures from multiple sources including paint, ambient air, and soil and dust contamination, especially to children who are among the most vulnerable to the effects of lead. On June 21, 2019, EPA announced new, tighter standards for lead in dust on floors and windowsills to protect children from the harmful effects of lead exposure. The standards were lowered from 40 [micro]g of lead in dust per square foot (ft\2\) on floors and 250 [micro]g of lead in dust per ft\2\ on interior windowsills, to 10 [micro]g/ft\2\ and 100 [micro]g/ft\2\, respectively. The lead hazard standards help property owners, lead paint professionals, and government agencies identify lead hazards in residential paint, dust and soil. On June 19, 2020 EPA released a proposal to lower the clearance levels for lead in dust on floors and windowsills after lead removal activities from 40 [micro]g/ft\2\ to 10 [micro]g/ft\2\ for floor dust and from 250 [micro]g/ft\2\ to 100 [micro]g/ft\2\ for windowsill dust (85 FR 37810). The dust lead clearance levels are used to demonstrate that abatement activities effectively and permanently eliminate those hazards. They apply in most pre-1978 housing and child-occupied facilities. The proposed, tighter standards would increase the effectiveness of abatement in pre-1978 homes and child care facilities. To address lead in soil, EPA will continue to remove, remediate, and take corrective actions at contaminated sites, including Superfund, Resource Conservation and Recovery Act (RCRA) Corrective Action, and other cleanup sites. EPA will also continue to work with state and tribal air agencies to help nonattainment areas meet the National Ambient Air Quality Standards. EPA is also focused on conducting critical research and improving public awareness by consolidating and streamlining Federal messaging. Lead and copper enter drinking water mainly from the corrosion of plumbing materials containing lead and copper. Lead was widely used in plumbing materials until Congress prohibited the use or introduction into commerce of pipes and pipe fittings and fixtures that contained more than eight percent lead and solder or flux that contained more than 0.2 percent lead in 1986. On September 1, 2020, EPA published the final rule: Use of Lead Free Pipes, Fittings, Fixtures, Solder, and Flux for Drinking Water. The Lead-Free final rule significantly limits the lead content allowed in plumbing materials (e.g , pipes, fittings, and fixtures) used in new construction and replacement of existing plumbing. Specifically, the Lead-Free rule reduces the percentage of lead content allowed in these materials from eight percent to 0.25 percent in accordance with the 2011 Reduction of Lead in Drinking Water Act. Many buildings were constructed prior to the restrictions on the use of plumbing materials that contained lead. There are currently an estimated 6.3 to 9.3 million homes served by lead service lines (LSLs) in thousands of communities nationwide, in addition to millions of older buildings with lead solder and faucets that contain lead. To reduce exposure to lead through drinking water, the Action Plan highlights several key actions, including EPA's commitment to making regulatory changes to implement the statutory definition of lead-free plumbing products and assisting schools and child care centers with the 3Ts approach (Training, Testing, and Taking Action) for lead in drinking water. The Action Plan also highlights EPA's support to states and communities by identifying funding opportunities through the Drinking Water State Revolving Fund and the Water Infrastructure Finance and Innovation Act loan program for updating and replacing drinking water infrastructure. In addition, the Action Plan highlights three newly authorized grant programs under the Water Infrastructure Improvements for the Nation (WIIN) Act, for which Congress appropriated $50 million in fiscal year (FY) 2018, to fund grants to small and disadvantaged communities for developing and maintaining infrastructure, for lead reduction projects, and to support the voluntary testing of drinking water in schools and child care centers. The Action Plan also highlights the importance of preventing lead exposure from drinking water by working with states, tribes, and local[[Page 4200]]stakeholders to share best practices and tools to better implement the NPDWR for Lead and Copper. For more information about the Federal Lead Action Plan see [*https://www.epa.gov/sites/production/files/2018-12/documents/fedactionplan\_lead\_final.pdf*](https://www.epa.gov/sites/production/files/2018-12/documents/fedactionplan_lead_final.pdf). Since the implementation of the Lead and Copper Rule (LCR), drinking water exposures have declined significantly, resulting in major improvements in public health. For example, the number of the nation's large drinking water systems that have exceeded the LCR action level of 15 parts per billion has decreased by over 90 percent. Between 2017 and 2019, fewer than 5 percent of all water systems reported an action level exceedance (EPA-815-F-19-007). Despite this progress, there is a compelling need to modernize and improve the rule by strengthening its public health protections and clarifying its implementation requirements to make it more effective and more readily enforceable. The LCR is a complicated rule due, in part, to the need to control corrosivity of drinking water as it travels through often antiquated distribution and plumbing systems on the way to the consumer's tap. States and public water systems need expertise and resources to identify the sampling locations and to work with customers to ***collect*** samples for analysis. Even greater expertise is needed for systems and states to identify the optimal corrosion control treatment and water quality parameter monitoring to assure that lead and copper levels are reduced to the extent feasible. The determination of the optimal corrosion control treatment is specific to each water system because it is based on the specific chemistry of the system's source water, and must be designed and implemented to take into account treatments used to comply with other applicable drinking water standards (56 FR 26487). Water systems cannot unilaterally implement all of the actions that are needed to reduce levels of lead in drinking water. Homeowners must also be engaged to assure successful LSL replacement because, in most communities, a portion of the LSL is owned by the water system and the remaining portion is the property of the homeowner. Water systems must also engage with consumers to encourage actions such as flushing of taps before use to reduce their exposure to lead in drinking water, where necessary. The ability of water systems to successfully engage with consumers is critical to reducing drinking water lead exposure. EPA sought input over an extended period on ways in which the Agency could address the challenges to further reducing drinking water lead exposure. Section VII of this preamble describes the engagements the Agency has had with small water systems, state and local officials, the Science Advisory Board, and the National Drinking Water Advisory Council (NDWAC). The Science Advisory Board provided recommendations in 2012 (SAB, 2012) and provided recommendations on the proposed Lead and Copper Rule revisions (LCRR) in 2020 (SAB, 2020). The NDWAC also provided recommendations on potential LCR revisions to EPA. The NDWAC provided written recommendations in December 2015 (NDWAC, 2015) and provided input to the Agency as part of consultation on the proposed LCRR in December 2019. This final rule includes a suite of actions to address lead contamination in drinking water that, taken together, will improve the LCR and further reduce lead exposure from the previous LCR, resulting in an enduring positive public health impact. This approach focuses on six key areas: a. Identifying areas most impacted. To help identify areas with the greatest potential for lead contamination of drinking water and most in need of remediation, EPA's final rule requires that all water systems complete and maintain a LSL inventory and ***collect*** tap samples from homes with LSLs if lead is present in the distribution system. To reduce elevated levels of lead in certain locations, EPA's final rule also requires water systems to engage in a ``find-and-fix'' process to identify the causes of these elevated levels as well as take potential actions to reduce lead levels. b. Strengthening treatment requirements. EPA is finalizing expanded requirements for corrosion control treatment (CCT) based on tap sampling results. The final rule also establishes a new trigger level of 10 [micro]g/L. At this trigger level, systems that currently treat for corrosion are required to re-optimize their existing treatment. Systems that do not currently treat for corrosion will be required to conduct a corrosion control study so that the system is prepared to respond quickly if necessary. Flexibility is important for small systems so that they can protect public health by taking the treatment actions that make sense for their communities. The LCRR provides new alternatives to CCT for small systems including Point-of-Use (POU) treatment and replacement of lead bearing plumbing materials. c. Systematically replacing lead service lines. The final LCRR requires water systems with high lead levels to initiate LSL removal, permanently reducing a significant source of lead in many communities. All water systems with LSLs or lead status unknown service lines must create an LSLR plan by the rule compliance date. The more stringent sampling requirements in the final rule will better identify elevated lead levels, which will result in more systems replacing LSLs. Systems that are above the trigger level but at or below the lead action level must conduct replacements at a goal rate approved by the state, and, systems that are above the action level, must annually replace a minimum of three percent per year, based upon a 2 year rolling average of the number of known or potential LSLs in the inventory at the time the action level exceedance occurs. Systems cannot end their replacement program until they demonstrate lead levels less than the action level for two years. Only full LSL replacements will be counted towards the required rate, not partials and not ``in lieu of'' samples. The final rule requires water systems to provide awareness to homes with LSLs annually, and replace the water system-owned portion of an LSL when a customer chooses to replace their customer-owned portion of the line within 45 days with the ability to have up to 180 days with notification to the state. d. Increasing sampling reliability. EPA is changing the criteria for selecting homes at which to ***collect*** tap samples and the way in which those samples are ***collected***. EPA is requiring tap sample site selection to focus on sites with LSLs (where present) and is requiring a new way to ***collect*** tap samples at these sites. Systems must ***collect*** fifth liter samples that are representative of water that has been in the LSL for several hours, which will provide better information on the highest concentration of lead in drinking water. The final LCR revisions prohibit tap sampling instructions that call for pre-stagnation flushing or, the cleaning or removing of faucet aerators, and include a requirement that tap samples be ***collected*** in bottles with a wide-mouth configuration. Collectively, these new, more stringent sampling requirements will better identify elevated lead levels and result in more water systems taking required lead mitigation actions. e. Improving risk communication. EPA is requiring systems to notify consumers of a system-wide action level exceedance within 24 hours. For individual tap samples that exceed 15 [micro]g/L, EPA is requiring systems to notify[[Page 4201]]the individual consumer within three days. EPA is also requiring the consistent use of clear and concise language in public notifications and all public education materials including the LCR Public Education (PE) and Consumer Confidence Report (CCR) on the health effects of exposure to lead in drinking water. The final rule increases the number, forms, and comprehensiveness of public education materials on lead in drinking water that are provided to the public. It also requires systems to conduct regular outreach to customers with LSLs. Systems must make their LSL inventory publicly available and must notify occupants of homes with LSL every year about their LSL, drinking water exposure risks, and mitigation options, including removal. The final rule's requirements to provide understandable and consistent information about the levels of lead in drinking water, the sources of lead in a system, and the risks of lead in drinking water, will increase public actions to limit exposure to lead in drinking water. f. Protecting children in schools. Since children are at most risk of significant harm from lead exposure, EPA is requiring that community water systems (CWS) test for lead in drinking water in schools and child care facilities. Systems must conduct drinking water sampling at each elementary school and each child care facility they serve over no more than five years, testing 20 percent of the facilities they serve each year. The system will be required to provide sampling results to the school or child care facility and information on actions that can be taken by the school or child care facility to reduce lead in the drinking water. The system will also be required to provide information to the school or child care facility on methods to communicate results to users of the facility and parents. CWSs are also required to provide testing to secondary schools on request during the 5 years of mandatory elementary and child care facility testing, and also to elementary schools and child care facilities on request after the first round of mandatory testing. These requirements will provide schools and child care facilities with an understanding of how to create and manage a drinking water testing program that is customizable to their needs and an appreciation of the benefits of such a program. Through strengthened treatment procedures, expanded sampling, and improved protocols for identifying lead in drinking water, EPA's LCR revisions will require more water systems to progressively take more actions to reduce lead levels at the tap. Additionally, by improving transparency and communication, the rule is expected to increase community awareness and accelerate the replacement of LSLs. By taking these ***collective*** actions EPA, states, and water systems will implement a proactive, holistic approach to more aggressively manage lead in drinking water.A. What are EPA's final revisions? EPA is promulgating revisions to the LCR that strengthen public health protection and improve implementation of the regulation in the following areas: Lead tap sampling; CCT; LSLR; consumer awareness; and public education (PE). This final rule adopts a regulatory framework recommended, in part, by state co-regulators through the Association of State Drinking Water Administrators (ASDWA) and incorporates many recommendations provided to EPA by the National Drinking Water Advisory Council (NDWAC). NDWAC is a Federal Advisory Committee established pursuant to section 1446 of the Safe Drinking Water Act (SDWA) that provides EPA with advice and recommendations related to the national drinking water program. EPA is finalizing revisions to the LCR that will require water systems to take actions at lower lead tap water levels than previously required; this will reduce lead in drinking water and better protect public health. The Agency is establishing a new lead ``trigger level'' of 10 [micro]g/L in addition to the 15 [micro]g/L lead action level. Public health improvements will be achieved as water systems are required to take a progressive set of actions to reduce lead levels at the tap. These actions are designed to reduce lead and copper exposure by ensuring effective CCT and re-optimization of CCT when the lead trigger level or action level is exceeded; enhancing water quality parameter (WQP) monitoring; establish a ``find-and-fix'' process to evaluate and remediate elevated lead at a site where the individual tap sample exceeds 15 [micro]g/L; require water systems to create an LSL inventory to identify the full extent of LSLs in the system; ensure tap sampling pools are targeted to the sites with elevated lead; and make consumers aware of the presence of a LSL, if applicable, to facilitate replacement of LSLs. The LCR revisions will improve tap sampling by improving the tap sampling protocol, taking samples that are more representative of the highest levels of lead in drinking water taps and better targeting higher risk sites for lead contamination, i.e , sites with LSLs or lead containing plumbing materials. EPA's revisions to the LCR Public Education (PE) and Consumer Confidence Report (CCR) requirements will improve communication with consumers. In addition, this final rule includes requirements for CWSs to conduct lead in drinking water testing and PE in schools and child care facilities. Together, these revisions to the existing framework and new requirements will result in greater public health protection at all sizes of CWSs and non-transient non-community water systems (NTNCWSs). Implementation of the revisions will better identify when and where lead contamination occurs, or has the potential to occur, and require systems to take actions to address it more effectively and sooner than under the previous rule. The following table compares the major differences between the previous Lead and Copper Rule (LCR) (promulgated in 1991 and last revised in 2007), the 2019 proposed Lead and Copper Rule revisions (LCRR), and the final rule requirements. In general, requirements that are unchanged are not listed.---------------------------------------------------------------------------------------------------------------- Previous LCR Proposed LCRR Final LCRR---------------------------------------------------------------------------------------------------------------- Action Level (AL) and Trigger Level (TL)----------------------------------------------------------------------------------------------------------------[cir] 90th percentile (P90) level [cir] 90th percentile (P90) level [cir] 90th percentile (P90) level above lead AL of 15 [micro]g/L or above lead AL of 15 [micro]g/L or above lead AL of 15 [micro]g/L or copper AL of 1.3 mg/L requires copper AL of 1.3 mg/L requires more copper AL of 1.3 mg/L requires more additional actions. actions than the current rule. actions than the previous rule. [cir] Defines lead trigger level [cir] Defines lead trigger level (TL) of 10 <=15 [micro]g/L (TL) of 10 15 [mu]g/L: [cir] P90 15 [mu]g/L: number of consecutive years meeting Semi-annually at the standard Semi-annually at the standard the following criteria: number of sites. number of sites.[cir] Serves <=50,000 people and <= [cir] P90 10 to 15 [mu]g/ [cir] P90 10 to 15 [mu]g/ lead & copper ALs. L: Annually at the standard number L: Annually at the standard number[cir] Serves any population size, of sites. of sites. meets state-specified optimal water [cir] P90 <=10 [mu]g/L: [cir] P90 <=10 [mu]g/L: quality parameters (OWQPs), and <= [ssquf] Annually and triennially at [ssquf] Annually at the standard lead AL. reduced number of sites using same number of sites and triennially at criteria as current rule except for reduced number of sites using same large systems and the copper 90th criteria as previous rule except percentile level is not considered. copper 90th percentile level is not [ssquf] Every 9 years based on considered. current rule requirements for a 9- [ssquf] Every 9 years based on year monitoring waiver. current rule requirements for a 9- year monitoring waiver. [cir] Triennial monitoring also applies to any system with lead and copper 90th percentile levels <=0.005 mg/L and <=0.65 mg/L, respectively, for 2 consecutive 6-month monitoring periods. [cir] 9-year monitoring waiver available to systems serving <=3,300.---------------------------------------------------------------------------------------------------------------- Corrosion Control Treatment (CCT) and Water Quality Parameters (WQPs)----------------------------------------------------------------------------------------------------------------CCT: CCT: CCT:[cir] Systems serving >50,000 people [cir] Specifies CCT requirements for [cir] Specifies CCT requirements for were required to install treatment systems with 10 15 [cir] Systems with P90 level >15 CCT steps if no longer exceed both [mu]g/L: [mu]g/L: ALs for two consecutive 6-month [cir] No CCT: must complete CCT [cir] No CCT: must complete CCT monitoring periods. installation regardless of their installation regardless of their[cir] Systems must operate CCT to subsequent P90 levels. subsequent P90 levels. meet any primacy agency-designated [cir] With CCT: must re-optimize [cir] With CCT: must re-optimize OWQPs that define optimal CCT. CCT. CCT.[cir] There is no requirement for [cir] CWSs serving <=10,000 people [cir] CWSs serving <=10,000 people systems to re-optimize. and non-transient water systems and non-transient water systems (NTNCWSs) can select an option (NTNCWSs) can select an option other than CCT to address lead. See other than CCT to address lead. See Small System Flexibility. Small System Flexibility.CCT Options: Includes alkalinity and CCT Options: Removes calcium CCT Options: Removes calcium pH adjustment, calcium hardness hardness as an option and specifies hardness as an option and specifies adjustment, and phosphate or any phosphate inhibitor must be any phosphate inhibitor must be silicate-based corrosion inhibitor. orthophosphate. orthophosphate.Regulated WQPs: Regulated WQPs: Regulated WQPs:[cir] No CCT: pH, alkalinity, [cir] Eliminates WQPs related to [cir] Eliminates WQPs related to calcium, conductivity, temperature, calcium hardness (i.e , calcium, calcium hardness (i.e , calcium, orthophosphate (if phosphate-based conductivity, and temperature). conductivity, and temperature). inhibitor is used), silica (if silica-based inhibitor is used). [cir] With CCT: pH, alkalinity, and based on type of CCT either orthophosphate, silica, or calcium.[[Page 4203]] WQP Monitoring: WQP Monitoring: WQP Monitoring:[cir] Systems serving >=50,000 [cir] Systems serving >=50,000 [cir] Systems serving >=50,000 people must conduct regular WQP people must conduct regular WQP people must conduct regular WQP monitoring at entry points and monitoring at entry points and monitoring at entry points and within the distribution system. within the distribution system. within the distribution system.[cir] Systems serving <=50,000 [cir] Systems serving <=50,000 [cir] Systems serving <=50,000 people conduct monitoring only in people must continue WQP monitoring people must continue WQP monitoring those periods > lead or copper AL. until they no longer > lead and/or until they no longer > lead and/or[cir] Contains provisions to sample copper AL for two consecutive 6- copper AL for two consecutive 6- at reduced number of sites in month monitoring periods. month monitoring periods. distribution system less frequency [cir] To qualify for reduced WQP [cir] To qualify for reduced WQP for all systems meeting their distribution monitoring, P90 must distribution monitoring, P90 must OWQPs. be <=10 [micro]g/L and the system be <=10 [micro]g/L and the system must meet its OWQPs. must meet its OWQPs.Sanitary Survey Review: Sanitary Survey Review: Sanitary Survey Review:[cir] Treatment must be reviewed [cir] CCT and WQP ***data*** must be [cir] CCT and WQP ***data*** must be during sanitary surveys; no reviewed during sanitary surveys reviewed during sanitary surveys specific requirement to assess CCT against most recent CCT guidance against most recent CCT guidance or WQPs. issued by EPA. issued by EPA.Find-and-Fix: No required follow-up Find-and-Fix: If individual tap Find-and-Fix: If individual tap samples or additional actions if an sample >15 [mu]g/L, systems must: samples >15 [micro]g/L. individual sample exceeds 15 [mu]g/ [cir] ***Collect*** a follow-up sample at [cir] Find-and-fix steps: L. each location >15 [mu]g/L. [cir] ***Collect*** tap sample at the same [cir] Conduct WQP monitoring at or tap sample site within 30 days. near the site >15 [mu]g/L. [cir] For LSL, ***collect*** any liter or [cir] Perform needed corrective sample volume. action. [cir] If LSL is not present, ***collect*** 1 liter first draw after stagnation. [cir] For systems with CCT. [cir] Conduct WQP monitoring at or near the site >15 [mu]g/L. [cir] Perform needed corrective action. [cir] Document customer refusal or nonresponse after 2 attempts. [cir] Provide information to local public health officials.---------------------------------------------------------------------------------------------------------------- LSL Inventory and LSLR Plan----------------------------------------------------------------------------------------------------------------Initial LSL Program Activities: Initial LSL Program Activities: Initial LSL Program Activities:[cir] Systems were required to [cir] All systems must develop an [cir] All systems must develop an complete a materials evaluation by LSL inventory or demonstrate LSL inventory or demonstrate the time of initial sampling. No absence of LSLs within first 3 absence of LSLs within 3 years of requirement to update materials years of final rule publication. final rule publication. evaluation. [cir] LSL inventory must be updated [cir] LSL inventory must be updated[cir] No LSLR plan is required. annually. annually or triennially, based on [cir] All systems with known or their tap sampling frequency. possible LSLs must develop an LSLR [cir] All systems with known or plan. possible LSLs must develop an LSLR plan.LSLR: LSLR: LSLR:[cir] Systems with LSLs with P90 >15 [cir] Rule specifies replacement [cir] Rule specifies replacement [micro]g/L after CCT installation programs based on P90 level for programs based on P90 level for must annually replace >=7% of CWSs serving >10,000 people: CWSs serving >3,300 people: number of LSLs in their [cir] If P90 >15 [micro]g/L: Must [cir] If P90 >15 [micro]g/L: Must distribution system when the lead fully replace 3% of LSLs per year fully replace 3% of LSLs per year action level is first exceeded. (mandatory replacement) for 4 based upon a 2 year rolling average[cir] Systems must replace the LSL consecutive 6-month monitoring (mandatory replacement) for at portion they own and offer to periods. least 4 consecutive 6-month replace the private portion at the [cir] If P90 >10 to 15 [micro]g/L: monitoring periods. owner's expense. Implement an LSLR program with [cir] If P90 >10 to 15 [micro]g/L:[cir] Full LSLR, partial LSLR, and replacement goals in consultation Implement an LSLR program with LSLs with lead sample results <=15 with the primacy agency for 2 replacement goals in consultation [micro]g/L (``test-outs'') count consecutive 1-year monitoring with the primacy agency for 2 toward the 7% replacement rate. periods. consecutive 1-year monitoring[cir] Systems can discontinue LSLR [cir] Small CWSs and NTNCWSs that periods. after 2 consecutive 6-month select LSLR as their compliance [cir] Small CWSs and NTNCWSs that monitoring periods <= lead AL. option must complete LSLR within 15 select LSLR as their compliance years if P90 >15 [micro]g/L See option must complete LSLR within 15 Small System Flexibility. years if P90 >15 [micro]g/L See [cir] Annual LSLR rate is based on Small System Flexibility. number of LSLs when the system [cir] Annual LSLR rate is based on first exceeds the action level plus number of LSLs and galvanized the current number of lead status requiring replacement when the unknown service lines. system first exceeds the action [cir] Only full LSLR (both customer- level plus the current number of owned and system-owned portion) lead status unknown service lines. count toward mandatory rate or goal- [cir] Only full LSLR (both customer- based rate. owned and system-owned portion) count toward mandatory rate or goal- based rate.[[Page 4204]] [cir] All systems must replace [cir] All systems replace their their portion of an LSL if portion of an LSL if notified by notified by consumer of private consumer of private side side replacement within 45 days replacement within 45 days of of notification of the private notification of the private replacement. replacement. If the system [cir] Following each LSLR, systems cannot replace the system's must: portion within 45 days, it must [cir] Provide pitcher filters/ notify the state and replace the cartridges to each customer for 3 system's portion within 180 months after replacement. Must be days. provided within 24 hours for full [cir] Following each LSLR, systems and partial LSLRs. must: [cir] ***Collect*** a lead tap sample at [cir] Provide pitcher filters/ locations served by replaced line cartridges to each customer for 6 within 3 to 6 months after months after replacement. Provide replacement. pitcher filters/cartridges within [cir] Requires replacement of 24 hours for full and partial galvanized service lines that are LSLRs. or ever were downstream of an LSL. [cir] ***Collect*** a lead tap sample at locations served by replaced line within 3 to 6 months after replacement. [cir] Requires replacement of galvanized service lines that are or ever were downstream of an LSL.LSL-Related Outreach: LSL-Related Outreach: LSL-Related Outreach:[cir] When water system plans to [cir] Inform consumers annually that [cir] Inform consumers annually that replace the portion it owns, it they are served by LSL or service they are served by LSL or lead must offer to replace customer- line of unknown lead status. status unknown service line. owned portion at owner's expense. [cir] Systems subject to goal-based [cir] Systems subject to goal-based[cir] If system replaces its portion program must: program must: only: [cir] Conduct targeted outreach that [cir] Conduct targeted outreach that[cir] Provide notification to encourages consumers with LSLs to encourages consumers with LSLs to affected residences within 45 days participate in the LSLR program. participate in the LSLR program. prior to replacement on possible [cir] Conduct an additional outreach [cir] Conduct an additional outreach elevated short-term lead levels and activity if they fail to meet their activity if they fail to meet their measures to minimize exposure. goal. goal. [cir] Systems subject to mandatory [cir] Systems subject to mandatory LSLR include information on LSLR LSLR include information on LSLR program in public education (PE) program in public education (PE) materials that are provided in materials that are provided in response to P90 > AL. response to P90 > AL. [cir] Include offer to ***collect*** lead tap sample within 72 hours of replacement. [cir] Provide test results within 3 business days after receiving results.---------------------------------------------------------------------------------------------------------------- Small System Flexibility----------------------------------------------------------------------------------------------------------------No provisions for systems to elect Allows CWSs serving <=10,000 people Allows CWSs serving <=10,000 people an alternative treatment approach and all NTNCWSs with P90 >10 and all NTNCWSs with P90 >10 but sets specific requirements for [micro]g/L to elect their approach [micro]g/L to select their approach CCT and LSLR. to address lead with primacy agency to address lead with primacy agency approval: approval: [cir] Systems can choose CCT, LSLR, [cir] Systems can choose CCT, LSLR, or provision and maintenance of provision and maintenance of point- point-of-use devices. of-use devices; or replace all lead- [cir] NTNCWSs can also elect to bearing plumbing materials. replace all lead-bearing materials.---------------------------------------------------------------------------------------------------------------- Public Education and Outreach----------------------------------------------------------------------------------------------------------------[cir] All CWSs must provide [cir] CWSs must provide updated [cir] CWSs must provide updated education material in the annual health effects language in all PE health effects language in all PE Consumer Confidence Report (CCR). materials and the CCR. materials and the CCR.[cir] Systems with P90 >AL must [cir] If P90 > AL: [cir] Customers can contact the CWS provide PE to customers about lead [cir] Current PE requirements apply. to get PE materials translated in sources, health effects, measures [cir] Systems must notify consumers other languages. to reduce lead exposure, and of P90 > AL within 24 hours. [cir] All CWSs are required to additional information sources. [cir] In addition, CWSs must: include information on how to[cir] Systems must provide lead [cir] Improve public access to lead access the LSL inventory and how to consumer notice to individuals information including LSL locations access the results of all tap served at tested taps within 30 and respond to requests for LSL sampling in the CCR. days of learning results. information. [cir] Revises the mandatory health[cir] Customers can contact the CWS [cir] Deliver notice and educational effects language to improve to get PE materials translated in materials to consumers during water- accuracy and clarity. other languages. related work that could disturb [cir] If P90 > AL: LSLs. [cir] Current PE requirements apply. [cir] Provide increased information [cir] Systems must notify consumers to local and state health agencies. of P90 > AL within 24 hours. [cir] Provide lead consumer notice [cir] In addition, CWSs must: to consumers whose individual tap [cir] Deliver notice and educational sample is >15 [micro]g/L within 24 materials to consumers during water- hours. related work that could disturb [cir] Also see LSL-Related Outreach LSLs. in LSLR section of table. [cir] Provide information to local and state health agencies. [cir] Provide lead consumer notice to consumers whose individual tap sample is >15 [micro]g/L as soon as practicable but no later than 3 days. Also see LSL-Related Outreach section of table.---------------------------------------------------------------------------------------------------------------- Change in Source or Treatment----------------------------------------------------------------------------------------------------------------Systems on a reduced tap monitoring Systems on any tap monitoring Systems on any tap monitoring schedule must obtain prior primacy schedule must obtain prior primacy schedule must obtain prior primacy agency approval before changing agency approval before changing agency approval before changing their source or treatment. their source or treatment. their source or treatment. These systems must also conduct tap monitoring biannually.----------------------------------------------------------------------------------------------------------------[[Page 4205]] Source Water Monitoring and Treatment----------------------------------------------------------------------------------------------------------------[cir] Periodic source water [cir] Primacy Agencies can waive [cir] Primacy Agencies can waive monitoring is required for systems continued source water monitoring continued source water monitoring with: if the: if the:[cir] Source water treatment; or [cir] System has already conducted [cir] System has already conducted[cir] P90 > AL and no source water source water monitoring for a source water monitoring for a treatment. previous P90 > AL; previous P90 > AL; [cir] primacy agency has determined [cir] primacy agency has determined that source water treatment is not that source water treatment is not required; and required; and [cir] System has not added any new [cir] System has not added any new water sources. water sources.---------------------------------------------------------------------------------------------------------------- Lead in Drinking Water at Schools and Child Care Facilities----------------------------------------------------------------------------------------------------------------[cir] Does not include separate [cir] CWSs must conduct lead in [cir] CWS must conduct sampling at testing and education program for drinking water testing and PE at 20% of elementary schools and 20% CWSs at schools and child care 20% of K-12 schools and licensed of child care facilities per year facilities. child cares in service area every 5 and conduct sampling at secondary[cir] Schools and child cares that years. schools on request for 1 testing are classified as NTNCWSs must [cir] Sample results and PE must be cycle (5 years) and conduct sample for lead and copper. provided to each sampled school/ sampling on request of all schools child care, primacy agency and and child care facilities local or state health department. thereafter. [cir] Excludes facilities built [cir] Sample results and PE must be after January 1, 2014. provided to each sampled school/ child care, primacy agency and local or state health department. [cir] Excludes facilities built or replaced all plumbing after January 1, 2014.---------------------------------------------------------------------------------------------------------------- Primacy Agency Reporting----------------------------------------------------------------------------------------------------------------Primacy Agencies must report Expands current requirements to Expands current requirements to information to EPA that includes include: include: but is not limited to: [cir] All P90 values for all system [cir] All P90 values for all system[cir] All P90 levels for systems sizes. sizes. serving >3,300 people, and only [cir] The current number of LSLs and [cir] The current number of LSLs and levels >15 [micro]g/L for smaller lead status unknown service lines lead status unknown service lines systems. for every water system. for every water system.[cir] Systems that are required to [cir] OCCT status of all systems [cir] OCCT status of all systems initiate LSLR and the date including primacy agency-specified including primacy agency-specified replacement must begin. OWQPs. OWQPs.[cir] Systems for which optimal corrosion control treatment (OCCT) has been designated.----------------------------------------------------------------------------------------------------------------B. Does this action apply to me? Entities that could potentially be affected include the following:------------------------------------------------------------------------ Examples of potentially affected Category entities------------------------------------------------------------------------Public water systems.............. Community water systems (a public water system that (A) serves at least 15 service connections used by year-round residents of the area served by the system; or (B) regularly serves at least 25 year- round residents). Non-transient, non-community water systems (a public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year).State and tribal agencies......... Agencies responsible for drinking water regulatory development and enforcement.------------------------------------------------------------------------ This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities that could be affected by this action. To determine whether your facility or activities could be affected by this action, you should carefully examine this final rule. As part of this document for the LCRR, ``state'' refers to the agency of the state or tribal government which has jurisdiction over public water systems consistent with the definition of ``state'' in 40 CFR 141.2 During any period when a state or tribal government does not have primary enforcement responsibility pursuant to section 1413 of the SDWA, the term ``state'' means the applicable Regional Administrator of the U.S Environmental Protection Agency. If you have questions regarding the applicability of this action to a particular entity, consult the person listed in the FOR FURTHER INFORMATION CONTACT section.II. BackgroundA. Health Effects of Lead and Copper Exposure to lead is known to present serious health risks to the brain and nervous system of children. Lead exposure causes damage to the brain and kidneys and can interfere with the production of red blood cells that carry oxygen to all parts of the body. Lead has acute and chronic impacts on the body. The most robustly studied and most susceptible subpopulations are the developing fetus, infants, and young children. Even low level lead exposure is of particular concern to children because their growing bodies absorb more lead than adults do, and their brains and nervous systems are more sensitive to the damaging effects of lead. EPA estimates that drinking water can make up 20 percent or more of a person's total exposure to lead. Infants who consume mostly formula mixed with tap water can, depending on the level of lead in the system and other sources of lead in the home, receive 40 percent to 60 percent of their exposure to lead from drinking water used in the formula (USEPA, 1988). Scientists have linked lead's effects on the brain with lowered intelligence quotient (IQ) and attention disorders in children (USEPA, 2013). Young children and infants are particularly vulnerable to lead because the physical and behavioral effects of lead occur at lower exposure levels in children than in adults. During[[Page 4206]]pregnancy, lead exposure may affect prenatal brain development. Lead is stored in the bones and it can be released later in life. Even at low levels of lead in blood, there is an increased risk of health effects in children (e.g , less than 5 micrograms per deciliter) and adults (e.g , less than 10 micrograms per deciliter) (National Toxicology Program, 2012). The 2013 Integrated Science Assessment for Lead (USEPA, 2013) and the HHS National Toxicology Program Monograph on Health Effects of Low-Level Lead (National Toxicology Program, 2012) have both documented the association between lead and adverse cardiovascular effects, renal effects, reproductive effects, immunological effects, neurological effects, and cancer. EPA's Integrated Risk Information System (IRIS) Chemical Assessment Summary provides additional health effects information on lead (USEPA, 2004a). For a more detailed explanation of the health effects associated with lead for children and adults see Appendix D of the Economic Analysis. Acute copper exposure causes gastrointestinal distress. Chronic exposure to copper is particularly a concern for people with Wilson's disease because they are prone to copper accumulation in body tissue, which can lead to liver damage, neurological, and/or psychiatric symptoms. For a more detailed explanation of the health effects associated with copper see Appendix E of the final rule Economic Analysis (USEPA, 2020). EPA did not propose revisions to the copper requirements; thus, the final rule does not revise the copper requirements.B. Statutory Authority EPA is publishing revisions to the LCR under the authority of the Safe Drinking Water Act (SDWA), including sections 1412, 1413, 1414, 1417, 1445, and 1450 of the SDWA. 42 U.S.C 300f et seq. Section 1412(b)(9) provides that ``[T]he Administrator shall, not less often than every 6 years, review and revise, as appropriate, each national primary drinking water regulation promulgated under this subchapter. Any revision of a national primary drinking water regulation shall be promulgated in accordance with this section, except that each revision shall maintain, or provide for greater, protection of the health of persons.'' 42 U.S.C 300g-1(b)(9). In promulgating this revised NPDWR, EPA followed the applicable procedures and requirements described in section 1412 of the SDWA, including those related to (1) the use of the best available, peer-reviewed science and supporting studies; (2) presentation of information on public health effects; and (3) a health risk reduction and cost analysis of the rule in 1412(b)((3)(A), (B), (C) of the SDWA, 42 U.S.C 300g-1(b)(3)(A)-(C). This rule revises the Lead and Copper Rule which established treatment technique requirements instead of a maximum contaminant level. Section 1412(b)(7)(A) of the SDWA authorizes EPA to ``promulgate a national primary drinking water regulation that requires the use of a treatment technique in lieu of establishing a maximum contaminant level, if the Administrator makes a finding that it is not economically or technologically feasible to ascertain the level of the contaminant.'' EPA's decision to promulgate a treatment technique rule for lead instead of a maximum contaminant level (MCL) in 1991 has been upheld by the United States Court of Appeals for the District of Columbia Circuit. American Water Works Association v. EPA, 40 F.3d 1266, 1270-71 (D.C Cir. 1994). In establishing treatment technique requirements, the Administrator is required to identify those treatment techniques ``which in the Administrator's judgment, would prevent known or anticipated adverse effects on the health of persons to the extent feasible.'' 42 U.S.C 300g-1(b)(7)(A). ``Feasible'' is defined in Section 1412(b)(4)(D) of the SDWA as ``feasible with the use of the best technology, treatment techniques and other means which the Administrator finds after examination for efficacy under field conditions and not solely under laboratory conditions, are available (taking cost into consideration).'' The legislative history for this provision makes it clear that ``feasibility'' is to be defined relative to ``what may reasonably be afforded by large metropolitan or regional public water systems.'' A Legislative History of the Safe Drinking Water Act, Committee Print, 97th Cong., 2d Sess. (1982) at 550. See also City of Portland v. EPA, 507 F.3d 706 (D.C Cir. 2007) (upholding EPA's treatment technique for Cryptosporidium and the Agency's interpretation that ``feasible'' means technically possible and affordable, rather than a cost/benefit determination). If the ``feasible'' treatment technique requirement would result in an increase in the health risk from drinking water by increasing the concentration of other contaminants in drinking water, or interfering with the efficacy of treatment techniques or processes that are used to comply with other national primary drinking water regulations, then the treatment techniques ``shall minimize the overall risk of adverse health effects by balancing the risk from the contaminant and the risk from other contaminants''; however, the resulting requirements may not be more stringent than what is ``feasible''. 42 U.S.C 300g-1(b)(5). Section 1414(c) of the SDWA, as amended by the WIIN Act, requires public water systems to provide notice to the public if the water system exceeds the lead action level. 42 U.S.C 300g-3(c). The SDWA section 1414(c)(2) provides that the Administrator ``shall, by regulation . . . prescribe the manner, frequency, form, and content for giving notice'' under section 1414(c). 42 U.S.C 300g-3(c)(2). The SDWA section 1414(c)(2)(C) specifies additional requirements for those regulations related to public notification of a lead action level exceedance ``that has the potential to have serious adverse effects on human health as a result of short-term exposure.'' The public notice must be distributed as soon as practicable, but not later than 24 hours after the water systems learns of the action level exceedance and the system must report the exceedance to both the Administrator and the primacy agency in that same time period. 42 U.S.C 300g-3(c)(2)(C)(i) and (iii). The requirement in Section 1414(c)(2)(C)(iii) to provide notification to EPA as well as the primacy agency was enacted in 2016 as part of the WIIN Act. One purpose of this requirement is to allow EPA to implement Section 1414(c)(2)(D), which was also enacted as part of the WIIN Act. It directs EPA to issue the required public notice for an exceedance of the lead action level, not later than 24 hours after the Administrator is notified of the exceedance, if the water system or the primacy agency has not issued the required public notice. EPA may receive this information directly from water systems or states. Because the Administrator's duty under Section 1414(c)(2)(D) is triggered only in the event of an action level exceedance and not any violation of an NPDWR, EPA interprets 1414(c)(2)(C)(iii) to require systems to report only action level exceedances (ALEs) to the Administrator. Section 1417(a)(2) of the SDWA provides that public water systems ``shall identify and provide notice to persons that may be affected by lead contamination of their drinking water where such contamination results from the lead content of the construction materials of the public water distribution system and/or corrosivity of the water supply sufficient to cause[[Page 4207]]leaching of lead. 42 U.S.C 300g-6(a)(2)(A)(i) and (ii). The notice ``shall be provided notwithstanding the absence of a violation of any national drinking water standard.'' 42 U.S.C 300g-6(a)(2)(A). Section 1445(a) of the SDWA authorizes the Administrator to establish monitoring, recordkeeping, and reporting regulations, to assist the Administrator in establishing regulations under the SDWA, in determining compliance with the SDWA, and in administering any program of financial assistance under the SDWA. 42 U.S.C 300j-4(a). In requiring a public water system to monitor under section 1445(a) of the SDWA, the Administrator may take into consideration the water system size and the contaminants likely to be found in the system's drinking water. 42 U.S.C 300j-4(a). The SDWA section 1445(a)(1)(C) provides that ``every person who is subject to a national primary drinking water regulation'' must provide such information as the Administrator may reasonably require to assist the Administrator in establishing regulations under section 1412. 42 U.S.C 300j-4(a)(1)(C). The monitoring, recordkeeping, and reporting requirements in today's rule, including the inventory requirements, are part of the NPDWR treatment technique requirements; in addition, EPA expects to consider the information ***collected*** in any future revisions to the Lead and Copper Rule and in administering financial assistance programs (e.g , grant programs for the replacement of LSLs and/or school sampling). Under section 1413(a)(1) of the SDWA a state may exercise primary enforcement responsibility (``primacy'') for NPDWRs when EPA has determined, among other things, that the state has adopted regulations that are no less stringent than EPA's. 42 U.S.C 300g-2(a)(1). To obtain primacy for this rule, states must adopt regulations that are at least as stringent as this rule within two years of EPA's promulgation, unless EPA grants the state a two-year extension. State primacy requires, among other things, adequate enforcement (including monitoring and inspections) and reporting requirements. EPA must approve or deny state primacy applications within 90 days of submission to EPA. 42 U.S.C 300g-2(b)(2). In some cases, a state submitting revisions to adopt an NPDWR has interim primary enforcement authority for the new regulation while EPA's decision on the revision is pending. 42 U.S.C 300g-2(c). Section 1413(b)(1) of the SDWA requires EPA to establish regulations governing the primacy application and review process ``with such modifications as the Administrator deems appropriate.'' In addition to the LCR revisions promulgated today which are more stringent than the previous LCR, this rule includes changes to primacy requirements related to this rule. Section 1450 of the SDWA authorizes the Administrator to prescribe such regulations as are necessary or appropriate to carry out his or her functions under the Act. 42 U.S.C 300j-9.C. Regulatory History EPA published the LCR on June 7, 1991, to control lead and copper in drinking water at the consumer's tap. The rule established a NPDWR for lead and copper consisting of treatment technique requirements that include CCT, source water treatment, lead service line replacement (LSLR), and PE. The rule established an action level of 0.015 mg/L or 15 [micro]g/L for lead and 1.3 mg/L or 1,300 [micro]g/L for copper. The action level is a concentration of lead or copper in the water that determines, in some cases, whether a water system must install CCT, monitor source water, replace LSLs, and undertake a PE program. The action level is exceeded if the concentration in more than 10 percent of tap samples ***collected*** during any monitoring period is greater than the action level (i.e , if the 90th percentile level is greater than the action level). If the 90th percentile value for tap samples is above the action level, it is not a treatment technique violation, but rather compels actions, such as WQP monitoring, CCT, source water monitoring/treatment, PE, and LSLR. Failure to take these actions results in the water system being in violation of the treatment technique or monitoring and reporting requirements. In 2000, EPA promulgated the Lead and Copper Rule Minor Revisions or LCRMR, which streamlined requirements, promoted consistent national implementation, and in many cases, reduced burden for water systems. One of the provisions of the LCRMR required states to report the lead 90th percentile to EPA's Safe Drinking Water Information System (SDWIS) database for all water systems serving greater than 3,300 persons. States must report the lead 90th percentile value for water systems serving 3,300 or fewer persons only if the water system exceeds the action level. The new reporting requirements became effective in 2002. In 2004, EPA published minor corrections to the LCR to reinstate text that was inadvertently dropped from the rule during the previous revision. In 2004, EPA undertook a national review of the LCR and performed a number of activities to help identify needed actions to improve implementation of the LCR. EPA ***collected*** and analyzed lead concentration ***data*** and other information required by the LCR, carried out review of implementation by states, held four expert workshops to further discuss elements of the LCR, and worked to better understand local and state efforts to test for lead in school drinking water, including a national meeting to discuss challenges and needs. EPA used the information ***collected*** during the national review to identify needed short-term and long-term regulatory revisions to the LCR. In 2007, EPA promulgated a set of short-term regulatory revisions and clarifications to strengthen implementation of the LCR in the areas of monitoring, treatment, customer awareness, LSLR, and improve compliance with the PE requirements to ensure drinking water consumers receive meaningful, timely, and useful information needed to help them limit their exposure to lead in drinking water. Long-term issues, requiring additional research and input, were identified for a subsequent set of rule revisions. EPA published proposed revisions to the LCR on November 13, 2019 for public review and comment (84 FR 61684). The proposal included provisions to strengthen procedures and requirements related to health protection and the implementation of the existing LCR in the following areas: Lead tap sampling; corrosion control treatment; LSL replacement; consumer awareness; and public education. In addition, the proposal included new requirements for CWSs to conduct lead in drinking water testing and public education in schools and child care facilities.III. Revisions to 40 CFR Part 141, Subpart I, Control of Lead and CopperA. Lead Trigger Level1. Proposed Revisions EPA proposed a lead ``trigger level'' of 10 [micro]g/L in addition to the LCR's current 15 [micro]g/L lead action level. The trigger level is not a health based standard. EPA proposed 10 [micro]g/L as a reasonable concentration that is below the action level and above the Practical Quantitation Level of 5 [micro]g/L at which to require water systems to take a progressive set of actions to reduce lead levels prior to an action level exceedance and to have a plan in place[[Page 4208]]to rapidly respond if there is an action level exceedance. For large and medium water systems, EPA proposed action that included optimizing CCT, a goal based LSLR program, and annual tap sampling (no reduced monitoring). EPA proposed that small water systems would be required to designate the actions they would take if they exceed the action level.2. Public Comment and EPA's Response A number of commenters supported the trigger level, stating that it would be beneficial because it initiates actions by public water systems to decrease their lead levels and requires the utility to take proactive steps to remove lead from the distribution system, reducing exposure to lead from drinking water throughout the utility's community. A commenter suggested that the trigger level be lowered to 5 [micro]g/L (the stakeholder added a reference to ``CDC'' however, the Centers for Disease Control and Prevention established a blood lead reference level of 5 [micro]g/deciliter, that is not a drinking water level). Other commenters suggested a trigger level of 1 [micro]g/L (recommended by the American Academy of Pediatrics (AAP, 2016)). The use of a trigger level of 10 [micro]g/L in the implementation of this treatment technique rule provides a reasonable concentration that is below the action level and above the Practical Quantitation Level of 5 [micro]g/L at which to require water systems to take a progressive set of actions to reduce lead levels prior to an action level exceedance and to have a plan in place to rapidly respond if there is an action level exceedance. Requiring such actions of systems only when a trigger level 10 [micro]g/L is exceeded, rather than all systems prioritizes actions at systems with higher lead levels and allows states to work proactively with water systems that are a higher priority. The actions water systems will be required to undertake if their 90th percentile exceeds the trigger level will require review and oversight from states to assure that they are effective in reducing drinking water lead levels. As shown in Exhibits 4-13 and 4-20 of the Economic Analysis, setting a lower trigger level would substantially increase the number of water systems required to obtain review and input from their primacy agency to comply with the CCT and LSLR requirements. EPA has concluded it is not practicable for this significant number of water systems to obtain this state review and approval. The LCR's action level prioritizes systems with the highest lead levels for state interaction and mandates actions to reduce drinking water lead levels. Similarly, the Agency has determined that 10 [micro]g/L is a reasonable level to trigger water systems with higher (but not the highest) lead levels to have interactions with states to prepare for and to undertake actions to reduce drinking water lead levels. Other commenters expressed concerns about the potential for confusion caused by separate trigger level and action level requirements. One of these commenters stated that the trigger level would be another decision-criterion for the public to mis-construe as a level of health concern. EPA does not agree with these commenters. The Agency has established a health based maximum contaminant level goal (MCLG) of zero for lead. The trigger level is not a health based level, rather it is a reasonable level at which to require systems to begin to take a progressive set of actions based upon lead levels at the tap that are appropriate to assure reduced exposure to lead. The concept of including additional thresholds to compel actions before an action level exceedance was suggested by the Association of State Drinking Water Administrators as a way to focus actions towards the systems with the greatest potential concerns (USEPA, 2018). This regulatory framework is similar to other NPDWRs, such as the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), which requires increasing levels of remedial action based on the concentration of the contaminant. EPA has revised the regulatory text in the final rule to improve its clarity and will work with primacy agencies and water systems to assure they understand the different actions that must be taken when systems exceed the trigger level or action level. Additional commenters suggested EPA lower the action level and eliminate the trigger level, stating the trigger level makes the rule unnecessarily complicated and needlessly adds to the regulatory burden. EPA disagrees that the action level should be lowered. EPA established the lead action level in 1991 to require small and medium-sized systems exceeding it to install corrosion control treatment and to require large systems and other systems with optimal corrosion control treatment (OCCT) to conduct LSLR. The action level was based on examination of ***data*** at 39 medium sized systems; while it was ``limited as a basis for making broad-based estimates of treatment efficacy,'' EPA concluded that ``the ***data*** are useful as general indictors of the range of levels systems have achieved with various treatment measures in place.'' (56 FR 26490). EPA acknowledged in 1991 that the selection of the action level ``is not based on a precise statistical analysis of the effectiveness of treatment'' but it ``reflects EPA's assessment of a level that is generally representative of effective corrosion control treatment, and that is, therefore, useful as a tool for simplifying the implementation of the treatment technique'' at those systems. (56 FR 26490). EPA decided to use the same action level as a screen to determine which systems with CCT must also replace LSLs (56 FR 26491). While EPA is not lowering the action level, the Agency is strengthening the public health protections of the treatment technique by improving the sampling procedures to better identify elevated levels of lead. This will result in more systems exceeding the action level and more actions to reduce drinking water exposure to lead. EPA disagrees with commenters that the trigger level results in unnecessary complexity and regulatory burden. While there is burden associated with the actions that systems must take when they exceed the trigger level, EPA determined that a progressive set of actions based upon lead levels at the tap are feasible to assure reduced exposure to lead. EPA in its Health Risk Reduction Cost Analysis (HRRCA) has found that a significant number of benefits accrue from systems being required to take mitigation activities as a result of trigger level exceedances. EPA also examined the costs and found that it is feasible for systems to take the actions required when there is a trigger level exceedance. Requiring these actions when a system's lead levels are high, but not exceeding the action level, will help both systems and states to engage in a manageable and orderly process to reduce lead levels in drinking water so that they remain below the lead action level. Accordingly, inclusion of the trigger level in the final rule will provide for ``greater protection of the health of persons'' consistent with the statutory authority in Section 1412(b)(9) of the Safe Drinking Water Act (SDWA) for revising existing drinking water standards. Additionally, this proactive approach to lead contamination in response to a trigger level will allow systems to quickly take action if there is a ALE, while reducing the likelihood that a water system will exceed the action level in the future or be faced with the need to implement emergency measures such as the distribution of water filters or bottled water in response to a lead crisis.[[Page 4209]]3. Final Revisions EPA is finalizing the lead trigger level of 10 [micro]g/L and maintaining the lead action level of 15 [micro]g/L. In the event of a trigger level exceedance, the actions water systems are required to take vary based on characteristics of the system. Each of the requirements brought about by a trigger level exceedance is discussed in detail elsewhere in this document. However, in summary, small CWSs serving populations of 10,000 or fewer persons and all sizes of NTNCWS that exceed the lead trigger level, but not the lead action level, must evaluate the small system flexibilities described in Section III.E of this preamble and identify the action they will take if they exceed the action level. Medium and large CWSs that exceed the trigger level, but do not exceed the action level, must implement requirements based on their CCT and LSL status as described below. Water systems with CCT in place and with no LSLs or service lines of unknown lead status are required to re-optimize CCT (see Section III.B); and conduct annual tap sampling (no reduced monitoring (see Section III.G)). Water systems without CCT in place and with no LSLs or service lines of unknown lead status are required to: conduct a CCT study and obtain state approval for designated CCT (see Section III.B ); and conduct annual tap sampling (no reduced monitoring (see Section III.G)). Water systems with CCT in place and with LSLs or service lines of unknown lead status are required to: Re-optimize CCT (see Section III.B); notify customers with LSLs or unknowns (see Section III.F); implement a goal-based LSLR program (see Section III.D); and conduct annual tap sampling (no reduced monitoring (see Section III.G)). Water systems without CCT in place and with LSLs or service lines (i.e , the pipe that connects the water main to the building) of unknown lead status are required to: Conduct a CCT study and obtain state approval for designated CCT (see Section III.B) notify customers with an LSL or unknowns (see Section III.F); implement a goal based LSLR program (see Section III.D); and conduct annual tap sampling (no reduced monitoring (see Section III.G).B. Corrosion Control Treatment Requirements Based on Lead 90th Percentile1. Proposed Revisions EPA proposed revised CCT requirements based on the water system's lead 90th percentile level and CCT status. The proposed rule required all water systems with CCT that have a lead trigger level exceedance (>10 [mu]g/L but <=15 [mu]g/L) or a lead action level exceedance (>15 [mu]g/L) to re-optimize their CCT. The proposed rule would require water systems to evaluate other corrosion control treatments, make a re-optimization recommendation, and receive state approval of any changes to CCT or water quality parameters (WQPs). The state could require the water system to conduct a CCT study under the proposed rule. The proposal required water systems without CCT that exceed the lead trigger level (10 [micro]g/L) to conduct a CCT study and make a CCT recommendation to the state. Once approved by the state, the CCT recommendation would be implemented if the water system exceeds the lead action level in subsequent tap sampling. Water systems without CCT that have previously conducted a CCT study and made CCT recommendations would not be required to prepare a new CCT study if they exceed the trigger level again unless the state determines that a new study is required due to changed circumstances, such as addition of a new water source or changes in treatment or if revised CCT guidance has been issued by EPA since the study was conducted. Under the proposed rule the state could also determine that a new CCT study is needed due to other significant information becoming available. EPA proposed changes to the CCT options that water systems must consider and the methods by which water systems would evaluate those options. EPA proposed removing calcium carbonate stabilization as a CCT option. EPA also proposed requiring water systems to evaluate two additional options for orthophosphate-based corrosion control: Maintaining a 1 mg/L orthophosphate residual concentration and maintaining a 3 mg/L orthophosphate residual concentration. EPA also proposed changes to the methodologies by which systems evaluate CCT options. EPA proposed that metal coupon tests could only be used as a screen to reduce the number of options that are evaluated using pipe rig/loops and would no longer be able to be used as the basis for determining the OCCT. EPA proposed that when systems choose to conduct coupon studies to screen potential options and/or pipe rig/loop studies, these systems cannot exclude a treatment option from the study based upon potential effects on other water quality treatment processes. Systems that are conducting coupon screening studies and/or pipe loop/rig studies should identify potential constraints, such as the impact that CCT options or treatment chemicals may have on other water quality treatment processes. Those impacts should be noted and considered as part of the CCT study design. EPA proposed that a medium or small water system that exceeds the lead action level (15 [micro]g/L), that has previously not exceeded the lead trigger level and does not have CCT installed, would be required to conduct a CCT study, make a treatment recommendation, and obtain state approval of the OCCT determination. EPA proposed that systems be required to complete these steps even if the system meets the lead action level in two subsequent, consecutive 6-month monitoring periods over the course of this process. Water systems that meet the action level for two consecutive 6-month monitoring periods before installing the state-approved treatment would be required to install that CCT upon any subsequent action level exceedance. EPA proposed to retain the current LCR provision that allows a state to waive the requirement for a CCT study.2. Public Comment and EPA's Response Commenters generally supported the evaluation or re-evaluation of corrosion control treatment based on a trigger level or action level exceedance because it would increase public health protection by prioritizing systems with the highest 90th percentiles. Many commenters had objections to the proposed re-optimization process. Some commented that the re-optimization process was too prescriptive, and that more flexibility was needed. Commenters wrote that the steps needed to optimize or reoptimize treatment varied based on factors including the presence/absence of LSLs, system size, 90th percentile lead concentration, and existing corrosion control treatment. Several commenters suggested a toolbox or ``bin approach'' that allows consideration of these factors by systems and states to determine which optimization/re-optimization process or ``bin'' is most appropriate. For example, water systems with LSLs and OCCT would be in a different ``bin'' than water systems with LSLs and no OCCT. Many commenters suggested that systems be allowed to modify the existing corrosion control treatment before considering alternate treatments. Commenters stated that the proposed re-optimization process might limit a system's ability to quickly and efficiently reduce lead levels. EPA agrees that optimization and re-optimization processes should[[Page 4210]]provide more flexibility. EPA agrees that for some systems, lead reductions can be achieved quickly with slight modifications of the existing CCT and should not be delayed potentially by two years for the results of the corrosion control study. EPA agrees it is appropriate for states to approve modifications of the system's existing CCT for the ``bin'' of systems that are between the trigger level and action level without a corrosion control study. EPA agrees that the process to optimize/reoptimize CCT should be determined based on system characteristics such as system size, the presence of LSLs and 90th percentile value. EPA agrees that a ``bin approach'' in which the steps of the optimization/re-optimization process depend upon system characteristics can provide flexibility for some systems to more effectively establish optimal CCT. EPA agrees that requirements to conduct harvested pipe loop studies and coupon studies are best delineated through such a bin approach. Harvested pipe loop studies are only required for systems with LSLs that exceed the lead action level. To the extent that there are any large systems without corrosion control treatment that have LSLs and exceed the lead practical quantitation level of 0.005 mg/L, those systems would also need to conduct a harvested pipe loop study. EPA believes that the CCT changes needed for systems of any size above the action level merit a thorough investigation of the impacts of the options on the existing LSL pipe scale. Commenters noted that some small systems may not have the technical capacity to construct and operate a harvested pipe loop study. EPA notes that in these cases the final rule provides flexibility to these small systems to implement a LSLR program or POU program. Coupon studies can serve as a screen to reduce the number of options for the harvested pipe loop study. Commenters noted that the construction of harvested flow-through pipe loops and the stabilization of those loops can take six months to one year before options can be evaluated. EPA agrees that more time is needed to construct pipe loops from harvested pipes and therefore is removing the requirement for initial treatment recommendations in the final rule for large and medium systems. For these systems, the final rule directs them to start constructing and operating the flow-through pipe loops after the action level exceedance in place of the initial treatment recommendation step, since the pipe loop study will be the basis for their treatment recommendation. Commenters indicated that for some systems, coupon studies rather than pipe loop studies may be an appropriate treatment recommendation tool. EPA agrees that coupon studies can be used for systems that do not have LSLs. The final rule only requires harvested pipe loop studies for systems that have LSLs. Many commenters had concerns with orthophosphate impacts on wastewater treatment. The use of orthophosphate for corrosion control can increase the phosphorus loading to wastewater treatment facilities. However, water systems conducting corrosion control studies cannot rule out orthophosphate simply based on the increase in loading to wastewater treatment facilities. The definition of optimal corrosion control treatment means the corrosion control treatment that minimizes lead and copper concentrations at users' taps while ensuring that the system does not violate any national primary drinking water regulations. SDWA Section 1412(b)(7)(A) requires that a treatment technique prevent known or anticipated adverse effects on the health of persons to the extent feasible. EPA has determined that orthophosphate treatment is a feasible corrosion control technology in accordance with SDWA Section 1412(b)(4)(E). Therefore, eliminating orthophosphate as an option because of concerns unrelated to compliance with national primary drinking water regulations may prevent a system from installing the treatment technique that reduces to the extent feasible the risks of adverse health effects from lead in drinking water. In designing the CCT studies, water systems should evaluate the orthophosphate treatment options in the coupon screening and/or pipe loop/rig studies. EPA has examined the potential costs of additional phosphorus usage on wastewater treatment systems and has included this in the Economic Analysis for the final rule. Many commenters objected to the required evaluations of orthophosphate addition at 1 mg/L and 3 mg/L. Some commenters characterized these as high orthophosphate doses. EPA disagrees that these orthophosphate doses are too high to be considered in the corrosion control study. The commenters may have assumed that the dose was measured as P which would be three times greater than the dose measured as PO4. EPA is clarifying that the orthophosphate doses to be studied are measured as PO4. The high-end dose in the corrosion control study of 3 mg/L as PO4 is at the low end of the typical range used in the United Kingdom where 95 percent of public water supplies are dosed with orthophosphate (Hayes and Hydes, 2010). EPA also notes that the 2018 edition of Recommended Standards for Water Works published by the Great Lakes--Upper Mississippi Board of State and Provincial Public Health and Environmental Managers includes a requirement that total phosphate not exceed 10 mg/L as phosphate sequestering iron and manganese, which are aesthetic concerns and not a health concern. There are also standards in the document for orthophosphate and blended phosphates for corrosion control noting that the system shall have a chemical feed system capable of maintaining an orthophosphate residual of at least 1.0 mg/L as P (3.0 mg/L as PO4) throughout the distribution system. The member states for this document are Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, and Wisconsin (Great Lakes, 2018). Some commenters supported the elimination of calcium carbonate stabilization as a corrosion control treatment alternative because they agreed with EPA's rationale that it is not an effective CCT option, but others did not, stating that it worked in some specific circumstances. EPA does not agree that calcium carbonate stabilization should remain as a CCT option. Based upon the available peer reviewed science, EPA has determined that calcium carbonate stabilization treatment does not form a consistent scale on lead and copper pipes to a level that makes it effective as a CCT option (AwwaRF and DVGW-Technologiezentrum Wasser, 1996; Schock and Lytle, 2011; Hill and Cantor, 2011). Therefore, EPA has determined it is not appropriate to require water systems to evaluate it as an option as part of a corrosion control study. Some commenters noted that some water systems have already been deemed optimized using this technique. EPA notes that states will still have the authority to designate the necessary water quality parameters to allow these systems to maintain this treatment as optimal corrosion control unless the system exceeds the lead trigger level or action level.3. Final Rule Requirements EPA has included a provision in the final LCRR to identify ``bins'' of systems for specific corrosion control treatment optimization requirements. The first bin is to provide flexibility regarding corrosion control studies for systems that are reoptimizing existing corrosion control treatment following a trigger level exceedance. In the final rule, states are allowed to approve existing[[Page 4211]]corrosion control treatment modifications without a corrosion control study for systems with lead levels between the trigger level and the action level. To clarify the systems that are not eligible for this flexibility, EPA added a definition of ``systems without corrosion control treatment'' that includes a public water system that does not have, or purchases all of its water from a system that does not have: (1) An optimal corrosion control treatment approved by the State; or (2) any pH adjustment, alkalinity adjustment, and or corrosion inhibitor addition resulting from other water quality adjustments as part of its treatment train infrastructure. Another bin created in the final rule identifies the subset of systems that must do a harvested pipe loop study. This bin includes large and medium systems with LSLs that exceed the lead action levels and any small system with LSLs that selected corrosion control treatment option. For the systems in this bin, Step 1 of the optimization or re-optimization process is the construction and operation of the flow-through pipe loops after the action level exceedance, which must be completed within one year of the exceedance. EPA retained the requirement that coupon studies can only be used as a screening tool for these systems. The final rule includes requirements to allow coupon studies to be the basis for a treatment recommendation tool for other systems that do not have a lead action level exceedance and LSLs. In the final rule, EPA has also clarified that the orthophosphate doses and benchmarks are orthophosphate measured as PO4. EPA removed calcium carbonate stabilization as a corrosion control treatment alternative in the final rule.C. Lead Service Line Inventory1. Proposed Revisions EPA proposed to improve the available information regarding LSL numbers and locations by requiring an inventory of service line materials to be prepared by CWSs and NTNCWSs. EPA proposed to require these systems to submit an initial inventory within three years of publication of the rule, and for the water systems to update the inventory annually as they gather more information through the course of their normal activities. EPA proposed requiring the inventory to identify not only LSLs but also galvanized service lines that are or were downstream of an LSL, service lines whose material composition is unknown, and service lines known not to be LSLs. The proposed rule required each LSL to be associated with a locational identifier. EPA proposed that the inventory be made publicly available and proposed that water systems serving greater than 100,000 people would be required to make their inventory available electronically.2. Public Comment and EPA's Response Several commenters supported requiring systems to make the LSL inventory publicly accessible because transparency is a critical step for building trust, informing and educating consumers about the sources of lead in drinking water, and reducing risk. Some commenters did not support a requirement to make the inventory publicly accessible, raising concerns that it could infringe on customer privacy and add to confusion, panic, and distrust of the water system, especially if the inventory identifies a high number of LSLs or service lines where the lead status is unknown. Commenters also raised concerns that the requirement could result in unintended impacts to economic development for a community and property values for individual locations with LSLs or lead status unknown service lines. Some commenters raised concerns with the requirement because there are alternatives to allowing open access to the general public (e.g , the requirement for the PWS to provide annual disclosure to customers with LSLs; a requirement to release the information after account verification; or other non-binding measures such as pre-purchase residential inspections). Many commenters supported the inclusion of specific street addresses in the inventory, citing the increased transparency and the potential to drive proactive LSLR. Some commenters noted that an inventory without addresses would be of limited utility to consumers, given that LSLs impact the individual locations where they are found. Some commenters did not support a requirement to include addresses in the inventory, citing local or state privacy laws that they claim would prohibit the publication of address-level information in their inventory. EPA agrees with commenters who support a requirement for water systems to make the inventory publicly accessible. Informed customers are better able to take actions to limit exposure to lead in drinking water and make decisions regarding replacement of their portion of a LSL, and to better understand the prevalence of lead sources in drinking water. A Federal requirement for a publicly accessible inventory that uses specific addresses is not necessary, and could complicate implementation of the inventory requirements for those systems that may have concerns about potential conflicts with state or local privacy laws or constitutional protections; therefore, the final rule only requires systems to provide a general location identifier in the publicly accessible inventory. An address is not the only means by which water systems can convey the location of LSLs, other location identifiers could be used such as blocks, streets, landmarks, or other geographic markers that are associated with an individual service line. An inventory that is publicly available with location information provides communities with updated information regarding the total number of LSLs, galvanized requiring replacement lines, lead status unknown lines, and non-LSLs, as well as the general areas where LSLs and galvanized requiring replacement service lines are located. Making this information publicly available also allows the community to track LSLR and material composition verification progress over time. In addition, prospective homebuyers could use the publicly accessible inventory to determine whether and how to work with the homeowner, real estate agent, or home inspector to identify a service line's material composition. For publicly available inventories that do not include addresses as location identifiers, consumers will be individually notified of their service line material classification under 40 CFR 141.85(e), after the water system conducts its initial inventory and annually thereafter. Finally, even though EPA has determined not to establish a Federal requirement to provide specific addresses in the inventory, this does not preclude water systems from doing so. Nor are states precluded by the SDWA from requiring water systems to do so. EPA received a comment suggesting the final rule strengthen inventory public accessibility requirements, making the inventory available online and extending this requirement to systems serving less than the proposed benchmark of 100,000 people. Requiring more inventories to be available online, commenters said, would allow consumers to more easily access the inventories. EPA agrees with these commenters and is requiring online publishing in the final rule for water systems serving over 50,000 persons, given that websites, social media platforms, and cloud-based file sharing applications are widely available and[[Page 4212]]can host information for free or low-cost. EPA received comments on other aspects of the inventory requirements such as the feasibility of creating initial inventories within three years after publication of the final rule. Some commenters believed an inventory could be created within three years, while others claimed that such an effort is not feasible. Some commenters noted the absence of a deadline to verify all service line materials, as is required in Michigan's LCR, and suggested that the final rule include a deadline. Some commenters needed clarification regarding methods for identifying LSLs. The Agency determined it is practicable and feasible for water systems to prepare the initial inventory by the rule compliance date, as the rule does not require a deadline to verify each service line's composition, allowing unidentified materials to be classified as lead status unknown. It is important that water systems complete the initial LSL inventory within three years of publication of the final rule to facilitate, for example, selection of tap sampling sites under new tiering criteria and to inform consumers about the presence of a known or potential LSL by the compliance date, which is based on Section 1412(b)(10) of the SDWA. The inventory is also critical to determining the number of LSLs to be applied to the LSLR rate under a lead trigger level exceedance and action level exceedance. EPA disagrees that an end date by which all LSLs and lead status unknown service lines must be verified is warranted or appropriate. The LCR is a national rule which applies to over 60,000 water systems with very different circumstances, including but not limited to the number of service connections, system size, the proportion of LSLs to total service lines, the age of the system, and the accessibility or existence of service line materials records. Water systems with limited or nonexistent records will be more reliant on physical inspection of service line materials, which will require more time and resources than systems with robust records. Additionally, some service line material investigations may require access to private property, but the customer may deny access or not respond to water system outreach, which could challenge a water system's ability to comply with a verification deadline. Some records used for the initial inventory may be outdated or inaccurate, requiring the inventory to be updated over time as new information becomes available. For other systems (such as those with very few lead status unknown service lines), a Federal deadline may discourage or unnecessarily prolong the water system's inventorying efforts. Therefore, EPA determined it is impractical to impose a single deadline for completing an accurate inventory; it is more appropriately treated as an ongoing effort that systems must engage in, while clearly communicating to the public and the state the progress towards completion. The final rule facilitates timely development and verification of the inventory by requiring service line materials to be tracked as they are encountered and through incentives to verify unknowns. By requiring water systems to issue annual notification to consumers served by unknowns, to include unknowns in the replacement rate if the water system exceeds the lead trigger or action level, and to implement risk mitigation measures after disturbance of an unknown, EPA has created incentives for water systems to reduce the number of unknown service lines in their inventory. EPA also requires that water systems include in their LSLR plan a strategy for verifying the material composition of lead status unknown service lines. An inventory verification strategy can improve efficiency by allowing the water system to integrate material composition investigations into its existing standard operating procedures for other activities. For example, if water system personnel are already deployed on a street for a main replacement, they may visually inspect system-owned lead status unknown service lines on that street or engage with affected customers to determine the material composition of the service line entering the home. Water systems may also create a strategy that involves proactive investigation of service line material compositions which is independent of other water system activities, such as the use of predictive models to evaluate the probability a service line is lead and other methods provided or required by the state. Such predictive models could also inform water systems in how they can approach LSLR in a more efficient manner. EPA encourages but does not require this practice as it allows consumers with lead status unknown service lines to be informed sooner about their service line material. EPA requested comment on the scope of the inventory, including whether it should be required to include customer-owned service lines, galvanized service lines, and lead status unknown service lines. Some commenters believed that the water system should only be responsible for inventorying the service lines under its control, which would exclude all customer-owned service lines. Some commenters suggested that lead status unknown service lines should not be included because inventories with large numbers of unknowns could cause public alarm. Other commenters did not object to inclusion of unknowns but sought for water systems to have the ability to make a judgment about the probability of an unknown being an LSL (for example, a new classification such as ``Unknown but likely non-lead''). Some commenters suggested lead connectors be inventoried. EPA disagrees with comments suggesting that the inventory requirement in the rule should only apply to service lines if they are owned by the system. Customer owned service lines are connected to either a system-owned service line or main and therefore, they are accessible to the system and historically, the LCR has not been limited to system-owned portions of the distribution system. The LCR has required systems to take actions with respect to portions of the distribution system that are not owned by the water system, including actions related to the materials evaluation and the determination of the number of LSLs in the distribution system for calculating the number of service lines required to be replaced. For example, the LCR has required that ``[t]he system shall identify the initial number of LSLs in its distribution system, including an identification of the portion(s) owned by the system. . . .'' Similarly, the previous LCR has provided that ``where the system does not own the entire LSL, the system shall notify the owner of the line that the system will replace the portion of the line that it owns and shall offer to replace the owner's portion of the line.'' Moreover, where service line ownership is divided between the system and the customer, water system actions can release lead from customer-owned pipes and cause subsequent customer lead exposure. For example, partial LSLR of the system-owned portion can result in a lead spike on the customer-owned portion from physical disturbance as well as lead release from galvanic corrosion. Regarding inventory development, EPA notes that customer-owned service lines are connected to either a system-owned service line or system-owned water main and are therefore accessible to the system. Accounting for locations of customer-owned LSLs will continue to be an integral part of the rule; without it, water systems would not be able to[[Page 4213]]coordinate replacement of customer-owned LSLs simultaneously with system-owned LSL, take required risk mitigation actions after replacement of a partial LSLR, or provide notice to persons served by LSLs. EPA disagrees that lead status unknown service lines should be excluded from the inventory. As EPA explained in the proposal, ``[b]ecause water systems may not have complete records to enable them to identify the material for every service line'' the proposed rule would require water systems to identify those lines as unknown, and then update the inventory on an annual basis to reflect more precise information about those lines. (84 FR 61695). EPA determined that such an approach strikes an appropriate balance between a voluntary and mandatory requirement to conduct an accurate and complete inventory of the service line materials in the distribution system. It provides significant flexibility that would not be available if the rule required an accurate and complete inventory by a fixed date; on the other hand, by structuring the replacement requirements so as to incentivize systems to verify the materials of unknown service lines, completion of an accurate inventory is more than an aspirational goal. Including unknown service lines in the inventory will demonstrate transparency, build trust, and present an opportunity for customer engagement, all of which should mitigate commenter concerns about potential customer alarm about the presence of lead status unknown service lines. Exclusion of lead status unknown service lines from the inventory would likely cause significantly more confusion and alarm to the consumers at locations that are excluded from the inventory entirely. Some commenters asked that multiple classifications be introduced for unknowns, for example ``unknown but likely non-lead'' or ``unknown--not lead,'' where records do not exist, but the water system believes the service line is likely not an LSL. A requirement to distinguish the categories of unknown service lines is not necessary for the portions of the rule that use the inventory, and therefore, EPA concluded it would not be appropriate to require in the final rule. Water systems may elect to provide more information in the inventory regarding their unknown lines as long as it clearly distinguishes service lines classified as ``Lead status unknown'' from those whose material has been verified through records or inspection. The distinction between unknown and verified service lines is critical to implementation of the LSLR requirements and will also help to avoid confusion. EPA adjusted the terminology for unknowns from ``service line of unknown material'' in the proposal to ``lead status unknown service line'' in the final rule. This change clarifies that water systems may classify a service line as ``non-lead'' rather than ``service line of unknown material'' where it knows that the service line is not an LSL but does not know the precise material, such as copper or plastic. EPA disagrees that the final rule should require lead connectors to be included in the inventory. In many cases, records on lead connectors are often extremely limited or may not exist at all. Unlike an inventory of service lines, whose material can be visually inspected often without excavation from inside the home or in the meter box, a complete and accurate inventory of connectors would require excavation that disturbs road pavement and repaving post-inspection--an undertaking that EPA expects would not be feasible or practical for most systems. Instead, EPA addresses the presence of lead connectors by requiring that water systems replace system-owned lead connectors whenever they are encountered during water system activities, such as emergency repairs or planned infrastructure work, and to offer to replace a customer-owned connector at no cost to the system. EPA encourages water systems to voluntarily include information about lead connectors in the inventory where such records exist. Commenters suggested that annual submission of the inventory to the state would create burden for the water system to submit its inventory and for the state to review it. EPA agrees that for some water systems, annual inventory updates may not be necessary. For example, water systems below the lead trigger level are not required to execute a system-wide LSLR program, meaning they will have fewer inventory changes to report. EPA agrees that linking inventory update frequency with the tap sampling monitoring period would be efficient for water systems and states because tap sampling must be conducted at LSL sites. Changes in the inventory and any resulting changes to the tap sampling plan made to ensure samples are ***collected*** at LSL sites can be reviewed by states concurrently. EPA also agrees that for water systems on 6-month monitoring, annual inventory updates are more appropriate given that LSLR rates apply annually.3. Final Rule Requirements The final rule requires all water systems to create a publicly accessible LSL inventory. The initial inventory must be available within three years and updated over time to reflect changes, such as verification of lead status unknown service line material compositions or LSLs that have been replaced. All water systems must create an inventory, regardless of size or other water system characteristics, and the inventory must include all service lines in the distribution system, without exclusions. Water systems with only non-LSLs are required to conduct an initial inventory, but they are not required to provide inventory updates to the state or the public and they may fulfill the requirement to make the inventory publicly accessible with a statement that there are no LSLs, along with a general description of the methods used to make that determination. For example, water systems where the entire distribution system (including customer-owned portions of the service line) was constructed after a state or Federal lead ban may designate applicable service lines as ``Non-lead.'' There is no deadline to investigate the material composition of all lead status unknown service lines. Water systems must create a strategy in their LSLR plan for investigating lead status unknown service lines in their inventory. This strategy, coupled with the incentive to investigate unknowns to ease future LSLR burden, will encourage water systems to verify all unknown service line materials in a timely manner. Other rule provisions ensure that customers served by lead status unknown service lines receive protections while inventory development is in progress, such as the requirement to receive targeted information that their service line material is unknown but may be an LSL. While EPA retained the proposed inventory classifications, the final rule modifies some terminology. To avoid potential customer confusion, galvanized service lines that are or were downstream of an LSL are no longer required to be classified as an LSL. Instead, they must be labeled ``Galvanized requiring replacement'' which allows their correct material composition to be listed while maintaining they are not to be classified as ``Non-lead'' because they must be replaced as part of the system's LSLR program. As previously described, the proposed ``Service lines of unknown material'' are referred to as ``Lead status unknown service lines'' in the final rule.[[Page 4214]]The classification of ``non-lead'' means that, as in the proposed rule, the water system does not need to identify the exact material of a service line, such as plastic or copper, if it is not an LSL or galvanized requiring replacement service line. The final rule does not include a requirement to investigate or inventory lead connectors for the reasons discussed above. EPA recommends reviewing records on connector material composition during the records search for the initial inventory. EPA also recommends but is not requiring that water systems inventory connector materials where records exist to provide additional information to consumers about additional lead sources that could contribute to lead in drinking water serving the residence. The final rule incorporates commenter suggestions to link the inventory update submission frequency with the system's compliance monitoring period or annually, whichever is greater. Because tap sampling must be conducted at LSL sites, changes in the inventory and any resulting changes to the tap sampling plan, to ensure samples are ***collected*** at LSL sites, can be reviewed by states concurrently. Water systems on triennial monitoring will be required to provide LSL inventory updates every three years. Water systems that exceed the lead trigger level must conduct tap sampling annually, and therefore, these systems must provide LSL inventory updates annually. Water systems that exceed the lead action level will conduct tap sampling every six months; however, they are required to update the inventory annually. The final rule requires the LSL inventory to be publicly accessible. The threshold required for water systems to publish their inventory online was reduced to 50,000 persons from the threshold of 100,000 as proposed. Internet platforms, such as websites, cloud-based file sharing applications, and social media, are widely available and can host information for free or low-cost. These provisions will strengthen the public accessibility to information in the inventory. EPA also added a requirement for the Consumer Confidence Report to include a statement that a service line inventory has been prepared and is available for review either online or at the water system offices. The final rule requires the publicly accessible inventory to provide a location identifier for lead service lines. The location identifier could be a general location such as a street, block, intersection, or landmark, or other geographic marker associated with the service line. An inventory created and maintained internally by water systems to track service line materials may use the specific address of each service line in order for the water system to provide the required notification under Sec. 141.85(e), but the final rule does not require that the system make the exact street addresses publicly available. Instead, the final rule gives the water system flexibility to determine which location identifier best meets the needs of its own community.D. Lead Service Line Replacement1. Proposed Revisions EPA proposed to accelerate lead service line replacement (LSLR) by proposing LSLR requirements target systems with higher lead levels and that address weaknesses in the current rule to achieve full LSLR in the communities where they are needed most. EPA proposed to require all water systems to replace the system-owned portion of an LSL after they were notified of a customer-initiated replacement of their portion. EPA proposed that water systems above the lead trigger level but at or below the lead action level would be required to implement a ``goal-based'' LSLR program at a rate approved by the state primacy agency. Water systems that exceeded the lead action level would be required to conduct mandatory, full LSLR at a minimum rate of three percent annually. While the proposal did not include a prohibition on partial replacements, it did not incentivize them and included required notification and risk mitigation actions. The proposal promoted full LSLR by allowing only full replacements to count towards the LSLR rate. Partial LSLR and ``test-outs'' would no longer count as a replacement as they do in the current LCR. EPA proposed a provision for water systems to create an LSLR plan by the rule compliance date, which would ensure operating procedures are in place that would ready the water system to perform the technical, financial, and other aspects of LSLR. EPA proposed that galvanized service lines that are currently or were formerly downstream of an LSL be replaced as part of a water system's LSLR program. These galvanized lines would be included when calculating the annual number of replacements applicable under goal-based or mandatory LSLR. Lead status unknown service lines (called ``service lines of unknown material'' in the proposal) were also proposed to be included in the LSLR rate calculation until the system determines that it is non-lead. EPA proposed requirements to address elevated lead levels that can result from disturbance of an LSL, such as after a meter replacement or lead connector replacement. EPA proposed risk mitigation steps required after an LSL disturbance, including flushing and delivery of a pitcher filter. EPA also proposed to require systems to replace the lead connectors (including goosenecks, pigtails that have been used to connect service lines to water mains) whenever encountered by the water system in the course of conducting maintenance or replacement of the water mains or adjacent infrastructure.2. Public Comment and EPA's Response EPA requested comment on the proposed requirements for water systems to create a LSLR plan. Specifically, EPA asked whether small water systems should be exempt from the requirement to prepare a LSLR plan concurrent with their inventory. Some commenters expressed that small water systems should not be required to create a LSLR plan, claiming that the requirement is too burdensome and potentially unnecessary, given that a small system may not choose LSLR as its compliance option following a lead action level exceedance. EPA agrees that small water systems should not have to recommend a goal LSLR rate within the LSLR plan because small systems would not conduct goal-based LSLR program under the small system compliance path. EPA disagrees, however, that small systems should be exempt from preparing a LSLR plan, as its other components are still relevant to small systems. For example, given that small systems must respond to customer-initiated LSLR, the requirement to develop procedures to conduct LSLR in their plan still applies. Additionally, given that small water systems may still replace LSLs at any time (i.e , after planned infrastructure work or an emergency repair), they must develop a strategy to inform customers before a full or partial LSLR. Furthermore, flushing procedures in the LSLR plan apply after an LSL is disturbed or replaced, which could apply, for example, to small systems replacing water mains or water meters. While there is some upfront burden associated with creating an LSLR plan, the plan could significantly reduce future burden for water systems and will reduce the response time if LSLR is needed. Plan components like the strategy to investigate the material of lead status unknown service lines, identify potential LSLR funding and have[[Page 4215]]procedures established for LSLR have the potential to significantly reduce the investigation burden that small systems choosing a LSLR compliance path would face after exceeding the action level and will ensure faster implementation. Investigating unknowns will also benefit public health by providing consumers with information about their service line material. EPA also requested comment on how water systems could identify and prioritize LSLR. Many commenters supported the concept and provided several examples of how LSLR could be prioritized. Commenter recommendations include prioritizing LSLR where large numbers of LSLs are present, tap sampling ***data*** indicates high lead levels, construction work is already scheduled, susceptible populations are served (such as child care facilities), areas with older infrastructure, or where disadvantaged populations are located. EPA agrees that water systems should include a prioritization strategy in the LSLR plan, as these and other factors could inform systems' LSLR efforts. Water systems could give specific consideration to, for example, prioritizing locations where susceptible populations are concentrated (such as child care facilities) and where disadvantaged populations live because these populations may be more susceptible to the impacts of lead exposure, or may be more likely to live in environments with other lead exposure sources. ***Data*** from the 2005 American Housing Survey suggest that non-Hispanic black individuals are more than twice as likely as non-Hispanic whites to live in moderately or severely substandard housing (Leech et al., 2016). Substandard housing is more likely to present risks from deteriorating lead-based paint (White et al., 2016). Additionally, minority and low-income children are more likely to live in proximity to lead-emitting industries and to live in urban areas, which are more likely to have contaminated soils (Leech et al., 2016). In addition, a water system could identify in its LSLR plan the factors that will guide the prioritization of the LSLRs and how the system will facilitate full LSLR where the customer is unable to pay for replacement of the customer-owned portion of the service line. EPA requested comment on the proposed requirement that water systems complete the replacement of the water system-owned portion of the LSL within 45 days of a customer-initiated replacement. Many commenters supported this requirement but suggested that water systems should be allowed more time to complete the replacement. Several cities in northern states, commenters noted, have construction moratoriums during winter months. EPA agrees that it may not be possible for water systems to obtain permits and complete LSLR within 45 days, therefore the final rule includes a provision to allow up to 180 days after notification to the state. EPA recommends water systems to establish a process for customer-initiated LSLRs that would allow for up front coordination on timing and would avoid the need for a reactionary replacement, where possible. EPA sought comment on how the number of replacements under a goal-based or mandatory LSLR program should be calculated. Some commenters pointed out that customer-owned LSLs are outside of the water system's control and they should not be included in the water system's LSLR rate calculation. EPA disagrees that customer-owned LSLR should be excluded from the LSLR program requirements. Under the currently applicable LCR, customer owned service lines are included in the LSLR calculations. Customer-owned service lines must be accounted for in determining the number of initial service lines in section 141.84(b)(1) The initial number of LSLs is the number of LSLs in place at the time the replacement program begins. The system shall identify the initial number of LSLs in its distribution system, including an identification of the portion(s) owned by the system. Excluding customer owned LSLs would continue to promote partial LSLR, which have not been shown to reliably reduce drinking water lead levels in the short-term, ranging from days to months, and potentially even longer. Partial replacements are often associated with elevated drinking water lead levels in the short-term (USEPA, 2011b). EPA notes that while customer-owned lines are not under the direct control of the water systems, there are many actions the water system can take to influence the customers behavior including educating the customer and providing financial assistance, such as loans or grants, to the customer (water systems are not required to bear the cost to replace the customer-owned portion). Moreover, the ``ownership'' status of LSLs is not necessarily static (e.g , it may change as a result of state law or regulations governing public utilities). EPA specifically requested comment on including galvanized service lines in goal-based and mandatory LSLR rates under the proposed LCR revisions. Some commenters agreed that galvanized lines should be replaced under LSLR programs, noting that science demonstrates that galvanized service lines that are or ever were downstream from an LSL can adsorb lead and contribute to lead in drinking water. Some commenters sought clarification regarding the burden of proof required to determine if a galvanized service line ``ever was'' downstream of an LSL. A few commenters recommended that the final rule take an approach that either requires replacement of all or no galvanized service lines due to the difficulty and burden often required to determine whether a galvanized line ``ever was'' downstream of an LSL. EPA agrees galvanized lines that are or were downstream of an LSL can contribute to lead in drinking water and should be replaced under a system's LSLR program. Some commenters believed that lead status unknown service lines should not be used in calculating the number of replacements required, while others suggested that water systems should receive replacement credit whenever an unknown is investigated and verified to be non-lead. EPA disagrees that unknowns should be excluded from the LSLR rate calculation. In the final rule, partial LSLR no longer count as a replacement because they do not result in a full LSLR, so allowing unknown verifications to count as a replacement without actually conducting a LSLR would run counter to the final rule's emphasis on full LSLR. Additionally, this policy would not incentivize, and would instead discourage, systems from conducting robust material investigations for their initial inventory or updating their inventory over time, given that improving the inventory would increase their LSLR burden as some unknowns are found to be LSLs. EPA also disagrees that verification of unknowns to be non-lead should count as a replacement. Counting a verification as ``replaced'' could also disincentivize a robust initial inventory in attempts to lower the LSLR burden and allow compliance with LSLR requirements without conducting an LSLR. EPA requested comment on the goal-based LSLR requirement for systems that exceed the trigger level, asking if a goal-based program provides adequate incentives for water systems to achieve meaningful LSLR, and such a program could be incorporated into existing infrastructure improvement programs. Commenters offered a wide range of views on the new construct. Commenters expressed some support for the proposed requirement, noting it[[Page 4216]]would increase the number of systems with an LSLR program. Many commenters asked for EPA to be more prescriptive regarding the goal LSLR rate in the final rule. For example, some commenters suggested that EPA should set a Federal goal LSLR rate, while others thought that EPA should set a minimum goal LSLR rate while maintaining the current provision which requires states to set a higher goal rate where feasible. Other commenters suggested that EPA set a maximum goal rate, such as three percent. EPA also requested comment on what criteria must be met for the Agency to establish a Federal goal rate for an individual water system under Sec. 142.19 Some commenters disagreed that EPA should maintain authority to supersede a state-approved goal LSLR rate. EPA disagrees that it should be more prescriptive regarding the goal LSLR rate. The goal-based LSLR program is intended to reflect the specific water system and state's priorities and community characteristics. EPA agrees with commenters that the final rule should not include a provision for the Regional Administrator to establish a goal LSLR rate that would supersede a state decision. States best understand individual water system's characteristics, its technical, financial, and managerial capacity, as well as community demographics. States may also set goal LSLR rates in accordance with statewide replacement policies, such as conducting LSLR in tandem with existing infrastructure work, taking a more active approach to LSLR, or making a determination that a higher replacement rate is feasible. EPA requested comment on the feasibility of a minimum annual LSLR rate of three percent as a result of a lead action level exceedance. While some commenters thought that a three percent LSLR was too burdensome, others believed the rate was not stringent enough and should be higher. Some noted that the current rule requires seven percent LSLR and claimed that a replacement rate of three percent would be backsliding in violation of the statutory requirement that revisions to existing drinking water standards ``maintain, or provide for greater, protection of the health of persons'' as the existing rule. Some commenters believed that a mandatory LSLR rate should apply at all times and regardless of a water system's lead levels, effectively requiring mandatory, proactive LSLR program at all water systems. EPA disagrees that a requirement to fully replace three percent of all known and unknown LSLs annually is too slow. Under the previous LCR, many water systems delayed or never initiated LSLR because the rule allows a system to stop LSLR with two bi-annual rounds of tap sampling at or below the action level (AL). A number of scenarios allowed water systems to delay or not begin LSLR. For example, under the previous LCR, water systems without CCT must conduct a study, obtain state approval for the recommended CCT, and obtain state approved optimal WQPs prior to beginning LSLR. Because a CCT study takes longer than one year, many water systems were able to complete two rounds of tap sampling at or below the AL and were not required to complete the CCT study. Further, a water system could delay initiation if the system did not have an accurate LSL inventory and needed time to identify the total number of LSLs in order to determine the number of LSLs required for 7 percent replacement. Meanwhile, that water system could complete two rounds of tap sampling at or below the AL resulting in an end of the LSLR program having replaced few or no LSLs. As a result, very few water systems have conducted LSLR programs under the previous rule. The LCRR no longer allows these delays; systems that exceed the trigger level (TL) must conduct a CCT study so they are prepared to quickly install CCT if there is a subsequent ALE. Also, water systems must prepare an LSL inventory prior to the compliance effective date and systems must conduct four rounds (two years) of bi-annual tap sampling at or below the AL before LSLR may stop. Requiring only full LSLR to count as a replacement will require more time and resources per replacement than partial LSLR, which was allowed in the previous rule because water systems will likely require customer consent to replace their portion of an LSL at customer cost and may need access to the customer's property. EPA notes that as in the previous LCR, states must require systems to replace LSLs on a shorter schedule, i.e , a higher annual percentage than required under the Federal rule, where the state determines a shorter schedule is feasible. EPA disagrees that reducing the LSLR rate to three percent is backsliding relative to the current LCR. The current LCR does not require full replacement of LSLs and the required seven percent replacement rate is rarely occurring since there are provisions in the current rule that allow for avoidance of LSLR. EPA has determined that the revisions to the LCR, as a whole, maintain or provide for greater public health protection. Because a treatment technique rule is not centered on a single compliance level, but rather on an integrated set of actions designed to reduce the level of exposure to a contaminant, the backsliding analysis for a treatment technique rule should be based on an assessment of public health protection as a result of implementation of the rule as a whole, rather than a comparison of numerical benchmarks within the treatment technique rule. Even when the lead service line removal rates are compared directly, this rule results in a greater rate of removal. Based on ***data*** presented in Tables 6-7 and 6-8 of this preamble, improvements in the final rule will result in a 5 to 73 fold increase in full LSLR investments by closing loopholes, improving sampling and monitoring requirements, compelling early action, and strengthening replacement requirements. LSL replacement programs are required to be initiated at systems that exceed the lead trigger level of 10 [micro]g/L versus 15 [micro]g/L in the previous LCR. The requirement for a LSLR plan for all systems will avoid delays in initiating LSLR that have hampered progress under the current rule. Furthermore, the more stringent sampling requirements in the final rule will better identify elevated lead levels associated with LSLs, which will result in more systems that exceed the trigger and action levels and are thus required to replace LSLs. The current rule allows systems to count the line as replaced towards their seven percent removal if a sample taken from an individual line is below 15 [micro]g/L--called ``testing out''--even when no replacement has occurred. The final rule eliminates the ability of water systems to ``test out'' lines from replacement. In addition, while the current rule requires a minimum of one year of mandatory LSLR, the final rule requires water systems to demonstrate lead levels below the 15 [micro]g/L action level for two years before ceasing mandatory LSLR. EPA also notes that the final rule's three percent LSLR rate includes a greater pool of service lines covered by the replacement requirements than the current rule, including not only LSLs, but also lead status unknown service lines and galvanized requiring replacement service lines. Including these known and potential lead sources is expected to result in more service lines requiring replacement under this construct at three percent than under the seven percent required in the previous LCR. Furthermore, the final rule includes provisions requiring water systems to replace lead connectors when encountered and complete[[Page 4217]]customer-initiated LSLR regardless of their 90th percentile lead levels, rather than requiring those actions only for systems that exceed the action level. This is bolstered by requirements for systems to make their LSL inventory publicly available and notify occupants of homes with LSL every year about their LSL, drinking water exposure risks, and mitigation options, including removal. In addition, only full LSLs will count towards the mandated replacement rate; partial LSLR may still be conducted in certain limited situations, but they will not count in calculating the number of lead lines that have been replaced, in contrast to the current LCR. Therefore, this element of the rule, taken by itself, meets the statutory standard for this rule that it maintains or provides for greater health protection. Lastly, LSLR is just one component of the revised rule. Other strengthened provisions in the rule such as corrosion control treatment, find-and-fix, and public education, will mitigate lead exposure to a greater extent relative to the current rule, and thus the rule as a whole provides more protection than the current rule. Some commenters suggested use of a rolling average replacement rate across several years to provide more flexibility to the water system than a static annual rate. Commenters noted that in the first year of mandatory LSLR, water systems may receive a high number of requests from customers to have their LSL replaced, while the pool of willing customers may decline in later years. Commenters believed that water systems should respond to as many customer requests as they can, even if it exceeds their mandatory LSLR rate, in order to remove lead sources sooner. Water systems should not be incentivized, commenters said, to replace the minimum number of LSLs in the first year to ensure a sufficient number of willing participants to meet the mandatory LSLR rate in later years. The Agency agrees that a rolling average construct is appropriate for the final rule. As commenters mentioned, a water system may receive heightened customer interest in LSLR immediately following a lead AL exceedance. Replacing more than 3% LSLs in the first year of an LSLR program under a rolling average rate will result in earlier reductions in drinking water lead exposure for those households served by systems that are able to obtain resources for a short term expedited replacement program. This would remove a potential unintended incentive under a fixed rate of 3% to replace the minimum number of LSLs in the first year to ensure there is sufficient customer participation to achieve 3% in the second year. For example, under a rolling average, a system that is able to expedite LSLRs in the first year following an ALE to replace 4% but in the second year is only able to replace 2% will achieve a 3% two year rolling average. EPA notes that while the final rule requires states to set the mandatory LSLR rate higher than 3% where feasible, the short-term ability of a water system to replace more than 3% immediately following a lead AL exceedance when customer interest is highest is not necessarily indicative of long-term feasibility. EPA also notes that a rolling average approach could provide flexibility to water systems that experience delays in initiating LSLR programs. While not mentioned by commenters, some systems may not immediately have access to LSLR financing following a lead AL exceedance, and therefore would face increased challenges to meet the mandatory 3% LSLR in the first year. These challenges could be compounded where the water system experiences delays securing financing and then faces, as commenters noted in the context of customer-initiated replacement, construction moratoriums in the winter months. The rolling average approach could alleviate these challenges. For example, a system that is only able to replace 2% in the first year due to delays may be able to expedite the LSLR program to replace 4% in the second year and achieve a 3% rolling two year average. EPA acknowledges that some households would experience delays in reductions to drinking water lead exposure under this example in comparison to a fixed annual rate. EPA recommends that water systems begin LSLR as quickly as possible following an ALE to assure that the system achieves the required 3% rolling annual average by the end of the second year following the ALE. EPA notes that by having the LSLR plan prepared in advance as required by the rule, systems should be positioned to avoid delays and have timely implementation of their LSLR program. EPA recognizes that potential funding or scheduling delays that may impede a water system's ability to achieve the LSLR rate or circumstances such as higher than average customer interest that may expedite a water system's ability to achieve the LSLR rate may occur throughout implementation of the LSLR program. Therefore, EPA has constructed the rolling average approach for the duration of the LSLR. For example, a water system that continually exceeds the lead AL may expend its initial funding source and need to seek new funding to continue LSLR. The rolling average approach is not intended to address delays caused by customer refusals, as the final rule includes a mechanism for a water system to cease LSLR after it shows no unknowns in its inventory and has received replacement refusals from all customers served by an LSL or galvanized requiring replacement service line. EPA sought comment on proposed risk mitigation procedures following LSLR or a LSL disturbance, such as the appropriateness of pitcher filters. The proposed rule categorized disturbances into two types: Minor disturbances that require consumer notification and flushing, and more significant disturbances requiring consumer notification, flushing, and pitcher filters. Some commenters claimed that high velocity flushing is appropriate for all disturbances and that filters should not be required as a result of any disturbance. EPA agrees that flushing can be effective at reducing lead in drinking water but disagrees that it is adequate in response to all disturbances. Use of pitcher filters or POU devices over a period of months can help reduce lead exposure from more significant disturbances that may cause sustained elevated lead concentrations over weeks or months. EPA has determined that pitcher filters provide the most viable and efficient option for both water systems and consumers. EPA agrees that POU devices are also effective for risk mitigation and acknowledges that some water systems may prefer POU devices to pitcher filters. It is important to note that systems that elect to distribute POU for risk mitigation after an LSLR are not required to maintain and/or own the devices since they would be used only for short-term mitigation and not for compliance purposes. Small water systems that select POU devices as their compliance alternative must maintain and test devices to be in compliance with the LCRR. EPA also received comments suggesting that notification and risk mitigation be provided after a customer's water is turned back on. A commenter noted that some work may require a customer's water to be turned on and off multiple times. EPA agrees with the commenter that providing notification and risk mitigation before the consumer uses the water is of primary importance and has revised the requirement for notification and risk communication to be provided prior to the water system returning the affected service line to service. EPA received many comments calling for the final rule to ban partial LSLR[[Page 4218]]under all circumstances. Commenters noted that partial replacements are not effective at reducing lead in drinking water and may cause a temporary lead spike. Many other comments supported the proposal's allowance of partial replacements, claiming that in some cases partial replacements are unavoidable, such as during emergency repairs. EPA agrees that it is not feasible to ban partial LSLR in all situations. Although partial LSLR can cause lead levels to be temporarily elevated, the practice may sometimes be unavoidable, such as resulting from an emergency repair. In another scenario, other water system activities may result in a significant LSL disturbance and the water system may find it appropriate to remove the portion it owns, while the customer does not agree to replace his or her portion. Because of circumstances such as those, it is appropriate for the rule to not prohibit all partial LSLR. The final rule discourages the practice of partial LSLR by excluding it from counting towards goal and mandatory LSLR rates, while also ensuring risk mitigation steps are taken when partials are conducted. One commenter noted that their state prohibits partial LSLR and considers lead connectors to be part of the LSL. The commenter sought clarification in the final rule as to how systems would comply with their partial LSLR ban as well as the proposed requirement to replace lead connectors as they are encountered. EPA agrees with this commenter and has provided clarification in the final rule to allow an exemption from the requirement to replace lead connectors as they are encountered if state law bans partial LSLR, includes lead connectors in the LSL definition, and requires systems to remove all LSLs irrespective of a system's 90th percentile lead level. This new provision will facilitate compliance with both state and Federal law while ensuring that consistent progress towards the replacement of lead connectors will occur over time. Some commenters requested that EPA allow verbal refusals or documented attempts to reach a non-responsive customer rather than limiting refusals to customer signatures turning down LSLR as was proposed. EPA agrees with commenters, noting that there may be times where, despite a good faith effort to engage the customer, the water system is unable to reach the customer to obtain a consent or refusal for LSLR. EPA agrees that compliance should be based on the effort to reach the customer to obtain a refusal, and that the water system should not be penalized as a result of customer actions.3. Final Rule Requirements All water systems with LSLs or lead status unknown service lines in their initial inventory must create and submit an LSLR plan to their state by the rule's compliance date. The LSLR plan must include a description of: (1) A strategy for determining the composition of lead status unknown service lines in its inventory, (2) procedures to conduct full LSLR, (3) a strategy for informing customers before a full or partial LSLR, (4) for systems that serve more than 10,000 persons, a recommended LSLR goal rate in the event of a lead trigger level exceedance, (5) a procedure for customers to flush service lines and premise plumbing of particulate lead, (6) a LSLR prioritization strategy based on factors including but not limited to the targeting of known LSLs, LSLR for disadvantaged consumers and populations most sensitive to the effects of lead, and (7) a funding strategy for conducting LSLRs which considers ways to accommodate customers that are unable to pay to replace the portion they own. Completing a LSLR plan will prepare water systems to take the steps necessary to remove a source of drinking water lead exposure when required. Water systems will be able to initiate removals in a more timely manner and may be able to more cost effectively identify and remove LSLs with careful preparation and planning. The final rule does not include a requirement for water systems to include pitcher filter tracking and maintenance plan because water systems will likely distribute the filter and all replacement cartridges simultaneously, making it unnecessary to track filters replacement schedules over time. The final rule adds a new LSLR plan component for water systems to include a strategy for accommodating customers who wish to replace the LSL but are unable to pay the cost of replacing the portion of they own. Nothing in this provision obligates the water system to pay for replacement of a customer-owned LSL. EPA notes potential environmental justice concerns associated with full LSLR when the customer is expected to pay the entire cost to replace the customer-owned portion of the LSL. EPA believes that these impacts can be mitigated by water systems developing a financial assistance strategy ahead of time. In recent years, EPA has become aware of water systems around the country that have successfully adopted one or more approaches for facilitating full LSLR (``Strategies for Achieving Full LSLR,'' docket EPA-HQ-OW-2017-0300). As part of their plan, water systems could investigate whether rate revenue can contribute to customer-owned LSLR or identify external LSLR funding, such as Federal or state grants or loans, that could be used to finance a customer's LSLR. EPA maintains a list of some funding sources that can be used for lead in drinking water reduction activities which can be reached at [*https://www.epa.gov/ground-water-and-drinking-water/funding-lead-service-line-replacement*](https://www.epa.gov/ground-water-and-drinking-water/funding-lead-service-line-replacement). EPA is also requiring that the LSLR plan must include a replacement prioritization strategy, which will inform how a water system will execute their LSLR program. The final rule requires the replacement of lead goosenecks, pigtails, and connectors any time they are encountered by the water system. Coupling lead connector replacement with other water system activities, such as main replacement or LSLR, will facilitate consistent progress is made toward elimination of this lead source from drinking water infrastructure over time. A new provision was added to allow systems to comply with state regulations which ban partial LSLR and consider lead connectors part of the LSL. The final rule requires that water systems complete customer-initiated LSLR within 45 days of being notified by the customer, with the possibility of an extension to 180 days after notification to the state. EPA encourages water systems to establish a process for customer-initiated LSLRs that would allow for up front coordination on timing and would avoid the need for a reactionary replacement of the water system portion of the LSL. To mitigate potential lead exposure associated with a partial LSLR until the system completes the full replacement, the water system must provide the consumer with a pitcher filter or POU device with six months of replacement cartridges, to consumers until the replacement is completed. Because of the potential for partial LSLR to contribute higher levels of lead into drinking water, water systems must also provide the customer with a filter within 24 hours of learning of a customer replacement that left a system-owned LSL in place within the past six months. This new requirement will ensure customers are protected from the effects of partial LSLR, regardless of who owns the remaining LSL portion. Water systems that conduct a full LSLR must also provide customer notification and risk mitigation before the service line is returned to service. EPA has retained the inclusion of galvanized service lines that are or were downstream of an LSL in the calculation[[Page 4219]]of the LSLR rate. Water systems are required to presume the galvanized service line was downstream of an LSL if unable to demonstrate that the galvanized service line was never downstream of a lead service line. This approach ensures that all galvanized service lines that may contribute lead into drinking water may be counted towards replacement under the water system's LSLR program. In the final rule, lead status unknown service lines must be considered in determining a water system's annual LSLR rate under a goal-based or mandatory LSLR program. This provides an incentive to water systems to verify the material of lead status unknown service lines. In the final rule, water systems must recommend a goal LSLR rate in their LSLR plan to be implemented after a lead trigger level exceedance. There is no required minimum or maximum for the recommended goal rate but it must be approved by the state. States may set a different LSLR goal rate than the rate recommended by the system. EPA expects that some systems may propose to conduct goal based LSLR in coordination with planned infrastructure work, while other systems may propose more expansive goal based LSLRs to address the most susceptible or disadvantaged populations. EPA believes it is appropriate for the system to propose a goal LSLR rate based upon an understanding of its individual opportunities and challenges in conducting LSLRs and the priorities in the community for improved public health protection. EPA believes that the primacy agency is in the best position to evaluate the system's recommendation and determine a goal rate. The final rule retains the proposed minimum mandatory full LSLR rate of three percent after a lead action level exceedance (ALE). The final rule also maintains the LCR's existing requirement that water systems conduct LSLR on a shorter schedule (i.e , greater than three percent annually) where the state has determined it is feasible for the system. The final rule incorporates commenters' suggestions to require that the mandatory LSLR rate be determined based upona rolling two year average. A water system that exceeds the action level must replace a rolling two year average of 3% per year (i.e , starting in year 2 following an ALE, a water system's compliance is determined every year based upon whether it replaced at least 6% in the prior two-year period). As stated in Sec. 141.84(a)(7), the number of LSLRs required under the mandatory LSLR program must be calculated using the number of LSLs and galvanized requiring replacement service lines at the time the system first exceeds the action level plus the number of unknowns at the beginning of each years of the system's LSLR program. A water system that has an ALE must conduct the mandatory LSLR program until the water system's 90th percentile lead levels are at or below the action level for 2 years and the cumulative percentage of LSLs replaced by the system is greater than or equal to 3% times the number of years that elapsed between the system's first ALE and the date on which the system's 90th percentile lead levels are at or below the action level for 2 years. A system with 90th percentile lead levels at or below the action level for 2 years that has not yet replaced the required cumulative percentage of lines, may discontinue LSLR only if it achieves replacement of the cumulative percentage of LSLRs before the end of the third year in which its 90th percentile lead levels are at or below the action level. For example, if a system exceeds the action level and replaces 2% in the first year following the ALE, 4% in the second year, and 2% in the third year that system will have met the requirement for a rolling two year 3% average. However if that system's 90th percentile lead levels drop below the action level in the second year and stays below the action level in the third year, that system cannot stop its LSLR program unless it replaces 1% in the fourth year to achieve a cumulative replacement of 9%.Where a water system fails to achieve its mandatory LSLR rate, it may remain in compliance if it has no remaining lead status unknown service lines in its distribution system and it provides documentation of refusals, or non-response, to the water system's efforts to fully replace all LSLs and galvanized requiring replacement service lines. The final rule builds on the proposal by allowing documentation of two good faith attempts to reach the customers that either resulted in a signed or verbal refusal, or non-response. This provision allows a water system to maintain compliance with the rule in the expected limited cases when customers do not cooperate enough with systems to meet the minimum LSLR requirements in the rule. This provision does not allow refusal of an individual customer to count as a replaced LSL. The final rule mandates risk mitigation best practices after partial replacements or other actions that cause LSL disturbances. These practices include consumer notification, flushing, a free pitcher filter or POU and replacement cartridges delivered to the affected consumer, and an offer to conduct a follow up tap sample between three and six months following the replacement to ensure lead levels have subsided. While the final rule does not include a ban on partial LSLR, provisions in the revised rule requirements will discourage partial LSLR relative to the previous rule; in addition, the revised requirements will reduce consumer exposure to lead in drinking water when partials and other LSL disturbances occur.E. Compliance Alternatives for a Lead Action Level Exceedance for Small Community Water Systems and Non-Transient, Non-Community Water Systems1. Proposed Revisions EPA proposed revisions that provide small Community Water Systems (CWSs), serving 10,000 or fewer persons, and all Non-Transient, Non-Community Water Systems (NTNCWSs) greater flexibility to comply with the requirements of the LCRR. In 1998, EPA designated corrosion control treatment as an affordable compliance technology for all categories of small systems in accordance with SDWA Section 1412(b)(4)(E)(iii) (USEPA, 1998c). EPA has determined that corrosion control treatment is still an affordable technology for the three categories of small systems, however, EPA recognized that small systems tend to have more limited technical, financial, and managerial capacity to implement complex treatment techniques. Small system flexibilities will provide alternatives to chemical treatment, as it is difficult for many small systems to find operators that have the more advanced skills necessary to implement and maintain such treatment. EPA proposed three compliance alternatives for a lead action level exceedance to allow increased flexibility for small CWSs that serve 10,000 or fewer people and four compliance alternatives for NTNCWSs of any size. The proposed rule would allow water systems to select the most financially and technologically viable strategy that is effective in reducing lead in drinking water. EPA proposed the following compliance alternatives for small CWSs: (1) Full LSLR, (2) installation and maintenance of Optimized Corrosion Control Treatment (OCCT), or (3) installation and maintenance of point-of-use (POU) treatment devices. EPA proposed the above three compliance alternatives for NTNCWSs and an additional compliance alternative of replacement of all lead bearing plumbing materials.[[Page 4220]]As proposed, the NTNCWS must have control of all plumbing materials and must have no LSLs to select this option.2. Public Comment and EPA's Response EPA requested comment on whether small system flexibility is needed by systems serving between 3,301 and 10,000 persons and whether a different threshold is more appropriate. Several commenters recommended the final LCRR revise the threshold for small systems to those serving 3,300 persons or fewer to be consistent with other drinking water rules. Some commenters supported the proposed LCRR small system definition and recommended that the small system flexibility provisions apply to systems serving 10,000 persons or fewer. Other commenters argue that the proposed threshold of 10,000 or fewer persons is too broad and it would apply to over ninety percent of the nation's water suppliers. These commenters stated that most systems serving 3,301 to 10,000 people likely have sufficient resources to comply with the regulatory requirements for larger systems and do not require the flexibility needed by smaller water systems. EPA agrees that the appropriate threshold to provide flexibility to small CWS is 10,000 or fewer persons served. The Agency agrees that small water systems serving 10,000 or fewer persons typically do not have the capacity to implement multiple measures simultaneously such as corrosion control treatment and LSLR programs. Small CWSs and NTNCWSs tend to have more limited technical, financial, and managerial capacity to implement complex treatment technique rules such as the LCR (USEPA, 2011a). Many small public water systems face challenges in reliably providing safe drinking water to their customers and consistently meeting the requirements of the SDWA and the National Primary Drinking Water Regulations (NPDWRs) (USEPA, 2011a). The cost of providing service places significant pressure on small water systems because they lack resources and economies of scale (USEPA, 2000c). The Agency determined the compliance flexibility options would be most appropriate for small water systems that serve 10,000 or fewer persons, as they are most frequently the systems that are struggling to maintain compliance with the current LCR and/or do not have the capacity to operate corrosion control treatment in conjunction with other complex treatment technique requirements. Small water systems serving 10,000 or fewer persons have more monitoring and reporting (M&R) violations, approximately 90 percent of all M&R violations for all NPDWRs. Recurring M&R violations can obscure more important water quality problems because MCL and maximum disinfectant residual level (MRDL) violations may not be discovered if a system fails to conduct routine monitoring. M&R requirements are often the simplest compliance requirements and systems that cannot complete these procedures may have other technical, financial and managerial issues (USEPA, 2011a). Small system flexibilities will provide alternatives to chemical treatment as it is difficult for many small systems to find operators that have the more advanced skills necessary to implement and maintain such treatment, particularly given the limited financial and programmatic capacity of many small utilities (Kane, 2018). EPA has concluded that these small systems can work with their state to identify an affordable and feasible treatment technique to reduce drinking water lead exposure. EPA expects that small systems will work with their state to identify the single most cost-effective measure from this list of affordable and feasible compliance options. That measure will depend upon the characteristics of the small system including the number of service connections, the number of LSLs and the technical capacity of the system's operators. Some commenters recommended that a threshold 3,300 or fewer persons should be used in the final rule as it would allow for consistency across NPDWRs. EPA notes that the NPDWR for lead and copper is a unique and complicated treatment technique rule that requires water systems with elevated lead to take a suite of actions to reduce lead levels in drinking water. To improve public health protection, the final rule maintains or modifies regulatory requirements from the previous LCR and includes new requirements that apply to all system sizes, for example, preparing an LSL inventory, ***collecting*** all tap samples from homes with LSLs, conducting ``find-and-fix'' assessments, conducting water system side LSLR when customer initiated LSLR occurs and providing filters, providing filters in the event of an LSL disturbance, and conducting public education outreach to customers served by an LSL. Additionally, the final rule establishes a new trigger level that, when exceeded, prompts a set of actions designed to protect public health. Given the complex requirements associated with this treatment technique rule, EPA has determined that it is not feasible for water systems serving 10,000 or fewer persons to implement the full suite of treatment technique requirements for systems that exceed the action under the final LCRR because, in most cases, they lack the technical, financial, and managerial capacity to do so. EPA has concluded that small system flexibilities are appropriate and allow water systems that exceed the action level, with state approval, to take the lead reduction approaches that both maximize public health protection to the extent feasible and are best tailored to their communities. EPA does not agree with commenters that support the small system flexibilities only for systems serving 3,300 or fewer persons. EPA recognizes that while small systems serving between 3,301 and 10,000 persons may have greater technical, managerial, and financial capacity than smaller systems, they still face limitations in their capacity to implement multiple treatment technique actions. EPA has determined that it is not feasible for most systems serving 10,000 or fewer persons to implement the multiple treatment technique actions of optimized CCT, PE and LSLR due to limitations in financial, managerial and technical capacity. Implementing such a complex NPDWR as the LCRR treatment technique rule requires consequential managerial, operational, and financial resources investment. New rule requirements, such as implementation of an LSLR goal based program when the lead TL is exceeded and mandatory 3% per year rate based on a two year rolling average LSLR when the AL is exceeded, preparing and updating an LSL inventory, ***collecting*** 5th liter samples from LSL sites and ***collecting*** tap samples from 100% LSL sites, conducting find-and-fix actions, testing in schools and child care facilities and conducting enhanced PE all represent significant new requirements for water systems. Small water systems will need to comply with all of these new LCRR components. Therefore, EPA has determined that systems serving 10,000 or fewer persons have less professional staff than larger systems; these systems have an average of 0.4 to 2.4 full time operators and 0.5 to 2.4 managers per system, which is approximately 2 to11 times less than the average number of operators in the larger systems. Average revenues for systems serving 10,000 or fewer persons are about 4 to 170 times smaller than average revenues for large systems (USEPA, 2009). Other commenters assert that POU treatment is implementable only in very small water systems. Some commenters[[Page 4221]]stated that POU treatment is not an appropriate option for small systems since they could not properly train users on how to maintain them. Other commenters suggested the POU treatment option is not cost-effective compared to corrosion control treatment for systems serving more than 3,300 people. EPA also recognizes the concerns over POU device maintenance problems; however, with proper installation and maintenance provided by the water system, including changing filter cartridges and resolving operational issues experienced by the user, POU devices are an effective option for some small CWSs and NTNCWSs. When POUs are identified by EPA in the list of technologies for small system compliance, Section 1412(b)(4)(E)(ii) of the SDWA requires PWSs using POU treatment units to own, control, and maintain the treatment units to ensure proper operation and maintenance and compliance with the treatment technique. It also requires that the POUs be equipped with mechanical warning devices to ensure that customers are automatically notified of operational problems. EPA believes that some small water systems can cost effectively install and maintain POU devices in their customer's homes and can educate their customers on the proper operation of these devices. Most NTNCWSs own and control all the outlets in their system and can ensure proper operation and maintenance of installed units. In addition, smaller CWSs serve fewer persons for which they would need to provide POU devices compared to larger CWSs. In the proposal, EPA also requested comment on whether different flexibilities would be more appropriate for small systems. Many commenters recommended that the lead-bearing plumbing replacement option proposed for NTNCWSs should be also extended as a compliance option for small CWSs. Commenters noted that this option could be beneficial for some small CWSs that do not wish to operate OCCT or install POU devices in perpetuity but have lead bearing plumbing materials that are in their control. One commenter wrote that small CWSs that control the premise plumbing include public water systems that are owned and operated by assisted living facilities, boarding schools, prisons, and apartment buildings. EPA agrees with the commenters and acknowledges that in certain circumstances, when small CWSs have no LSLs and have control of all of the plumbing materials in the system, replacement of all lead-bearing plumbing material might be feasible, affordable, and a more effective option than CCT for the system to reduce drinking water lead exposure. Some commenters expressed concerns that small CWSs that elect to conduct LSLR would not be required to implement immediate measures to reduce lead exposures. One commenter noted this approach ``is not acceptable from public health, health equity or environmental justice perspectives'' because it creates the potential for consumers to be exposed to high lead levels for up to 15 years without CCT or POU devices in place. Other commenters were concerned that small CWSs that elect to implement CCT would not be required to undertake LSLR. These commenters noted that this approach allows LSLs to remain in the ground indefinitely, thus raising ``serious environmental justice concerns.'' EPA agrees that systems serving greater than10,000 persons can and should implement both corrosion control treatment and LSLR programs if the system exceeds the action level. For systems serving less than 10,000 people, EPA has determined it is appropriate to retain both LSLR and CCT as compliance alternative options as outlined in the proposed LCRR. CCT may be the most appropriate option for small CWSs and NTNCWSs that have many LSLs because LSLR is a resource-intensive process and may not be a feasible solution for some systems. LSLR, on the other hand, may be a feasible option for small CWSs and NTNCWSs that have fewer LSLs and that could be removed within a few years. The state must require a system to replace LSLs on a shorter schedule, taking into account the number of LSLs in the system, where a shorter replacement schedule is feasible. The LSLR option could allow those systems to avoid the need to add a CCT process that would require continual operation and maintenance. EPA has determined that it is not feasible for small systems serving fewer than 10,000 to both operate optimized CCT and conduct LSLR. As explained in greater detail above, these systems have limited operator staff to manage CCT and LSLR programs. Systems serving 10,000 or fewer persons do not enjoy the economies of scale of larger systems therefore the cost of multiple treatment technique actions may not be affordable for these smaller systems. Additionally, the LCRR includes several public education requirements including annual notice to sites served by an LSL that will provide consumers with information about the risks of the LSLs and the actions they can take to reduce their risks. Regardless of the compliance options selected, all water systems are required to conduct public education when the lead action level is exceeded. Finally, the LCRR will afford all NTNCWSs and small CWSs the flexibility to evaluate the best treatment technique for them to control lead and to implement their chosen approach based on state approval.3. Final Rule Requirements Under the final LCRR, small CWSs that serve 10,000 persons or fewer and any NTNCWS that exceeds the lead trigger level but do not exceed the lead and copper action levels must evaluate the four compliance alternatives and make a recommendation to the state within six months on which compliance alternative the water system would implement if the water system subsequently exceeds the lead action level. The state must approve the recommendation or designate an alternative compliance option within six months of submittal. In the event these water systems exceed the lead action level, they must implement the state-approved compliance option. Any small CWSs and any NTNCWS that exceeds the lead action level and had not previously exceeded the trigger level, must evaluate the compliance alternatives and make a recommendation to the state within six months. The state must approve the system's recommendations or designate an alternative compliance option within six months; these water systems must implement the state-approved compliance option.a. Lead Service Line Replacement Water systems that select and are approved for LSLR and subsequently exceed the lead action level are required to implement a full LSLR program on a schedule specified by the state, not to exceed 15 years. EPA is requiring that NTNCWSs and small CWSs with LSLs that exceed the lead action level of 15 [micro]g/L that choose to fully replace all of their LSLs until none remain must ensure they have the authority or consent to remove the customer-owned portion of every LSL in its distribution system or obtain refusals from customers. If the water system's 90th percentile drops below the lead action level, the water system must continue to replace LSLs until none remain. This option is projected to be a feasible and affordable, as well as practical choice for small systems that have few LSLs that could be removed within a few years, thus potentially avoiding the need to add a CCT process that would[[Page 4222]]need to be continually operated and maintained.b. Corrosion Control Treatment Water systems that select and are approved for implementation of optimized CCT and subsequently exceed the lead action level are required to implement the state-approved option for CCT. The final rule provides flexibility for NTNCWSs and small CWSs to install and maintain optimized CCT as a compliance alternative after exceeding the lead action level. EPA has determined in its analysis that some water systems may choose this alternative as the feasible, affordable, and most effective strategy for reducing lead in drinking water (e.g , small water systems with many LSLs to replace or a large number of households and non-residential buildings that would make installation and maintenance of POU devices logistically challenging) (see section VI.C.4 of this preamble). EPA is requiring water systems, including small water systems, that have already installed CCT and subsequently exceed the lead action level to re-optimize CCT.c. Point-of-Use Devices Water systems that select and are approved for the POU option and subsequently exceed the lead action level, are required to implement a POU program on a schedule specified by the state, but not to exceed one year for CWSs and three months for NTNCWSs. The final rule provides flexibility for NTNCWSs and small CWSs to install and maintain POU devices, independently certified by a third party to meet the American National Standards Institute standard applicable to the specific type of POU unit to reduce lead in drinking water, as a compliance alternative to a lead action level exceedance in lieu of CCT and LSLR. EPA is requiring small CWSs that select this compliance alternative to provide a minimum of one POU device per household and one for every tap that is used for cooking and/or drinking in every building in its distribution system, regardless of whether that household or building is served by an LSL, to ensure the residents can access filtered water. Since system-wide CCT is not being provided under this option, even homes and non-residential buildings without LSLs would need to be provided with a POU device to address lead leaching from old lead solder or brass plumbing fittings and fixtures. EPA is requiring NTNCWSs to provide a POU device for every tap intended for drinking or cooking to ensure all building users can easily access filtered water. The water system is responsible for maintenance of the device, including changing filter cartridges and resolving operational issues experienced by the customer. Small CWSs that serve relatively few households, or NTNCWSs that are responsible for the facility's plumbing, may find this to be the feasible, affordable, and most effective compliance alternative (see section VI.C.4 of this preamble). Small CWSs must ensure water system personnel have access to the homes of the residents and the non-residential structures to install and maintain the POU devices, including changing the filters. Systems are also required to provide instructions on the proper use of POU devices to maximize the units' lead level reduction effectiveness.d. Replacement of Lead Bearing Plumbing Materials Water systems that select and are approved to replace all lead-bearing plumbing and subsequently exceed the action level are required to replace all lead bearing plumbing on a schedule specified by the state, but not to exceed one year. Under the final rule, NTNCWSs and small CWSs that have control over all plumbing in its buildings and no LSLs may choose to replace all lead bearing plumbing in response to a lead action level exceedance. EPA is requiring that the replacement of all lead bearing plumbing occur on a schedule set by the state which must not exceed one year.F. Public Education Under the current LCR, water systems that exceed the lead action level must initiate a public education program within 60 days of the end of the tap sampling period in which the action level exceedance occurred. The purpose of public education is to inform consumers that elevated levels of lead have been found in the drinking water, provide information about sources of lead in drinking water, provide information about the health effects of lead, and explain the actions consumers can take to reduce exposure as well as the actions the water system is taking to reduce drinking water lead levels. Under the current rule, water systems are required to provide consumers with their tap sample results within 30 days.1. Proposed Revisions Proposed revisions included a requirement for systems to update public education materials with revised mandatory health effects language. EPA proposed to modify requirements to provide consumers with their lead tap sample results within 24 hours if the sample is greater than 15 [micro]g/L, while maintaining the current rule requirement to provide tap sample results within 30 days for sample results less than or equal to 15 [micro]g/L. EPA proposed additional public education requirements following a lead action level exceedance. EPA proposed that CWSs conduct annual outreach to state and local health agencies to explain the sources of lead in drinking water, describe health effects of lead, with the expectation they would explore collaborative efforts. EPA proposed a requirement for systems with LSLs to annually notify consumers served by an LSL or service line of unknown lead status and to provide them with public education annually until the LSL is replaced or the unknown service line is determined not to be an LSL. EPA proposed that this notification inform consumers of the health effects and sources of lead in drinking water (including LSLs), how to have water tested for lead, actions consumers can take to reduce exposure to lead, and information about the opportunities for LSLR, including the water system's requirement to replace its portion of an LSL when notified by a customer that they intend to replace the customer-owned portion of the LSL. EPA also proposed additional public education requirements for water systems that are required to conduct a goal based LSLR program but that fail to meet their annual LSLR goal. EPA proposed to require those systems to conduct additional public outreach activities to increase customer awareness of the potential higher exposure to lead from an LSL and advance customer interest in participating in the goal based LSLR program. EPA proposed that CWSs conduct one or more of the following annual public outreach activities, until the water system meets its replacement goal: (1) A social media campaign (e.g , Facebook, Twitter), (2) outreach to organizations representing plumbers and contractors to provide information about lead in drinking water including health effects, sources of lead, and the importance of using lead free plumbing materials, (3) certified mail to LSL customers inviting them to participate in the LSLR program, (4) conduct a town hall meeting or participate in a community event to provide information on the LSLR program, (5) visit targeted customers to discuss LSLR program and opportunities for LSLR, or (6) obtain written refusal from all LSL customers to participate in the LSLR program. Outreach to organizations representing plumbers and contractors is included as an outreach activity that[[Page 4223]]systems may conduct, as plumbers and contractors may also be a source of information about lead in drinking water for customers and may help with identifying LSLs during home repair. EPA proposed that CWSs conduct annual outreach to state and local health agencies to explain the sources of lead in drinking water, describe health effects of lead, and explore collaborative efforts.2. Public Comment and EPA's Response EPA received many comments on the mandatory health effects language required in all public education materials, the CCR, and the 24 hour public notice of a lead action level exceedance. Some commenters characterized the proposed language as redundant, too long and not clearly stating the level of risk. Some commenters recommended using more definitive language about the health risk in adults. Some commented that the language improperly describes the scientific evidence on adult risks as ``recent.'' Several commenters provided suggestions for making the language clearer and more concise. EPA has revised the mandatory health effects language in the final rule to address many of these suggestions and to provide better risk communication and improve accuracy and clarity, resulting in a more concise message and simpler sentence structure for clearer communication. EPA also received comments on the proposed consumer notice requirement for individual samples that exceed 15 [micro]g/L. Many commenters expressed concern over the ability of water systems to deliver a notice to consumers within 24 hours of learning of a tap sample over 15 [micro]g/L and recommended that water systems be allowed two business days to notify consumers. After considering these comments, EPA has determined that it may not be possible for water systems to provide consumer notification within 24 hours, therefore the final rule will require water systems to provide the consumer notification as soon as practicable but no later than 3 calendar days. Once systems receive tap sample results that exceed 15 [micro]g/L, they can choose from several options that make it feasible to provide the consumer notice within 3 days, including delivery electronically, by phone, hand delivery, mailing with a post mark within 3 days, or any other method approved by the state. EPA requested comment on whether the Agency should require water systems to distribute public education materials to homes with unknown service line types to inform them of the potential for their service line to be made of lead and the actions they can take to reduce their exposure to drinking water lead. Many commenters supported the new provision and noted that it would encourage homeowner engagement in LSLR, while some expressed concern that notifying consumers that their service lines are of unknown lead status may cause fear and distrust of the water system. EPA does not find any compelling evidence that public education to consumers with lead status unknown service lines would cause increased fear and distrust so is finalizing requirements to notify customers with an LSL and lead status unknown lines. Persons served by a lead status unknown service line may decide to take steps to determine the material of their service line and/or take measures to reduce their potential exposure to lead in drinking water. Providing information to aid customer decision making should provide greater transparency increasing trust. EPA requested comment on the appropriateness of required outreach activities a water system should conduct if they do not meet the goal LSLR rate in response to a trigger level exceedance. EPA also requested comment on other actions or additional outreach efforts water systems could take to meet their LSLR goal rate. Many commenters supported outreach to encourage participation in the LSLR program but expressed concern about how well the activities followed risk communication best practices. Commenters expressed concern that some of the outreach activities (e.g , social media campaign) would exclude some consumers. EPA agrees that a social media campaign on its own may exclude some segments of the population and has revised the outreach requirements in the final rule to be more inclusive. In the final rule, conducting a social media campaign is still an option but must be accompanied by at least two other forms of outreach to ensure that water systems reach individuals who may not use social media. At least one of the activities must include the following: (1) Send certified mail to customers with lead or galvanized requiring replacement service lines, inviting them to participate in the LSLR program, (2) conduct a townhall meeting, (3) participate in a community event to provide information about its LSLR program and distribute public education materials, (4) contact customers by phone, text message, email or door hanger, or (5) use another method approved by the state to discuss the LSLR program and opportunities for LSLR. Many commenters suggested alternative means for reaching customers such as newspapers, television, radio, and reverse 911 calls, or that states be able to approve alternative methods. EPA has added some of the outreach efforts commenters suggested (e.g , newspaper, television, and radio) as additional options that CWSs may select if they continue to fail to meet their goal LSLR. In addition to conducting at least one of the above five activities, CWSs must conduct at least two activities from the following list if they continue to fail to meet their goal LSLR: (1) Conduct a social media campaign, (2) conduct outreach via newspaper, television, or radio, (3) contact organizations representing plumbers and contractors by mail to provide information about lead in drinking water, or (4) visit targeted customers to discuss the LSLR program and opportunities for replacement. EPA requested comment on the appropriateness, frequency, and content of required outreach to state and local health agencies and whether the requirement should apply only to a subset of the country's CWSs. Many commenters supported requiring water systems to engage with public health agencies; however, they expressed concern that an annual report from all CWSs to local and state health agencies would not be an effective way to encourage collaboration and would overload health agencies with virtually the same information. Some commenters suggested that the outreach requirement be limited to CWSs with action level exceedances or CWSs with LSLs. Additionally, many commenters recommended that outreach be led by the state. EPA acknowledges concerns about the amount of information health agencies would be receiving from water systems; however, under the final rule each CWS will provide unique information. In addition to providing important information on sources of lead in drinking water and actions to reduce lead in drinking water that health agencies may incorporate in their lead poisoning program materials, CWSs must also provide system-specific information about find-and-fix activities and information about school and child care facility testing. Therefore, it is important that all CWSs provide this information so that the state and local health agencies in their service area can evaluate it along with other ***data*** they may have such as blood lead levels and take steps to investigate other potential sources of lead in the communities they serve. The purpose of this outreach is[[Page 4224]]also to provide an opportunity for CWSs to explore collaborative efforts with local and state health agencies and work together on public education programs; therefore, EPA believes it is important for all CWSs to participate. Collaborating with local and state health agencies serves as an additional way for CWSs to reach consumers who may be affected by lead in their drinking water, so they can take measures to reduce their exposure. Many commenters requested clarification of whether this provision requires systems to provide public education to health care providers and caregivers. EPA acknowledges commenters' confusion and has clarified that is not required in the final rule. The requirement is for annual outreach to local and state health agencies. Some commenters also expressed concern with the January 15 deadline and recommended that it be conducted on the same schedule with the Consumer Confidence Report (CCR) or other required outreach. In response, EPA has updated the reporting date to July 1, consistent with the CCR.3. Final Rule Requirements EPA is requiring public education materials to include the following revised mandatory health effects statement: Exposure to lead in drinking water can cause serious health effects in all age groups. Infants and children can have decreases in IQ and attention span. Lead exposure can lead to new learning and behavior problems or exacerbate existing learning and behavior problems. The children of women who are exposed to lead before or during pregnancy can have increased risk of these adverse health effects. Adults can have increased risks of heart disease, high blood pressure, kidney or nervous system problems. EPA is requiring that water systems must notify persons served at the sampling site for any individual tap sample that exceeds 15 [micro]g/L, as soon as practicable but no later than 3 days after receiving the sampling results. This is in addition to the existing LCR requirement to provide a notice of the individual tap sample results from lead testing to persons served at the sampling site, which must be sent within 30 days of receiving results. For tap samples that do not exceed 15 [micro]g/L, the 30-day consumer notice will remain in effect. In the final rule, water systems that have individual tap samples greater than 15 [micro]g/L must also implement the ``find-and-fix'' provisions as described in section III.K of this preamble. EPA is requiring systems with lead, galvanized requiring replacement, or lead status unknown service lines in their inventory to notify and provide public education materials to households served by a lead, galvanized requiring replacement, or lead status unknown service line. Targeted public education for persons served by a lead, galvanized requiring replacement, or lead status unknown service line is intended to raise awareness of people in a household that may have higher lead exposures so that they may take actions to reduce exposure to lead and participate in LSLR programs. CWSs must provide this notification and public education annually until the LSL or galvanized requiring replacement service line is replaced or the lead status unknown service line is determined not to be an LSL. The notice is required to include a statement that the person served by the water system has an LSL, galvanized requiring replacement, or lead status unknown service line, information on the health effects of lead, and actions they can take to reduce exposure to lead. For persons served by an LSL or galvanized requiring replacement service line, the notice must also provide information about the opportunities for LSLR, including the water system's requirement to replace its portion of an LSL when notified by a property owner that they intend to replace their portion of the LSL. This notification must include a description of any programs that provide financing solutions for property owners seeking to replace their portion of an LSL, if such funding is available. For persons served by a lead status unknown service line, this notice must include information about ways that homeowners can verify the material of the service line. EPA is also requiring water systems with LSLs that exceed the lead trigger level of 10 [micro]g/L to provide information about their LSLR program and opportunities for LSLR to persons served by LSLs or lead status unknown service lines. Systems must send the notification within 30 days of the end of the monitoring period in which the trigger level exceedance occurred and repeat it annually until the system is no longer in exceedance. Additionally, EPA is requiring water systems that cause a disturbance to a lead, galvanized requiring replacement, or lead status unknown service line to notify persons at the service connection and provide them with information to reduce their exposure to potentially elevated lead levels. This can include disturbances resulting in the water to an individual service line being shut off or bypassed, such as operating a valve on a service line or meter setter. It can also include disturbances caused by partial or full LSLR or those resulting from the replacement of an inline water meter, a water meter setter, or gooseneck, pigtail, or connector. EPA is requiring CWSs serving more than 10,000 persons that fail to meet their annual LSLR goal to conduct additional public outreach activities. Failure to meet the LSLR goal, by itself, will not be a violation of the treatment technique or monitoring and reporting requirements; however, failure to conduct public outreach activities will result in a treatment technique violation. To increase customer awareness of the potential higher exposure to lead from an LSL and advance customer interest in participating in the goal based LSLR program, water systems must conduct annual public outreach activities until the water system meets its replacement goal or a water system is no longer required to perform a goal based LSLR program. To enhance community engagement and allow water system flexibility as suggested by the NDWAC, EPA is providing options to meet this requirement, so water systems can conduct effective community engagement. A water system that does not meet its LSLR goal rate must select at least one of the following outreach activities to conduct in the following year: (1) Send certified mail to customers with lead or galvanized requiring replacement service lines inviting them to participate in the LSLR program, (2) conduct a town hall meeting, (3) participate in a community event to provide information on the LSLR program and distribute public education materials, (4) contact customers by phone, text message, email, or door hanger, or (5) use another method approved by the state to discuss the LSLR program and opportunities for LSLR. If the water system continues to fail to meet the annual replacement goal in the following year, the water system must conduct one of the above activities and at least two additional outreach activities per year from the following activities to promote participation in the LSLR program: (1) Conduct a social media campaign (e.g , Facebook, Twitter), (2) conduct outreach via newspaper, television, or radio, (3) contact organizations representing plumbers and contractors by mail to provide information about lead in drinking water including health effects, sources of lead, and the importance of using lead free plumbing materials, (4) visit targeted customers to discuss the LSLR program and opportunities for[[Page 4225]]replacement, or (5) obtain written refusal from all LSL or galvanized requiring replacement service line customers to participate in the LSLR program. A refusal includes a signed or verbal statement by the customer refusing LSLR, or documentation of no response after two good faith attempts to reach the customer. Water systems must provide written certification to the state that they have conducted the required outreach activities under this rule. In addition, EPA is requiring that CWSs conduct annual outreach to state and local health agencies to discuss the sources of lead in drinking water, health effects of lead, steps to reduce exposure to lead in drinking water, and information on find-and-fix activities. CWSs are expected to use this as an opportunity to collaborate with state and local health agencies. State and local health agencies include the state health department and city or county health department. For tribal systems, this would be the Indian Health Service Area, Division of Environmental Health Services program, or applicable tribal program if administered through self-determination contracts or compacts under the Indian Self-Determination and Education Assistance Act. This annual outreach will provide an opportunity for water utilities to participate in joint communication efforts, led by state health departments, state lead poisoning prevention agencies, and/or state drinking water primacy agencies (NDWAC, 2015). By working together, CWSs and health agencies can help ensure that caregivers, health care providers, and communities they serve hear and respond appropriately to information about lead in drinking water. CWSs may also use this as an opportunity to develop public education materials in consultation with health agencies. EPA is clarifying the content of the annual outreach to local and state health agencies in the final rule to include providing information about find-and-fix activities conducted in the previous calendar year, including the location of the tap sample site that exceeded 15 [micro]g/L, the result of the initial tap sample, the result of the follow up tap sample, the result of water quality parameter monitoring and any distribution system management actions or corrosion control treatment adjustments made. EPA is also changing the reporting date from January 15 to July 1 to coincide with notifying local and state health agencies of school sampling results, consistent with the CCR. CWSs may send one letter that covers both find-and-fix activities and school sampling results to local and state health agencies. EPA is requiring that small CWSs and NTNCWSs that select POU devices as their compliance option in response to a lead action level exceedance must provide public education materials to inform users how to properly use POU devices to maximize the units' effectiveness in reducing lead levels in drinking water.G. Monitoring Requirements for Lead and Copper in Tap Water Sampling1. Proposed Revisions Several changes to the LCR were proposed in the LCRR to improve tap sampling requirements in the areas of site selection tiering criteria, sample ***collection*** methods, and sampling frequency. In addition, to improve transparency and raise consumer awareness, EPA proposed that water systems make the results of these tap samples publicly available within 60 days of the end of the tap sampling monitoring period. EPA proposed revisions to tiering criteria for selection of tap sampling sites to better target locations expected to have higher levels of lead in drinking water. Under the proposed LCRR, Tier 1 sampling sites for CWSs consist of single-family structures (SFS) that are served by an LSL. When multiple-family residences (MFRs) comprise at least 20 percent of the structures served by a water system, the water system may include these types of structures (served by an LSL) in its sampling pool as Tier 1 sampling sites. However, a large apartment building would be unlikely to have an LSL. EPA proposed Tier 2 sampling sites for CWSs to be buildings, including MFRs that are served by an LSL. EPA also proposed that Tier 3 sampling sites for CWSs consist of SFSs that contain copper pipes with lead solder installed before the effective date of the applicable state's lead ban. EPA proposed that NTNCWS Tier 1 sampling sites consist of buildings that are served by an LSL and the remaining tap samples be taken at buildings with copper pipe and lead solder installed before the effective date of the applicable state's lead ban (Tier 3 sites). EPA did not modify the definition of a ``representative site'' but referred to it as a ``Tier 4'' site in the proposal. EPA proposed additional requirements for water systems to enable prioritization of LSL sites in tap sampling. Under the LCRR proposal, all water systems with LSLs or potential LSLs must re-evaluate their lead sampling sites based on their LSL inventory. These water systems would be required to update their inventory annually and ensure tap sampling sites are served by an LSL. Under the current LCR, water systems with LSLs must ***collect*** at least half of their tap samples from sites with known LSLs. However, in the proposal, water systems with LSLs would be required to ***collect*** all tap samples from sites with known LSLs if possible. Under the proposal, water systems with an adequate number of LSL sites to meet the required minimum number of tap sampling sites must calculate their lead 90th percentile using only tap samples from LSL sites (100 percent LSLs). EPA proposed that if a water system does not have an adequate number of LSL sites to meet the minimum number of tap samples to calculate the 90th percentile level, it may ***collect*** the remainder of the samples from non-LSL sites only after all the LSL tap sampling sites are utilized. If the water system conducts tap sampling at non-LSL sites beyond what is required, EPA proposed that the water system could only include the tap samples with the highest lead concentrations to meet the number of requisite sites for the 90th percentile calculation. EPA also proposed that tap samples ***collected*** which are not used in the lead 90th percentile calculation must still be reported to the state. EPA proposed the use of grandfathered ***data*** to determine their tap sampling monitoring schedule if the ***data*** were from sites that met new requirements. Water systems that ***collect*** lead tap samples after the publication date of the final rule, but before the rule compliance date (three years after final rule publication), in accordance with the proposed tap sample site selection criteria, could use ***data*** to determine the tap sampling monitoring schedule. EPA proposed that water systems which do not have qualifying grandfathered ***data***, must use the lead 90th percentile results from the first tap sampling monitoring period after the compliance date of the final rule. There were no proposed changes to the copper sampling requirements. However, due to the proposed increased tap sampling frequency requirements for lead, each tap sample ***collected*** may not need to be analyzed for both lead and copper as schedules may diverge for some water systems. EPA proposed a lead trigger level of 10 [micro]g/L which affects the tap sampling frequency. Under the proposal, water systems that exceed the lead trigger level of 10 [micro]g/L but do not exceed the copper and lead action levels and are conducting tap sampling on a triennial basis, would begin annual tap sampling at the standard number of sites for lead[[Page 4226]]but may remain on triennial sampling for copper at the reduced number of sites. EPA proposed that water systems that do not exceed the lead trigger level for three consecutive years of annual monitoring could reduce their lead monitoring to triennial at the reduced number of sites. Under the proposal, qualification for reduced monitoring would be contingent upon several factors, including but not limited to, results of lead and copper tap sampling, the size of the water system, and maintaining water quality parameters (WQPs) for optimized CCT. The schedule for tap sampling may be affected when these factors change. Criteria for reduction in tap sampling frequency and number of sites were more stringent in the proposal compared to the current rule. A water system must not exceed the trigger level of 10 [micro]g/L to be eligible for a triennial monitoring schedule at the reduced number of tap sample sites for lead, and large water systems are not eligible for triennial monitoring unless they meet the practical quantitation level (PQL). The proposed revisions to tap sampling frequency and locations were meant to ensure more frequent tap sampling would occur at sites more likely to have elevated lead levels. EPA proposed several changes to the tap sampling protocol, consistent with the Agency's February 2016 memorandum (USEPA, 2016d). Specifically, EPA proposed to prohibit tap sample instructions that include pre-stagnation flushing, aerator removal prior to tap sampling, and use of narrow mouth ***collection*** bottles. EPA also proposed that tap samples be ***collected*** in wide-mouth bottles that are one liter in volume. Wide-mouth bottles are advantageous for lead and copper tap samples because they allow for a higher water flow rate compared to a narrow-necked bottle. ***Collection*** of tap samples using a wide-mouth bottle is more characteristic of faucet water flow when filling a glass of water.2. Public Comment and EPA's Response EPA did not propose to change the current LCR sampling protocol requirement for samples to be one liter first draw tap samples. However, EPA did request comment on alternative tap sampling procedures for locations with an LSL; specifically, whether water systems with LSLs should ***collect*** a tap sample representative of water in contact with the LSL (i.e , the ``fifth liter''). EPA received a wide variety of comments on this topic, with many in support of the fifth liter and several opposed to it. Some commenters suggested ***collecting*** both a first liter and a fifth liter sample and using the highest copper and lead result in the 90th percentile calculation. Others commented on the method in EPA's request for comment of ***collecting*** a first draw copper sample and a fifth liter lead sample. Those that supported ***collecting*** a fifth liter state that the current first liter tap sampling protocol does not capture lead from the highest source, the LSL, thereby providing a false sense of security to residents, while a fifth liter could more accurately capture the highest lead levels at the site. These commenters state that the first liter protocol fails to measure the impact of the greatest contributor to lead levels in the home, the LSL. Commenters emphasized that the first liter can capture lead from premise plumbing but does not effectively capture lead levels from the service line, since it may extend 50 feet or more from the building. Commenters stated the fifth liter sample will better identify systems that should take action to address elevated lead levels. The commenters that were opposed to the fifth liter sample, stated that this technique would be too complicated for residents to carry out, resulting in more confusion and sampling errors. Commenters noted that if the fifth liter sample option is finalized, samplers will need to be well trained in this method. Other commenters disagreed with the fifth liter sample, because they argue it is not consistent with how a consumer would use the water. Tap sampling is required under the LCR to evaluate the effectiveness of corrosion control treatment and to determine if additional actions including LSLR are needed to reduce drinking water lead exposure. EPA agrees with commenters who support the fifth liter sample option for locations with LSLs. EPA has determined that in locations with LSLs, first liter samples can underestimate system lead levels compared to a fifth liter sample. Such underestimation of system lead levels based on first-draw sampling could allow water systems to be unaware that their corrosion control treatment is not working well (Lytle et al., 2019). Without appropriate awareness from tap sampling, systems will not take actions to reduce lead exposure and communicate lead in drinking water risks to consumers. Numerous studies have evaluated the contribution of lead in drinking water from different sources (e.g , service lines, faucets, meters). A study published by American Water Works Association (AWWA) Water Research Foundation (2008) ``Contributions of Service Line and Plumbing Fixtures to Lead and Copper Rule Compliance Issues'' (Sandvig et al., 2008) estimates that 50 percent to 75 percent of lead in drinking water comes from LSLs. Thus, when present, LSLs are the greatest contributor of lead in a home's drinking water. Research using sequential tap sample ***collection*** techniques on homes with LSLs indicates that a first draw sample may not represent the significant contributions of LSLs to a home's drinking water lead levels (Lytle et al., 2019). Therefore, relying on first liter samples for lead could allow a situation in which there may be high lead levels in a system but a 90th percentile concentration below the trigger level or action level. Given that LSLs are the greatest contributor of lead in drinking water, EPA reviewed the sampling ***data*** in the AwwaRF, 2008, Del Toral, 2013, and Lytle et al., 2019 studies to determine the liter in any given sequential sampling profile that was most likely to contain the water that remained stagnant within a customer-owned LSL. Based on this information, EPA selected the fifth liter as the most likely to capture this water and any elevated levels of lead. Additionally, the fifth liter is more likely to capture the water from the customer-owned portion of the service line, which may remain in place from partial LSLRs conducted by systems under the previous rule. The first draw sample represents water that has traveled through the service line but that has sat in contact with the plumbing materials inside the home prior to the tap for the stagnation period. The first draw is an effective sampling technique to identify lead corrosion from taps, solder, pipes and fittings within the home but is not an effective sampling approach to capture corrosion from LSLs. Therefore, the final LCRR requires systems to ***collect*** fifth liter samples at LSL sites because the ***data*** gathered from fifth liter samples to calculate the 90th percentile is a better indicator of the effectiveness of corrosion control treatment in a system. EPA finds that requiring the fifth liter sample for tap sampling would be more representative of lead concentrations in service lines than the first liter sample, which will provide better information on the highest concentration of lead in the system's drinking water. This better information will more appropriately identify the need for required actions designed to reduce lead and copper exposure by ensuring effective CCT and re-optimization of CCT when water quality declines; enhancing water quality parameter (WQP) monitoring; implementing a ``find-and-fix'' process[[Page 4227]]to evaluate and remediate elevated lead at a site where the individual tap sample exceeds 15 [micro]g/L; and making consumers aware of the presence of a LSL, if applicable, to facilitate replacement of LSLs. EPA disagrees with commenters who stated that a fifth liter sample option is too complicated for samplers to perform. To address commenters' concern regarding the proposed fifth liter protocol, EPA modified it to no longer require the use of a gallon container as some customers may not be able to manage a gallon container of water. EPA also modified the protocol so that samplers ***collect*** five one liter bottles which allows for ***collection*** of a first liter for copper analysis and a fifth liter for lead analysis, thus reducing the potential need for two separate sampling events. Although there are additional steps in the fifth liter protocol for LSL sites, EPA will work with states and stakeholders to provide templates for sampling instructions that are clear and simple. Samplers will be able to ***collect*** samples in accordance to this new protocol with minimal error. The EPA disagrees with commenters who stated that the fifth liter sample option should not be required because it does not represent water that is typically consumed. The LCR tap sampling requirements are not intended to represent typical consumption; rather, the tap sampling is intended to determine the effectiveness of corrosion control treatment and to determine if additional actions are needed including LSLR to reduce drinking water exposure to lead. EPA received many comments on the proposed tiering criteria for selection of tap sampling sites. Some commenters stated the proposed tiers were biasing samples against copper sites and suggested EPA should diversify tap sample sites. Other comments suggested the removal of Tier 2 sites altogether due to the difficulty of reaching this population to carry out the sampling. EPA disagrees with these comments because the changes in the tiering requirements are designed to increase the likelihood of ***collecting*** tap samples at sites expected to have elevated lead levels. Many commenters recommended EPA modify the tiers to consider sites with plumbing materials other than LSLs, such as galvanized pipes, lead goosenecks, and other lead fittings. Some of these comments raised concerns about water systems with few or no LSLs, but that have galvanized service lines impacted by lead, or lead goosenecks, pigtails, or connectors in their distribution system. Several comments supported the proposed tiering criteria, while others offered alternative approaches. EPA agrees that galvanized service lines impacted by lead, or lead goosenecks, pigtails, or connectors should be considered in the tiering criteria for selecting tap samples and has modified the final rule to reflect this. Many commenters requested clarification on how the 90th percentile calculation should be performed when systems have a mix of Tier 1 through 4 sites. Commenters suggest that for systems with a mix of Tier 1 through 4 sites, they should not be permitted to ``dilute'' the sampling pool with Tier 4 sites if they have a sufficient number of Tier 3 sites, similar to how EPA proposed calculating the 90th percentile when there is a mix of Tier 1 and Tier 2 sites. EPA agrees and notes this is addressed in the regulatory text under Sec. 141.86(a). For example, for a water system to use Tier 4 sites it must have an insufficient number of Tier 1 through 3 sites: A CWS with insufficient Tier 1, Tier 2, and Tier 3 sampling sites shall complete its sampling pool with ``Tier 4 sampling sites''. Many commenters state that the rule does not capture worst-case scenario copper concentrations, since the proposed tiering criteria focus on high risk sites for lead. While EPA agrees more emphasis has been placed on LSL sites, water systems without LSLs will be focusing on sites with copper pipe with lead solder. Several commenters asked that the method for calculating the 90th percentile in the current rule be maintained. A commenter noted how follow-up samples from find-and-fix are not included in the 90th percentile calculation and suggested that if the follow-up sample provides information confirming that the initial sample was taken in error, the initial sample result should not be used in the 90th percentile calculation Several commenters also requested clarification whether follow-up samples taken after a partial or full LSLR are included in the 90th percentile calculation. Some commenters disagree with this inclusion, stating it may deter water systems from carrying out replacement activities. EPA clarifies that follow-up samples ***collected*** under the find-and-fix provisions or after a LSLR are not included in the 90th percentile calculation but must be submitted to the state. The find-and-fix samples may be outside of the tap sampling monitoring period or ***collected*** using a different tap sample protocol. EPA received many comments on the tap sampling protocol in the proposed LCRR. EPA proposed the use of wide-mouth ***collection*** bottles and the prohibition of flushing the taps prior to the 6-hour stagnation period and cleaning or removing tap aerators in anticipation of sampling. Many commenters supported these updated provisions, stating it will limit these practices which were altering sample results and could make them lower, while others disagreed with them, stating it will negatively impact lead results. In addition, some commenters explained that there is confusion when, in certain cases, customers should be flushing stagnant water out of taps or cleaning aerators to prevent lead exposure. EPA disagrees with commenters who were in favor of allowing pre-stagnation flushing in LCR tap sampling. Flushing, or running taps, has long been understood to decrease water lead levels in a home, and thus has been a recommendation by Federal, state, and local authorities as a way to reduce lead exposure prior to water use, especially in residences of higher risk (e.g , houses containing LSLs) as well as a beneficial practice at homes that may have lead solder or faucets and fixtures that are not ``lead-free''. Flushing removes water that may be in contact with LSLs for extended periods of time, which is when lead typically leaches into drinking water (USEPA, 2016). As a general matter, EPA recommends consumers flush taps as a regular public health protective practice to reduce household exposure to lead in drinking water. However, in the case of ***collecting*** tap samples to determine whether corrosion control is effective or additional actions must be taken to reduce exposure, this practice may mask potential higher lead levels and is prohibited in this final rule. EPA also disagrees with commenters that supported removing and cleaning the faucet aerator prior to sampling. The taps used for monitoring likely contain an aerator as part of the faucet assembly, and particulate matter, including lead, may accumulate within these aerators. Thus, removing and/or cleaning these aerators just prior to sample ***collection*** could mask the contribution of particulate lead. It is advisable to regularly remove and clean faucet aerators to avoid particulate matter build-up. As a general matter, EPA recommends consumers clean faucet aerators as a regular public health protective practice to reduce household exposure to lead in drinking water. However, if customers only remove and clean the aerators before sample ***collection***, the sample results will not be representative. Thus, EPA has prohibited the removal and/or cleaning[[Page 4228]]of the faucet aerator as part of the procedures for ***collection*** of lead and copper tap samples. EPA did not propose revisions to the requirement that tap samples be taken after the water has stood motionless in the plumbing system for at least six hours. Some commenters asked that a maximum stagnation time also be included in the protocol to avoid situations where water has been stagnant for such an extended period of time (i.e , vacation homes) that results would not be representative of regular use. EPA does not believe that a maximum stagnation period is necessary for the rule. Water systems can choose other sites from the same tier in the sample pool if they are aware that this is a problem. Therefore, EPA has not added a maximum stagnation time into the final rule requirements. Several commenters suggested that EPA include alternative sampling techniques such as random-daytime sampling or using filters to measure the lead levels after water is used under normal circumstances for a specified period of time. EPA considered suggestions for other sampling methodologies such as random-daytime sampling. EPA disagrees with these commenters. EPA determined that first liter samples at non-LSL sites and the fifth liter at LSL sites are the most appropriate means to evaluate CCT for both lead and copper. Suggested methods such as random-daytime sampling are too complex for compliance sampling that is implemented by customers and would require an increased cost and burden to water systems. Random daytime sampling is a practice that ***collects*** samples at random locations in the distribution system at random times throughout the day. Lead levels vary significantly from location to location based upon differing plumbing materials. Lead levels also vary over time based upon water use at a location. The LCRR controls for these variables by tiering sampling locations to select sites with leaded plumbing materials and by requiring a stagnation period prior to ***collecting*** a sample. These protocols will assure that elevated lead levels will be found, if present, which enables the system to evaluate corrosion. EPA proposed to expand to all systems the current LCR requirement applicable to most systems that change their source water or make a significant treatment change, to obtain approval from their primacy agency prior to making the change. EPA requested comment on whether the regulation should specify a minimum tap sampling frequency following the source water change or significant treatment change and if so, whether it should be annual or biannual tap sampling. EPA received substantial comments from this request. Some commenters asked EPA to define ``significant'' as this can include a wide range of changes, some of which may not warrant increased sampling requirements. They noted that there are several factors that come into play that should determine the appropriate tap sampling frequency following the change, factors include: Full water quality parameter sampling of the new source, applicable saturation indices results, current or proposed corrosion control treatment, blending with existing sources, size of system, and previous LCR tap sampling. Some commenters expressed that this should be determined by the state based on these factors and the risk profile of the type of change proposed. Many commenters asked EPA to establish a minimum tap sampling frequency of every six months following these changes to fully account for the impact to water quality from the addition or change in source water or long term treatment while others stated annual monitoring would be appropriate because it is more feasible for water systems. Some requested six-month monitoring for new sources and annual monitoring for treatment changes. After a full evaluation of these comments, EPA has determined a minimum tap sampling frequency of once every six months following a change in source water or a significant treatment change is appropriate. Deterioration in water quality or unintended consequences of source water or treatment changes will be more quickly identified and therefore addressed when tap sampling occurs every six months. To provide additional clarification if a significant change would include any long-term change in treatment and the addition of a new source as specified in Sec. 141.90(a)(3), which includes examples of long term treatment changes. States have the expertise to determine which changes qualify as significant to warrant standard 6-month monitoring. EPA received comments on customer-requested tap sampling. Many commenters disagreed with including the results of this sampling in the 90th percentile. They state that EPA should provide clear guidance on how to discard these samples before including them in the calculation. However, other commenters mention how carrying out customer-requested tap sampling is positive and can empower customers to take action upon receipt of results. Others assert that when samples are taken upon customer request, they should be ***collected*** with the standard compliance protocol to standardize the sampling process, especially if they are included in the 90th percentile calculation. Some commenters asked how to include these samples in the compliance pool and whether they should be included only if they are sites served by an LSL. Some asked for clarification on customer-requested samples that are ***collected*** outside of the compliance period or not in accordance with the tap sampling compliance protocol. EPA agrees that samples taken upon customer-request should be used in the 90th percentile calculation only if they are from known LSL sites (or appropriate tier if no LSLs), ***collected*** during the tap sampling period, and use the appropriate tap sampling protocol. EPA encourages water systems to create and maintain a program for testing at residences where customers request it and to share the sampling results with customers.3. Final Rule Requirements The frequency of monitoring and number of samples to be ***collected*** and analyzed is based primarily on how many people the water system serves and previous tap water monitoring results. If residents are ***collecting*** tap samples, the water system must recruit volunteers at the sites that are most likely to have elevated lead based on the tiering criteria described in the section below. To the extent feasible, water systems are required to use the same tap sample sites each monitoring period. If a resident decides to discontinue participation in tap sampling, the water system must select a similarly ``tiered'' site. Due to potential non-response from resident volunteers, EPA recommends including more sampling sites in the pool of targeted sampling sites than is required. The water system is required to calculate a 90th percentile of the sampling results from all sites separately for lead and copper at the end of each monitoring period. This 90th percentile value is reported to the state and used to determine whether the system must comply with other requirements of the rule, such as corrosion control treatment, source water monitoring, public education, and LSLR. Water systems with LSLs are required to ***collect*** samples from all LSL sites (Tier 1 and 2) unless there is an insufficient number to meet the minimum number of samples required. In those cases, the water system must use Tier 3, 4, or 5 sites, in that order. In the final rule, EPA revised the tap sample tiering criteria to include 5 tiers for several reasons. First, this revision[[Page 4229]]ensures that priority is given to highest risk lead sources in the absence of LSLs; galvanized service lines that have been impacted by a lead source such as lead goosenecks, pigtails and connectors. Galvanized lines that are or were downstream of a lead source such as a LSL can contribute to lead in drinking water. These lines have zinc coating containing lead that can leach into drinking water when corroded. They also can capture lead from upstream lead sources and release lead if water quality changes or these pipes are disturbed. These sites have been designated as Tier 3. In this way, these materials are prioritized in tap sampling site selection and will be sampled for non-LSL systems that have these. In the final rule, Tier 4 sites will be comprised of single-family structures containing copper pipes with lead solder and Tier 5 sites are representative of sites throughout the distribution system. NTNCWSs must sample at sites with LSLs (Tier 1), unless they have insufficient numbers to meet the minimum requirement of sites, then they can choose from Tier 3 sites and then Tier 5 sites. Revised Lead and Copper Site Selection Criteria---------------------------------------------------------------------------------------------------------------- CWS NTNCWS Tier ----------------------------------------------------------------------------------------- Proposed rule Final rule Proposed rule Final rule----------------------------------------------------------------------------------------------------------------Tier 1................ ***Collect*** samples from ***Collect*** samples from ***Collect*** samples from ***Collect*** samples from SFSs served by LSLs. SFSs served by LSLs. building served by buildings served by Tier 1 samples can Tier 1 samples can LSL. LSL. be ***collected*** from be ***collected*** from MFRs if they MFRs if they represent at least represent at least 20 percent of 20 percent of structures served by structures served by the water system. the water system.Tier 2................ ***Collect*** samples from ***Collect*** samples from N/A................. N/A. buildings and MFRs buildings and MFRs served by LSLs. served by LSLs.Tier 3................ ***Collect*** samples from ***Collect*** samples from ***Collect*** samples from ***Collect*** samples from SFSs with copper SFSs with galvanized buildings with SFSs with pipes with lead service lines copper pipe and galvanized service solder installed downstream of an lead solder lines downstream of before the effective LSL, currently or in installed before an LSL, currently date of the state's the past or known to the effective date or in the past or lead ban. be downstream of a of the state's lead known to be lead connector. ban. downstream of a lead connector.Tier 4................ Representative sample ***Collect*** samples from Representative N/A. where the plumbing SFSs with copper sample where the is similar to that pipes with lead plumbing is similar used at other sites solder installed to that used at served. before the effective other sites served.. date of the state's lead ban.Tier 5................ N/A.................. Representative sample N/A................. Representative where the plumbing sample where the is similar to that plumbing is similar used at other sites to that used at served. other sites served.----------------------------------------------------------------------------------------------------------------Acronyms: CWS = community water system; LSL = lead service line; MFR = multi-family residence; N/A = not applicable; NTNCWS = non-transient non-community water system; SFS = single family structure. In the final rule, EPA made significant changes to the tap sample ***collection*** protocol under Sec. 141.86(b). For LSL sites, a first liter and a fifth liter must be ***collected*** and analyzed. The first liter analyzed for copper and the fifth liter for lead. Water systems without LSL sites must ***collect*** a first draw one-liter sample for analysis for lead and copper. The fifth liter protocol requirements are described in Sec. 141.86(b). This change to the overall protocol from first draw to fifth liter sample will increase the likelihood that the highest levels of lead will be captured, and appropriately trigger systems into improved corrosion control treatment, LSLR and public education programs to reduce drinking water lead exposure. Only sites served by an LSL will ***collect*** a fifth liter for lead analysis. A first-draw sample will be retained for copper analysis at these sites. For sites not served by an LSL, a first-draw sample will be ***collected*** and analyzed for lead and/or copper depending on the water system's monitoring schedules for lead and copper. EPA is finalizing the modifications to the tap sampling protocol regarding the removal and cleaning of aerators and pre-stagnation flushing in anticipations of sampling efforts. EPA is also promulgating the requirement that all tap samples be ***collected*** in wide-mouth sample bottles so that ***collection*** is occurring when the faucet is flowing at a high rate, typical of normal water use such as pouring a glass of water. EPA added a requirement for tap sampling every six months following the addition of a new source water or a long-term change in treatment in the final rule unless the state determines that the addition of the new source or long term treatment change is not significant and therefore does not warrant more frequent monitoring. The new requirement is described in Sec. 141.86(d)(2)(iv).H. Water Quality Parameter Monitoring1. Proposed Revisions Under the current LCR, water systems that have CCT monitor water quality parameters (WQPs) to ensure effective CCT. WQP samples must be ***collected*** at taps every six months and at entry points to the distribution system every six months prior to CCT installation and every two weeks thereafter. EPA proposed several revisions to the WQP monitoring requirements. EPA proposed to eliminate calcium carbonate stabilization as a potential option for CCT and thus, to remove the WQPs associated directly with this CCT option (e.g , all parameters related to calcium hardness (calcium, conductivity, and water temperature)). EPA proposed additional WQP monitoring samples be ***collected*** by water systems that have CCT and that have any individual tap sample(s) with lead results exceeding 15 [mu]g/L. The additional WQP monitoring is a part of proposed provisions for ``find-and-fix'' (see section III.K of this preamble), which would require water systems to ***collect*** follow-up lead tap samples at every sampling site that has an individual lead sample greater than 15 [mu]g/L within 30 days of obtaining results of the individual sample greater than 15 [mu]g/L. EPA also proposed a WQP sample be ***collected*** at a location on the same size water main located within a half mile of the residence with the lead result greater than 15 [mu]g/L. This WQP monitoring was proposed to be completed within five days of receiving results of the individual lead sample greater than 15 [mu]g/L. Water systems with existing distribution system WQP monitoring sites that meet the main size/proximity requirements could conduct the sampling at that location. EPA proposed that any water system which adds sites for the purposes of[[Page 4230]]WQP monitoring specified in this paragraph include those additional sites in future WQP monitoring. EPA also proposed that both CCT and WQPs be assessed during sanitary surveys for water systems with CCT. EPA proposed that states conduct a periodic review of WQP results and other ***data*** to ensure the water system is maintaining the optimal CCT and to assess if there should be modifications to the CCT to further reduce lead and copper levels in tap samples. In addition to the updates for WQP requirements previously specified, EPA proposed several supplementary changes to the current rule. EPA also proposed revisions to the requirements for water systems to reduce the number of sites sampled and the frequency of WQP sampling. As a prerequisite to reducing the number of sites used in water quality parameter monitoring, the current rule requires the water system to maintain the range of water quality parameters for two 6-month monitoring periods. EPA proposed that water systems would also need to meet the lead 90th percentile trigger level for those two 6-month monitoring periods to be eligible for a reduction in the number of sites for WQP sampling. As a prerequisite to reducing the frequency of monitoring for water quality parameters, under the current rule, the water system must maintain the range of WQP values for three consecutive years to reduce to annual monitoring. Under the proposal, the water system would need to also meet the lead 90th percentile trigger level for those three consecutive years in order to be eligible for yearly monitoring. Under the current rule, if the water system meets the WQP requirements determined by the state and the lead 90th percentile trigger level for three additional annual monitoring periods, it may reduce its WQP monitoring frequency to once every three years. EPA also proposed that for every phase of potential reduced WQP monitoring (i.e , semi-annual, annual and triennial), the water system would also be required to meet the lead trigger levels. This would ensure that the required WQP monitoring sites and frequency continue when water systems have high lead levels. For a water system on reduced monitoring, EPA proposed that grandfathered ***data*** may be used if ***collected*** in accordance with the proposed revisions and its 90th percentile in either grandfathered ***data*** or initial tap sampling is at or below the trigger level.2. Public Comments and EPA Response As noted in Section III.B, EPA received mixed comments on its proposal to delete calcium carbonate stabilization as a mandatory corrosion control treatment and the removal of calcium, temperature, and conductivity as mandatory water quality parameters when it was selected as the corrosion control treatment. EPA has removed calcium carbonate stabilization and its associated unique water quality parameters from the final rule as options for systems that are optimizing or re-optimizing CCT. However, for systems that have previously been deemed optimized using this treatment approach, the key water quality parameters of pH and alkalinity are being maintained in the final rule and states will be allowed to designate additional water quality parameters to reflect optimal corrosion control (provided the system does not exceed the trigger level or action level). EPA received many comments about the number of water quality parameter sites that could be added as a result of the proposed find-and-fix requirements. Commenters expressed concern that added WQP sites could not be removed and could over time become too numerous. The systems that will be subject to optimal water quality parameter monitoring are all large systems, medium systems that continue to exceed an action level, and small systems that exceed an action level and have selected optimal corrosion control treatment under the small system flexibility. EPA agrees with commenters that suggested there should be a limit on the number of water quality parameter locations that may be added and has determined the maximum sites should be two times the standard number of water quality parameter sites. EPA determined that this is a sufficient number of sites to ensure water quality. When a system exceeds this upper threshold for the number of sites, the State has discretion to switch out sites that have been added if the newer site can better assess the effectiveness of the corrosion control treatment and to remove sites during sanitary survey evaluation of OCCT. Several commenters stressed that the final rule should require all systems to conduct regular monitoring of the optimal water quality parameters. EPA agrees with these commenters that triennial monitoring does not provide enough ***data*** on water quality in the distribution system. Significant changes in distribution system water quality can occur over a three-year period and water systems need to conduct more frequent WQP sampling to assure CCT is being effectively maintained.3. Final Rule Requirements The final rule includes the proposed revision to the WQP monitoring requirements with two modifications. Section 141.82(j)(1)(vi) of the final rule limits the number of WQP sites that must be added through the find-and-fix process to two times the standard number of WQP sites. The final rule allows states to determine which sites will be retained if a system exceeds the find-and-fix threshold of two times the standard number of water quality parameter sites. This is summarized in the table below. Number of Water Quality Parameter Sites in Distribution System---------------------------------------------------------------------------------------------------------------- Standard Find-and-fix System size (number people served) monitoring (number Reduced monitoring threshold (number WQP sites) (number WQP sites) WQP sites)---------------------------------------------------------------------------------------------------------------->100,000......................................... 25 10 5010,001-100,000................................... 10 7 203,301-10,000..................................... 3 3 6501-3,300........................................ 2 2 4101-500.......................................... 1 1 2<=100............................................ 1 1 2---------------------------------------------------------------------------------------------------------------- As an example, if a system that serves more than 100,000 persons reached the find-and-fix threshold of 50 water quality parameter locations, the state has the discretion to determine which added find-and-fix sites to retain if new locations are needed to assess corrosion control treatment. States have the flexibility to decide that it is necessary[[Page 4231]]to retain all the WQP sites and exceed the find-and-fix maximum if it deems it necessary to demonstrate optimal corrosion control treatment. Second, the final rule requires all WQP locations to be sampled at least annually and specifies that samples should be taken throughout the monitoring period to reflect seasonal variability and triennial monitoring does not provide sufficient ***data***.I. Source Water Monitoring1. Proposed Revisions The 1991 LCR required water systems to conduct source water monitoring following an action level exceedance. Based on the results of the source water monitoring, the state must decide whether it is necessary for the water system to install source water treatment to reduce lead and/or copper tap levels. Regardless of whether a state decides that treatment is needed or not, the water system is still required to conduct source water monitoring following the state decision. EPA proposed to discontinue additional source water monitoring requirements if (a) a water system has conducted source water monitoring for a prior lead and/or copper action level exceedance, (b) the state has determined that source water treatment is not required, and (c) a water system has not added any new water source(s). EPA proposed these changes to eliminate monitoring requirements that are not necessary to protect public health. Lead and copper are rarely found in the source water in significant quantities (Chin, D., Karalekas, P.C.J , 1985; USEPA, 1988; USEPA, 1990b); thus, where the state has decided that source water treatment is not needed, EPA proposed to allow the state to waive source water monitoring for any subsequent action level exceedance under the conditions listed above and to eliminate the regular monitoring currently required for source water lead and copper.2. Public Comment and EPA's Response Several commenters expressed support for waiving source water monitoring as outlined in the proposed LCRR. One commenter specifically expressed support for source water monitoring waivers to be issued by the state in the case of subsequent action level exceedances as outlined in the proposed LCRR. Other commenters opposed the waiver, citing lack of public access to ***data*** that lead can occur naturally in source water in some geologic settings, and that they have ``more than a dozen public water systems that treat for naturally occurring, elemental lead found in their source water and even more systems with low levels of lead that do not require treatment.'' The Agency does not dispute that lead may be found in source water in certain geologic settings; however, the final LCRR requires that any system which adds a new source shall ***collect*** an additional source water sample from each entry point to the distribution system during two consecutive six-month monitoring periods until the system demonstrates that drinking water entering the distribution system has been maintained below the maximum permissible lead and copper concentrations specified by the state. EPA disagrees that source water monitoring results should be made publicly available because source water sampling results are not representative of water quality at the tap.3. Final Rule Revisions The final LCRR eliminates source water lead and copper monitoring that is not necessary to protect public health. Lead and copper are rarely found in the source water in significant quantities (Chin, D., Karalekas, P.C.J , 1985; USEPA, 1988; USEPA, 1990b); thus, where the state has decided that source water treatment is not needed, the state may waive source water monitoring for any subsequent action level exceedance under certain conditions. The final LCRR includes the provision for discontinued additional source water monitoring requirements if (a) a water system has conducted source water monitoring for a prior lead and/or copper action level exceedance, (b) the state has determined that source water treatment is not required, and (c) a water system has not added any new water source(s).J. Public Education and Sampling at Schools and Child Care Facilities1. Proposed Requirements EPA proposed a new requirement for all CWSs to sample for lead at schools and child care facilities they serve and to provide public education for those facilities. The intent of the requirement is to inform and educate targeted CWS customers and users about risks for lead in premise plumbing at schools and child care facilities since large buildings, such as schools, can have higher potential for elevated lead levels due to complex premise plumbing and inconsistent water use patterns. While schools are not likely to be served by LSLs, they may have lead in premise plumbing; therefore, EPA proposed these requirements because public education and water system sampling would provide schools and child care facilities with assurance in the process and benefits of managing a drinking water testing program and the information necessary for them to take actions to reduce lead risk. While, prior to this rule, EPA did not require public water systems to conduct sampling in schools and child care facilities, the Agency had established a voluntary program: 3Ts for Reducing Lead in Drinking Water in Schools and Child Care Facilities--A Training, Testing and Taking Action Approach (3Ts) (EPA-815-B-18-007). The purpose of this program is to assist states, schools, and child care facilities with conducting their own testing programs, conducting outreach, and taking action to address elevated levels of lead. Some states and localities have established mandatory and voluntary programs to test for lead in schools and child care facilities. However, many schools and child care facilities have not been tested for lead. A 2018 survey by the Government Accountability Office (GAO) found that 41 percent of school districts had not tested for lead and an additional 16 percent did not know if they had been tested (GAO, 2018). EPA proposed these requirements because students and young children are especially vulnerable to lead exposure and spend a large portion of their day in schools and child care facilities. Lead in drinking water can be a significant contributor to overall exposure to lead, particularly for infants whose diets often include foods or formula made with water from public water systems (i.e , baby food, juice, or formula). Young children and infants are particularly vulnerable to lead because the physical and behavioral effects of lead occur at lower exposure levels in children than in adults. In children, low levels of exposure have been linked to damage to the central and peripheral nervous system, learning disabilities, shorter stature, impaired hearing, and impaired formation and function of blood cells. Children spend on average over six hours per day at school ((U.S Department of ***Agriculture*** (USDA) National Center for Education ***Statistics***), with many spending more time at on-site before- or after-school care or activities. Children consume water in these facilities through drinking and as part of food preparation. Across the country, about 100,000 schools participate in the national school lunch program, serving daily lunch to approximately 30 million students (USDA, National School Lunch[[Page 4232]]Program, 2019). Ninety thousand schools serve breakfast to 14.8 million students every day (USDA). The Healthy, Hunger-Free Kids Act of 2010 (HHFKA), which authorizes funding and sets policy for USDA's child nutrition programs, requires schools participating in federally funded meal programs to make water available during meal periods at no cost to students (section 202 of HHFKA (42 U.S.C 1758(a)(2)(A))). The Act also mandates that child care facilities provide free drinking water throughout the day (section 221 of HHFKA (42 U.S.C 1766 (u)(2))). The combination of potential higher lead levels in large buildings, vulnerability of children to lead, and the length of time spent at schools and child care facilities presents lead risks to children that can be mitigated through public education, sampling, and voluntary remediation actions. Furthermore, the requirement for water systems to conduct sampling at schools and child care facilities provides an added measure of protection, above the other elements of the treatment technique rule, in light of the vulnerabilities of the population served and the potential variability of lead levels within the system and within a school or child care facility over time. Large buildings such as schools can have a higher potential for elevated lead levels because, even when served by a water system with well operated OCCT, there may be longer periods of stagnation due to complex premise plumbing systems and inconsistent water use patterns. In such situations, there may not be technical improvements that can be made to the OCCT. However, risk can be mitigated through public education and voluntary remediation actions such as replacement of premise plumbing. Water systems have developed the technical capacity to conduct sampling for lead in operating their system and complying with current drinking water standards. EPA proposed that the CWS be required to provide information about the health risks and sources of lead in drinking water and ***collect*** samples from five drinking water outlets at each school and two drinking water outlets at each child care facility within its distribution system once every five years. It would share results with the facility, local and state health departments, and the state primacy agency. Samples would be first draw after at least 8-hours but not more than 18-hours stagnation in the building and be 250 ml in volume. EPA proposed this sampling protocol to be consistent with the recommended sampling protocols under the Agency's 3Ts Toolkit. The smaller sample size is more representative of the amount of water consumed per serving and the stagnation time is representative of daily water use within these facilities. These samples would serve as a preliminary screen for lead risks within the facility and are not necessarily representative of lead levels in other outlets. EPA proposed that the CWS compile a list of schools and child care facilities served by the water system to conduct outreach and sampling, including distributing the 3Ts for Reducing Lead in Drinking Water Toolkit (EPA-815-B-18-007), or subsequent guidance issued by EPA that provides information on identifying lead risks, follow-up sampling procedures, stakeholder communication, and remediation options. A CWS's distribution of the 3Ts would initiate or contribute to active communication with schools and child care facilities, who are critical customers that serve a vulnerable population. EPA also proposed that the CWS provide results to schools and child care facilities, the drinking water primacy agency, and the local and state health department where the facility is located no more than 30 days after receipt of results. The results of the samples would not be used as part of the CWS's calculation of the 90th percentile value because these samples are being ***collected*** in a manner to inform whether action is needed at a specific school or child care facility and not whether corrosion control is effective system-wide. EPA did not propose requirements for CWSs to take remediation actions at facilities following the sampling and notification requirements. The managers of these facilities have established lines of communication with the occupants of these buildings (and their parents or guardians) and have control over routine maintenance and plumbing materials that may need to be addressed. The managers of the schools and child care centers can use the sampling results and the 3Ts to make decisions about additional voluntary actions to reduce lead risks in their facilities, including implementing their own 3Ts program. EPA proposed a process for a water system to opt out of the sampling requirements. In the preamble, EPA described a process for a state or primacy agency to waive these requirements for individual CWSs to avoid duplication of effort with existing drinking water testing requirements in schools and child care facilities. EPA proposed that if a state has a program that requires schools and child care facilities to be sampled in a manner consistent with the proposed requirements, the state may use that program in lieu of the proposed requirements.2. Public Comments and EPA's Response EPA requested comment on an alternative to the proposed requirements for public education and sampling at schools and child care facilities described in this section. Under the proposed alternative, a CWS would be required to conduct annual outreach to school and child care facilities about the health risks and source of lead and drinking water, and would test at school and child care facilities as described in the proposal only when requested by a facility in their service area. Under this alternative, EPA assumed that 5 percent of schools and child care facilities in a water system service area would request testing per year (see Economic Analysis Chapter 5, section 5.3.2.5 for additional detail). EPA received many comments on the proposed school and child care sampling requirements spanning a variety of topics. These included comments on the proposed and alternative options, requests for clarification on aspects of the requirements that relate to CWS compliance, the required number of samples, requests for exemptions, and comments on waivers for existing sampling programs. EPA specifically asked for public comment on the proposed option that CWSs be required to sample for lead in school and child care facilities once every five years or if CWSs should be required to sample in facilities on request only. Some commenters supported the proposed requirements citing the importance of testing in these facilities, while others supported the alternative option citing the benefits of providing public education materials to interested schools and child care facilities and reduced burden to CWSs. Conversely, some commenters objected to the alternative proposal citing concerns that facilities may not request testing due to lack of knowledge about lead risks, the importance for testing for lead, or fear of testing results. Some commenters also argued that the requirements should be removed from the final rule stating that CWSs should not be the entity responsible for testing in schools and child care facilities and citing concerns about costs and resources, while others argued that the proposed requirements would not provide benefits to schools or child care[[Page 4233]]facilities. A few commenters also stated that sampling of school or child care facilities would be more effective if led by the Department of Education or the Department of Health and Human Services. Based upon comments, EPA has decided to combine the proposed and alternative options by incorporating both mandatory and on request sampling into the final rule. CWSs must conduct sampling in elementary schools and child care facilities as described in the proposed requirements for one sampling cycle (5 years) and will offer sampling to secondary schools on request. After the first cycle is complete, CWSs must continue to conduct outreach to schools and child care facilities and must sample at the request of a facility. These requirements are intended to educate schools and child care facilities about the risks of lead in drinking water and inform them of ways to mitigate lead risks. The initial sampling accompanied by continued lead in drinking water outreach will provide elementary schools and child care facilities with an understanding of how to create and manage a drinking water testing program that is customizable to their needs and an appreciation of the benefits of such a program. The cycle of sampling is intended to reinforce the importance and benefits of lead testing in elementary schools and child care facilities. Children under the age of 7 are at the greatest risk of drinking water lead exposure, and prioritizing sampling in those facilities with the greatest risks will reduce burden on CWSs and will enable them to focus upon those schools and child care facilities with the most susceptible populations. This construct will also allow CWSs, following the initial cycle of sampling, to focus resources on sampling in schools and child care facilities that request assistance. EPA anticipates that after the first sampling cycle, elementary schools and child care facilities will better understand the process and benefits of lead testing and be more likely to implement their own 3Ts programs. However, facilities interested in further assistance will have the opportunity to be tested for lead by the CWS on request prompted through annual outreach. CWSs will not be required to sample more than 20 percent of the schools and child care facilities they serve in a given year. EPA disagrees that the requirements for testing in schools and child care facilities should be removed from the final rule or that the requirements provide no benefits. Individual outlets, such as water fountains, can leach lead even when a water system has OCCT. The requirements are part of a targeted public education effort to educate schools and child care facilities and their users of the risks from lead in premise plumbing, the importance of testing for lead in drinking water, and to help them make decisions to mitigate lead risks. The requirement for CWSs to conduct sampling and public education for this vulnerable subset of consumers is within EPA's authority to promulgate a treatment technique rule to ``prevent known or anticipated adverse effects on the health of persons to the extent feasible'' (SDWA 1412(b)(7)(A)). School and child care facility sampling contributes to increased public awareness of the potential for elevated levels of lead in premise plumbing independent of a water system's 90th percentile value. EPA also anticipates that increased familiarity with the 3Ts will assist facilities in taking steps to reduce lead risks to vulnerable populations. EPA also disagrees that the requirements would be more effective if led by another Federal agency. Few existing mandatory and voluntary programs are administered by state or local departments of education (Cradock et al., 2019). EPA notes that the Department of Education and the Department Health and Human Services are signatories to the 2019 Memorandum of Understanding (MOU) on Reducing Lead Levels in Schools and Child Care Facilities along with other Federal partners and organizations. The signatories to the MOU agree to work together to encourage schools and child care facilities to take actions to address lead in their facilities. This includes testing for lead in drinking water, disseminating results, and taking corrective actions. EPA intends for the requirements to complement these efforts and not replace ongoing initiatives to address lead risks in schools and child care facilities. EPA concluded that CWSs have the technical expertise to assist in schools and child care facilities in drinking water testing. EPA also received many comments requesting clarification on achieving CWS compliance. Some commenters suggested that a CWS would be in violation of the proposed requirements if a school or child care facility did not respond to outreach for testing. Similarly, commenters suggested that meeting the requirement to sample in 20 percent of schools and 20 percent of child care facilities per year depended on facilities responding to CWS outreach. Some commenters cited these concerns as a rationale for supporting the alternative on request option. EPA notes that some schools and child care facilities may not respond to CWS outreach, meaning a CWS would not be able to obtain a refusal. EPA agrees that further clarification was needed and revised Sec. 141.92(a)(3) to document a non-response after a CWS has made two separate good faith attempts to reach the facility. EPA also clarified in Sec. 141.92(c) that non-responses and refusals may be accounted for in the annual 20 percent testing requirement for elementary schools and child care facilities during the mandatory sampling. Some commenters suggested that the sampling requirements be expanded to include more samples per facility and more frequent sampling. Commenters argued that limited sampling may fail to detect elevated lead levels and some schools and child care facilities may infer from results that there is no lead risk. Other commenters noted that some schools and child care facilities do not follow the 3Ts and may not conduct follow-up sampling or take remediation actions. Some commenters further suggested that the 3Ts Toolkit is not sufficient for addressing lead issues. EPA disagrees that sampling requirements be expanded, as the intent is to provide a preliminary screen for lead in schools and child care facilities and an improved understanding of the importance of lead testing, and is not a replacement for comprehensive testing as detailed in the 3Ts. EPA further disagrees with comments regarding the effectiveness of the 3Ts. The GAO indicated in a 2018 report that 60 percent of school districts were not familiar with the 3Ts guidance, but for those that were, 68 percent reported finding the guidance helpful in reducing lead risks in their facilities (GAO, 2018). Requiring distribution of the 3Ts along with testing results is intended to both increase awareness of the need for lead testing and provide schools and child care facilities with information and tools they can use to reduce lead risks in their drinking water. Conversely, some commenters suggested that facilities be exempted from testing based on construction dates (e.g , 1986 ban on lead solder) or that repeat testing is not necessary if a facility is tested once, or all outlets are tested once, and results show no or low lead levels. The proposed requirements exempt CWSs from sampling in schools and child care facilities constructed after 2014 (consistent with Section 1417 of the SDWA), as these facilities will have been constructed with lead free plumbing components. Prior to the amendment of Section 1417 of the SDWA by the Reduction of Lead in Drinking Water Act, fixtures could[[Page 4234]]contain up to 8 percent of lead by weighted average and be classified as lead free. Changing the exemption date to 1986 would therefore be less protective of public health. EPA also disagrees with allowing exemptions based on previous low and non-detected lead levels. Lead levels at an outlet or within a building have been shown to vary over time, with lead levels at one outlet not necessarily characterizing lead levels at other others in the building. Therefore, exempting water systems from testing in facilities based on the previous results of samples taken at a limited number of outlets is not appropriate. EPA received many comments on the alternative school and child care sampling programs in Sec. 141.92(d). Commenters noted an inconsistency between the preamble in the November 2019 notice, which described the state providing waivers to CWSs where existing school and child care sampling requirements are at least as stringent as Sec. 141.92, and the proposed requirement which stated ``the water system may execute that program [existing state or local regulations] to comply with the requirements of this section,'' implying a different mechanism. As noted above, EPA recognizes this inconsistency and has updated Sec. 141.92(d) to describe the conditions by which a state may issue a full or partial waiver to CWSs. In addition, commenters encouraged EPA to accommodate sampling protocols of existing state and local programs, stating that programs using different stagnation times or sample volumes should not be excluded if they require more sampling more outlets more frequently and include remediation activities. EPA agrees that there are a variety of programs that may differ from the proposed requirements but may otherwise be sufficient or more comprehensive. In response, the final rule provides additional flexibility for existing programs to reduce duplicative testing by CWSs.3. Final Rule Requirements EPA is requiring CWSs to sample for lead in the elementary schools and child care facilities they serve once during the first five years after the compliance date for the final rule, and to sample for lead in the secondary schools they serve on request. After all elementary schools and child care facilities are tested once, the CWS will be required to conduct sampling at all the schools and child care facilities they serve when requested by a facility. EPA is retaining the exemption for schools and child care facilities constructed after January 1, 2014. However, in response to public comment, EPA has revised this exemption to include facilities built after the date of state adopted standards that meet the definition of lead free in accordance with Section 1417 of the SDWA, as amended by the Reduction of Lead in Drinking Water Act, to account for localities that adopted lead free standards earlier than 2014. These requirements apply to all CWSs regardless if they receive water from a wholesale system. EPA is retaining the proposed requirement that all CWSs compile a list of schools and licensed child care facilities served by the system to conduct public education outreach and sampling. EPA notes that pursuant to Sec. 141 90(i)(1)(i), the CWS shall use a good faith effort to identify facilities in their service area, such as reviewing water system billing and other records to identify service connections for schools and child care facilities and by requesting information from appropriate state agencies. During the first five years after the rule compliance date, the CWS is required to contact the elementary schools and child care facilities identified and provide them information about health risks of lead in drinking water at least annually, schedule sampling, and provide the 3Ts Toolkit (or subsequent EPA guidance). The CWS must also contact the secondary schools identified in the list at least annually and provide them with health information, and information on how to request sampling. As the list is updated, new schools and child care facilities will be identified and included in the annual outreach. In the first cycle of sampling, an elementary school or child care facility may decline or not respond to sampling. In response to comments, EPA has revised the requirement to allow the CWS to document non-responses in addition to refusals. The CWS is required to contact 20 percent of elementary schools and 20 percent of child care facilities per year such that all facilities are sampled once (over the 5 years). In response to comments on flexibility, the final rule will allow an alternative schedule to be approved by the state, as long as all elementary schools and child care facilities are sampled once within a 5-year period. EPA has also clarified that non-responses and refusals may be accounted for in the 20 percent testing rate. CWSs are also required to sample secondary schools at the request of the facility during the 5-year period of mandatory sampling for elementary schools and child care facilities. If a CWS receives requests from more than 20 percent of the secondary schools it serves during a year, it may defer additional requests to the following year. A CWS is not required to conduct sampling in more than 20 percent of the secondary schools it serves in any year during the cycle of mandatory sampling for elementary schools and child care facilities. Once the CWS has completed the requirements for all elementary schools and child care facilities once, EPA is requiring the CWS to sample both elementary and secondary schools and child care facilities on request. When offering sampling on request, the CWS shall continue to distribute annual information on the health risks of lead in drinking water and is required to provide annual information to schools and child care facilities about the opportunity to request sampling. At least 30 days prior to sampling, the CWS must provide instructions to facilities on how to identify outlets for sampling. If the CWS receives requests from more than 20 percent of the schools and 20 percent of the child care facilities it serves in a given year, the CWS may defer additional requests to the following year. The CWS is not required to complete sampling in more than 20 percent of the schools and 20 percent of the child care facilities it serves in a given year, and may sample the other facilities in the following year. The CWS is also not required to sample any individual school or child care facility more than once every five years. While not required, EPA recommends that CWSs consider factors such as age of students, building construction date, socioeconomic indicators, presence of LSLs, and Federal funding through Title 1 (20 U.S.C 6301 et seq.) and Head Start (42 U.S.C 9801 et seq.) to prioritize sampling in facilities that serve vulnerable or disadvantaged populations. EPA is retaining the sampling protocol and the provisions to provide sample results to schools and child care facilities along with remediation information within 30 days of receipt of results. EPA has clarified that the remediation information is detailed in the 3Ts. Schools and child care facilities are encouraged to use the testing results and 3Ts Toolkit to inform follow-up activities and remediation actions. For consistency across other reporting requirements, the final rule includes provisions for CWSs to report all results to the primacy agency and local and state health departments as part of annual reporting. EPA is retaining the proposed process for a state to waive school and child care facility sampling requirements for individual CWSs to avoid duplication of effort and has clarified this in the final[[Page 4235]]rule. During the cycle of mandatory sampling in elementary schools and child care facilities, a state may issue a CWS a written waiver if there is a state or local program to sample for lead in drinking water at schools or child care facilities that meets the requirements of this rule. This also may include schools or child care facilities that are sampling for lead through facility or district policy. If the sampling meets the final rule requirements, with the exception of stagnation time and sample volume, a waiver may be granted if remediation actions are required as part of the program. Likewise, programs with less frequent sampling (e.g , every six years) that sample more outlets and require remediation, will meet the requirements for a waiver. A state may also issue waivers for voluntary sampling programs that meet the requirements for CWSs to offer sampling on request to secondary schools during the cycle of mandatory sampling in elementary schools and child care facilities, and to all schools and child care facilities thereafter. Some mandatory and voluntary programs are or have previously been funded, wholly or in part, under grant programs for school and child care testing established by the WIIN Act. Therefore, waivers may also be granted if sampling is conducted in accordance with a grant awarded under Section 1464(d) of the SDWA. A state may not issue a waiver to extend past the time period covered by the mandatory or voluntary program. If a program is limited to a subset of schools and child care facilities defined in Sec. 141.92(a)(1) of this final rule, a state may issue a partial waiver. For example, if a state has a required program for testing lead in drinking water in both elementary and secondary public schools but not in other types of schools or child care facilities, then a CWS serving only public schools can receive a full waiver. If a CWS serves both public and non-public schools and child care facilities, then the CWS would be required to notify and sample at the non-public schools and child care facilities and could receive a partial waiver to acknowledge that the CWS is not responsible for sampling in public schools. A state may issue full or partial waivers for existing voluntary programs. For example, if a state agency offers testing to all public schools when requested, the state could grant a partial waiver such that a CWS would not be required to offer sampling to public secondary schools in its service area during the time the CWS is conducting mandatory sampling in elementary schools and child care facilities. When the CWS is offering sampling on request to all schools and child care facilities, a state could then grant a waiver such that the CWS would not be required to offer sampling to the elementary and secondary public schools in its service area for the duration of the voluntary program.K. Find-and-Fix1. Proposed Revisions EPA proposed a ``find-and-fix'' approach that would require water systems to perform additional actions when an individual tap sample exceeds 15 [mu]g/L. Water systems would be required to ***collect*** a follow-up sample for each tap sample site that exceeded 15 [mu]g/L within 30 days of receiving the tap sample result. The results of these ``find-and-fix'' follow-up samples would be submitted to the state but would not be included in the system's 90th percentile calculation because multiple investigatory samples at locations with high lead levels would bias results. If the water system is unable to ***collect*** a follow-up sample at a site, the water system would have to provide documentation to the state for why it was unable to ***collect*** a follow-up sample. The water system would be required to provide the follow-up tap sample results to consumers within 30 days of receiving the result (consistent with the current rule), unless that follow-up sample also exceeds 15 [mu]g/L, in which case, EPA proposed the water system must notify the consumer within 24 hours of learning of the result. EPA proposed that water systems with CCT that have an individual tap sample that exceeds the lead action level, would be required to ***collect*** an additional WQP sample within five days of obtaining the lead tap sample result. For a CWS, this WQP sample must be ***collected*** from a site in the same water pressure zone, on the same size or smaller water main within 0.5 miles of the residence with the tap sample exceeding the lead action level. Water systems with an existing WQP site that meets these criteria would be able to sample at that location. Any water system that is unable to regain access to the same site to ***collect*** a follow-up tap sample may decide to sample at another site within close proximity of the original site and with similar structural characteristics. EPA proposed that WQP samples be ***collected*** within 5 days, since WQP sites are more accessible sites and do not require coordination with customers. The proposal included requirements to sample WQPs as close to the lead tap sample site as possible so that the water quality will more closely match the conditions at the site that exceeded 15 [micro]g/L. The intent of the proposed requirements for a follow-up tap sample ***collected*** for lead was to help the water system determine the potential source of lead contamination (e.g , premise plumbing, LSL) and the intent of the required WQP sample for water systems with CCT was to help determine if CCT is optimized, if additional WQP sites are needed, and/or if WQPs set by the state are being met. Such steps would help identify the source of the elevated lead to initiate appropriate mitigation. EPA proposed that when a water system is unable to identify and/or mitigate the risk, it must submit a justification to the state. Under the proposal, the water system would be required to determine if problems with the CCT are leading to elevated levels of lead in the tap samples and then implement a mitigation strategy if necessary. In addition to the follow-up tap sample and the WQP sampling, the water system could review distribution system operations or other factors to determine the cause of the elevated lead level. CCT adjustment may not be necessary to address every exceedance. Water systems would note the cause of the elevated lead level if known in their recommendation to the state. Mitigation strategies could include a water system-wide adjustment to CCT, flushing portions of the distribution system, or other strategies to improve water quality management to reduce lead levels. Under this proposal, water systems would be required to confirm the find-and-fix steps were completed and recommend water system actions, such as spot flushing, to the state for approval within six months of the end of the monitoring period in which the site(s) first exceeded 15 [mu]g/L and the state would have six months to approve the recommendation. EPA proposed implementation requirements for water systems that do not have CCT and recommends installation of it and for water systems with CCT that recommends re-optimization of CCT. A water system may identify a fix that is out of its control. For example, if the source of lead in drinking water was an old faucet owned by the customer, and the customer did not wish to replace the faucet, the water system would provide documentation to the state under this proposal. All other fixes recommended by a water system would be implemented on a schedule specified by the state.2. Public Comment and EPA's Response EPA received a number of comments that expressed concerns that a single[[Page 4236]]elevated tap lead sample could trigger a system-wide corrosion control installation or re-optimization. One commenter stated that requiring the installation of corrosion control equipment for the entire utility if the cause of a sample exceedance is listed as corrosive water in one home, is excessive. Others commented that this provision is unwarranted, inappropriate, or a disproportionate response which could result in expensive and time-consuming distribution system evaluations. EPA disagrees that the find-and-fix provisions are unwarranted. These requirements initiate sampling and other activities that will assess the potential cause of the elevated levels of lead and will prompt additional feasible actions that will reduce the risks to persons at the locations where there may be elevated levels of lead. Many commented that corrosion control adjustments should only be made in response to ***data*** demonstrating that current corrosion control is deficient throughout the distribution system, and not in response to a small number of individual tap samples. Many commenters also interpreted the rule to require corrosion control treatment modifications to be the typical response to address a site that exceeded 15 [mu]g/L. In response to these comments, the final rule emphasizes localized distribution system management as the likely fix. Mitigation strategies could include, flushing or other strategies to improve water quality management. However, in some instances where the find and fix corrosion control assessment monitoring finds that optimal water quality parameters are not being maintained in a portion of the distribution system, systems may need to implement localized or centralized adjustment of corrosion control treatment. A system that does not have existing corrosion control treatment is not required to conduct a corrosion control study or to install treatment as a result of find-and-fix unless the state determines it is necessary. Some commenters noted that small water systems without corrosion control treatment may not be able to ***collect*** water quality parameter samples within five days as these systems may not have ready access to instruments and laboratories that can perform these analyses. EPA agrees and is allowing small water systems without corrosion control treatment up to 14 days to perform this monitoring. Many commenters also requested clarity on the purpose and location of the samples, with several interpreting the proposed rule as requiring the water quality parameter monitoring to be conducted at the site with the lead result above 15 [mu]g/L. Many commenters also questioned the recommendation in the proposed rule to take a lead sample at a nearby site of similar plumbing characteristics, if the system was unable to take a follow-up sample at the site that was above 15 [mu]g/L. EPA agrees that sampling at a different site in the vicinity will not help assess the lead source at the site that was above15 [mu]g/L, so the final rule does not require systems to do this. If the water system is unable to ***collect*** a follow-up sample at a site, the water system must provide documentation to the State, explaining why it was unable to ***collect*** a follow-up sample. EPA also agrees that clarification is needed and has provide more details in the final rule of where and when follow up samples must be ***collected***.3. Final Rule Requirements For the final rule, EPA is clarifying that the water quality parameter monitoring (Step 1) is intended to assess the corrosion control treatment at a nearby location in the distribution system and the follow-up sample at the tap sampling site above 15 [mu]g/L (Step 2) is intended to identify the lead source at the site. Step 1 of the process is the corrosion control assessment step in which water quality parameter sampling must be done within five days of the system receiving the tap sample results exceeding 15 [mu]g/L, except for small water systems (serving 10,000 people or fewer persons) without corrosion control treatment that may perform the sampling within 14 days. The sampling is to replicate as closely as possible the water quality conditions at the time when the tap exceeded 15 [mu]g/L. The water quality parameter sampling location is not at the tap that exceeded 15 [mu]g/L but must be within the same pressure zone, on the same size main and within a half-mile from the tap sample site. Section 141.82(j)(1)(v) of this final rule allows systems with an existing WQP site that meets these criteria to sample at that site. Section 141.82 (j)(1)(vi) requires that a system that does not have an existing WQP site that meets the criteria to add the additional WQP site to its routine monitoring. Since the monthly total coliform sampling for large systems vastly exceeds the water quality parameter monitoring in the distribution system for the lead and copper rule, EPA expects coliform sampling locations should be available that are in the same pressure zone, on the same size main, and within a half mile of the site that exceeded 15 [mu]g/L in many large systems. Medium-size systems may also find that total coliform sampling sites are available and can meet the criteria for sampling location when the existing water quality parameter sites are not located in that area of the distribution system. The maximum WQP sites that a system would have to sample are two times the standard number sites required. When a system exceeds this upper threshold for the number of sites, the state has discretion to determine if the newer sites can better assess the effectiveness of the corrosion control treatment and may remove existing WQP sites during sanitary survey evaluation of OCCT. Step 2 is designated as site assessment in the final rule. In Step 2, water systems are required to conduct follow-up sampling at the tap sampling site above 15 [mu]g/L. This is intended to help the system identify the source of the lead, such as the service line, brass faucet, lead solder, and/or gooseneck/pigtails, if possible. The final rule allows tap sample ***collection*** of a different volume or using a different protocol (if needed to better identify the source of lead) than samples ***collected*** under the tap monitoring and therefore the sample is not included in the 90th percentile calculation. If the water system is unable to carry out follow-up tap sampling (i.e , the customer refuses a follow-up tap sample or there is a lack of response), the water system is responsible for documenting the reason for not carrying out the sampling. Water systems must note the cause of the elevated lead level, if known from the site assessment. In Step 3, water systems evaluate the results of the monitoring from Steps 1 and 2 to determine if the cause of the lead tap sample above 15 [mu]g/L is due to a source of lead at the sampling location, to corrosive water quality parameters or is unknown. If the water system determines the cause of the elevated level of lead is solely due to a source of lead at the sampling location, or is unknown, the system is not required to recommend an action to fix the cause of the elevated lead. If the water system finds that corrosive water quality parameters are the cause, the system must determine if distribution system management changes such as flushing to reduce water age or adjustment of the corrosion control treatment are necessary to restore optimal water quality parameters in that portion of the system. Adjustment of corrosion control treatment could include changing the feed rates for the corrosion inhibitor for a portion of the distribution system or for the entire[[Page 4237]]system to ensure that optimal water quality parameters are maintained for optimal corrosion control. The system must submit the recommendation to the state within six months after the end of the tap sampling period in which the site(s) exceeded 15 [mu]g/L. Systems in the process of optimizing or re-optimizing optimal corrosion control treatment (Sec. 141.82(a)-(f)) do not need to submit a recommendation for find and fix as they are currently adjusting corrosion control treatment.L. Water System Reporting Requirements1. Proposed Revisions EPA proposed changes to water system reporting requirements in conjunction with corresponding proposed changes to the regulatory requirements. These changes in reporting requirements were proposed to inform state decision-making and improve implementation and oversight. In addition to the proposed tap sampling protocol revisions, EPA proposed that a water system would also be required to submit for state approval its tap sampling protocol that are provided to residents or individuals who are conducting tap sampling. The sampling protocol would be required to be written in accordance with new rule requirements. EPA proposed that the state would review the protocol to ensure that it does not include prohibited instructions for pre-stagnation flushing, and cleaning and/or removing the faucet aerator prior to sample ***collection*** and ensures the use of wide-mouth ***collection*** bottles. Under the proposal, water systems would also need to provide certification to the state that the approved sampling protocol has not been modified within 10 days of the end of the tap sampling monitoring period, and to submit an updated version if any modifications are made. EPA also proposed to include new reporting requirements in conjunction with the revisions to the LSLR requirements in the final rule. By the rule's compliance date, the water system would be required to submit to the state an inventory of service lines. The water system would have to submit an updated inventory annually thereafter that reflects LSLs replaced and lead status unknown service lines that have been identified in the distribution system. EPA also proposed that any water system with LSLs and 90th percentile tap sampling ***data*** that exceeds the lead trigger level would be required to annually certify to the state that it conducted notification in accordance with proposed LSL customer notification provisions. The notification would ensure customers were properly alerted about the trigger level exceedance, potential risks of lead in drinking water, and informed about the water system's goal based LSLR program. In addition, under the proposal, a CWS must certify that it has completed the notification and sampling requirements at a minimum of 20 percent of schools and child care facilities served by the water system annually. The certification would include the number of schools and child care facilities served by the water system, the number of schools and child care facilities sampled in the calendar year, and the number of schools and child care facilities that have refused tap sampling. In addition, the proposal required that a CWS must certify that individual sampling results were shared with the respective school and child care facility, and with local or state health departments. If a CWS does not serve any school or licensed child care facilities, the water system would have to annually certify to the state that it made a good faith effort to identify schools and child care facilities and confirm that no schools or child care facilities are served by the water system. The good faith effort could include reviewing customer records and requesting lists of schools and child care facilities from the state or other licensing agency. Certification was to be sent to the state by July 1 of each year for the previous calendar year's activity. EPA also proposed reporting requirements for small CWSs using the point-of-use compliance flexibility option. These systems would need to report their sampling results and corrective actions taken if a POU sample exceeded 10 [mu]g occurred. In addition, they would certify the maintenance of the POUs if requested by the state. Additionally, calcium results were no longer subject to reporting requirements under the proposed rule, because calcium was eliminated as a CCT option and thus not a regulated OWQP.2. Public Comment and EPA's Response EPA received many comments on the various reporting requirements. Many of the commenters expressed concern about the increased burden the proposed reporting requirements could impose and several offered suggestions such as an online tool, using existing opportunities such as sanitary surveys for reporting, or allowing the water system to self-certify instead of certifying that certain requirements are complete to the state. Commenters expressed that these burdens range from administrative to financial, and that small systems are likely to be impacted most. Some commenters argue against some of the reporting requirements to certify or re-submit material annually, stating that systems could track this on their own but provide to the state upon request. Many commenters were worried there would not be an adequate tracking tool or ***data*** system such as EPA's Safe Drinking Water Information System (SDWIS) to manage the reporting requirements of the proposal. Some commenters state that they would need to create tracking systems of their own and would need additional staff and ***data*** management systems. EPA agrees that new reporting requirements create a burden for water systems and states and has made changes to streamline reporting in the final rule as described below. EPA intends to support the ***data*** management needs of primacy agencies for the LCRR through the SDWIS Modernization development project, and to have a product available for state use by the compliance date of the LCRR. EPA will work closely with state program and information technology staff on LCRR database needs and on overall SDWIS modernization. Regarding LSL reporting requirements, some commenters asked that reporting of updates to the service line inventory cease after all LSLs have been identified in the inventory as none would be installed in the future. EPA does not agree since updated inventories also reflect LSLR which include customer initiated and required LSLR following a trigger level and action level exceedance. The state needs to have this information to track compliance of LSLR requirements. Several commenters stated it is redundant to require water systems to submit a service line inventory and replacement plans after an action level exceedance because water systems are already submitting these. However, other commenters stated that LSLR plans should be submitted to the state regardless of the 90th percentile results. Based on commenter input, EPA has modified the requirement in the final rule; water systems will not be required to submit the inventory and replacement plans after an action level exceedance since they are submitted at the rule compliance date and updated inventories are submitted according to their tap sampling monitoring frequency (i.e , annually or triennially) thereafter, thereby reducing the frequency of reporting inventory updates. In addition, there are off-ramps for[[Page 4238]]submitting inventory updates for those systems that can verify they no longer have LSLs, galvanized lines requiring replacement, or lead status unknown service lines in their distribution. Some commenters requested that the final rule retain the reporting deadlines in the current rule. For instance, reporting lead and copper results within 10 days of the end of the tap sampling monitoring period instead of before the tap sampling period ends (for systems where the state calculates the 90th percentile) which was proposed. Many commenters had concern about the school and child care sampling and public education reporting requirements. Several commenters asked why after sampling results are reported, they also must be certified that they completed this requirement to the state. Several commenters offer suggestions on how to reduce the burden of these requirements or streamline them, such as submitting an annual report, or maintaining the records on hand and submitting upon request from the state. Many commenters had concerns about the number of attempts and documenting refusals when a facility simply does not respond. EPA has made changes to Sec. 141.92(a)(3) regarding schools and child care facility refusals and nonresponse and the reporting Sec. 141.90(i) so that CWSs certify once per year that they have met the schools and child care facility requirements for the previous calendar year. In addition, the annual certification is due July 1 of each year consistent with the timing for annual CCR certification. Regarding the proposed reporting requirements for the ``find-and-fix'' provision, several commenters state it is impractical to maintain lists and tracking of all the ``fixes'' done by the water system and that this gives rise to privacy concerns for homeowners. Some commenters suggested a requirement for water systems to include ``find-and-fix'' activities in an annual or monthly report. Several commenters asked for guidance such as a template or checklist for the find-and-fix provisions states review. EPA evaluated public comments and agrees that clear steps, be included in the find-and-fix requirements and has made modifications to the final rule accordingly. This should also streamline find-and-fix reporting.3. Final Rule Requirements Many of the reporting requirements from the proposal have been retained in the final rule. However, EPA has taken into consideration all of the comments and has modified several sections to reduce burden, enhance efficiency of reporting and/or to include new necessary provisions. Many changes were made for clarification and organizational purposes in Sec. 141.90, while others were made to reflect changes made to corresponding sections of the rule proposal. The lead service line reporting requirements have been updated to allow systems to discontinue inventory updates when they no longer have service lines that need to be replaced or materials verified (i.e , no remaining lead status unknown). In addition, the inventory requirements are now linked to the tap sampling monitoring schedules in Sec. 141.86(d) to streamline dates for reporting. Also, systems must report annually that they completed any customer-initiated LSLR, in addition to requesting an extension to complete a customer-initiated LSLR. The final rule clarifies that all water systems must report to the state an addition of a new source or long-term treatment change prior to adding the source or modifying treatment. In addition, this final rule includes a requirement for water systems to submit a tap site sample plan prior to the compliance date of the rule with tap sampling sites that meet the new site selection tiering criteria based on their LSL inventory to ensure states can verify the tap sampling sites comply with the requirements in the final rule and can track changes in the tap sampling pool. Regarding reporting for small system compliance flexibility options, an additional reporting requirement was added for systems who have opted to remove lead-bearing plumbing from their distribution system; they must certify within one year that the material has been eliminated. Under reporting for schools and childcare facilities, EPA has made several changes, including reporting requirements for elementary and childcare facilities in the first five years of monitoring and reporting requirements for school and childcare sampling that is performed on-request.IV. Other Revisions to 40 CFR Part 141A. Consumer Confidence Report In 1996, Congress amended the Safe Drinking Water Act (SDWA). Among other things, this amendment added a provision requiring that all CWSs deliver to their customers a water quality report annually called a Consumer Confidence Report (CCR). CCRs summarize information water systems ***collect*** to comply with regulations. The CCR includes information on source water, the levels of any detected contaminants, compliance with drinking water rules (including monitoring requirements), and some educational language, including a mandatory health effects statement regarding lead.1. Proposed Revisions As recommended by the NDWAC (see section VII.L.2 of this preamble), EPA consulted with risk communication experts to propose revised mandatory health effects language for the CCR. In addition, EPA proposed to use consistent mandatory lead health effects language in PE, CCR, and Public Notification materials. To improve clarity, EPA proposed to require CWSs to include a revised mandatory health effects statement that would inform consumers that lead is harmful for all age groups and to include a mandatory statement about LSLs (e.g , their presence and how to replace them) for water systems with LSLs. The proposed statement is below. Exposure to lead can cause serious health effects in all age groups. Infants and children who drink water containing lead could have decreases in IQ and attention span and increases in learning and behavior problems. Lead exposure among women who are pregnant increases prenatal risks. Lead exposure among women who later become pregnant has similar risks if lead stored in the mother's bones is released during pregnancy. Recent science suggests that adults who drink water containing lead have increased risks of heart disease, high blood pressure, kidney or nervous system problems. To increase transparency and improve public access to information, EPA also proposed to require CWSs to report the range of lead tap sample results in addition to the currently required 90th percentile and the number of samples that are greater than the lead action level for each monitoring period. Reporting the range of tap sample lead levels would allow consumers to understand how high tap sample levels were at individual sites.2. Public Comment and EPA's Response Several commenters suggested revisions to the informational health effects statement on lead in drinking water that would be required in the CCR to make the language more readable and useful to consumers. Some commenters recommended requiring the CCR to include information on LSLs and the LSL inventory, including the number of LSLs, the number of lead status unknown service lines, the total number of service lines in the water system, and a statement that a service line inventory has been prepared and is available for[[Page 4239]]review. They also recommended requiring the CCR to notify consumers that complete lead tap sampling ***data*** are available for review and how to access the ***data***. EPA agrees this is important information to consumers and has incorporated these recommendations in the final rule requirements for the CCR. A few commenters expressed concern that the CCR is no longer an effective method to communicate drinking water contaminant related issues and suggested use of other platforms such as social media. EPA supports using diverse methods of communication to reach consumers and provided recent guidance on electronic delivery of CCRs. In the final rule, EPA has increased the number and forms of public education materials. EPA has also worked to improve risk communication by consulting with risk communication experts, adopting clearer and more concise health effects language, and keeping the health effects language consistent across the CCR, 24 hour public notice for a lead action level exceedance, and all public education materials. In addition, the Agency has recommended that systems use social media to provide public education and outreach, for example to convey information about their LSLR program.3. Final Revisions EPA is finalizing the requirement for reporting tap sampling results in the CCR as proposed, while clarifying the meaning of ``round of sampling'' for systems on six-month monitoring given the new sampling requirements in the LCRR. The final rule requires water systems to include in the CCR the 90th percentile concentration of the most recent round(s) of sampling, the number of sampling sites exceeding the action level, and the range of tap sampling results for lead and copper. These results should be provided for each sampling event completed in the reporting period. This means that water systems on six-month monitoring will be required to include both rounds of lead and copper results. In response to comments, EPA added a new provision requiring water systems to include information in the CCR on how to access the service line inventory. EPA also added a new provision requiring water systems to include information in the CCR on how to access the results of all tap sampling. EPA incorporated some of the commenters' suggested revisions to increase the clarity and accuracy of both the lead informational statement and mandatory health effects statement required in the CCR. The mandatory health effects statement for the final rule reads as follows and is also required in the public notice of an action level exceedance and in public education materials: Exposure to lead in drinking water can cause serious health effects in all age groups. Infants and children can have decreases in IQ and attention span. Lead exposure can lead to new learning and behavior problems or exacerbate existing learning and behavior problems. The children of women who are exposed to lead before or during pregnancy can have increased risk of these adverse health effects. Adults can have increased risks of heart disease, high blood pressure, kidney or nervous system problems.B. Public Notification The current Public Notification Rule (PN) is part of the Safe Drinking Water Act 1996 Right To Know provisions. The rule is designed to ensure that consumers will know if there is a problem with their drinking water. These notices alert consumers if there is risk to public health. They also notify customers: If the water does not meet drinking water standards; if the water system fails to test its water; if the system has been granted a variance (use of less costly technology); or if the system has been granted an exemption (more time to comply with a new regulation). In 2000, EPA revised the existing Public Notification Rule. (40 CFR part 141, subpart Q) The revisions matched the form, manner, and timing of the notices to the relative risk to human health. The revised rule makes notification easier and more effective for both water systems and their customers. In 2016, section 2106 of the WIIN Act amended section 1414(c)(1) of the SDWA to require water systems to provide to persons served by the system ``[n]otice that the public water system exceeded the lead action level under section 141.80(c) of title 40, Code of Federal Regulations (or a prescribed level of lead that the Administrator establishes for public education or notification in a successor regulation promulgated pursuant to section 1412).'' The WIIN Act also amended section 1414(c)(2) of the SDWA to require EPA's public notification regulations to require systems to notify the public no later than 24 hours after a system learns of an exceedance of the lead action level if it '' ``has the potential to have serious adverse effects on human health as a result of short-term exposure'' just as section 1414(c)(2) has applied to violations of drinking water standards that have the potential to have serious adverse effects on human health as a result of short-term exposure. These situations are currently categorized as ``Tier 1'' under the current public notification rules (see Table 2 to Sec. 141.201). Tier 1 notices must ``be distributed as soon as practicable, but not later than 24 hours, after the public water system learns of the violation or exceedance'' pursuant to section 1414(c)(2)(C)(i) of the SDWA. The WIIN Act also amended section 1414(c)(2)(iii) to require that such notifications be provided to the Administrator in addition to the head of the state agency that has primary enforcement responsibility under section 1413 of the SDWA, as applicable, as soon as practicable, but not later than 24 hours after the public water system learns of the violation or exceedance.'' In a State with primacy, EPA interprets the notice to the Administrator ``as applicable'' only when there is an action level exceedance; it would not apply to other Tier 1 situations where a State has primacy. This notice allows EPA to identify whether it must provide notice as required in section 1414(c)(2)(D), which was added to Section 1414(c)(2) as part of the WIIN Act. It provides that if a State with primary enforcement responsibility or the water system has not issued a notice for an exceedance of a lead action level that has the potential to have serious adverse effects on human health as a result of short-term exposure, the Administrator is required to issue the required notice. Because EPA does not have any obligation to issue a Tier 1 notice for violations of drinking water standards in states with primacy, there is no need for EPA to be notified of those Tier 1 situations.1. Proposed Revisions EPA proposed to incorporate these requirements for CWSs and NTNCWSs with a lead ALE as part of proposed revisions to the Lead and Copper Rule (LCR). Specifically, the proposed rule incorporated the amendments to section 1414 of the SDWA in 40 CFR part 141, subpart Q-Public Notification of Drinking Water Violations (and as necessary into any provisions cross-referenced therein), and added exceedances of the lead AL under Sec. 141.80(c) to the list of Tier 1 violations subject to the new 24-hour notice requirements discussed above. EPA proposed to categorize a lead AL exceedance as Tier 1 based on the conclusion that such exceedances ``have the potential to have serious adverse health effects on human health as a result of short-term exposure.'' Since exposure to lead can result in serious health effects as a result of short-term exposure in some circumstances, EPA proposed that any lead AL exceedance result in Tier 1 public notification. In[[Page 4240]]addition, EPA proposed to update the mandatory health effects statement for PN to be consistent with the proposed CCR revisions.2. Public Comment and EPA's Response EPA received many comments expressing concerns about the ability of water systems to meet the proposed 24-hour distribution requirement for notification of an AL exceedance. Many commenters requested that water systems be allowed at least two business days to deliver the public notice. EPA acknowledges commenters' concerns; however, the Agency disagrees that systems would not be able to provide the notice within 24 hours. For several years, water systems have been required to provide Tier 1 notification for certain violations of drinking water standards within 24 hours of learning of the violation. Systems can prepare to provide the notice by creating a notification template in advance and may choose from several options for distribution of a public notification that make it feasible to provide the notice to all persons served by the system within 24 hours of learning of the exceedance. These options are specified in Sec. 141.202(c) of the rule and include broadcast media such as radio and television, posting the notice in conspicuous locations throughout the area served by the water system, hand delivery of the notice to persons served by the water system, or another delivery method approved by the primacy agency. Many commenters questioned the categorization of a lead AL exceedance as a Tier 1 violation, particularly given it is not a health-based value. Some suggested that it be categorized as a Tier 2 violation. However, as described above, Section 2106 of the 2016 WIIN Act amended section 1414(c)(2) of the SDWA to require EPA's public notification regulations to require systems to notify the public no later than 24 hours after a system learns of an exceedance of the lead AL if it ``has the potential to have serious adverse effects on human health as a result of the customer did not wish to replace the faucet exposure.'' The scientific evidence demonstrates that exposure to lead is associated with increased risk of serious adverse health effects. The strongest evidence is for cognitive effects from prenatal and childhood exposure. Also of concern are studies showing increases in risk of cancer and cardiovascular, renal, reproductive, immunological, and neurological effects in adults (USEPA, 2013; National Toxicology Program, 2012; USEPA, 2004a). Given there is no safe level of lead, and there are life stages (e.g , early childhood) where any lead exposure is especially problematic, lead AL exceedances could have serious adverse health consequences. Accordingly, to avoid these impacts, consumers must be notified as soon as possible as required under the SDWA.3. Final Revisions The final rule adds exceedances of the lead AL of 15 [micro]g/L to the list of Tier 1 violations subject to the new 24-hour distribution requirement for notification of an AL exceedance. This is based on the conclusion that such exceedances have the potential to have serious adverse health effects on human health as a result of short-term exposure. Therefore, the final rule requires CWSs and NTNCWSs with a lead ALE to provide public notice to persons served by the system within 24 hours of learning of the ALE; that is, within 24 hours of the system receiving and calculating the 90th percentile value. A copy of the notice must also be sent to both the primacy agency and the Administrator in accordance with the requirements of Sec. Sec. 141.4(c)(2)(iii) and 141.31(d). EPA has also updated the mandatory health effects language required in the public notice of a lead ALE as well as the CCR and public education materials to enhance clarity and accuracy. The mandatory health effects language in the final rule reads as follows: Exposure to lead in drinking water can cause serious health effects in all age groups. Infants and children can have decreases in IQ and attention span. Lead exposure can lead to new learning and behavior problems or exacerbate existing learning and behavior problems. The children of women who are exposed to lead before or during pregnancy can have increased risk of these adverse health effects. Adults can have increased risks of heart disease, high blood pressure, kidney or nervous system problems.C. Definitions1. Proposed Revisions Under the Proposed Lead and Copper Rule Revisions, EPA proposed new and revised definitions under Sec. 141.2 Definitions for ``aerator,'' ``pre-stagnation flushing,'' ``wide-mouth bottle,'' and ``tap sampling protocol,'' were added to correspond with proposed rule changes regarding tap sampling methods. In addition, EPA proposed changes to population size criteria for small and medium-size water systems to reflect the 1996 changes to SDWA for small-system flexibility, where small water systems serve 10,000 or fewer customers. Definitions were added in the proposal to ensure readers understood the criteria for identifying a ``child care facility,'' and a ``school,'' in relation to new sampling requirements for these facilities. In addition, definitions for ``trigger level,'' ``find-and-fix,'' ``customer,'' and ``consumer'' were included in the proposal because ``trigger level'' and ``find-and-fix'' were new requirements under the proposal, while ``customer'' and ``consumer'' referred to defined groups impacted by aspects of the proposal such as public education under Sec. 141.85 Further, in the proposal, terms related to LSLs, such as ``galvanized service line,'' ``trenching,'' ``potholing,'' ``hydrovacing,'' and ``gooseneck, pigtail, or connector,'' were defined because these are processes or materials associated with the LSLR requirements of the proposal. EPA also modified the definition of a ``lead service line'' to better fit the rule requirements in the proposal. These changes included removing lead goosenecks, pigtails, and connectors from the definition and specifying when galvanized lines are considered an LSL for purposes of conducting LSLR. EPA made these modifications to align with rule requirements which prioritize the identification, replacement, and tap sampling at sites with LSLs, as they are the primary source of lead in drinking water when present. The definition of a lead service line does not include lead goosenecks, pigtails or connectors to avoid water systems replacing only lead connectors to meet goal rate and mandatory LSLR requirements. ``Sampling period'' was also added in reference to the months of the year that sampling is permitted under Sec. 141.86, while ``monitoring period'' was added and defined, to refer to the tap sampling frequency the water system is required to conduct. To ensure appropriate implementation of rule requirements, definitions for ``pitcher filter'' and ``point-of-use'' (POU) device were also included in the proposal. Definitions for a ``method detection limit'' (MDL) and a ``practical quantitation level'' (PQL) were provided in the proposed rule to better explain analytical methods in the current and proposed rules.2. Public Comment and EPA Response Many commenters were concerned about the new definitions of ``consumer'' and ``customer'' and explained that they were misused or used interchangeably throughout the rule. For instance, in the proposal, ``customer'' was defined as paying users[[Page 4241]]of the water system, whereas ``consumer'' included all users, including those paying the water bill. Commenters noted there was confusion about their use for LSL notification and public education purposes and interpreted a requirement to notify ``consumers'' to mean any person who may have used the water and questioned how a water system can notify transient populations. Commenters also noted that owners of the service line were not explicitly included in either definition and that they are an important group that should be contacted under certain circumstances. EPA agrees that the proposed definitions may be confusing and has not included them in Sec. 141.2 of the final rule. EPA instead modified the regulatory text to specify the group of people affected in each section of the rule in lieu of using ``consumer'' and ``customer'' (e.g , ``persons served water by a lead service line'') throughout this final rule. Many comments suggested modifications to the proposed definitions for ``pitcher filter'' such as specifying if EPA intends only the filter or the pitcher and the filter. Other suggestions included requiring pitcher filters to meet a standard by a certifying body that the device reduces lead. EPA agreed with some of the commenters' concerns and has included in the definition that a pitcher filter must be certified by an American National Standards Institute (ANSI) certifying body to reduce lead. Many commenters requested clarification on definitions for ``child care facility'' and ``school''. Several were opposed to including ``licensed'' with respect to child care facilities while others stated they should be limited to state-licensed child care sites. Some commenters asked EPA to remove ``or other location'' from the definition of ``school''. Some commenters asked if higher education centers like universities and technical schools are included in the school definition and therefore in school sampling requirements. EPA modified the proposed school testing requirements to distinguish testing required at child care facilities and elementary schools versus those for secondary schools. In response to this, EPA has added new definitions for ``elementary school'' and ``secondary school'', so that it is clear which facilities are referred to in the requirements under Sec. 141.92 These definitions are consistent with the National Center for Education ***Statistics*** Glossary ([*https://nces.ed.gov/programs/coe/glossary.asp*](https://nces.ed.gov/programs/coe/glossary.asp)). After evaluations of public comments, EPA agrees and has modified the definitions of ``school'' and ``child care facility'' in the final rule to reduce any ambiguity as it was not EPA's intent to include locations such as museums or athletic facilities in the definition of ``school'' while EPA has maintained that licensed facilities are included in the ``child care facility'' definition. Commenters asked for more detail on ``wide-mouth bottle'' and EPA has included a specific diameter to define a wide mouth bottle in the final rule. Many commenters disagreed with how EPA defined ``sampling period'' and ``monitoring period'' stating that EPA did not use these terms consistently throughout the rule. They also note these definitions may conflict with other NPDWRs. In the final LCRR, EPA has uniquely defined these in regard to tap sampling for purposes of the LCRR. The LCRR includes definitions for ``tap sampling monitoring period'' to describe frequency and ``tap sampling period'' to describe the time period in which samples must be ***collected***. Some of the comments requested clarification on ``unknown'' service lines, which prompted EPA to create new definitions such as ``lead status unknown service line'' to clearly delineate a category for unknown service lines. EPA agrees that clarification is needed and has included descriptions both in the LSL inventory requirements and as a new definition in Sec. 141.2 EPA received significant comment on the definition of an LSL, specifically, whether it is appropriate for a galvanized service line to be considered an LSL if it ever was or is currently downstream of an LSL. Many of these commenters expressed that water systems will not have records to demonstrate if a galvanized service line ``ever was or is currently downstream of any lead service line or service line of unknown material,'' some stating that galvanized service lines should be included regardless of what is upstream. Other commenters stated that galvanized service lines should not be included to reduce burden to the water system. As proposed, most galvanized service lines would be deemed an LSL because of lack of information about upstream LSLs. In addition, commenters questioned why the proposal requires replacement of galvanized lines, but they cannot be used for tap sampling sites. EPA determined that a galvanized service line that is or ever was downstream from an LSL requires replacement but is not included in the LSL definition to reduce confusion and because it has its own definition. In addition, EPA included sites served by a galvanized requiring replacement in the tap sample site selection criteria (tier 3) in the final rule. This also helps clarify that while galvanized service lines that were or are upstream of an LSL require replacement, they are not appropriate sites for tap sampling. Many commenters were opposed to the exclusion of lead connectors (goosenecks, pigtails, etc.) from the proposed definition of an LSL, some stating this was violating SDWA's anti-backsliding provision under Section 1412(b)(9). Some commenters reference the SDWA definition of an LSL as well as an LSL as defined by the California and Michigan regulations. Commenters provided input about what should and should not be included in the LSL definition and noted where there were contradictions in the rule between tap sampling, LSL inventory and replacement requirements regarding an LSL. EPA agreed that clarity was needed in the definition of an LSL due to its importance related to LSL inventory, LSLR outreach, and selection of tap sample sites and has clarified this in section III.C of this preamble. EPA has modified the definition to simplify it and to specify that it is for the purposes of the LCRR only, to prioritize tap sampling sites and replacement of full LSLs. EPA excluded the lead connector portion of the LSL definition and has clarified the lead connector definition itself. For purposes of this rule, lead connectors are not a part of the service line and are required to be replaced only when identified while conducting other maintenance and replacement activities. EPA has kept these connectors out of the LSL definition to ensure water systems are conducting LSLR on service lines and not counting replacement of connectors as a replaced LSL. A commenter noted that the definition for ``service line sample'' should be removed since the LCRR no longer allows test out of LSLs.3. Final Rule Requirements As stated above, EPA has made many changes to the definitions in the Proposed Lead and Copper Rule Revisions, including modifying the proposed definitions, removing some additional terms and defining other additional terms. Definitions that were modified in the final rule include: ``action level,'' ``find-and-fix,'' ``first draw sample,'' ``galvanized service line,'' ``gooseneck, pigtail or connector,'' ``lead service line,'' ``pitcher filter,'' ``point-of-use device,'' ``pre-stagnation flushing,'' ``school,'' ``child care facility,'' ``tap sampling protocol,'' ``wide-mouth bottle,'' and changing[[Page 4242]]``trigger level'' to ``lead trigger level.'' EPA revised definitions for ``monitoring period'' and ``sampling period'' to ``tap sampling monitoring period'' and ``tap sampling period.'' In addition, EPA has added the following definitions to improve the final rule: ``Full lead service line replacement,'' ``lead status unknown service line,'' ``partial lead service line replacement,'' ``elementary school,'' ``secondary school'' and ``system without corrosion control treatment.'' These were added to ensure consistent implementation for LCRR requirements for preparing a service line inventory, LSLR, carrying out school sampling and conducting CCT studies. In addition, ``hydrovacing,'' ``trenching,'' and ``potholing'' have been removed because of their minimal use in the rule. EPA has also no longer included the terms ``consumer'' and ``customer'' in the definitions and has instead been more specific in each part of the rule about the impacted person or group. EPA removed the definition for ``service line sample'' because test outs of LSLs are not allowed in the LCRR. EPA has maintained the current definitions of ``small water system'' and ``medium-size water system'' in Sec. 141.2 consistent with the proposal.V. Rule Implementation and EnforcementA. What are the state recordkeeping and reporting requirements?1. Proposed Revisions EPA proposed requirements that would improve oversight and enforcement of the LCRR by the state. The proposal was consistent with a recommendation from GAO which recommended in its report ``Drinking Water: Additional ***Data*** and Statistical Analysis May Enhance EPA's Oversight of the Lead and Copper Rule,'' that EPA require states to report available information about lead pipes to EPA's SDWIS (or a future redesign) database and should require states to report all 90th percentile sample results for small water systems (GAO-17-424, 2017).2. Public Comment and EPA's Response Commenters noted the burdensome reporting and recordkeeping requirements of the proposed rule. The many proposed transactions between water systems and states, and between states and the EPA, would cause significant costs for primacy agencies. Many commenters noted that ***data*** management is critical for the final LCRR and inquired about the development of SDWIS Prime. EPA has accounted for the costs to states to implement and enforce the rule requirements in the proposed and final rules. While the costs to states have increased in the final rule relative to the previous rule, public health is better protected under the revised LCRR. The increased costs result from several improvements in the final rule that will benefit public health, such as additional LSLR and better implementation of CCT. These benefits are monetized and presented in the final rule's economic analysis. EPA is intending to provide states with LCRR ***data*** management capabilities through the SDWIS Modernization system development project. EPA worked with states to form the SDWIS Modernization Board in January 2020. The Board is not an advisory group reaching consensus, the Board provided input into the third party-led SDWIS Modernization Alternatives Analysis through the end of June 2020. State members of the Board are expected to convey option recommendations to EPA by the end of July 2020, with EPA expected to select an option in August 2020. Following option selection, EPA is intending to engage with states in the development and testing of the SDWIS Modernization ***data*** system through Spring 2022. EPA will then provide assistance to states in their adoption of the new system. The system will include functions for ensuring ***data*** quality as well as for primacy agencies to be able to connect the system to locally run applications, such as the Drinking Water Application running on a state server. EPA is intending to provide LCRR ***Data*** Entry Instructions (DEIs) by Fall 2021. The LCRR DEIs will provide detailed guidance to Primacy Agencies regarding the LCRR monitoring, record keeping, and reporting requirements.3. Final Rule Requirements EPA is requiring that the state retain all record keeping requirements from the current LCR. In addition, EPA is requiring the state to maintain a record of all public water system's LSL inventories and annual updates. This information is necessary for the state to calculate goal and mandatory LSLR rates, as well as verify correct tap sample site selection tiering. EPA is also requiring the state to maintain a record of the state's decision and approval related to water system changes to source water or treatment. The state is required to maintain records regarding the required steps water systems must complete as required under the final ``find-and-fix'' requirements. Finally, the state is also required to maintain records of the small system flexibility compliance alternative the state approved for non-transient non-CWS s and small CWSs. This information allows the state to track water systems' progress with corrosion control treatment, complete LSLR, use of POU devices, and replacement of leaded premise plumbing, as appropriate. EPA is requiring states to report additional ***data*** elements to EPA. The state is required to report the OCCT status of all water systems, including the parameters that define the optimization (for example, orthophosphate residual or target pH and alkalinity values). EPA is requiring that all 90th percentile value be reported for all size systems. EPA has found that many states already voluntarily report 90th percentile lead values for all systems to the SDWIS. EPA also requires that states report the current number of LSLs at every water system. National information about the numbers of LSLs in public water systems will support EPA oversight of the LCR as well as EPA and other Federal agencies in targeting programs to reduce lead exposure, such programs established by the WIIN Act (WIINA, 2016) and America's Water Infrastructure Act (AWIA, 2018).B. What are the special primacy requirements?1. Proposed Revisions The proposed revision added new primacy requirements to match new requirements in other rule sections, such as state designation of a goal LSLR rate. The proposed rule also included a provision that would give EPA the authority to set an alternative goal rate where it determines an alternative rate is feasible. The new school sampling requirement for water systems resulted in a proposed state requirement to define a school or child care facility and determine if any existing testing program is at least as stringent as the Federal requirements. States must also verify compliance with find-and-fix requirements.2. Public Comment and EPA's Response Many commenters noted the increased ***data*** management demands of the proposed rule. Some commenters noted that the state flexibilities could create additional work for the states. For example, some commenters preferred EPA to set a national goal-based LSLR rates instead of the state. Some commenters disagreed that EPA should have authority to supersede a state-[[Page 4243]]approved LSLR goal rate. See section III.D.2 of this document for EPA's response to these comments. States had many other comments about the level of burden on the states required by the rule. EPA acknowledges the increased burden for states but notes that the additional requirements are feasible and will improve implementation and enforcement of the LCRR. EPA received several comments requesting Agency guidance on implementation of the revised rule. EPA understands this is a critical component to ensure the rule's effectiveness in protecting public health. The Agency intends to develop implementation guidance targeting the areas of the rule that are most likely to support compliance. In addition to guidance, EPA will also provide training and other supporting materials that will help states and water systems implement the revised rule, reduce state transaction costs, and promote greater national consistency.3. Final Rule Requirements For the final rule EPA clarified that because water systems that serve 10,000 or fewer people do not need to recommend a goal LSLR rate to the state, states do not need to approve a goal LSLR rate for these systems. Water systems below this threshold will follow the small system flexibility and will not engage in a goal-based LSLR program after exceeding the lead trigger level. In response to comments, the final rule does not include provisions for the Regional Administrator to establish an LSLR goal rate that would supersede a state decision. EPA also included a special primacy requirement that states must establish a higher mandatory LSLR rate where feasible for all water systems.VI. Economic Analysis This section summarizes the final rule Economic Analysis (EA) supporting document (USEPA, 2020a) for the Lead and Copper Rule (LCR) revisions, which is prepared in compliance with section 1412(b)(3)(C)(ii) of SDWA and under Executive Order 12866. Section 1412(b)(3)(C)(ii) of SDWA states that when proposing a national primary drinking water regulation (NPDWR) that includes a treatment technique, the Administrator shall publish and seek comment on an analysis of the health risk reduction benefits and costs likely to be experienced as the result of compliance with the treatment technique and the alternative treatment techniques that are being considered, taking into account, as appropriate, the factors required under section 1412(b)(3)(C)(i). EPA is also using the health risk reduction cost analysis (HRRCA) in the development of this final rule for purposes of Section 1412(b)(4), (5), and (7) of the SDWA (i.e , to determine the feasibility of the treatment techniques). Clause (i) lists the following analytical elements: (1) Quantifiable and non-quantifiable health risk reduction benefits; (2) quantifiable and non-quantifiable health risk reduction benefits from reductions in co-occurring contaminants; (3) quantifiable and non-quantifiable costs that are likely to occur solely as a result of compliance; (4) incremental costs and benefits of rule options; (5) effects of the contaminant on the general population and sensitive subpopulations including infants, children, pregnant women, the elderly, and individuals with a history of serious illness; (6) any increased health risks that may occur as a result of compliance, including risks associated with co-occurring contaminants; and (7) other relevant factors such as uncertainties in the analysis and factors with respect to the degree and nature of the risk. Costs discussed in this section are presented as annualized present values in 2016 dollars, which is consistent with the timeframe for EPA's water system characteristic ***data*** used in the analysis. EPA estimated the year or years in which all costs occur over a 35-year time period. Thirty-five years was selected to capture costs associated with rule implementation as well as water systems installing and operating corrosion control treatment and implementing LSLR programs. EPA then determined the present value of these costs using discount rates of 3 and 7 percent. Benefits, in terms of health risk reduction from the LCR revisions, result from the activities performed by water systems, which are expected to reduce risk to the public from exposure to lead and copper in drinking water at the tap. EPA quantifies and monetizes some of this health risk reduction from lead exposure by estimating the decrease in lead exposure accruing to children from 0 to 7 years of age from the installation and re-optimization of corrosion control treatment (CCT), LSLRs, and the implementation of point-of-use (POU) filter devices and by quantifying and monetizing the resulting change in intelligence quotient (IQ) in children.A. Public Comments on the Economic Analysis of the Proposed Rule and EPA Response EPA published an economic analysis for the proposed rule in accordance with SDWA section 1412(b)(3)(C) (USEPA, 2019f and 2019g). The proposed rule EA and the appendices to the proposed rule EA can be found in the rule docket, under the docket ID numbers EPA-HQ-OW-2017-0300-0003 and EPA-HQ-OW-2017-0300-0002 respectively). EPA solicited comment on all aspects of the economic analysis for the proposed LCRR. In particular, the Agency requested comment on the five drivers of costs identified in its economic analysis: (1) The existing number of LSLs in PWSs; (2) the number of PWS above the AL or TL under the previous rule and proposed rule monitoring requirements; (3) the cost of installing and optimizing corrosion control treatment; (4) the effectiveness of CCT in mitigating lead concentrations; and (5) the cost of LSLR. EPA received a number of comments and ***data*** submissions associated with these five topics that the Agency has considered to reevaluate and refine the cost estimates. As a result of the new information submitted by commenters and additional ***data*** obtained by EPA in response to comments, the Agency has improved the estimates of costs and benefits for the final rule. EPA received a number of comments regarding the estimates of the existing number of LSLs in PWSs. Commenters provided state level summary ***data*** on the specific systems with LSLs from Indiana, Wisconsin, and Nevada. EPA has evaluated these comments and is using this ***data*** in combination with new ***data*** ***collected*** from states that have LSL inventory requirements (e.g , Michigan, Maryland, Ohio), to update the dataset of systems with LSLs. With this updated ***data***, EPA has significantly expanded, from proposal, the number of systems with known LSL status to determine the baseline proportion of systems below or equal to the TL, above the TL and below or equal to the AL, and above the AL for both the low and high cost scenarios evaluated in the economic analysis. The impact of the expanded dataset of systems with known LSL status was found to have a small impact on the low and high scenario baseline proportion of systems that exceeded the TL or AL between the proposed and final rule analyses. EPA also received comments on the estimates of the number of water systems that would exceed the TL and AL in the economic analysis for the proposal. EPA received information from the states of Wisconsin, Indiana, Ohio, Connecticut, North Dakota and Nevada about the expected number of water systems that would exceed the TL and AL in those states given a first liter sampling protocol. EPA revised the estimates of systems without LSLs that would exceed the TL and AL based upon first liter sample results and used ***data*** provided by these states to assess[[Page 4244]]the representativeness of the revised estimates for the final economic analysis. After considering the comments on the alternative fifth liter sampling technique for systems with LSLs described in section III.G of this document, EPA prepared revised estimates of the number of systems with LSLs that would exceed the AL and TL as a result of the fifth liter sample requirements in the final rule. EPA used the revised ***data*** set of systems with known LSLs to estimate the number of systems that will be required to ***collect*** fifth liter samples. In addition, EPA obtained more detailed ***data*** from the State of Michigan. The Michigan ***data*** represents 2019 lead tap sample compliance ***data*** that includes both first and fifth liter lead tap samples from homes with LSLs. EPA estimated the number of systems that would exceed the TL and the AL using the ratio between the first liter and fifth liter 90th percentile values from 133 Michigan systems. This new ***data*** from Michigan, along with the expansion of the number of systems with known LSL status, resulted in a larger proportion of systems with ALEs under the low cost scenario and a smaller proportion of systems with ALEs in the high cost scenario in the final rule analysis than was estimated in the proposed rule. This would tend to increase the estimated cost of the final rule low cost scenario compared to the proposal analysis and lower the cost for the final rule high cost scenario compared to the proposal. See Chapter 4, section 4.3.5 of the final rule EA for additional detail (USEPA, 2020a). EPA received comments on the proposed rule's cost estimates for the installation and operation and maintenance of CCT. The Nevada Division of Environmental Protection provided cost estimates representing four of the state's water systems. Based on the reported information EPA was able to compare the capital and operations and maintenance (O&M) costs of one of the small groundwater systems that had installed a zinc orthophosphate feed system with the EPA Work Breakdown Structure Zinc Orthophosphate Model and the cost curves used in the LCR analysis. Capital cost of the Nevada system fell close to the mid-point of the range between the low and high estimated cost curves used in the proposed regulatory analysis, and the system's O&M costs fell well below the costs estimated by the EPA cost curves. After considering the comments, the Agency has determined that cost estimates for installing and operating CCT in the proposal are accurate for purposes of a national cost estimate and is retaining the methodology for the final rule. In response to EPA's request for comment about the effectiveness of CCT, the Agency received general comments that CCT is very effective with caveats such as: The water in the distribution system must be used on a regular basis, and sampling should be required to check on proper operation of CCT. The Agency agrees with commenters that CCT can be effective in reducing drinking water lead levels if carefully operated and monitored. The Agency did not receive any comments on how to improve the estimates of the effectiveness of CCT from the proposed economic analysis and is therefore maintaining the same assumptions used in the proposed rule analysis. EPA received comments on the cost of LSLR, primarily dealing with the need for more current ***data***. EPA agrees with the commenters that new information has become available since the time of proposal that would provide better estimates of LSLR unit costs for the final rule analysis. In the analysis of the proposed rule EPA had developed a dataset of 24 utility reported estimates of LSLR costs. EPA evaluated this dataset along the other replacement cost survey information and selected the American Water Works Association (AWWA) 2011 survey (Cornwell et al., 2016) as the primary source of ***data*** for LSLR unit cost estimates for the proposed rule. Since proposal, EPA has identified cost ***data*** in news reports, press releases, and utility websites that has allowed the Agency to expand the utility ***data*** ***collected*** during the proposed rule analysis. The Agency's search found additional cost estimates from 63 utilities. EPA then selected only the subset of ***data*** values that represent reported actual replacement costs from pilot studies and/or recent or on-going LSLR projects. This resultant dataset provides costs estimates across full, customer-side, and system-side replacements from 38 systems, which represent costs and practices from 2016 to 2020 (only two cost values from the proposal dataset remain in the revised dataset). The cost information in the updated dataset are variable in the reported replacement costs covered by the various programs, but a number of the ***data*** sources specifically indicate they include surface restoration cost. Therefore, the cost analysis for the final rule includes surface restoration. The estimated mean costs for utility-side, customer-side, and full LSLR have increased by 122, 26, and 13 percent, respectively, using the newly developed ***data*** as compared with the AWWA 2011 values used for proposal. For the final rule, EPA used the 25th and 75th percentile values from the new dataset in the low and high cost scenarios, respectively. All utility-side, customer-side, and full LSLR unit costs under both the low and high cost scenarios are larger than those used in the proposed rule analysis except for full replacement in the high cost scenario. In addition to the more specific comments received on the cost of LSLR, public commenters raised concerns about the proposed rule requirement that systems would have to replace, within 45 days, the utility-owned portion of an LSL if they become aware that a customer has replaced their portion of the line. Commenters indicated concern that the number of ``customer initiated'' LSLR might at times become too numerous for systems to complete the replacement within the 45 days allowed. In response to these comments, EPA conducted a search for new ***data*** on the number of customer initiated LSLR occurring at water systems. EPA found ***data*** from DC Water (2016) that could be used to determine a rate of customer initiated replacements. This new ***data*** allowed the Agency to provide quantified costs for customer initiated LSLR in the final rule analysis which were not available at the time of proposal. See Chapter 5, section 5.3.4 of the final rule EA for additional detail (USEPA, 2020a). The inclusion of these new quantified cost categories increases final rule estimated total cost compared to the proposed rule's total cost. EPA asked for comment on the assumptions regarding labor required to comply with the proposed rule. The Association of State Drinking Water Administrators (ASDWA) provided EPA with a version of their Costs of States Transactions Study (CoSTS) model which estimated the first five years of total and incremental burden to states for implementing the proposed LCRR (a number of individual States and some PWSs also indicated in comments that EPA review the ASDWA CoSTS model). Burden totals from this model were significantly higher for some state oversight activities than those estimated by EPA for the proposed LCRR. EPA carefully evaluated the information and assumptions in the CoSTS model and used them to develop revised state burden estimates for the cost analysis of the final rule. EPA revised cost estimates for a number of state activities including: Administrative activities, technical assistance, review of LSLR plans and LSL inventories, approval of systems' LSLR goals, review and approval of tap sampling site plans,[[Page 4245]]review of school and child care testing programs, review of annual reports on school and child care testing programs, and review and approval of small system flexibility recommendations. EPA also added a new one-time cost element for both states and PWSs to initially confer on the system's 90th percentile status and new requirements under the LCRR based on the system's first two 6-month monitoring periods under the revised tap sampling requirements of the LCRR. These increases in burden to states will result in higher estimated total costs for the final rule when compared to the burden estimates used in the analysis of the proposed rule. EPA solicited peer reviewed information on the evidence relevant to quantifying the incremental contribution of blood lead concentrations (especially at blood lead level (BLL) less than 5 [mu]g/dL) to cardiovascular disease (and associated mortality) relative to other predictors such as diet, exercise, and genetics that may be useful in a future benefits analysis. EPA received a number of comments that cited studies which EPA had identified in the proposed rule analysis, as well as one additional study by Chowdhury et al. (2018). Chowdhury et al. is a systematic review on cardiovascular morbidity endpoints that concludes that lead is associated with an increased risk of cardiovascular disease. EPA has added this reference to its qualitative discussions on the health impacts of lead in Appendix J of the final rule EA. Although the EPA did not quantify or monetize changes in adult health benefits for the proposed LCRR, the Agency estimated the potential changes in adult drinking water exposures and thus blood lead levels to illustrate the extent of lead reduction to the adult population as a result of the proposed LCRR. Commenters indicated that the Agency should include quantification and monetization of the adult cardiovascular disease (CVD) benefits associated with reductions in water lead concentrations in the health risk reduction and cost analysis (HRRCA referred to in this notice as the final rule economic analysis or final rule EA) for the LCRR. Some of the commenters have indicated that EPA has a legal obligation to include this benefit in the HRRCA under section 1412(b)(3) of SDWA. EPA does not agree with these commenters that a quantified assessment of CVD benefits is necessary in this HRRCA. EPA conducts a HRRCA when proposing any NPDWR, as required in section 1412(b)(3)(C)(i) and (ii) of the SDWA. SDWA Section 1412(b)(3)(C)(i)(I) requires the inclusion of quantifiable and nonquantifiable health risk reduction benefits for which there is a factual basis in the rulemaking record to conclude such benefits are likely to occur as a result of the rule. SDWA section 1412(b)(3)(C)(iii) provides that ``[t]he Administrator may identify valid approaches for the measurement and valuation of benefits'' for the HRRCA. EPA exercised its discretion to identify the validity of the approaches used to measure and value CVD benefits and determined not to quantify CVD benefits for this rulemaking because the methodology which links changes in adult blood lead levels to CVD health endpoints, including mortality, has not yet undergone the necessary panel peer review. There remains uncertainty about the best quantitative relationship to describe the impacts of changes in current adult blood lead levels on the risk of CVD mortality. The studies currently available to the Agency which quantitatively describe the risk relationship attempt to control for a variety of potential confounders that may affect CVD risk as well as exposure to lead. EPA needs additional scientific guidance on which studies sufficiently control for potential confounding factors that might introduce bias into the estimated lead CVD risk relationship. The Agency will also seek input from an expert peer review panel on the modeling of the lead cessation lag (i.e , the time between the lead exposure reduction and the reduction in CVD risk). For additional information on the uncertainties associated with the assessment of the CVD mortality health endpoint which need to be clarified through the panel peer review process see Appendix J of the final rule EA. However, EPA has considered the substantial unquantified benefits to the rule, including those associated with reductions in adverse cardiovascular effects that are described in the HRRCA. Some commenters asserted that if the Agency monetized the benefits of CVD, the Agency would have proposed more stringent requirements because greater quantified benefits would justify more burdensome regulation. EPA disagrees. The Agency considered information from the HRRCA at proposal to determine, as required by SDWA section 1412(b)(4)(C) ``whether the benefits . . . justify, or do not justify, the costs.'' The Agency found that the quantified and non-quantified benefits justified the cost of the proposed rule requirements. EPA considered costs and benefits in its rulemaking process, as required by SDWA. The Agency established the treatment technique requirements in the rule to ``prevent known or anticipated adverse effects on the health of persons to the extent feasible'' consistent with section 1412(b)(7)(A) of the SDWA, while also ensuring that ``[a]ny revision of a national primary drinking water regulation shall . . . maintain, or provide for greater, protection of the health of persons'' as required in section 1412(b)(9) of the SDWA. EPA is not employing the discretionary provision of SDWA section 1412(b)(6) that allows the Agency to promulgate an NPDWR that ``maximizes health risk reduction benefits at a cost that is justified by the benefits.'' Therefore, the Agency's decision to not monetize CVD benefits did not affect the stringency of the final rule. EPA conducted an analysis of quantifiable and non-quantifiable benefits that meets the statutory requirements and EPA considered both quantified and non-quantified benefits in the rulemaking. EPA received a number of comments that encouraged the Agency to obtain more ***data*** to better estimate the costs and benefits of the proposed rule. EPA engaged in additional ***data*** ***collection*** in response to comments improving upon the analysis conducted for the proposed rule. The Agency ***collected*** information post proposal from state and Federal websites, new reports, independent and drinking water system developed reports, and vendor information resulting in updates to: The number of systems with known LSL status; the unit cost of LSLR; the rate of customer initiated LSLR; the cost of scavenged pipe-loop and coupon CCT studies; the number of schools and child cares; and the current amount of state required school and child care testing. EPA reexamined the profile ***data*** set that was used by the Agency to estimate the reductions of lead levels as a result of CCT and LSLR. EPA reviewed the CCT designations made in the profile dataset and changed the designations based on new information. Re-running the model that simulates the water lead concentrations for various combinations of CCT and LSL presence for the final rule analysis resulted in increased lead concentrations for the no-LSL present scenarios and lower lead concentrations for the cases where full and partial LSLs are present and there is no or partial CCT present as compared to the estimated values used in the proposed rule analysis (see Exhibit 6-15 for the complete list of estimated concentrations used in the final rule analysis). The new estimates for lead concentration result in smaller changes in exposure as compared with the proposed rule. So, relative to the[[Page 4246]]proposed rule a unit improvement in CCT or LSLR will result in smaller changes in lead concentration reductions, BLL reductions, and monetized IQ benefits. Exhibit 6-1 summarizes the ***data*** improvements made in response to comments received on the proposed rule analysis that have an impact of the estimated costs and benefits for the final rule. These impacts are separate from and irrespective of changes to the regulatory requirements. The exhibit indicates the impact the ***data*** change had on estimated costs. Exhibit 6-1--***Data*** Improvements Made in Response to Comments Received on the Proposed LCRR Analysis------------------------------------------------------------------------ Impact on cost/benefit estimate ***Data*** from proposal------------------------------------------------------------------------Expanded dataset of systems with known Small impact on LSL status. estimated cost for previous rule (baseline).2019 State of Michigan lead compliance Increase low cost ***data*** used in conjunction with expanded scenario estimated cost. dataset of systems with known LSL Decrease high cost status. scenario estimated cost.Lead Service Line Replacement unit Increase estimated costs. costs.Estimate for customer initiated LSLR... Increase estimated cost (only qualitatively considered in the proposal).Updated state burden estimates based on Increase estimated ASDWA CoSTS model. costs.Revised tap water lead concentration Decrease estimated values. benefit.------------------------------------------------------------------------B. Affected Entities and Major ***Data*** Sources Used To Characterize the Sample Universe The entities potentially affected by the LCR revisions are public water systems (PWSs) that are classified as either CWSs or NTNCWSs. These water systems can be publicly or privately owned. In the economic analysis modeling performed in support of this rulemaking, EPA began with the 50,067 CWSs and 17,589 NTNCWSs in the Safe Drinking Water Information System Fed ***Data*** Warehouse (SDWIS/Fed) as its foundational ***data*** set. EPA used a variety of ***data*** sources to develop the drinking water industry characterization for the regulatory analysis. Exhibit 6-2 lists the major ***data*** sources, describes the ***data*** used from each source, and explains how it was used in the final rule EA. Additional detailed descriptions of these ***data*** sources and how they were used in the characterization of baseline industry conditions can be found in Chapter 4 of the final rule EA (USEPA, 2020a). Exhibit 6-2--Major ***Data*** Sources Used To Develop the Baseline Industry Characterization------------------------------------------------------------------------ Baseline ***data*** derived from the ***Data*** source source------------------------------------------------------------------------SDWIS/Fed third quarter 2016 ``frozen'' Public water system dataset \1\. inventory, including population served, number of service connections, source water type, and water system type. Also used to identify NTNCWSs that are schools and child care facilities. Status of CCT, including identification of water systems with CCT and the proportion of water systems serving <= 50,000 people that installed CCT in response to the previous LCR. Analysis of lead 90th percentile concentrations to identify water systems at or below the TL of 10 [micro]g/L, above the TL, and above the AL of 15 [micro]g/L at the start of rule implementation by LSL status, i.e , presence or absence of LSLs for the previous rule and LCRR. Used in concert with ***data*** from Michigan described below for the LCRR.2 3 The proportion of water systems that are on various reduced monitoring schedules for lead and copper tap and WQP monitoring. The frequency of source and treatment changes and those source changes that can result in additional source water monitoring. Length of time that water systems replace LSLs if required under the previous LCR.2006 CWSS (USEPA, 2009)................ Number of distribution system entry points per system. PWS labor rates.Geometries and Characteristics of Design and average Public Water Systems (USEPA, 2000a). daily flow per water system.1988 AWWA Lead Information Survey...... LSL inventory, including the number of water systems with LSLs, and the average number of LSLs per water system, as reported in the 1991 LCR RIA (Weston and EES, 1990).2011 and 2013 AWWA Surveys of Lead LSL inventory, Service Line Occurrence (as summarized including the number of water in Cornwell et al., 2016). systems with LSLs and the average number of LSLs per water system.Six-Year Review 3 of Drinking Water Baseline distribution Standards (2006-2011). of pH for various CCT conditions. Baseline orthophosphate dose for CCT.[[Page 4247]] 2019 State of Michigan Lead and Copper Analysis of the ratio Compliance Monitoring ***Data*** (Michigan of fifth to first liter lead EGLE, 2019). tap samples to estimate the increase in lead 90th percentile levels based on the use of fifth liter samples. Ratios are applied to SDWIS/ Fed lead 90th percentile ***data*** to identify systems at or below the TL of 10 [micro]g/L, above the TL, and above the AL of 15 [micro]g/L under the final LCRR by LSL status. Percent of individual samples exceeding 15 [micro]g/ L for the final LCRR.------------------------------------------------------------------------Acronyms: AL = action level; AWWA = American Water Works Association; CCT = corrosion control treatment; CWSS = Community Water System Survey; LCR = Lead and Copper Rule; LCRR = Lead and Copper Rule revisions; LSL = lead service line; Michigan EGLE = Michigan Department of Environment, Great Lakes, and Energy; NTNCWS = non- transient non-community water system; public water system; RIA = regulatory impact assessment; SDWIS/Fed: Safe Drinking Water Information System/Federal Version; TL = trigger level; WQP = water quality parameter; USEPA = United States Environmental Protection Agency.Note:\1\ Contains information reported through June 30, 2016.\2\ As detailed in Chapter 3 of the Economic Analysis for the Lead and Copper Rule Revisions (USEPA, 2020a), a system's lead 90th percentile level is a key factor in determining a system's requirements under the previous rule and final LCRR.\3\ In the analysis of lead 90th percentile concentrations at PWSs EPA used SDWIS/Fed ***data*** for systems with known LSL status. This sub-set of systems with known LSL status was identified using ***data*** from 12 states (including ***data*** received in public comments from Indiana, Wisconsin, and Nevada), Region 9 tribal systems, and web searches identifying individual systems including the systems serving greater than 1,000,000 persons. See Chapter 4, section 4.3.5 of the Economic Analysis for the Lead and Copper Rule Revisions (USEPA, 2020a) for additional detail.C. Overview of the Cost-Benefit Model Under the regulatory provisions of the final rule, PWSs will face different compliance scenarios depending on the size and type of water system, the presence of LSLs, and existing corrosion controls. In addition, PWSs will also face different unit costs based on water system size, type, and number of entry points (e.g , labor rates and CCT capital, and O&M unit costs). PWSs have a great deal of inherent variability across the water system characteristics that dictate both compliance activities and cost. Because of this variability, to accurately estimate the national level compliance costs (and benefits) of the final LCR revisions, as well as describe how compliance costs are expected to vary across types of PWSs, the cost-benefit model creates a sample of representative ``model PWSs'' by combining the PWS-specific ***data*** available in SDWIS/Fed with ***data*** on baseline and compliance characteristics available at the PWS category level. In some cases, the categorical ***data*** are simple point estimates. In this case, every model PWS in a category is assigned the same value. In other cases, where more robust ***data*** representing system variability are available the category-level ***data*** includes a distribution of potential values. In the case of distributional information, the model assigns each model PWS a value sampled from the distribution, in order to characterize the variability in this input across PWSs. The model follows each model PWS in the sample through each year of analysis--determining how the PWS will comply with each requirement of the final rule, estimating the yearly compliance cost, and tracking the impact of the compliance actions on drinking water lead concentrations. It also tracks how other events, such as changing a water source or treatment affect the water system's compliance requirements for the next year. The model's detailed output provides results for 36 PWS categories, or strata. Each PWS reporting category is defined by the water system type (CWS and NTNCWS), primary source water (ground and surface), and size category (there are nine). The following sub-sections present summarized national cost and benefit totals by regulatory categories. The detailed output across the 36 PWS categories can be found in Appendix C of the final rule EA (USEPA, 2020a). In constructing the initial model PWS sample for the cost-benefit analysis, EPA began with the 50,067 CWSs and 17,589 NTNCWS in SDWIS/Fed. Also, from SDWIS/Fed, EPA knows each water system's type (CWS or NTNCWS); primary water source (surface water or groundwater); population served; CCT status (yes/no); ownership (public or private); and number of connections. The available LCR ***data*** limited EPA's ability to quantify uncertainty in the cost-benefit model. During the development of the model, it became clear that not only were many of the inputs uncertain, but for many LCR specific inputs, EPA only has limited midpoint, high, and low estimates available and does not have information on the relative likelihood of the available estimates. This includes major drivers of the cost of compliance including: The baseline number of systems with LSLs and the percent of connections in those system that are LSLs; the number of PWSs that will exceed the AL and/or TL under the revised tap sampling requirements; the cost of LSL replacement; the cost of CCT; and the effectiveness of CCT in PWSs with LSLs. Therefore, EPA estimated final LCRR compliance costs under low and high bracketing scenarios. These low and high cost scenarios are defined by the assignment of low and high values for the set of uncertain cost drivers listed above. Detailed descriptions of these five uncertain variables and the derivation of their values under the low and high cost scenarios can be found in Chapter 5, Section 5.2.4.2 of the final rule EA (USEPA, 2020a). With the exception of the five uncertain variables which define the difference between the low and high cost scenarios the remaining baseline water system and compliance characteristics are assigned to model PWSs, as described above, and remain constant across the scenarios. This allows EPA to define the uncertainty characterized in the cost range provided by the low and high scenarios and maintains consistency between the estimation of costs for the previous and final rules (e.g , percentage of lead tap water samples that will be invalidated). Chapters 4 and 5 of the final rule EA describe in greater detail the baseline and major cost driving ***data*** elements, their derivation, and the inherent sources of uncertainty in the developed ***data*** elements. Section 5.3 and 5.4 of the final rule EA discuss how each ***data*** element is used in the estimation of costs and provides examples and references to how these ***data*** were developed. Because PWS baseline characteristics are being assigned from distributional source ***data*** to capture the variability across PWS characteristics, EPA needed to ensure that its sample size was large enough that the results of the cost-benefit model were stable for each of the[[Page 4248]]36 PWS categories. To ensure stability in modeled results, EPA oversampled the SDWIS/Fed inventory to increase the number of water systems in each PWS category. For every PWS category, EPA set the target minimum number of model PWSs to 5,000. To calculate the total estimated costs for each PWS category, the model weights the estimated per water system costs so that when summed the total cost is appropriate for the actual number of water systems known to be in the category. The exception to the assignment of water system characteristics discussed above are the 21 very large water systems serving more than one million people. Because of the small number of water systems in this size category, the uniqueness of their system characteristics, and the potential large cost for these systems to comply with the regulatory requirements, using the methods described above to assign system attributes could result in substantial error in the estimation of the national costs. Therefore, EPA attempted to ***collect*** information on very large water systems' CCT practices and chemical doses, pH measurements and pH adjustment practices, number of LSLs, service populations, and average annual flow rates for each entry point to the distribution system. EPA gathered this information from publicly available ***data*** such as SDWIS/Fed facility-level ***data***, Consumer Confidence Reports, and water system websites. In addition, the AWWA provided additional ***data*** from member water systems to fill in gaps. When facility-specific ***data*** was available, EPA used it to estimate compliance costs for the very large water systems. If ***data*** was not available, EPA assigned baseline characteristics using the same process as previously described. See Chapter 5, Section 5.2.4.3 of the final rule EA for a summary of the ***data*** EPA ***collected*** on these very large systems (USEPA, 2020a). The cost model estimates the incremental cost of the LCR revisions over a 35-year period. In accordance with EPA's policy, and based on guidance from the Office of Management and Budget (OMB), when calculating social costs and benefits, EPA discounted future costs (and benefits) under two alternative social discount rates, 3 percent and 7 percent. When evaluating the economic impacts on PWSs and households, EPA uses the estimated PWS cost of capital to discount future costs, as this best represents the actual costs of compliance that water systems would incur over time. EPA used ***data*** from the 2006 Community Water System Survey (CWSS) to estimate the PWS cost of capital. EPA calculated the overall weighted average cost of capital (across all funding sources and loan periods) for each size/ownership category, weighted by the percentage of funding from each source. The cost of capital for each CWS size category and ownership type is shown in Exhibit B-3 in Appendix B of the final rule EA. Since similar cost of capital information is not available for NTNCWSs, EPA used the CWS cost of capital when calculating the annualized cost per NTNCWS. Total capital investment may be greater than costs water systems bear when complying with future regulatory revisions because financing support for lead reduction efforts is available from State and local governments, EPA programs, and other Federal agencies. The availability of funds from government sources, while potentially reducing the cost to individual PWSs, does not reduce the social cost of capital to society. See Chapters 4 and 5 of the final rule EA for a discussion of uncertainties in the cost estimates. EPA projects that rule implementation activities will begin immediately after rule promulgation. These activities will include one-time PWS and State costs for staff to read the revised rule, become familiar with its provisions, and develop training materials and train employees on the revised rule. States will also incur burden hours associated with adopting the rule into state requirements, updating their LCR program policies and practices, and modifying ***data*** management systems. PWSs will incur costs to comply with the LSL materials inventory requirements and develop an initial LSLR plan in years one through three of the 35-year analysis period. EPA expects that water systems will begin complying with all other LCRR rule requirements three years after promulgation, or in year four of the analysis. Some requirements of the final rule must be implemented by water systems regardless of their water quality and tap sampling results (e.g , CWS school and child care facilities sampling programs), however, most of the major cost drivers are a function of a water systems 90th percentile lead tap sample value. The 90th percentile value, if it exceeds the lead trigger level or action level, dictates: The tap sampling and water quality parameter (WQP) monitoring schedules, the installation/re-optimization of CCT, ``find-and-fix'' adjustments (triggered when a single lead tap sample exceeds 15 [mu]g/L, which has an increasing likelihood in the model as 90th percentile tap sample results increase) which include potential changes to CCT, the installation of point-of-use filters at water systems selecting this treatment option as part of the small water system flexibilities under the final rule, the goal-based or mandatory removal of LSLs and water system and state administrative costs. Because of uncertainty in the estimation of the 90th percentile lead values the Agency developed low and high estimates for this cost driving variable. EPA used both the minimum and maximum 90th percentile tap sample values from SDWIS/Fed over the period from 2007 to 2015, to assign a percentage of PWSs by size, and CCT and LSL status to each of three groups, those at the trigger level (TL) or below, those above the lead trigger but at or below the action level (AL), and those above the lead AL. These assignments represent the status of systems under the previous rule. See Chapters 4 and 5 of the final rule EA for additional information (USEPA, 2020a). Because the tap sampling requirements for LSL water systems under the final LCR revisions call for 100 percent of lead tap samples to be taken from sites with LSLs and for those samples to be fifth liter samples, representing the lead concentration from the LSL, the likelihood that a PWS would have a lead 90th percentile greater than the TL or AL is higher under the final rule compared to the previous LCR. In order to assess this higher likelihood of TL or AL exceedances under the LCRR tap sampling requirements EPA used information from Slabaugh et al. (2015) to develop adjustment factors to capture the impact of taking 100 percent of lead tap samples from sites with LSLs. To account for the fifth liter sampling requirement at LSL sites EPA used 2019 State of Michigan compliance sampling ***data*** that was received as part of the public comment process on the proposed rule. This dataset had paired first and fifth liter sampling ***data*** for 133 LSL systems (Michigan state law requires that both first and fifth liter samples be taken at LSL sites) that allowed the Agency to calculate a set of ratios representing the relationship between first and fifth liter lead 90th percentile values. EPA assigned the LSL systems to the three 90th percentile value groups, those without a TL or AL exceedance, those with a TL but not an AL exceedance, and those with an AL exceedance utilizing the adjustment factors derived from the Slabaugh et al. (2015) ***data*** and the calculated ratios from the Michigan dataset. The use of the Michigan ***data*** results in large numbers of systems being assigned to[[Page 4249]]the AL exceedance category for the low cost scenario and fewer systems being assigned to the AL exceedance category in the high cost scenario that would have occurred using the proposed rule assignment methodology. A detailed discussion of the development of the 90th percentile value initial group placement, the adjustments made for the LSL water systems given the tap sampling requirements, and the percentages of systems assigned to the 90th percentile value groups under both the previous and final LCRR for the low and high cost scenarios are found in Chapters 4 and 5 of the EA. Once water systems are assigned to the groupings based on their CCT and LSL status, individual 90th percentile lead tap sample values are assigned from the distribution of 90th percentile values within each grouping. Several regulatory compliance activities are assumed to not affect a water system's 90th percentile value. These include, for example, developing an inventory of LSLs, CWS sampling at schools and child care facilities, and public education. In the model, the only compliance activities that will change a water system's 90th percentile lead tap sample are installation of CCT; re-optimization of existing CCT; removal of LSLs; and a water system-wide ``find-and-fix'' activity (assumed to be equivalent to a system-wide increase in pH). In addition to these rule compliance activities, changing a water source or treatment technology can also result in a change in a water system's 90th percentile tap sample value. Because a water system's 90th percentile lead value is so important to determining regulatory requirements and cost under the rule revisions, the cost model, under both the low and high cost scenarios, tracks each water system's 90th percentile lead value over each annual time step in the model. Based on the initial 90th percentile lead values, a number of rule compliance actions are triggered. With the implementation of CCT, LSLR, and ``find-and-fix'' corrections, 90th percentile lead tap sample values are expected to decrease. The model allows for future increases in 90th percentile lead values as a result of changes in source water and treatment. The likelihood of these events occurring have been derived from SDWIS/Fed ***data*** (see Chapter 4, Section 4.3.8 of the final rule EA). When a change in source or treatment occurs in a modeled year, a new 90th percentile value is assigned to the water system. This value may be higher or lower than the current value thus potentially triggering new corrective actions. In the model, if a water system already has ``optimized'' CCT in place, it is assumed that no additional action is needed and that the current treatment is adequate, therefore the 90th percentile will not change.D. Cost Analysis This section summarizes the cost elements and estimates total cost of compliance for the previous LCR, the final LCR revisions and the incremental cost of the final rule, under both the low and high cost scenarios, by the major regulatory components and discounted at 3 and 7 percent. These components include implementation and administrative costs, sampling costs, CCT costs, LSL inventory and replacement costs, POU costs, and public education and outreach costs for water systems and states. Note that reporting costs are represented in the cost totals provided in the estimates below, but a separate summary of the reporting costs, as required by the Paperwork Reduction Act, can be found in section VII.C of this preamble. This section also quantifies the potential increase in phosphates that would result from the increased use of corrosion inhibitors under the rule, the resulting cost for treating to remove the additional phosphates at downstream waste water treatment plants that may be constrained by ***nutrient*** discharge limits, and discusses the ecological impacts that may result from increased phosphorus loads to surface waters.1. Drinking Water System Implementation and Administrative Costs All water systems will have one-time start-up activities associated with the implementation of the LCRR. These compliance costs include water system burden to read and understand the revised rule; water systems assigning personnel and resources for rule implementation; water system personnel time for attending trainings provided by the state; and clarifying regulatory requirements with the state during rule implementation. This category of cost is not impacted by the variables that define the low and high cost scenarios, therefore only one set of estimated costs exist in the category. The estimated annualized national PWS implementation and administrative costs for the LCR revisions are $2,576,000 at a 3 percent discount rate and $4,147,000 at a 7 percent discount rate. Since there are no costs in this category under the previous LCR, the PWS implementation and administrative incremental costs are also $2,576,000 at a 3 percent discount rate and $4,147,000 at a 7 percent discount rate. Additional information on the estimation of water system implementation and administrative costs can be found in Chapter 5, section 5.3.1 of the final rule EA (USEPA, 2020a).2. Sampling Costs The final LCR revisions affect most of the LCR's sampling requirements, including lead tap sample monitoring, lead WQP monitoring, copper WQP monitoring, and source water monitoring. The revised rule also includes new requirements for CWSs to sample at schools and child care facilities within their distribution systems. The copper tap sampling requirements of the previous rule are not impacted by the regulatory revisions and therefore do not appear in the summarized sampling costs. Additional lead WQP monitoring and lead tap sampling that is specifically required by the previous rule and the LCRR after the installation or re-optimization of corrosion control treatment is accounted for in the CCT costs and not in the WQP monitoring or tap sampling costs. Lead tap sampling site selection tiering requirements have been strengthened under the revised rule, increasing the cost to water systems with LSLs for the development of a tap sampling pool that consists of all LSL sites. Also, the sampling protocol requiring fifth liter samples from LSL sites will impact the cost of materials used to ***collect*** the tap sample at each LSL location. The other cost components of lead tap sampling remain generally unchanged and include sample ***collection*** (apart from fifth liter testing kit costs), analysis, and reporting cost. The frequency of required lead tap sampling will also increase based on lead tap sample 90th percentile values calculated with fifth liter tap samples. Both the lead and copper WQP monitoring cost totals represent ***collection*** and lab analysis cost of samples both at entry points to and taps within the distribution system, as well as PWS reporting costs. The schedules for conducting these activities at modeled water systems are dependent on a water system's projected lead 90th percentile value, the presence of CCT, and past tap sampling results. The final rule requires source water monitoring the first time a PWS has an action level exceedance. This monitoring is not required again unless the water system has a change in source water. Sampling at schools and child care facilities represents new requirements for CWSs under the LCR revisions.[[Page 4250]]Unlike the other sampling requirements of the rule, school and child care facility sampling is not affected by a water system's 90th percentile lead tap sample value. The final rule requires that all schools and child care facilities (constructed prior to January 1, 2014 or the date the state adopted standards that meet the definition of lead free in accordance with Section 1417 of the Safe Drinking Water Act, as amended by the Reduction of Lead in Drinking Water Act, whichever is earlier) must be sampled once every five years (schools and child care facilities may refuse the sampling or be non-responsive, but the water system must document this refusal or non-response to the state) for two consecutive rounds of sampling. After the initial sampling at all elementary school and child care facilities in their service area (over a five year period) CWSs are only required to provide sampling upon request from the school or child care facility. CWSs must conduct sampling at secondary schools at any time on request. This program's costs are presented with sampling cost, but they also represent public education costs of the LCRR. The costs of complying with the rule include water systems: (1) Identifying schools and child care facilities in their service area and preparing and distributing an initial letter explaining the sampling program and the 3Ts Toolkit, (2) coordinating with the school or child care facility to determine the sampling schedule and the logistics of ***collecting*** the samples, (3) conducting a walkthrough at the school or child care facility before the start of sampling, (4) sample ***collection*** from the school or child care facility, (5) sample analysis, and (6) providing sampling results to the school or child care facility, the state, and the local and/or state health department. Exhibit 6-3 and 6-4 show the national annualized sampling costs for both the low and high estimate scenarios, under the previous LCR, the final LCRR, and the incremental cost, discounted at 3 and 7 percent, respectively. Additional information on the estimation of sampling cost can be found in the Chapter 5, section 5.3.2 of the final rule EA (USEPA, 2020a). Exhibit 6-3--National Annualized Sampling Costs--All PWS at 3% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------Lead Tap Sampling Monitoring............................ $34,536,000 $46,775,000 $12,239,000 $36,604,000 $55,386,000 $18,782,000Lead Water Quality Parameters Monitoring................ 7,265,000 8,225,000 959,000 8,311,000 10,211,000 1,900,000Copper Water Quality Parameters Monitoring.............. 140,000 152,000 13,000 134,000 150,000 16,000Source Water Monitoring................................. 20,000 9,419 -11,000 50,000 31,000 -18,000School Sampling......................................... 0 12,582,000 12,582,000 0 12,960,000 12,960,000 ----------------------------------------------------------------------------------------------- Total Annual Sampling Costs......................... 41,962,000 67,744,000 25,782,000 45,099,000 78,739,000 33,641,000-------------------------------------------------------------------------------------------------------------------------------------------------------- Exhibit 6-4--National Annualized Sampling Costs--All PWS at 7% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------Lead Tap Sampling Monitoring............................ $33,746,000 $47,597,000 $13,851,000 $36,573,000 $58,566,000 $21,993,000Lead Water Quality Parameters Monitoring................ 6,986,000 7,980,000 995,000 8,397,000 10,683,000 2,286,000Copper Water Quality Parameters Monitoring.............. 133,000 145,000 12,000 128,000 143,000 15,000Source Water Monitoring................................. 25,000 13,000 -12,000 66,000 45,000 -20,000School Sampling......................................... 0 14,461,000 14,461,000 0 14,969,000 14,969,000 ----------------------------------------------------------------------------------------------- Total Annual Sampling Costs......................... 40,890,000 70,197,000 29,307,000 45,164,000 84,407,000 39,243,000--------------------------------------------------------------------------------------------------------------------------------------------------------3. Corrosion Control Treatment Costs Under the LCRR, drinking water systems are required to install CCT or re-optimize their existing CCT if their lead tap sample 90th percentile exceeds the trigger level or action level. A system may be required to perform a ``find-and-fix'' adjustment to their CCT based on their current level of CCT in place if an individual lead tap samples exceed 15 [mu]g/L. In the cost model, 90th percentile lead tap sample exceedances are initially determined using SDWIS/Fed historic ***data*** which is adjusted to account for sampling at 100 percent LSL sites in LSL systems and the fifth liter sampling methodology changes. In subsequent model periods a 90th percentile lead tap sample exceedance can be triggered by a change in water system source water or treatment. Small CWSs serving 10,000 or fewer people and all NTNCWSs may also elect to conduct LSLR or implement a POU program as part of the regulatory flexibilities in the LCRR. See section III.E of this preamble for additional information on the compliance alternatives available to small CWSs and NTNCWSs, and section VI.D.5 for a discussion of the modeling and a summary of the number of systems estimated to select each alternative compliance option. The capital and O&M costs for water systems installing or optimizing CCT are based on the assumption that water systems will install and operate CCT that achieves finished water characteristics of 3.2 mg/L of orthophosphate and pH at or above 7.2 (for water systems with starting pH values less than 8.4). For those water systems assigned higher initial pH values in the model, between 8.4 and 9.2, EPA assumed the CCT optimization would require adjusting pH to meet or exceed 9.2 (no orthophosphate addition would be needed). The distributions of water system starting values for orthophosphate and pH, used in the cost model, are both drawn from SDWIS/Fed and Six-Year Review Information ***Collection*** Request (ICR) dataset (see Chapter 4, section 4.3.6 of the final rule EA). All capital cost equations are a function of design flow, and all O&M costs are a function of average daily flow. Since CCT is conducted at the[[Page 4251]]water system's entry points (EPs), the cost model calculates the design flow and average daily flow of each EP. The cost model uses two different sets of unit cost functions representing the low and high capital cost scenarios developed in the engineering Work Breakdown Structure models for CCT (see EPA's report: Technologies and Costs for Corrosion Control to Reduce Lead in Drinking Water (USEPA, 2020b)). Using these bracketing capital cost values is designed to characterize uncertainty in the cost model estimates and when combined with O&M costs and EP flow values, are used to calculate the low and high CCT cost estimates per model PWS. Note that optimization O&M costs are obtained through an incremental cost assessment. The cost model calculated the O&M existing cost and subtracts them from the optimized O&M cost to obtain the incremental re-optimization costs. In the cost model, water systems are assumed to always install and optimize their CCT, to the standards described above, before making any adjustment to CCT as a result of being triggered into the ``find-and-fix'' requirements of the rule. Each time a model PWS has individual lead tap samples exceeding 15 [mu]g/L in a monitoring period, costs for follow-up lead tap and WQP sampling are applied. In the case of corrective actions, there are four stages implemented with each successive ``find-and-fix'' trigger. In the first period, where a tap sample is above 15 [mu]g/L, the model assumes there was a site specific sample issue and no water quality adjustments are needed. The second period having an exceedance results in the implementation of a spot flushing program to reduce water age in affected areas of the distribution system. With the third ``find-and-fix'' trigger, one of two things are assumed to occur at a single-entry point: A water system that has orthophosphate dosing and the pH target of 7.2 or greater will increase pH to 7.5, or a water system that previously optimized to a pH value of 9.2 will increase pH to 9.4 If ``find-and-fix'' is triggered for a fourth time, a water system is assumed to adjust all EPs to the new target pHs of 7.5 or 9.4, depending on the current treatment in place. Using O&M cost functions estimated for ``find-and-fix'' (see the Technologies and Costs for Corrosion Control to Reduce Lead in Drinking Water (USEPA, 2020b)), the cost model, when triggered into stage 3 and 4 CCT adjustment, first calculates the total annual O&M cost for treating to the ``find-and-fix'' standards previously listed as if no CCT was installed, then subtracts the PWS's current CCT annual O&M cost from the new ``find-and-fix'' annual O&M cost, to derive the share of the PWS's annual CCT O&M costs attributable to ``find-and-fix'' actions. The model also calculates the capital cost to retrofit the CCT water system for additional pH adjustment under both the low and high cost model scenarios. If a water system is triggered into a fourth round of ``find-and-fix'' CCT adjustment, the 7.5 or 9.4 pH requirements will be applied to all entry points. Individual entry point costs are summed to obtain total water system costs under the low and high model runs. In addition to the capital and O&M cost of CCT installation, re-optimization, or ``find-and-fix,'' water systems will also face several ancillary costs associated with changes in CCT status. Before the installation or re-optimization of CCT at a water system, a CCT study may need to be conducted or revised and the water system would need to consult with the state on the proposed changes to CCT (these costs also apply to water systems undergoing source water or treatment changes). After the change in CCT, a water system would conduct follow-up tap sampling and WQP monitoring at entry points and at taps in the distribution system, report the results of the initial post-CCT adjustment findings to the state, and review WQP ***data*** with the state on an ongoing basis as part of the water system's sanitary surveys. See the final rule EA Chapter 5, Section 5.3.3.3 for additional detail on these requirements (USEPA, 2020a). Exhibits 6-5 and 6-6 show the range of estimated national costs for CCT under the previous LCR, the LCR revisions, and the incremental cost, discounted at 3 and 7 percent, respectively. Note that a range of CCT capital costs are used in this assessment, but the total range in Exhibits 6-5 and 6-6 is impacted by all five of the uncertain variables which enter the model as low and high estimates. See Section VI.C of this preamble and Chapter 5, Section 5.2.4.2 of the final rule EA, for additional information on the variables that define the low and high cost scenarios. The CCT Operation and Maintenance (Existing) category in these exhibits are EPA's estimate of the ongoing cost of operating corrosion control at PWS where CCT was in place at the beginning of the period of analysis. Additional information on the estimation of CCT costs can be found in Chapter 5, section 5.3.3 of the final rule EA (USEPA, 2020a). Exhibit 6-5--National Annualized Corrosion Control Technology Costs--All PWS at 3% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------CCT Operations and Maintenance (Existing)............... $327,171,000 $327,171,000 $0 $327,490,000 $327,490,000 $0CCT Related Sanitary Survey and Source or Treatment 1,356,000 1,735,000 379,000 1,355,000 1,719,000 363,000 Change Notification Activities.........................CCT Installation........................................ 13,424,000 7,138,000 -6,286,000 41,261,000 19,392,000 -21,869,000CCT Installation Ancillary Activities................... 43,000 122,000 80,000 119,000 754,000 635,000CCT Re-Optimization (Due to ALE)........................ 2,479,000 6,575,000 4,096,000 15,374,000 33,425,000 18,051,000CCT Re-Optimization Ancillary Activities (Due to ALE)... 11,000 1,449,000 1,438,000 81,000 27,261,000 27,180,000CCT Re-Optimization (Due to TLE)........................ 0 5,452,000 5,452,000 0 20,724,000 20,724,000CCT Re-Optimization Ancillary Activities (Due to TLE)... 0 98,000 98,000 0 444,000 444,000Find and Fix Installation............................... 0 8,271,000 8,271,000 0 31,688,000 31,688,000Find and Fix Ancillary Activities....................... 0 5,884,000 5,884,000 0 8,190,000 8,190,000 ----------------------------------------------------------------------------------------------- Total Annual Corrosion Control Technology Costs..... 344,483,000 363,894,000 19,412,000 385,681,000 471,087,000 85,407,000--------------------------------------------------------------------------------------------------------------------------------------------------------[[Page 4252]] Exhibit 6-6--National Annualized Corrosion Control Technology Costs--All PWS at 7% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------CCT Operations and Maintenance (Existing)............... $306,521,000 $306,521,000 $0 $306,822,000 $306,822,000 $0CCT Related Sanitary Survey and Source or Treatment 1,293,000 1,662,000 368,000 1,293,000 1,641,000 348,000 Change Notification Activities.........................CCT Installation........................................ 12,499,000 6,623,000 -5,876,000 40,703,000 18,919,000 -21,783,000CCT Installation Ancillary Activities................... 57,000 168,000 111,000 160,000 1,034,000 875,000CCT Re-Optimization (Due to ALE)........................ 2,299,000 5,664,000 3,365,000 15,724,000 33,041,000 17,317,000CCT Re-Optimization Ancillary Activities (Due to ALE)... 15,000 1,913,000 1,898,000 107,000 35,996,000 35,888,000CCT Re-Optimization (Due to TLE)........................ 0 4,784,000 4,784,000 0 20,888,000 20,888,000CCT Re-Optimization Ancillary Activities (Due to TLE)... 0 140,000 140,000 0 633,000 633,000Find and Fix Installation............................... 0 6,986,000 6,986,000 0 29,911,000 29,911,000Find and Fix Ancillary Activities....................... 0 5,848,000 5,848,000 0 8,668,000 8,668,000 ----------------------------------------------------------------------------------------------- Total Annual Corrosion Control Technology Costs..... 322,684,000 340,307,000 17,623,000 364,809,000 457,554,000 92,745,000--------------------------------------------------------------------------------------------------------------------------------------------------------4. Lead Service Line Inventory and Replacement Costs The LCR revisions require all water systems to create an LSL materials inventory during the first three years after rule promulgation or demonstrate to the state and make publicly available the information that the water system does not have LSLs. Because many water systems have already complied with state inventory requirements (e.g , Michigan, see [*https://www.michigan.gov/documents/egle/egle-dwehd-PDSMISummaryData\_682673\_7.pdf*](https://www.michigan.gov/documents/egle/egle-dwehd-PDSMISummaryData_682673_7.pdf)) that are at least as stringent as those required under the LCRR, EPA adjusted the likelihood of conducting a new inventory to reflect state requirements. Water system inventory costs also reflect the development, by all water systems with LSLs, of an initial LSLR plan. The LSLR plan would include a strategy for determining the composition of ``lead status unknown'' service lines in its inventory, procedures to conduct full LSLR, a strategy for informing customers before a full or partial LSLR, a LSLR goal rate in the event of a lead trigger level exceedance for systems serving more than 10,000 persons, a procedure for customers to flush service lines and premise plumbing of particulate lead, a LSLR prioritization strategy, and a funding strategy for conducting LSLR. Depending on a water system's 90th percentile lead tap sample value, it may be required to initiate an LSLR program. Small CWSs, serving 10,000 or fewer persons, and NTNCWSs have flexibility in the selection of a compliance option if the trigger or action levels are exceeded. These water systems may elect to implement either the LSLR, CCT, or POU compliance options. See section III.E of this preamble for additional information on the compliance alternatives available to small CWSs and NTNCWSs. Under both the low and high cost scenarios, the model estimates the cost for implementing LSLR, CCT, and POU for each water system that meets the small water system flexibility criteria and maintains only the cost associated with the least costly option for each system. The cost model under both the low and high cost scenarios applies the estimated LSLR costs to those CWSs serving 10,000 or fewer persons and any NTNCWSs for which the LSLR option is determined to be the least cost compliance alternative. Systems where CCT or POU are found to be less costly compliance alternatives than LSLR do not receive LSLR costs in the model. See section VI.D.5 of this preamble for a discussion of the modeling and a summary of the number of systems selecting each alternative compliance option. Prompted by public comment on the proposed rule indicating that the Agency should utilize new LSLR unit cost ***data*** that has recently become available, EPA ***collected*** information from state and system websites, and media reports. The dataset provides costs estimates across full, customer-side, and system-side replacements from 38 systems that have publicly reported actual replacement costs from pilot studies and recent or on-going LSLR projects. This dataset, though more representative of current unit costs than the survey ***data*** used for the proposed rule analysis, still has a small number of observations and is an opportunity sample based on public availability of the information and was not ***collected*** using a systematic sampling technique that would allow for a statistical assessment of representativeness. The resultant estimates of replacement costs based on these ***data*** are uncertain. Therefore, EPA developed low- and high-end LSLR cost values that are used in the cost model to provide a low/high cost range to inform the understanding of uncertainty (note: Four other factors used to produce the low and high cost estimates also influence the LSLR total cost estimates). EPA uses the 25th and 75th percentile values from the new dataset to develop the low/high unit costs for utility-side, customer-side, and full LSLR. These values are larger than those used in the proposed rule analysis except for full replacement in the high cost scenario. See Chapter 5, Section 5.3.4.3 and Appendix A, Section 2 of the final rule EA (USEPA, 2020a) for more information on the development of the LSLR unit cost range. LSLR cost includes not only the physical replacement of the service line but also the development and distribution of LSLR program outreach materials; contacting customers and site visits to confirm service line material and site conditions before replacement; providing customers with flushing procedures following a replacement; delivering pitcher filters and cartridges concurrent with the LSLR, and maintenance for six months; ***collecting*** and analyzing a tap sample three to six months after the replacement of an LSL and informing the customer of the results; and, reporting program results to the state. Under the final rule, water systems with a 90th percentile lead tap sample value greater than 10 [mu]g/L and less than or equal to 15 [mu]g/L are considered to have a trigger level exceedance. These water systems are required to develop and implement a ``goal-based'' LSLR program where the annual replacement goal is set locally through a water system and state determination process. This program is required to operate for at least two annual monitoring periods after the system's lead 90th percentile tap sample has returned to levels at or below the trigger level. Ancillary costs[[Page 4253]]incurred by these water systems include the development and delivery of outreach materials to known and potential LSL households and submitting annual reports to the state on program activities. For water systems that do not meet the annual ``goal-based'' replacement rate, the final rule requires that additional outreach to LSL customers and other consumers be conducted. The additional outreach conducted is determined in conjunction with the state and is progressive, increasing when a water system misses an additional annual goal. The Final LCRR provides compliance flexibility to water systems with 90th percentile tap sample ***data*** that exceeds 15 [mu]g/L (the lead action level). These systems are required to implement a mandatory LSLR program replacing a rolling 2 year average of 3% per year using a baseline number of LSLs equal to the number of LSLs and galvanized requiring replacement service lines at the time the system first exceeds the lead trigger or action level plus the number of unknowns at the beginning of each year of the system's LSLR program. This rolling average allows systems that experience LSLR rate fluctuation to still meet a 3% replacement rate on average for the prior two year period every year the water system is required to implement the LSLR program. The regulation also requires that a cumulative number of replacements be reached equal to 3% of the sum of known lead, galvanized requiring replacement, and lead status unknown service lines in the initial inventory, times the number of years that elapsed between the system's first ALE and the date on which the system's 90th percentile lead levels are at or below the action level for 2 years (four consecutive 6-month monitoring periods). EPA does not have information on the annual variation in replacement rates which systems may experience when required to conduct mandatory replacement, therefore, the Agency has assumed an annual replacement rate of 3% (which equals a 3% rolling average value across all two year time periods). EPA's costs capture all estimated replacements required under the rule, but because the assumed 3% annual rate may not capture the year to year variation in LSL replacement rate. EPA's estimated discounted costs may be under or over estimated. The LCRR also requires that CWSs replace the water system-owned portion of an LSL in response to receiving notification that a customer-owned portion of an LSL was replaced at the customer's initiative. The Agency developed new ***data*** in response to comments received on the proposed rule which allowed for the estimation of this category of LSLR costs for the final rule. The inclusion of this new cost category will increase the estimated LSLR costs in the final rule analysis relative to the methodology used in the proposed rule analysis. EPA assumes that all customer initiated LSLRs that occur in systems with trigger level or action level exceedances count toward the goal-based and mandatory removal targets and costs for those programs. EPA estimated costs for customer initiated LSLR are based on only those replacements estimated to occur at systems that are at or below the trigger level. Exhibits 6-7 and 6-8 show the estimated annualized national cost for both the low and high cost scenarios, discounted at 3 and 7 percent, respectively, of water systems developing the LSL inventory, water systems conducting the goal-based and mandatory LSLR programs, costs to CWSs for removing their portion of an LSL after receiving notification that a customer-owned portion of an LSL was replaced outside of a water system replacement program and household removal costs for the customer-owned portion of the LSL under the previous LCR, the final LCRR, and the incremental cost. EPA did not estimate costs to households of replacing the customer-owned portion of an LSL outside of a goal-based or mandatory program because these replacements do not occur in response to these LCR revisions. Detailed information on the estimation of LSLR costs can be found in Chapter 5, section 5.3.4 of the final rule EA (USEPA, 2020a). Exhibit 6-7--National Annualized Lead Service Line Replacement Costs--All PWS at 3% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------Lead Service Line Inventory............................. $0 $6,318,000 $6,318,000 $0 $10,109,000 $10,109,000System Lead Service Line Replacement Plan............... 0 304,000 304,000 0 395,000 395,000System Lead Service Line Replacement (Mandatory)........ 600,000 15,550,000 14,950,000 26,777,000 62,417,000 35,641,000Lead Service Line Replacement Ancillary Activities 27,000 1,087,000 1,060,000 500,000 3,383,000 2,882,000 (Mandatory)............................................System Lead Service Line Replacement (Goal Based)....... 0 6,298,000 6,298,000 0 22,580,000 22,580,000Lead Service Line Replacement Ancillary Activities (Goal 0 755,000 755,000 0 1,524,000 1,524,000 Based).................................................Activities Triggered by Not Meeting Goal................ 0 6,087,000 6,087,000 0 19,663,000 19,663,000System Lead Service Line Replacement (Customer- 0 6,943,000 6,943,000 0 18,946,000 18,946,000 initiated).............................................System Lead Service Line Replacement Ancillary 0 1,030,000 1,030,000 0 1,224,000 1,224,000 Activities (Customer-initiated)........................ ----------------------------------------------------------------------------------------------- Total Annual PWS Lead Service Replacement Costs..... 628,000 44,372,000 43,744,000 27,277,000 140,242,000 112,965,000--------------------------------------------------------------------------------------------------------------------------------------------------------Household Lead Service Line Replacement (Mandatory)..... 182,000 0 -182,000 5,466,000 0 -5,466,000Household Lead Service Line Replacement (Goal based).... 0 8,100,000 8,100,000 0 19,542,000 19,542,000 ----------------------------------------------------------------------------------------------- Total Annual Lead Service Replacement Costs......... 810,000 52,472,000 51,662,000 32,743,000 159,784,000 127,041,000--------------------------------------------------------------------------------------------------------------------------------------------------------[[Page 4254]] Exhibit 6-8--National Annualized Lead Service Line Replacement Costs--All PWS at 7% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------Lead Service Line Inventory............................. $0 $6,863,000 $6,863,000 $0 $10,593,000 $10,593,000System Lead Service Line Replacement Plan............... 0 467,000 467,000 0 607,000 607,000System Lead Service Line Replacement (Mandatory)........ 638,000 16,681,000 16,044,000 37,623,000 79,869,000 42,246,000Lead Service Line Replacement Ancillary Activities 29,000 1,249,000 1,220,000 704,000 4,438,000 3,734,000 (Mandatory)............................................System Lead Service Line Replacement (Goal Based)....... 0 6,676,000 6,676,000 0 28,204,000 28,204,000Lead Service Line Replacement Ancillary Activities (Goal 0 824,000 824,000 0 1,956,000 1,956,000 Based).................................................Activities Triggered by Not Meeting Goal................ 0 6,636,000 6,636,000 0 25,589,000 25,589,000System Lead Service Line Replacement (Customer- 0 6,442,000 6,442,000 0 17,189,000 17,189,000 initiated).............................................System Lead Service Line Replacement Ancillary 0 965,000 965,000 0 1,118,000 1,118,000 Activities (Customer-initiated)........................ ----------------------------------------------------------------------------------------------- Total Annual PWS Lead Service Replacement Costs..... 667,000 46,803,000 46,136,000 38,327,000 169,562,000 131,235,000--------------------------------------------------------------------------------------------------------------------------------------------------------Household Lead Service Line Replacement (Mandatory)..... 193,000 0 -193,000 7,681,000 0 -7,681,000Household Lead Service Line Replacement (Goal based).... 0 8,587,000 8,587,000 0 24,409,000 24,409,000 ----------------------------------------------------------------------------------------------- Total Annual Lead Service Replacement Costs......... 860,000 55,389,000 54,529,000 46,008,000 193,971,000 147,963,000--------------------------------------------------------------------------------------------------------------------------------------------------------5. Point-of-Use Costs Under the final rule requirements, small CWSs, serving 10,000 or fewer persons, and NTNCWSs with a 90th percentile lead value above the action level of 15 [mu]g/L may choose between LSLR, CCT installation, or POU device installation and maintenance. See section III.E of this preamble for additional information on the compliance alternatives available to small CWSs and NTNCWSs. In addition to the cost to provide and maintain POU devices, water systems selecting the POU compliance option face additional ancillary costs in the form of: (1) POU implementation planning for installation, maintenance, and monitoring of the devices, (2) educating customers on the proper use of the POU device, (3) sampling POU devices to insure the device is working correctly, and (4) coordination with, obtaining approvals from, and annual reporting to the state. The cost model applies these POU costs to those CWS serving 10,000 or fewer persons and any NTNCWSs for which the POU option is estimated to be the least cost compliance alternative. The determination of the least cost compliance alternative is computed across each representative model PWS in the cost model based on its assigned characteristics including: The number of LSLs, cost of LSLR, the presence of corrosion control, the cost and effectiveness of CCT, the starting of WQP monitoring, the number of entry points, the unit cost of POU, and the number of households. For a more complete discussion on the assignment of system characteristics, see section VI.C of this preamble and Chapters 4 and 5 of the final rule EA. These characteristics are the primary drivers in determining the costs once a water system has been triggered into CCT installation or re-optimization, LSLR, or POU provisions. The model estimates the net present value for implementing each compliance alternative and selects the least cost alternative to retain in the summarized national rule costs. EPA estimated low and high cost scenarios, to characterize uncertainty in the cost model results. These scenarios are functions of assigning different low and high input values to a number of the variables that affect the relative cost of the small system compliance choices (see Chapter 5 section 5.2.4.2 of the final rule EA for additional information on uncertain variable value assignment). Therefore, as the model output shows, the choice of compliance technology is different across the low and high cost scenarios. Exhibits 6-9 and 6-10 show the total number of CWSs serving 10,000 or fewer persons and NTNCWSs, the total number of systems by type and population size that would select one of the small system compliance options, the number of NTNCWSs selecting each compliance alternative in the model, and the number of CWSs by population size selecting each compliance alternative in the model, under both the low and high cost scenarios. The POU device implementation seems to be the least cost alternative when the number of households in the system is low as demonstrated by the decrease in the selection of the POU option as CWS population size increases in the model. Given the centralized nature of CCT, requiring installation and maintenance only at the drinking water treatment plant, this compliance technology can benefit from economies of scale. Therefore, the installation of CCT becomes more cost effective as system population size increases. The pattern seen in the selection of LSLR between the low and high cost scenarios demonstrates that the choice of compliance by small systems is driven by relative costs. Under the low cost scenario larger percentages of systems select LSLR given the assumed lower numbers of LSLs per system and lower cost of replacement under this scenario. Exhibit 6-9--NTNCWS and Small CWS Counts Impacted Under Flexibility Option--Low Cost Scenario [Over 35 year period of analysis]-------------------------------------------------------------------------------------------------------------------------------------------------------- NTNCWS CWS ----------------------------------------------------------------------------------------------- All systems <=100 101-500 501-1,000 1,001-3,300 3,301-10,000--------------------------------------------------------------------------------------------------------------------------------------------------------Total PWS Count in System Size Category................. 17,589 12,046 15,307 5,396 8,035 4,974Total PWS Count of Systems with LSLR, POU, or CCT 714 641 910 314 418 257 activity...............................................[[Page 4255]] Number of PWSs with Lead Service Line Removals.......... 48 274 330 74 29 2Number of PWSs that Install CCT......................... 4 4.33 232 134 155 82Number of PWSs that Re-optimize CCT..................... 25 2 144 101 234 173Number of PWSs that Install POU......................... 637 361 205 4 1-------------------------------------------------------------------------------------------------------------------------------------------------------- Exhibit 6-10--NTNCWS and Small CWS Counts Impacted Under Flexibility Option--High Cost Scenario [Over 35 year period of analysis]-------------------------------------------------------------------------------------------------------------------------------------------------------- NTNCWS CWS ----------------------------------------------------------------------------------------------- All systems <=100 101-500 501-1,000 1,001-3,300 3,301-10,000--------------------------------------------------------------------------------------------------------------------------------------------------------Total PWS Count in System Size Category................. 17,589 12,046 15,307 5,396 8,035 4,974Total PWS Count of Systems with LSLR, POU, or CCT 1,407 1,362 2,029 877 1,475 894 activity...............................................Number of PWSs with Lead Service Line Removals.......... 56 59 40 8 50 10Number of PWSs that Install CCT......................... 7 1 346 284 349 178Number of PWSs that Re-optimize CCT..................... 21 20 381 542 1,072 704Number of PWSs that Install POU......................... 1,322 1,283 1,261 42 4 2-------------------------------------------------------------------------------------------------------------------------------------------------------- The estimated national annualized point-of-use device installation and maintenance costs for the final rule, under the low cost scenario, are $3,418,000 at a 3 percent discount rate and $3,308,000 at a 7 percent discount rate. The POU costs of the LCRR for the high cost scenario are $20,238,000 discounted at 3 percent and $19,928,000 discounted at 7 percent. Since POU costs are zero under the previous LCR, the incremental costs range from $3,418,000 to $20,238,000 at a 3 percent discount rate and from $3,308,000 to $19,928,000 at a 7 percent discount rate, under the low and high cost scenarios respectively. Additional information on the estimation of POU costs can be found in Chapter 5, section 5.3.5 of the final rule EA (USEPA, 2020a).6. Public Education and Outreach Costs In addition to the previous LCR public education requirements for water systems with a lead action level exceedance, the cost model includes final rule requirements for ongoing lead education that apply to all water systems and actions specifically for systems with LSLs, regardless of the 90th percentile level, and requirements in response to a single lead tap sample exceeding 15 [mu]g/L. The rule requires a number of updates to existing public education and additional outreach activities associated with LSLs. The public education requirements costed for all water systems, regardless of their lead 90th percentile tap sample levels, include: (1) Updating Consumer Confidence Report language, (2) developing a lead outreach plan and materials for new customers, (3) developing an approach for improved public access to lead information, (4) providing increased information on lead in drinking water to state and local health departments, and (5) providing annual documentation and certification to the state that public outreach on lead has been completed. The cost of LCR public education requirements applying to all water systems with LSLs are: (1) The planning, initially implementing and maintaining customer and public access to LSL location and tap sampling ***data*** information, and (2) the development of lead educational materials for water-related utility work and delivery of those materials to affected households during water-related work that could result in service line disturbance. The LCRR public education costs that are applied to water systems that exceed the 15 [mu]g/L action level include: (1) The development of lead language for public education in response to a lead action level exceedance, (2) delivery of education materials to customers for CWSs and posting of lead information for NTNCWSs, (3) water systems contacting public health agencies to obtain a list of additional community organizations that should receive public education materials, (4) water systems notifying public health agencies and other community organizations, (5) large water systems posting a lead notice on their website, (6) water system issuing a press release, (7) community water systems consulting with the state on the materials development and appropriate activities while the action level is exceeded, and (8) annually certifying public education activities have been completed. The rule also includes a requirement for water systems to notify affected customers as soon as practicable but no later than 3 days of becoming aware of an individual lead tap sample exceeding the 15 [mu]g/L. The model includes the development cost of the notification and education materials to be delivered to affected households and the incremental cost of expedited delivery of the notification. In developing this cost, EPA assumed systems would contact customers by phone and NTNCWSs would email and post sample results. Note that materials costs related to follow-up testing when a sample exceeds 15 [micro]g/L are included in the tap sampling costs in section VI.D.2 of this preamble. The estimated annualized national water system public education and outreach costs for the previous LCR range from $345,000 to $1,467,000 at a 3 percent discount rate under the low and high cost scenarios respectively. At a 7 percent discount rate, the annualized estimated previous rule PE cost range is from $471,000 to $2,016,000. Under the LCRR low cost scenario, the estimated impacts are $37,207,000 at a 3 percent discount rate and $36,555,000 at a 7 percent discount rate. Under the high scenario the estimated annualized costs are $45,461,000 at a 3 percent discount rate and $45,628,000 at a 7 percent discount rate. Therefore, the incremental estimated public education and outreach costs for water systems range from $36,861,000 to $43,994,000 at a 3 percent discount rate and $36,084,000 to $43,612,000 at a 7 percent discount[[Page 4256]]rate. See Chapter 5, section 5.3.6 of the final rule EA for additional detailed information on the estimation of public education and outreach costs (USEPA, 2020a).7. Annualized per Household Costs The cost model calculates the annualized cost per household, by first calculating the cost per gallon of water produced by the CWS. This cost per gallon represents the cost incurred by the system to comply with the requirements of the LCRR. This includes CCT cost, LSL inventory creation, system funded LSLR, tap sampling, public education, and administrative costs. Because of uncertainty in five important LCRR cost driver input variables, discussed in section VI.A of this preamble, the Agency developed low and high cost scenarios. These scenarios produce a range in the estimated cost per gallon and two estimates for annualized per household costs. The model multiplies this low and high scenario costs per gallon by the average annual household consumption (in gallons) to determine the cost per household per year associated with increased costs borne by the CWS. EPA then adds to both these values the low and high total consumer-side LSLR cost borne by households in the system, divided by the number of households served by the system, to derive the CWS's average annual household low and high scenario cost estimates. Exhibits 6-11 and 6-12 show the distributions of incremental annualized costs for CWS households by primary water source and size category. (Note that the percentiles represent the distribution of average household costs across CWSs in a category, not the distribution of costs across all households in a CWS category.) Some households that pay for a customer-side LSLR will bear a much greater annual household burden. EPA estimates the cost of removing the customer-owned side of a service line range from $2,514 to $3,929, with a central tendency of $3,559. The percentage of customers in each water system paying the higher customer-side LSL costs depends on the number of LSL in the water system, the rate of replacement, and the details of the water systems LSLR program. Exhibit 6-11--Annualized Incremental Cost per Household by Community Water System Category--Low Cost Scenario [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- 10th 25th 50th 75th 90th Funding Source water Size Percentile Percentile Percentile Percentile Percentile--------------------------------------------------------------------------------------------------------------------------------------------------------Private............... Ground................ Less than 100........... $5.36 $7.00 $11.32 $18.48 $26.40Private............... Ground................ 100 to 500.............. 1.45 2.32 4.03 5.85 9.92Private............... Ground................ 500 to 1,000............ 0.44 0.54 0.68 0.95 2.18Private............... Ground................ 1,000 to 3,300.......... 0.16 0.22 0.32 0.42 0.98Private............... Ground................ 3,300 to 10,000......... 0.25 0.31 0.45 0.64 1.96Private............... Ground................ 10,000 to 50,000........ 0.04 0.06 0.09 0.34 0.72Private............... Ground................ 50,000 to 100,000....... 0.05 0.06 0.10 0.31 0.34Private............... Ground................ 100,000 to 1,000,000.... 0.03 0.04 0.10 0.26 0.31Private............... Surface............... Less than 100........... 4.96 7.39 12.05 19.57 34.61Private............... Surface............... 100 to 500.............. 1.43 2.26 4.08 6.92 13.97Private............... Surface............... 500 to 1,000............ 0.40 0.51 0.78 1.68 3.49Private............... Surface............... 1,000 to 3,300.......... 0.16 0.21 0.35 0.77 1.16Private............... Surface............... 3,300 to 10,000......... 0.23 0.31 0.49 1.57 2.45Private............... Surface............... 10,000 to 50,000........ 0.04 0.06 0.36 0.64 2.23Private............... Surface............... 50,000 to 100,000....... 0.03 0.05 0.19 0.30 1.26Private............... Surface............... 100,000 to 1,000,000.... 0.02 0.05 0.19 0.27 0.97Private............... Surface............... Greater than 1,000,000.. 0.13 0.13 0.14 0.14 0.14Public................ Ground................ Less than 100........... 3.83 4.95 8.27 14.29 21.12Public................ Ground................ 100 to 500.............. 1.00 1.37 2.36 3.89 7.28Public................ Ground................ 500 to 1,000............ 0.32 0.39 0.51 0.93 1.95Public................ Ground................ 1,000 to 3,300.......... 0.12 0.16 0.24 0.37 0.86Public................ Ground................ 3,300 to 10,000......... 0.20 0.26 0.36 0.52 1.63Public................ Ground................ 10,000 to 50,000........ 0.03 0.05 0.07 0.42 0.57Public................ Ground................ 50,000 to 100,000....... 0.04 0.05 0.21 0.26 0.28Public................ Ground................ 100,000 to 1,000,000.... 0.03 0.05 0.09 0.22 0.27Public................ Ground................ Greater than 1,000,000.. 0.06 0.06 0.09 0.10 0.10Public................ Surface............... Less than 100........... 3.48 6.44 12.26 22.00 29.05Public................ Surface............... 100 to 500.............. 0.92 1.45 2.71 4.75 8.36Public................ Surface............... 500 to 1,000............ 0.31 0.39 0.60 1.28 2.65Public................ Surface............... 1,000 to 3,300.......... 0.12 0.16 0.26 0.57 0.97Public................ Surface............... 3,300 to 10,000......... 0.21 0.27 0.40 1.32 1.94Public................ Surface............... 10,000 to 50,000........ 0.04 0.06 0.14 0.57 2.22Public................ Surface............... 50,000 to 100,000....... 0.03 0.06 0.24 0.31 1.10Public................ Surface............... 100,000 to 1,000,000.... 0.03 0.06 0.18 0.28 0.40Public................ Surface............... Greater than 1,000,000.. 0.04 0.07 0.09 0.10 0.34-------------------------------------------------------------------------------------------------------------------------------------------------------- Exhibit 6-12--Annualized Incremental Cost per Household by Community Water System Category--High Cost Scenario [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- 10th 25th 50th 75th 90th Funding Source water Size Percentile Percentile Percentile Percentile Percentile--------------------------------------------------------------------------------------------------------------------------------------------------------Private............... Ground................ Less than 100........... $-10.82 $6.65 $10.86 $18.53 $30.58Private............... Ground................ 100 to 500.............. 1.28 2.31 4.31 6.81 17.50Private............... Ground................ 500 to 1,000............ 0.44 0.56 0.78 3.71 7.09Private............... Ground................ 1,000 to 3,300.......... 0.17 0.25 0.36 1.15 2.66Private............... Ground................ 3,300 to 10,000......... 0.24 0.33 0.52 2.44 5.85Private............... Ground................ 10,000 to 50,000........ 0.05 0.07 0.10 0.49 1.45Private............... Ground................ 50,000 to 100,000....... 0.05 0.06 0.08 0.35 1.42[[Page 4257]] Private............... Ground................ 100,000 to 1,000,000.... 0.04 0.08 0.36 0.64 4.51Private............... Surface............... Less than 100........... 3.72 6.49 15.93 30.31 69.90Private............... Surface............... 100 to 500.............. 1.17 2.25 6.70 13.09 44.49Private............... Surface............... 500 to 1,000............ 0.37 0.61 3.15 4.78 19.00Private............... Surface............... 1,000 to 3,300.......... 0.15 0.26 1.01 2.38 7.74Private............... Surface............... 3,300 to 10,000......... 0.17 0.37 1.96 3.35 9.98Private............... Surface............... 10,000 to 50,000........ 0.05 0.08 0.40 1.13 5.70Private............... Surface............... 50,000 to 100,000....... 0.03 0.05 0.13 0.39 2.54Private............... Surface............... 100,000 to 1,000,000.... 0.03 0.09 0.36 0.95 4.36Private............... Surface............... Greater than 1,000,000.. 0.16 0.16 0.16 0.16 0.17Public................ Ground................ Less than 100........... -5.87 4.63 7.76 15.88 27.31Public................ Ground................ 100 to 500.............. 0.96 1.41 2.65 6.26 14.49Public................ Ground................ 500 to 1,000............ 0.32 0.41 0.62 3.17 7.14Public................ Ground................ 1,000 to 3,300.......... 0.12 0.17 0.29 1.04 3.33Public................ Ground................ 3,300 to 10,000......... 0.20 0.27 0.41 1.88 4.83Public................ Ground................ 10,000 to 50,000........ 0.04 0.06 0.08 0.40 1.60Public................ Ground................ 50,000 to 100,000....... 0.04 0.05 0.19 0.30 2.24Public................ Ground................ 100,000 to 1,000,000.... 0.04 0.06 0.30 0.44 3.97Public................ Ground................ Greater than 1,000,000.. 0.08 0.08 0.10 0.10 0.10Public................ Surface............... Less than 100........... 3.30 5.45 13.70 29.79 62.64Public................ Surface............... 100 to 500.............. 0.90 1.47 4.85 10.08 34.08Public................ Surface............... 500 to 1,000............ 0.30 0.44 2.61 3.98 13.98Public................ Surface............... 1,000 to 3,300.......... 0.12 0.20 0.83 1.63 5.51Public................ Surface............... 3,300 to 10,000......... 0.21 0.33 1.66 2.64 8.76Public................ Surface............... 10,000 to 50,000........ 0.05 0.07 0.38 1.08 5.11Public................ Surface............... 50,000 to 100,000....... 0.04 0.06 0.25 0.37 2.85Public................ Surface............... 100,000 to 1,000,000.... 0.04 0.08 0.37 0.97 4.42Public................ Surface............... Greater than 1,000,000.. 0.04 0.08 0.09 0.12 0.61--------------------------------------------------------------------------------------------------------------------------------------------------------8. Primacy Agency Costs For each of the drinking water cost sections previously described, primacy agencies (i.e , states) have associated costs. The first of these groupings is implementation and administrative costs which are associated with rule adoption, program development, coordinating with the EPA, modification of ***data*** systems and ***data*** entry, training for both state and PWS employees, and on-going technical assistance to systems. The next burden category specifically for states is the sampling related costs resulting from the review of sampling plans, communications materials, ***collected*** lead tap, water quality parameter, source water, and school and child care monitoring ***data***/reports, and waiver and sample invalidation requests. CCT costs accruing to states come from consultations on and review of the selection process (including CCT studies) and installation or re-optimization of corrosion control technologies, the setting of optimal water quality parameters, and the consultation and review of actions taken in response to source water, treatment changes, and ``find-and-fix'' sample results. Other major drivers of state cost are the LSLR inventory and replacement activities. States assist systems in the development of their LSL inventories, review the completed inventories, LSLR plans and outreach materials, approve the goal-based replacement rate for a trigger level exceedance and determine additional activities for PWSs not meeting this goal-based rate, and annually review LSLR program reports and updates to the inventory. States review, consult, and approve CCT re-optimization when a PWS with CCT in place has a trigger level exceedance. States also review, consult, and approve the action level exceedance compliance approach that small CWSs serving 10,000 or fewer persons and NTNCWSs submit when the system exceeds the trigger level. The compliance choice set for these systems includes CCT installation or re-optimization, LSLR, or POU device installation. Costs incurred by states for CCT and LSLR are discussed above. For POU programs, state burden results from reviewing the POU implementation plan, outreach materials, annual tap site sampling plans, results, and certifications for customer notification, and annual required program reports. The final category of state costs assessed in the EPA model are those associated with the final rule's public education requirements. States must review new required CCR changes, outreach material to health departments, and PE materials for disturbances of lead service lines for CWSs with LSLs, galvanized requiring replacement, and service lines of unknown material. In the case of systems that exceed the lead action level the state must also review revisions to lead language in the tier-one public notification and consult on the other PE activities a system must conduct in response to the exceedance. States will also review the annual public education certification submissions from systems. In EPA's cost model, the majority of the costs associated with states are determined on a per water system basis. State actions and costs are largely driven by the rule required actions that are triggered for the individual water systems. The exception to this rule is the implementation and administrative costs which are tallied on a per primacy agency basis. Unit cost values for the final LCRR were updated based on burden information from the Association of State Drinking Water Administrators' Costs of States Transactions Study (CoSTS) model (ASDWA, 2020). These updated unit cost values are substantially higher that those used in the proposed rule analysis. The per water system costs and per primacy agency costs are summed to obtain aggregate costs for this category. The cost model estimates that primacy agencies will incur incremental estimated annualized costs, under the low cost scenario, totaling $19,707,000 at a 3 percent discount rate and $20,876,000 at a 7 percent discount rate. For the high cost scenario total estimated incremental cost is[[Page 4258]]$20,756,000 at a 3 percent discount rate and $22,216,000 at a 7 percent discount rate. Additional information on the estimation of primacy agency costs can be found in Chapter 5, section 5.4 of the final rule EA (USEPA, 2020a).9. Costs and Ecological Impacts Associated With Additional Phosphate Usage Adding orthophosphate creates a protective inner coating on pipes that can inhibit lead leaching. However, once phosphate is added to the public water system (PWS), some of this incremental loading remains in the water stream as it flows into wastewater treatment plants (WWTPs) downstream. This generates treatment costs for certain WWTPs. In addition, at those locations where treatment does not occur, water with elevated phosphorus concentrations may discharge to water bodies and induce certain ecological impacts. To estimate the potential fate of the orthophosphate added at PWSs, EPA developed a conceptual mass balance model. EPA applied this conceptual model to estimate the increase in loading at WWTPs, given an initial loading from corrosion control at water treatment plants. WWTPs could incur costs because of upstream orthophosphate addition if they have permit discharge limits for phosphorus parameters. The percentage of WWTPs with phosphorus limits has increased over time. From 2007 to 2016, in annual percentage rate terms, the growth rate in the percentage of WWTPs with phosphorus limits is 3.3 percent (see Chapter 5, Section 5.5.1 of the Final Rule EA). EPA assumed this increase would continue as states transition from narrative to numerical ***nutrient*** criteria and set numeric permits limits, especially for impaired waters. EPA applied the growth rate observed from 2007 to 2016 to estimate the anticipated percentage of WWTPs with phosphorus limits in future years. This growth rate results in an estimated 41 percent of WWTPs with phosphorus discharge limits after 35 years. Applied as the percentage of WWTPs that need to take treatment actions, this estimate is likely conservative, particularly given the potential availability of alternative compliance mechanisms, such as, individual facility variance and ***nutrient*** trading programs. The specific actions a WWTP might need to take, if any, to maintain compliance with a National Pollution Discharge Elimination System (NPDES) phosphorus limit will depend on the type of treatment present at the WWTP and the corresponding phosphorus removal provided. Based on a review of NPDES ***data***, it is likely that most of the WWTPs that already have phosphorus limits have some type of treatment to achieve the limit. Some treatment processes can accommodate incremental increases in influent loading and still maintain their removal efficiency. Such processes might not need significant adjustment to maintain their existing phosphorus removal efficiency, given an incremental increase. Other treatment processes may need modifications to their design or operation to maintain their removal efficiency in the face of an influent loading increase. EPA derived a unit cost of $4.59 per pound for removing incremental phosphorus (see Chapter 5, section 5.5.1 of the final rule EA for additional information). This unit cost includes the cost of additional chemical consumption and the operating cost of additional sludge processing and disposal. The costs a WWTP could incur depend on the magnitude of the loading increase relative to the specific WWTP's effluent permit limit. WWTPs, whose current discharge concentrations are closer to their limit, are more likely to have to act. WWTPs whose current concentrations are well below their limit may not incur costs but might, under certain conditions, incur costs (for example, when phosphorus removal achieved by technology is sensitive to incremental phosphorus loading increases). Furthermore, future phosphorus limits could be more stringent than existing limits in certain watersheds. Therefore, EPA conservatively assumed that any WWTP with a discharge limit for phosphorus parameters could incur costs. Accordingly, in calculating costs, EPA used the anticipated percentage of WWTPs with phosphorus discharge limits as the likelihood that incremental orthophosphate loading from a drinking water system would reach a WWTP with a limit. EPA combined this likelihood and the unit cost (previously estimated) with incremental phosphorus loading to calculate incremental costs to WWTPs for each year of the analysis period. The incremental annualized cost that WWTPs would incur to remove additional phosphorous associated with the LCRR, under the low cost scenario, ranges from $1,152,000 to $1,458,000 at a 3 and 7 percent discount rate, respectively. The high cost scenario produced an incremental estimated impact of $1,828,000 using a 3 percent discount rate, and $2,607,000 at a 7 percent discount rate. EPA estimates that WWTP treatment reduces phosphorus loads reaching water bodies by 59 percent but they are not eliminated. The rule's national-level total incremental phosphorus loads reaching water bodies are projected to grow over the period of analysis from the low/high scenario range of 161,000 to 548,000 pounds fifteen years after promulgation to the low/high scenario range of 355,000 to 722,000 pounds at year 35. See Chapter 5, section 5.5.2 of the final rule EA for information on how loading estimates are calculated. The ecological impacts of these increased phosphorous loadings are highly localized: Total incremental phosphorus loadings will depend on the amount and timing of the releases, characteristics of the receiving water body, effluent discharge rate, existing total phosphorus levels, and weather and climate conditions. Detailed spatially explicit information on effluents and on receiving water bodies does not exist in a form suitable for this analysis. Rather, to evaluate the potential ecological impacts of the rule, EPA evaluated the significance of the national-level phosphorus loadings compared to other phosphorous sources in the terrestrial ecosystem. To put these phosphorus loadings in context, estimates from the U.S Geological Survey (USGS) Spatially Referenced Regression On Watershed Attributes (SPARROW) model suggest that anthropogenic sources deposit roughly 750 million pounds of total phosphorus per year (USEPA, 2019b). The total phosphorus loadings from the LCRR high cost scenario would contribute about 1 percent (7 million/750 million) of total phosphorus entering receiving waterbodies in a given year, and the incremental amount of total phosphorus associated with the LCRR relative to the previous LCR grows only 0.1 percent (722,000/750 million). At the national level, EPA expects total phosphorus entering waterbodies as a result of the final LCR revisions to be small, relative to the total phosphorus load deposited annually from all other sources. National average load impacts may obscure localized ecological impacts in some circumstances, but the existing ***data*** do not allow an assessment as to whether this incremental load will induce ecological impacts in particular areas. It is possible, however, that localized impacts may occur in certain water bodies without restrictions on phosphate influents, or in locations with existing elevated phosphate levels. An increase in phosphorus loadings can lead to economic impacts and undesirable aesthetic impacts. Excess[[Page 4259]]***nutrient*** pollution can cause eutrophication--excessive plant and algae growth--in lakes, reservoirs, streams, and estuaries throughout the United States. Eutrophication, by inducing primary production, leads to seasonal decomposition of additional biomass, consuming oxygen and creating a state of hypoxia, or low oxygen, within the water body. In extreme cases, the low to no oxygen states can create dead zones, or areas in the water where aquatic life cannot survive. Studies indicate that eutrophication can decrease aquatic diversity for this reason (e.g , Dodds et al. 2009). Eutrophication may also stimulate the growth of harmful algal blooms (HABs), or over-abundant algae populations. Algal blooms can harm the aquatic ecosystem by blocking sunlight and creating diurnal swings in oxygen levels because of overnight respiration. Such conditions can starve and deplete aquatic species.10. Summary of Rule Costs The estimated annualized low and high scenario costs, discounted at 3 percent and 7 percent, that PWSs, households, and primacy agencies will incur in complying with the previous LCR, the LCRR, and incrementally are summarized in Exhibits 6-13 and 6-14. The total estimated incremental annualized cost of the LCRR range from $161 to $335 million at a 3 percent discount rate, and $167 to $372 million at a 7 percent discount rate in 2016 dollars. The exhibits also detail the proportion of the annualized costs attributable to each rule component. Exhibit 6-13--National Annualized Rule Costs--All PWS at 3% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate PWS annual costs ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------Sampling................................................ $41,962,000 $67,744,000 $25,782,000 $45,099,000 $78,739,000 $33,641,000PWS Lead Service Line Replacement....................... 628,000 44,372,000 43,744,000 27,277,000 140,242,000 112,965,000Corrosion Control Technology............................ 344,483,000 363,894,000 19,412,000 385,681,000 471,087,000 85,407,000Point-of Use Installation and Maintenance............... 0 3,418,000 3,418,000 0 20,238,000 20,238,000Public Education and Outreach........................... 345,000 37,207,000 36,861,000 1,467,000 45,461,000 43,994,000Rule Implementation and Administration.................. 0 2,576,000 2,576,000 0 2,576,000 2,576,000 ----------------------------------------------------------------------------------------------- Total Annual PWS Costs.............................. 387,417,000 519,210,000 131,792,000 459,523,000 758,343,000 298,820,000--------------------------------------------------------------------------------------------------------------------------------------------------------State Rule Implementation and Administration............ 6,145,000 25,852,000 19,707,000 7,137,000 27,893,000 20,756,000Household Lead Service Line Replacement................. 182,000 8,100,000 7,918,000 5,466,000 19,542,000 14,076,000Wastewater Treatment Plant Costs........................ 161,000 1,313,000 1,152,000 695,000 2,523,000 1,828,000 ----------------------------------------------------------------------------------------------- Total Annual Rule Costs............................. 393,904,000 554,475,000 160,571,000 472,821,000 808,301,000 335,481,000-------------------------------------------------------------------------------------------------------------------------------------------------------- Exhibit 6-14--National Annualized Rule Costs--All PWS at 7% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate PWS annual costs ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------Sampling................................................ $40,890,000 $70,197,000 $29,307,000 $45,164,000 $84,407,000 $39,243,000PWS Lead Service Line Replacement....................... 667,000 46,803,000 46,136,000 38,327,000 169,562,000 131,235,000Corrosion Control Technology............................ 322,684,000 340,307,000 17,623,000 364,809,000 457,554,000 92,745,000Point-of Use Installation and Maintenance............... 0 3,308,000 3,308,000 0 19,928,000 19,928,000Public Education and Outreach........................... 471,000 36,555,000 36,084,000 2,016,000 45,628,000 43,612,000Rule Implementation and Administration.................. 0 4,147,000 4,147,000 0 4,147,000 4,147,000 ----------------------------------------------------------------------------------------------- Total Annual PWS Costs.............................. 364,711,000 501,316,000 136,605,000 450,316,000 781,224,000 330,908,000--------------------------------------------------------------------------------------------------------------------------------------------------------State Rule Implementation and Administration............ 6,073,000 26,949,000 20,876,000 7,429,000 29,645,000 22,216,000Household Lead Service Line Replacement................. 193,000 8,587,000 8,393,000 7,681,000 24,409,000 16,728,000Wastewater Treatment Plant Costs........................ 211,000 1,669,000 1,458,000 1,097,000 3,705,000 2,607,000 ----------------------------------------------------------------------------------------------- Total Annual Rule Costs............................. 371,188,000 538,521,000 167,333,000 466,523,000 838,983,000 372,460,000--------------------------------------------------------------------------------------------------------------------------------------------------------E. Benefits Analysis The final LCRR is expected to result in significant health benefits, since both lead and copper are associated with adverse health effects. Lead is a highly toxic pollutant that can damage neurological, cardiovascular, immunological, developmental, and other major body systems. EPA is particularly concerned about ongoing exposure experienced by children because lead can affect brain development. Additionally, children through their physiology and water ingestion requirements may be at higher risk. Research shows that, on average, formula-fed infants and young children consume more drinking water per day on a body weight basis than adolescents. Using the USDA Continuing Survey of Food Intakes by Individuals (CSFII) ***data***, Kahn and Stralka (2009) demonstrated this trend, is most pronounced in children under 1 year of age who drink more than double older children and adults per kg of body weight. Additionally, children absorb 2-4 times more lead than adults through the gastrointestinal tract ((Mushak, 1991, WHO, 2011, and Ziegler et al., 1978). No safe level of lead exposure has been identified (USEPA, 2013). EPA's health risk reduction and benefits assessment of the LCR revisions concentrates on quantification and monetization of the estimated impact of reductions in lead exposure on childhood IQ. As explained in Appendix D of the final rule Economic[[Page 4260]]Analysis (USEPA 2020a), there are additional non-quantified lead health impacts to both children and adults that will be realized as a result of this rulemaking. Although copper is an essential element for health, excess intake of copper has been associated with several adverse health effects. Most commonly, excess exposure to copper results in gastrointestinal symptoms such as nausea, vomiting, and diarrhea (National Research Council, 2000). In susceptible populations, such as children with genetic disorders or predispositions to accumulate copper, chronic exposure to excess copper can result in liver toxicity. Because household level ***data*** on the change in copper concentrations that result from changes in CCT are not available, this analysis does not quantify any potential benefits from reduced copper exposure that may result from the rule. See Appendix E in the final rule EA for additional copper health impact information. To quantify the potential impact to exposed populations of changes in lead tap water concentrations as a result of the LCR revisions, EPA: Utilized sample ***data*** from 15 cities representing 14 water systems from across the United States and Canada to estimate potential household lead tap water concentrations under various levels of corrosion control treatment, LSLR, and implementation of POU devices; Modeled exposure using the lead tap water concentration ***data*** estimated from the 15 city sampling ***data***, information on peoples' water consumption activities, and background lead levels from other potential pathways; Derived the potential change in BLLs that result from the changes in drinking water lead exposure; Used concentration response functions, from the scientific literature, to quantify estimated changes in IQ for children given shifts in BLLs; Estimated the unit value of a change in childhood IQ; and Applied the unit values to the appropriate demographic groups experiencing changes in lead tap water concentrations as a result of the regulatory changes across the period of analysis. Subsections VI.E.1 through 4 of this preamble outline the estimation of lead concentration values in drinking water used to estimate before and after rule revision implementation concentration scenarios, the corresponding estimated avoided IQ loss in children, and a summary of the monetized benefits of the LCRR.1. Modeled Drinking Water Lead Concentrations EPA determined the lead concentrations in drinking water at residential locations through the ***collection*** and analysis of consecutive sampling ***data*** representing homes pre and post removal of LSLs, including partial removal of LSLs, under differing levels of water system corrosion control treatment. The ***data*** was ***collected*** from multiple sources including water systems, EPA Regional Offices and the Office of Research and Development, and authors of published journal articles (Deshommes et al., 2016). This ***data*** includes lead concentrations and information regarding LSL status, location, and date of sample ***collection***, representing 18,039 samples ***collected*** from 1,638 homes in 15 cities representing 14 city water systems across the United States and Canada. EPA grouped the samples into LSL status categories (``LSL,'' ``Partial,'' ``No LSL''). Samples were also grouped by CCT treatment, assigning status as having ``None,'' ``Partial,'' or ``Representative.'' ``Partial'' includes those water systems with some pH adjustment and lower doses of a phosphate corrosion inhibitor, but this treatment is not optimized. ``Representative'' are those water systems in the dataset that have higher doses of phosphate inhibitors, which in the model are considered optimized (see the final rule EA Chapter 6, section 6.2.1 for additional detail and docket number EPA-HQ-OW-2017-0300 for the ***data***). In response to comments received by the Agency, the city assignments to CCT groupings were updated between the proposed and final rules. EPA reviewed the CCT designations made in the dataset and changed the designations for Halifax, Cincinnati before 2006, and Providence/Cranston. EPA fit several regression models (see the final rule EA Chapter 6, section 6.2.2 for additional detail) of tap water lead concentration as predicted by LSL presence (``LSL'' or ``No LSL''), LSL extent (``Partial''), CCT status, and ``profile liter.'' Profile liter is the cumulative volume a sample represented within a consecutive sampling series at a single location and time. Models to describe the profile liter accounted for the variation among sampling events, sampling sites, and city. The water lead concentrations exhibited a right-skewed distribution; therefore, the variable was log-transformed to provide a better modeled fit of the ***data***. EPA selected one of the regression models based on its fit and parsimony and used it to produce simulated lead concentrations for use in the benefits analysis (Exhibit 6-8, in Chapter 6 of the final rule EA). The selected model suggests that besides water system, residence, and sampling event, the largest effects on lead concentration in tap water come from the presence of LSLs and the number of liters drawn since the last stagnation period. CCT produces smaller effects on lead concentration than LSLs, and these effects are larger in homes with LSLs. To statistically control for some sources of variability in the input ***data***, EPA did not use summary ***statistics*** from the original ***data*** directly in estimating the effects of LSL and CCT status. Instead, EPA produced simulated mean lead concentrations for 500,000 samples, summarized in Exhibit 6-15, based on the selected regression model. The simulations were performed on the log-scale to conform to the fitted model (which used a log-transformed water lead concentration variable) and converted to the original scale to produce geometric means and geometric standard-deviations. Geometric means are more representative of the central tendency of a right-skewed distribution than are arithmetic means and prevent overestimation of the impact of water lead levels on estimated blood lead levels and resulting IQ and benefits values. The simulated sample concentrations represent estimates for new cities, sites, and sampling events not included in the original dataset. These simulations rely on estimates of variability and uncertainty from the regression model and given information on LSL and CCT status. Individual estimates are best thought of as the central tendency for a lead tap sample concentration given regression model parameters and estimated variance. The simulated samples represent, on average, the lead concentrations taken after a short flushing period of roughly 30 seconds for all combinations of LSL and CCT status. This represents a point near the average peak lead concentration for homes with full or partial LSLs, and a point slightly below the peak lead concentration for homes with no LSLs, regardless of CCT status. EPA estimates that improving CCT will produce significant reductions in lead tap water concentration overall. However, for full LSLRs, the final model produced predictions of drinking water concentrations that overlapped almost completely for all CCT conditions. Therefore, EPA used the pooled estimate of predicted drinking water concentrations for all CCT conditions in residences with no LSL in place for the[[Page 4261]]main analysis in Chapter 6 of the final rule EA. Because small CWSs, that serve 10,000 or fewer persons, have flexibility in the compliance option they select in response to a lead action level exceedance, some CWSs are modeled as installing POU devices at all residences. See section III.E of this preamble for additional information on the compliance alternatives available to small CWSs. For individuals in these systems, EPA assumed, in the analysis, that consumers in households with POU devices are exposed to the same lead concentration as residents with ``No LSL'' and ``Representative'' CCT in place. Note that the simulated concentrations for the final rule analysis, in Exhibit 6-15, have increased lead concentrations for the ``no-LSL'' scenarios and lower lead concentrations for the cases where full and partial LSLs are present and there is no or partial CCT present as compared to the estimated values used in the proposed rule analysis. These changes from the proposal will result in lower estimated changes in BLLs for both children and adults as a result of LSLR and improvements in CCT. Estimated IQ benefit for children will also decrease for a change in treatment of LSLR as compared to the proposed rule values. Exhibit 6-15--LSL and CCT Scenarios and Simulated Geometric Mean Tap Water Lead Concentrations and Standard Deviations at the Fifth Liter Drawn After Stagnation for Each Combination of LSL and CCT Status---------------------------------------------------------------------------------------------------------------- Simulated Simulated SD Simulated mean of log \a\ of log geometric Simulated LSL status CCT status lead lead mean lead geometric SD ([micro]g/L) ([micro]g/L) ([micro]g/L) \a\ of lead----------------------------------------------------------------------------------------------------------------LSL........................... None............ 2.89 1.33 18.08 3.78Partial....................... None............ 2.13 1.33 8.43 3.77No LSL........................ None............ \b\-0.19 \b\ 1.35 \b\ 0.82 \b\ 3.86LSL........................... Partial......... 2.29 1.33 9.92 3.78Partial....................... Partial......... 1.55 1.32 4.72 3.75No LSL........................ Partial......... \b\-0.19 \b\ 1.35 \b\ 0.82 \b\ 3.86LSL........................... Representative.. 1.70 1.33 5.48 3.77Partial....................... Representative.. 0.97 1.32 2.64 3.76No LSL........................ Representative.. \b\-0.19 \b\ 1.35 \b\ 0.82 \b\ 3.86----------------------------------------------------------------------------------------------------------------\a\ Standard deviations reflect ``among-sampling event'' variability.\b\ Bolded values show how simulated results were pooled to produce a common estimate for homes with no LSL across CCT conditions. In the estimation of the costs and benefits of the LCR revisions, each modeled person within a water system is assigned to one of the estimated drinking water concentrations in Exhibit 6-15, depending on CCT, POU, and LSL status. EPA estimated benefits under both the low cost and high cost scenarios used in the LCRR analysis to characterize uncertainty in the cost estimates.The low cost scenario and high cost scenario differ in their assumptions made about: (1) The existing number of LSLs in PWSs; (2) the number of PWS above the AL or TL under the previous and final rule monitoring requirements; (3) the cost of installing and/or re-optimizing corrosion control treatment (CCT);(4) the effectiveness of CCT in mitigating lead concentrations; and (5) the cost of LSLR (Section VI.C above and Chapter 5, section 5.2.4.2 of the final rule EA (USEPA, 2020a)). EPA predicted the status of each system under the low and high scenarios at baseline (prior to rule implementation) and in each year of rule implementation. Depending on the timing of required actions that can change CCT, POU, and LSL status under both the baseline and LCRR low and high scenario model runs, changes in lead concentration and resultant blood lead are predicted every year for the total population served by the systems for the 35-year period of analysis. In the primary benefits analysis for the final rule, improvements to CCT and the use of installed POU devices are only predicted for individuals in households with LSLs prior to implementation of the LCRR requirements (consistent with discussion above about the limits of the ***data*** for predicting the impact of CCT when LSL are not present). In the model, LSL removals are predicted by water system, by year, and multiplied by the average number of persons per household (across demographic categories) to determine the number of people shifting from one LSL status to another. To predict the changes in exposure that result from an improvement in CCT, EPA predicts the entire LSL population of a water system will move to the new CCT status at the same time. EPA also assumes that the entire water system moves to the drinking water lead concentration, assigned to POU when this option is implemented, which implies that everyone in households in a distribution system with LSLs is properly using the POU. See Chapter 6, section 6.3 of the final rule EA (USEPA, 2020a) for more detailed information on the number of people switching lead concentration categories under the low and high cost scenarios.2. Impacts on Childhood IQ The 2013 Integrated Science Assessment for Lead (USEPA, 2013) states that there is a causal relationship between lead exposure and cognitive function decrements in children based on several lines of evidence, including findings from prospective studies in diverse populations supported by evidence in animals, and evidence identifying potential modes of action. The evidence from multiple high-quality studies using large cohorts of children shows an association between blood lead levels and decreased intelligence quotient (IQ). The 2012 National Toxicology Program Monograph concluded that there is sufficient evidence of association between blood lead levels less than 5 [mu]g/dL and decreases in various general and specific measures of cognitive function in children from three months to 16 years of age. This conclusion is based on prospective and cross-sectional studies using a wide range of tests to assess cognitive function (National Toxicology Program, 2012). EPA quantitatively assessed and monetized the benefits of avoided losses in IQ as a result of the LCR revisions. Modeled lead tap water concentrations (previously discussed in this notice) are used to estimate the extent to which the LCRR would reduce avoidable loss of IQ[[Page 4262]]among children. The first step in the quantification and monetization of avoided IQ loss is to estimate the likely decrease in blood lead levels in children based on the reductions in lead in their drinking water as a result of the rulemaking. EPA estimated the distribution of current blood lead levels in children, age 0 to 7, using EPA's Stochastic Human Exposure and Dose Simulation Multimedia (SHEDS-Multimedia) model coupled with its Integrated Exposure and Uptake Biokinetic (IEUBK) model. The coupled SHEDS-IEUBK model framework was peer reviewed by EPA in June of 2017 as part of exploratory work into developing a health-based benchmark for lead in drinking water (ERG, 2017). For further information on SHEDS-IEUBK model development and evaluation, refer to Zartarian et al. (2017). As a first step in estimating the blood lead levels, EPA utilized the SHEDS-Multimedia model, which can estimate distributions of lead exposure, using a two-stage Monte Carlo sampling process, given input lead concentrations in various media and human behavior ***data*** from EPA's Consolidated Human Activity Database (CHAD) and the Centers for Disease Control and Prevention's (CDC) National Health and Nutrition Examination Survey (NHANES). SHEDS-Multimedia, in this case, uses individual time-activity diaries from CDC's NHANES and EPA's CHAD for children aged 0 to 7 to simulate longitudinal activity diaries. Information from these diaries is then combined with relevant lead input distributions (e.g , outdoor air lead concentrations) to estimate exposure. Drinking water tap concentrations for each of the modeled LSL and CCT scenarios, above, were used as the drinking water inputs to SHEDS-Multimedia. For more detail on the other lead exposure pathways that are held constant as background in the model, see Chapter 6, section 6.4, of the final rule EA. In the SHEDS-IEUBK coupled methodology, the SHEDS model takes the place of the exposure and variability components of the IEUBK model by generating a probability distribution of lead intakes across media. These intakes are multiplied by route-specific (e.g , inhalation, ingestion) absorption fractions to obtain a distribution of lead uptakes (see Exhibit 6-21 in the final rule EA Chapter 6, section 6.4). This step is consistent with the uptake estimation that would normally occur within the IEUBK model. The media specific uptakes can be summed across exposure routes to give total lead uptake per day. Next, EPA used age-based relationships derived from IEUBK, through the use of a polynomial regression analysis, to relate these total lead uptakes to blood lead levels. Exhibit 6-16 presents modeled SHEDS-IEUBK blood lead levels in children by year of life and LSL, CCT status, and POU. The blood lead levels in this exhibit represent what children's blood lead level would be if they lived under the corresponding LSL, POU, and CCT status combination for their entire lives. Note that when ``No LSL'' is the beginning or post-rule state, 0.82 [micro]g/L is the assumed concentration across all levels of CCT status (none, partial, representative). The extent to which changes in CCT status make meaningful differences in lead concentrations for those without LSLs cannot be determined from this exhibit. Exhibit 6-16--Modeled SHEDS-IEUBK Geometric Mean Blood Lead Levels in Children for Each Possible Drinking Water Lead Exposure Scenario for Each Year of Life-------------------------------------------------------------------------------------------------------------------------------------------------------- GM blood lead level ([micro]g/dL) \b\ for specified year of life Lead service line status Corrosion control treatment ------------------------------------------------------------------------------- status 0-1 \a\ 1-2 2-3 3-4 4-5 5-6 6-7 Avg.\c\--------------------------------------------------------------------------------------------------------------------------------------------------------LSL....................................... None........................ 3.61 2.47 2.65 2.47 2.48 2.66 2.34 2.67Partial................................... None........................ 2.35 1.83 1.88 1.81 1.81 1.88 1.65 1.89No LSL.................................... None........................ 0.97 1.14 1.18 1.15 1.14 1.19 0.98 1.11LSL....................................... Partial..................... 2.57 1.93 2.05 1.95 1.94 2.03 1.76 2.03Partial................................... Partial..................... 1.72 1.52 1.57 1.54 1.51 1.58 1.37 1.54No LSL.................................... Partial..................... 0.97 1.14 1.18 1.15 1.14 1.19 0.98 1.11LSL....................................... Representative.............. 1.85 1.57 1.64 1.60 1.57 1.63 1.43 1.62Partial................................... Representative.............. 1.36 1.33 1.36 1.34 1.32 1.37 1.19 1.32No LSL.................................... Representative.............. 0.97 1.14 1.18 1.15 1.14 1.19 0.98 1.11-------------------------------------------------------------------------------------------------------------------------------------------------------- POU 0.97 1.14 1.18 1.15 1.14 1.19 0.98 1.11--------------------------------------------------------------------------------------------------------------------------------------------------------\a\ Due to lack of available ***data***, blood lead levels for the first year of life are based on regression from IEUBK for 0.5- to 1-year-olds only.\b\ These represent the blood lead for a child living with the LSL/CCT status in the columns to the left. Each year blood lead corresponding to actual modeled child is summed and divided by 7 in the model to estimate lifetime average blood lead.\c\ This column contains calculated average lifetime blood lead levels assuming a child lived in the corresponding LSL/CCT scenario for their entire life. Lifetime average blood lead levels above 5 [micro]g/dL are in bold lettering.This table presents modeled SHEDS-IEUBK blood lead levels in children by year of life. The blood lead levels presented in Exhibit 6-16, are used as inputs for the benefits modeling. The EPA benefits analysis uses lifetime average blood lead values to determine estimates of avoided IQ loss that correspond to reductions in water lead concentrations resulting from changes in LSL, POU and CCT status at some point in a representative child's life (between ages 0 and 7), and those made prior to the child's birth for those born 7 years after the rule is implemented. Therefore, the EPA cost-benefit model, in each year of the analysis, calculates IQ benefits based on the cohort, or percent of the modeled population, that turns 7 years of age in the year being analyzed. The EPA model, for both the baseline and LCRR, tracks PWS implementation over the period of analysis. This ***data*** allows the model to determine the number of children that fall within each of the 10 possible LSL/CCT/POU lead exposure scenarios for each of the seven years prior to the year being modeled. The model then calculates a set of average lifetime blood lead levels for the possible LSL/CCT/POU exposure scenarios (the set of scenarios includes not only the change in LSL, CCT, and POU status but also the years, 0-7, in which the status changes occur) and applies these values to the appropriate percent of the 7 year old cohort (the percent of 7 year olds that are estimated to experience the scenarios represented by the average lifetime BLLs) for that analysis year under both the baseline and LCRR requirements. The change in average lifetime BLLs for the 7 year old cohort is then used to determine the incremental benefit of avoided IQ losses. In order to relate the child's estimated average lifetime blood lead level to an estimate of avoided IQ loss, EPA selected a concentration-response function based on lifetime blood lead from the independent analysis by Crump et al. (2013). This study used ***data*** from a 2005 paper by Lanphear et al., which has formed the basis of concentration-response functions used[[Page 4263]]in several EPA regulations (National Ambient Air Quality Standard (USEPA, 2008a); the Toxic Substances Control Act (TSCA) Lead Repair and Renovation Rule (USEPA, 2008b); and Steam Electric Effluent Limitation Guidelines Rule (USEPA, 2015). The Crump et al. (2013) function was selected over Lanphear et al. (2005) to minimize issues with overestimating predicted IQ loss at the lowest levels of lead exposure (less than 1 [micro]g/dL BLL), which is a result of the use of the log-linear function. The Crump et al. (2013) function avoids this issue by adding one to the estimated blood lead levels prior to log-transformation in the analysis. Since the revisions to the LCR are expected to reduce chronic exposures to lead, EPA selected lifetime blood lead as the most appropriate measure with which to evaluate benefits. No threshold has been identified for the neurological effects of lead (Budtz-J[oslash]rgensen et al., 2013; Crump et al., 2013; Schwartz et al., 1991; USEPA, 2013). Therefore, EPA assumes that there is no threshold for this endpoint and quantified avoided IQ loss associated with all blood lead levels. EPA, as part of its sensitivity analysis, estimated the BLL to IQ relationship using Lanphear et al. (2019) and Kirrane and Patel (2014).\1\ See Chapter 6, section 6.4.3 and Appendix G of the final rule EA for a more detailed discussion (USEPA, 2020a).--------------------------------------------------------------------------- \1\ Lanphear et al., (2005) published a correction in 2019 that revised the results to be consistent with the Kirrane and Patel (2014) corrections.--------------------------------------------------------------------------- The estimated value of an IQ point decrement is derived from EPA's reanalysis of Salkever (1995), which estimates that a one-point increase in IQ results in a 1.871 percent increase in lifetime earnings for males and a 3.409 percent change in lifetime earnings for females. Lifetime earnings are estimated using the average of 10 American Community Survey (ACS) single-year samples (2008 to 2017) and projected cohort life tables from the Social Security Administration. Projected increases in lifetime earnings are then adjusted for the direct costs of additional years of education and forgone earnings while in school. The reanalysis of Salkever (1995) estimates a change of 0.0812 years of schooling per change in IQ point resulting from a reduction in lead exposure for males and a change of 0.0917 years of schooling for females. To estimate the uncertainty underlying the model parameters of the Salkever (1995) reanalysis, EPA used a bootstrap approach to estimate a distribution of model parameters over 10,000 replicates (using random sampling with replacement). For each replicate, the net monetized value of a one-point decrease in IQ is subsequently estimated as the gross value of an IQ point, less the value of additional education costs and lost earnings while in school. EPA uses an IQ point value discounted to age 7. Based on EPA's reanalysis of Salkever (1995), the mean value of an IQ point in 2016 dollars, discounted to age 7, is $5,708 using a 7 percent discount rate and $22,503 using a 3 percent discount rate.\2\ See Appendix G, of the final rule EA (USEPA, 2020a) for a sensitivity analysis of avoided IQ loss benefits based on Lin et al. (2018).--------------------------------------------------------------------------- \2\ It should be noted that these values are slightly different than those used in other recent rulemaking (e.g , the Lead Dust Standard and the proposed Perchlorate rule). This is simply due to the differences in the age of the child when the benefits are accrued in the analysis. Benefits for the LCRR are accrued at age seven and therefore the value of an IQ point is discounted back to age 7 in the LCRR analysis. This results in a slightly higher estimate than the values used for the Perchlorate Rule and the Lead Dust Standard, which are discounted to age zero and age three, respectively. It should also be noted, and is described in Section 6.4.5, that the benefits in the LCRR are further discounted back to year one of the analysis and annualized within the EPA LCRR cost-benefit model.--------------------------------------------------------------------------- EPA used the estimated changes in lifetime (age 0 to 7) average blood lead levels that result from changes in LSL, CCT, or POU status as inputs to the concentration response function from the independent analysis by Crump et al. (2013). The resultant annual avoided IQ decrements per change in LSL, CCT, and/or POU status change are then summed and multiplied by the EPA reanalyzed Salkever (1995) value per IQ point, which represent a weighted average for males and females (3 or 7 percent depending on the discount rate being used to annualize the stream of benefits across the period of analysis). This annual stream of benefits was annualized at 3 and 7 percent over the 35-year period of analysis, and further discounted to year one of the period of analysis. See Exhibit 6-19 (discounted at 3 percent) and Exhibit 6-20 (discounted at 7 percent) for the estimated benefit from avoided IQ losses from both LSL removals and improvements to CCT at public water system as a result of the previous rule, the LCR revisions, and the incremental difference between the previous and final rule estimates under both the low and high cost scenarios.3. Impacts on Adult Blood Lead Levels EPA identified the potential adverse adult health effects associated with lead utilizing information from the 2013 Integrated Science Assessment for Lead or EPA ISA (USEPA, 2013) and the HHS National Toxicology Program Monograph on Health Effects of Low-Level Lead (National Toxicology Program, 2012). The EPA ISA uses a five-level hierarchy to classify the weight of evidence for causation based on epidemiologic and toxicological studies, and the NTP Monograph conducted a review of the epidemiological literature for the association between low-level lead exposure (defined by blood lead levels <10 [micro]g/dL) and select health endpoints, and categorized their conclusions using a four-level hierarchy. Constraining the assessment to the highest/most robust two levels from each of the documents finds that the EPA ISA reports ``causal'' and ``likely to be causal'', and the NTP Monograph indicates ``sufficient'' and ``limited'' evidence of association between lead and adult adverse cardiovascular effects (both morbidity and mortality effects), renal effects, reproductive effects, immunological effects, neurological effects, and cancer. (See Appendix D of the final rule EA). Although EPA did not quantify or monetize the reduction in risk associated with adult health effects for the LCRR, the Agency has estimated the potential changes in adult drinking water exposures and thus blood lead levels to illustrate the extent of the lead reduction to the adult population estimated as a result of the LCRR. EPA estimated blood lead levels in adults for each year of life, beginning at age 20 and ending with age 80. Males and females are assessed separately because ***data*** from the CDC's National Health and Nutrition Examination Survey (NHANES) indicate that men have higher average blood lead levels than women, thus the baseline from which the changes are estimated. To estimate the changes in blood lead levels in adults associated with the rule, EPA selected from a number of available models a modified version of its Adult Lead Methodology (ALM). The ALM ``uses a simplified representation of lead biokinetics to predict quasi-steady state blood lead concentrations among adults who have relatively steady patterns of site exposures'' (USEPA, 2003). The model assumes a linear slope between lead uptake and blood lead levels, which is termed the ``biokinetic slope factor'' and is described in more detail in Chapter 6 section 6.5 of the final rule EA. Although the model was originally developed to estimate blood lead level impacts from lead in soil, based on the record, EPA finds the ALM can be tailored for use in estimating blood lead concentrations in any adult exposed population and is able to consider other[[Page 4264]]sources of lead exposure, such as contaminated drinking water. The biokinetic slope factor of 0.4 [micro]g/dL per [micro]g/day is valid for use in the case of drinking water since it is in part derived from studies that measure both adult blood lead levels and concentrations of lead in drinking water (Pocock et al., 1983; Sherlock et al., 1982). EPA estimated expected BLLs for adults with the ALM using the lead tap water concentration ***data*** by LSL, CCT, and POU status derived from the profile dataset, discussed in section VI.E.1 and shown in Exhibit 6-15 of this preamble. For the background blood lead levels in the model, EPA used geometric mean blood lead levels for males and females for each year of life between ages 20 and 80 from NHANES 2011-2016, which may result in some minor double counting of exposure from drinking water. Exhibit 6-17 displays the estimated blood lead levels for adults by each LSL, POU or CCT combination summarized by age groups (blood lead values for each year of age are used to determine average BLL). EPA also estimated BLLs using output for other exposure pathways from SHEDS in the ALM and the All Ages Lead Model, these results are shown in Appendix G of the final rule EA (USEPA, 2020a). The All Ages Lead Model results are not used in the primary analysis because updates to the model from a recent peer review have not been completed. Exhibit 6-17--Estimates of Blood Lead Levels in Adults Associated With Drinking Water Lead Exposures From LSL/CCT or POU Status Combinations-------------------------------------------------------------------------------------------------------------------------------------------------------- Geometric mean blood lead level ([micro]g/dL) for Corrosion control specified age group in years from the ALM Lead service line status treatment status Sex ----------------------------------------------------------- 20-29 30-39 40-49 50-59 60-69 70-80--------------------------------------------------------------------------------------------------------------------------------------------------------LSL................................... None..................... Males.................... 1.87 2.02 2.22 2.42 2.63 2.89 Females.................. 1.57 1.69 1.89 2.22 2.35 2.52Partial............................... None..................... Males.................... 1.31 1.44 1.64 1.84 2.03 2.25 Females.................. 1.01 1.11 1.31 1.64 1.75 1.88No LSL................................ None..................... Males.................... 0.87 0.99 1.19 1.39 1.55 1.75 Females.................. 0.57 0.66 0.86 1.19 1.27 1.38LSL................................... Partial.................. Males.................... 1.40 1.53 1.73 1.93 2.12 2.35 Females.................. 1.10 1.20 1.40 1.73 1.84 1.98Partial............................... Partial.................. Males.................... 1.09 1.22 1.42 1.62 1.80 2.01 Females.................. 0.79 0.89 1.09 1.42 1.52 1.64No LSL................................ Partial.................. Males.................... 0.87 0.99 1.19 1.39 1.55 1.75 Females.................. 0.57 0.66 0.86 1.19 1.27 1.38LSL................................... Representative........... Males.................... 1.14 1.27 1.47 1.67 1.84 2.06 Females.................. 0.84 0.94 1.14 1.47 1.56 1.69Partial............................... Representative........... Males.................... 0.97 1.10 1.30 1.50 1.67 1.87 Females.................. 0.67 0.77 0.97 1.30 1.39 1.50No LSL................................ Representative........... Males.................... 0.87 0.99 1.19 1.39 1.55 1.75 Females.................. 0.57 0.66 0.86 1.19 1.27 1.38-------------------------------------------------------------------------------------------------------------------------------------------------------- POU Males.................... 0.87 0.99 1.19 1.39 1.55 1.75 Females.................. 0.57 0.66 0.86 1.19 1.27 1.38-------------------------------------------------------------------------------------------------------------------------------------------------------- As discussed in the analysis of childhood IQ impacts section VI.E.2 of this preamble, the estimated BLLs in Exhibit 6-17 are average adult annual blood lead levels given the corresponding estimated lead tap water concentrations resulting from LSL, CCT, and POU status. The LCRR cost-benefit model, tracks the changes in LSL, CCT and POU status over time and the percentage of males and females in LSL households for each water system that are impacted by the changes in LSL, CCT, or POU status. These exposure histories and the corresponding BLL from the ALM model are then averaged across adult life spans to obtain a set of potential average lifetime blood lead levels for representative adults (average lifetime BLLs for potential exposure scenarios). Exhibit 6-18 shows the estimated changes in average lifetime blood lead levels for adults that move from the set of initial LSL, CCT, and POU status combinations to a new status as a result of LSL removal, and/or installation of CCT or POU. Note that when ``No LSL'' is the beginning or post-rule state, 0.82 [micro]g/L is the assumed concentration across all levels of CCT status (none, partial, representative). The extent to which changes in CCT status make meaningful differences in lead concentrations for those without LSLs cannot be determined from this exhibit. Exhibit 6-18--Estimated Lifetime Average Blood Lead Change for Adults Moving Between LSL, CCT, and POU Status Combinations-------------------------------------------------------------------------------------------------------------------------------------------------------- Pre-rule drinking water Post-rule drinking water Estimated---------------------------------------------------------------------------------------------------------------------------------------- change in the geometric means of blood Lead conc. Lead conc. lead change ([micro]g/L) LSL status CCT status ([micro]g/L) LSL status CCT status ---------------- Ages 20-80 ([micro]g/dL)-------------------------------------------------------------------------------------------------------------------------------------------------------- 18.08 LSL...................... None.................... 0.82 No LSL.................. None.................... 1.03 18.08 LSL...................... None.................... 5.48 LSL..................... Representative.......... 0.75 18.08 LSL...................... None.................... 0.82 No LSL.................. Representative.......... 1.03 ---------------------------------------------------- 18.08 LSL...................... None.................... 0.82 POU 1.03 ---------------------------------------------------- 8.43 Partial.................. None.................... 0.82 No LSL.................. None.................... 0.46 8.43 Partial.................. None.................... 2.64 Partial................. Representative.......... 0.35[[Page 4265]] 8.43 Partial.................. None.................... 0.82 No LSL.................. Representative.......... 0.46 ---------------------------------------------------- 8.43 Partial.................. None.................... 0.82 POU 0.46 ---------------------------------------------------- 0.82 No LSL................... None.................... 0.82 No LSL.................. Representative.......... 0.00 ---------------------------------------------------- 0.82 No LSL................... None.................... 0.82 POU 0.00 ---------------------------------------------------- 9.92 LSL...................... Partial................. 0.82 No LSL.................. Partial................. 0.54 9.92 LSL...................... Partial................. 5.48 LSL..................... Representative.......... 0.27 9.92 LSL...................... Partial................. 0.82 No LSL.................. Representative.......... 0.54 ---------------------------------------------------- 9.92 LSL...................... Partial................. 0.82 POU 0.54 ---------------------------------------------------- 4.72 Partial.................. Partial................. 0.82 No LSL.................. Partial................. 0.23 4.72 Partial.................. Partial................. 2.64 Partial................. Representative.......... 0.12 4.72 Partial.................. Partial................. 0.82 No LSL.................. Representative.......... 0.23 ---------------------------------------------------- 4.72 Partial.................. Partial................. 0.82 POU 0.23 ---------------------------------------------------- 0.82 No LSL................... Partial................. 0.82 No LSL.................. Representative.......... 0.00 ---------------------------------------------------- 0.82 No LSL................... Partial................. 0.82 POU 0.00 ---------------------------------------------------- 5.48 LSL...................... Representative.......... 0.82 No LSL.................. Representative.......... 0.28 ---------------------------------------------------- 5.48 LSL...................... Representative.......... 0.82 POU 0.28 ---------------------------------------------------- 2.64 Partial.................. Representative.......... 0.82 No LSL.................. Representative.......... 0.11 ---------------------------------------------------- 2.64 Partial.................. Representative.......... 0.82 POU 0.11 ---------------------------------------------------- 0.82 No LSL................... Representative.......... 0.82 POU 0.00--------------------------------------------------------------------------------------------------------------------------------------------------------4. Total Monetized Benefits Exhibits 6-19 and 6-20 show the estimated, monetized national annualized total benefits, under the low and high cost scenarios, from avoided child IQ decrements associated with the previous LCR, the LCRR, and the increment of change between the two, for CCT improvements, LSLR, and POU device implementation discounted at 3 and 7 percent, respectively. The potential changes in adult blood lead levels estimated from changing LSL and CCT status under the LCRR can be found in section VI.E.3 of this preamble and Chapter 6, section 6.5, of the final rule EA (USEPA, 2020a). The impact of lead on the risk of attention-deficit/hyperactivity disorder and reductions in birth weight are discussed in Appendix J of the final rule EA. It should also be noted that because of the lack of granularity in the assembled lead concentration profile ***data***, with regard to CCT status when samples were ***collected*** (see section VI.E.1 of this preamble), the benefits of small improvements in CCT, like those resulting from the ``find-and-fix'' rule requirements, cannot be quantified in the model. For additional information on non-quantified benefits see section VI.F.2 of this preamble. Exhibit 6-19--Summary of Estimated National Annual Monetized Benefits--All PWS at 3% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------Number of Children Impacted (over 35 years)............. 29,000 928,000 900,000 704,000 3,210,000 2,506,000Annual IQ Point Decrement Avoided (CCT Due to ALE)...... 190 3,225 3,035 5,228 17,583 12,355Annual Value of IQ Impacts Avoided (CCT Due to ALE)..... $3,344,000 $56,083,000 $52,739,000 $96,449,000 $318,322,000 $221,873,000Annual IQ Point Decrement Avoided (CCT Due to TLE)...... 0 3,680 3,680 0 10,463 10,463Annual Value of IQ Impacts Avoided (CCT Due to TLE)..... $0 $64,736,000 $64,736,000 $0 $190,822,000 $190,822,000Annual IQ Point Decrement Avoided (LSLR--Mandatory)..... 128 2,620 2,492 3,106 8,204 5,097Annual Value of IQ Impacts Avoided (LSLR--Mandatory).... $2,375,000 $47,525,000 $45,150,000 $61,497,000 $156,772,000 $95,275,000Annual IQ Point Decrement Avoided (LSLR--Goal Based).... 0 1,807 1,807 0 3,337 3,337Annual Value of IQ Impacts Avoided (LSLR--Goal Based)... $0 $32,855,000 $32,855,000 $0 $63,610,000 $63,610,000Annual IQ Point Decrement Avoided (LSLR--Customer 0 1,572 1,572 0 1,677 1,677 Initiated).............................................Annual Value of IQ Impacts Avoided (LSLR--Customer $0 $27,540,000 $27,540,000 $0 $29,198,000 $29,198,000 Initiated).............................................Annual IQ Point Decrement Avoided (POU)................. 0 17 17 0 2,214 2,214[[Page 4266]] Annual Value of IQ Impacts Avoided (POU)................ $0 $324,000 $324,000 $0 $44,498,000 $44,498,000 ----------------------------------------------------------------------------------------------- Total Annual Value of IQ Benefits................... $5,719,000 $229,062,000 $223,344,000 $157,946,000 $803,222,000 $645,276,000-------------------------------------------------------------------------------------------------------------------------------------------------------- Exhibit 6-20--Summary of Estimated National Annual Monetized Benefits--All PWS at 7% Discount Rate [2016$]-------------------------------------------------------------------------------------------------------------------------------------------------------- Low cost estimate High cost estimate ----------------------------------------------------------------------------------------------- Previous LCR Final LCRR Incremental Previous LCR Final LCRR Incremental--------------------------------------------------------------------------------------------------------------------------------------------------------Number of Children Impacted (over 35 years)............. 29,000 928,000 900,000 704,000 3,210,000 2,506,000Annual IQ Point Decrement Avoided (CCT Due to ALE)...... 190 3,225 3,035 5,228 17,583 12,355Annual Value of IQ Impacts Avoided (CCT Due to ALE)..... $581,000 $9,551,000 $8,971,000 $17,790,000 $57,148,000 $39,358,000Annual IQ Point Decrement Avoided (CCT Due to TLE)...... 0 3,680 3,680 0 10,463 10,463Annual Value of IQ Impacts Avoided (CCT Due to TLE)..... $0 $11,232,000 $11,232,000 $0 $34,750,000 $34,750,000Annual IQ Point Decrement Avoided (LSLR--Mandatory)..... 128 2,620 2,492 3,106 8,204 5,097Annual Value of IQ Impacts Avoided (LSLR--Mandatory).... $451,000 $8,703,000 $8,252,000 $12,707,000 $30,776,000 $18,069,000Annual IQ Point Decrement Avoided (LSLR--Goal Based).... 0 1,807 1,807 0 3,337 3,337Annual Value of IQ Impacts Avoided (LSLR--Goal Based)... $0 $6,039,000 $6,039,000 $0 $12,469,000 $12,469,000Annual IQ Point Decrement Avoided (LSLR--Customer 0 1,572 1,572 0 1,677 1,677 Initiated).............................................Annual Value of IQ Impacts Avoided (LSLR--Customer $0 $4,797,000 $4,797,000 $0 $5,038,000 $5,038,000 Initiated).............................................Annual IQ Point Decrement Avoided (POU)................. 0 17 17 0 2,214 2,214Annual Value of IQ Impacts Avoided (POU)................ $0 $62,000 $62,000 $0 $9,417,000 $9,417,000 ----------------------------------------------------------------------------------------------- Total Annual Value of IQ Benefits................... $1,032,000 $40,385,000 $39,353,000 $30,497,000 $149,599,000 $119,102,000--------------------------------------------------------------------------------------------------------------------------------------------------------F. Cost-Benefit Comparison This section summarizes and describes the numeric relationship between the monetized incremental costs and benefits of the final LCR revisions. The section also discusses both the non-monetized costs and benefits of the rulemaking. Exhibits 6-21 and 6-22 compare the annualized monetized incremental costs and benefits of the LCRR for the low and high cost scenarios. Under a 3 percent discount rate, the net annualized incremental monetized benefits, under the low and high cost scenarios, range from $49 to $296 million. Under the low and high cost scenarios and a 7 percent discount rate, the net annualized incremental monetized benefits range from a negative $148 to negative $273 million. Exhibit 6-21--Comparison of Estimated Monetized National Annualized Incremental Costs to Benefits of the LCRR at 3% Discount Rate [2016$]------------------------------------------------------------------------ Low cost High cost PWS annual costs scenario scenario------------------------------------------------------------------------Annualized Incremental Costs............ $160,571,000 $335,481,000Annualized Incremental Benefits......... 223,344,000 645,276,000 ------------------------------- Annual Net Benefits................. 62,773,000 309,795,000------------------------------------------------------------------------ Exhibit 6-22--Comparison of Estimated Monetized National Annualized Incremental Costs to Benefits of the LCRR at 7% Discount Rate [2016$]------------------------------------------------------------------------ Low cost High cost PWS annual costs scenario scenario------------------------------------------------------------------------Annualized Incremental Costs............ $167,333,000 $372,460,000Annualized Incremental Benefits......... 39,353,000 119,102,000 ------------------------------- Annual Net Benefits................. -127,980,000 -253,358,000------------------------------------------------------------------------[[Page 4267]]1. Non-Monetized Costs The LCRR is expected to result in additional phosphate being added to drinking water to reduce the amount of lead leaching into water in the distribution system. EPA's cost model estimated that, nationwide, the LCRR will result in post WWTP total incremental phosphorus loads to receiving waterbodies increasing over the period of analysis, under the low cost and high cost scenarios, by a range of 161,000 to 548,000 pounds fifteen years after promulgation, and increasing under the low cost and high cost scenarios by a range of 355,000 to 722,000 pounds at year 35. At the national level, under the high cost scenario, this additional phosphorous loading to waterbodies is small, less than 0.1 percent of the total phosphorous load deposited annually from all other anthropogenic sources. However, national average receiving waterbody load impacts may obscure significant localized ecological impacts. Impacts, such as eutrophication, may occur in water bodies without restrictions on phosphate deposits, or in locations with existing elevated phosphate levels. See Chapter 5, section 5.5 of the final rule EA (USEPA, 2020a) for additional information.2. Non-Quantified Non-Monetized Benefits In addition to the benefits monetized in the final rule analysis for reductions in lead exposure, there are several other benefits that are not quantified. The risk of adverse health effects due to lead that are expected to decrease as a result of the LCRR are summarized in Appendix D of the final rule EA and are expected to affect both children and adults. EPA focused its non-quantified impacts assessment on the endpoints identified using two comprehensive U.S Government documents summarizing the recent literature on lead exposure health impacts. These documents are EPA's Integrated Science Assessment for Lead (ISA) (USEPA, 2013); and the HHS National Toxicology Program Monograph on Health Effects of Low-Level Lead (National Toxicology Program (NTP), 2012). Both of these sources present comprehensive reviews of the literature on the risk of adverse health effects associated with lead exposure. EPA summarized those endpoints to which either EPA ISA or the NTP Lead Monograph assigned one of the top two tiers of confidence in the relationship between lead exposure and the risk of adverse health effects. These endpoints include cardiovascular effects, renal effects, reproductive and developmental effects, immunological effects, neurological effects, and cancer. There are a number of final rule requirements that reduce lead exposure to both children and adults that EPA could not quantify. The final rule will require additional lead public education requirements that target consumers directly, schools and child care facilities, health agencies, and specifically people living in homes with LSLs. Increased education will lead to additional averting behavior on the part of the exposed public, resulting in reductions in the negative impacts of lead. The rule also will require the development of LSL inventories and making the location of LSLs publicly accessible. This will give exposed consumers more information and will provide potential home buyers this information as well, possibly resulting in additional LSL removals initiated by homeowners before, during, or following home sale transactions. The benefits of these additional removals are not quantified in the analysis of the LCRR. As indicated in section VI.E.4 of this preamble, because of the lack of granularity in the lead tap water concentration ***data*** available to EPA for the regulatory analysis, the benefits of small improvements in CCT to individuals residing in homes with LSLs, like those modeled under the ``find-and-fix,'' are not quantified. EPA also did not quantify the benefits of reduced lead exposure to individuals who reside in homes that do not have LSLs. EPA has determined that the revised LCR requirements may result in reduced lead exposure to the occupants of these buildings as a result of improved monitoring and additional actions to optimize CCT. In the analysis of the LCRR, the number of non-LSL homes potentially affected by water systems increasing their corrosion control during the 35-year period of analysis is 8 million in the low cost scenario and 17 million in the high cost scenario. These households, while not having an LSL in place, may still contain leaded plumbing materials, including leaded brass fixtures, and lead solder. These households could potentially see reductions in tap water lead concentrations. EPA has assessed the potential benefits to children of reducing lead water concentrations in these homes (see Appendix F of the final rule EA) but has determined that the ***data*** are too limited and the uncertainties too significant to include in the quantified and monetized benefit estimates of this regulation. Additionally, the risk of adverse health effects associated with copper that are expected to be reduced by the LCRR are summarized in Appendix E of the final rule EA. These risks include acute gastrointestinal symptoms, which are the most common adverse effect observed among adults and children. In sensitive groups, there may be reductions in chronic hepatic effects, particularly for those with rare conditions such as Wilson's disease and children pre-disposed to genetic cirrhosis syndromes. These diseases disrupt copper homeostasis, leading to excessive accumulation that can be worsened by excessive copper ingestion (National Research Council, 2000).G. Other Regulatory Options Considered The Office of Management and Budget recommends careful consideration ``of all appropriate alternatives for the key attributes or provisions of a rule (Office of Management and Budget, 2003). Pursuant to this guidance, EPA considered other regulatory options when developing the final LCRR related to: The lead in drinking water sampling program at schools and licensed child care facilities, the lead tap sampling protocol requirements for water systems with LSLs, LSL locational information to be made publicly available, and providing small system flexibility to CWSs that serve a population of 3,300 or fewer persons. Exhibit 6-23 provides a summary of the final LCRR requirements and other option considered for these four areas.[[Page 4268]] Exhibit 6-23--Summary of Other Options Considered for the Final LCRR---------------------------------------------------------------------------------------------------------------- Area Final LCRR Other option considered----------------------------------------------------------------------------------------------------------------Lead in Drinking Water Sampling Mandatory program is, one five-year round Mandatory program: Program at Schools and Licensed of lead sampling: 20% of schools and Child Care Facilities. 20% of elementary schools and licensed child care licensed child care facilities tested facilities tested annually. annually. 5 samples per 5 samples per school. school. 2 samples per licensed child care 2 samples per licensed child facility. care facility. On request program is implemented for On request program: secondary schools, and in elementary Schools and licensed schools and child cares following the one child care facilities would cycle of mandatory sampling: be tested on request. Maximum required sampling under 5 samples per on request program: 20 percent of schools school. and licensed child cares tested annually. 2 samples per 5 samples per elementary and licensed child care secondary school. facility. 2 samples per licensed child care facility.Lead Tap Sampling Requirements for Systems with LSLs ***collect*** 100% of Systems with LSLs Systems with Lead Service Lines their samples from LSLs sites, if ***collect*** 100% of their (LSLs). available. samples from LSLs sites, if Samples are fifth liter, available. ***collected*** after 6-hour minimum stagnation Samples are first time. liter, ***collected*** after 6- hour minimum stagnation time.Publicly Available LSL Locational Systems report a location identifier Systems report the exact Information. (e.g , street, intersection, landmark) street address of LSLs. for LSLs.Small System Flexibility............. CWSs that serve 10,000 or fewer persons, CWSs that serve 3,300 or and all NTNCWSs, are provided compliance fewer persons, and all flexibility when they exceed the AL. NTNCWSs, are provided compliance flexibility when they exceed the AL.----------------------------------------------------------------------------------------------------------------1. Lead Public Education and Sampling at Schools and Child Care Facilities The final LCRR requires that all elementary schools and child care facilities must be sampled by CWSs once during an initial five year mandatory sampling period (schools and child care facilities may refuse the sampling, but the water system must document this refusal or non-response to the state). The CWS must also provide the facility with the 3Ts Toolkit. After this one cycle, or five years, of mandatory sampling, CWSs must provide sampling and public education though the 3Ts, on request, to all elementary school and child care facilities in their service area into the future. The final LCRR also requires CWSs to provide on request sampling to all secondary schools receiving water from their distribution system. EPA assumed that 5 percent of elementary and secondary schools, and child care facilities would request sampling per year under the on request sampling program. In developing the final rule requirements, EPA assessed two other alternatives. The first was requiring that all CWSs conduct a mandatory sampling and public education program for schools and licensed child care facilities that they serve. The attributes of the mandatory program are consistent with the final LCRR's requirements for the five-year round of monitoring at elementary schools and child care facilities, except this program continues with consecutive five-year monitoring rounds in perpetuity at all schools and child care facilities. The second alternative EPA considered was a purely on request program. This program would limit sampling to K-12 schools or child care facilities served by the water system that request sampling. The on request program is representative of the final rule sampling and public education requirements for secondary schools, and elementary schools and child care facilities after the cycle of mandatory testing. This alternative program, however, would begin on request sampling as part of the initial implementation of the school and child care testing program at all schools and child care facilities. In assessing the costs for the program, EPA maintained the assumption that five percent of schools and licensed child care facilities per year would elect to participate in the sampling program and that CWSs would contact each facility annually to determine its interest in the program in lieu of developing a sampling schedule for each facility. Exhibit 6-24 shows that the estimated costs of the final rule requirements are between those of the perpetual mandatory program and the on request program. Note that the costs of the final LCRR and on request option are highly dependent on the percentage of facilities that request to participate in the sampling program. There is a great degree of uncertainty regarding the percentage of facilities that will request this sampling and how this interest may fluctuate over time, indicating a higher degree of uncertainty in the estimated costs from the final LCRR and the on request program. The same is true for the unquantified benefits estimated to result from each alternative.[[Page 4269]] Exhibit 6-24--National Annualized Costs for School Sampling Alternatives Considered in the Rulemaking [2016$]---------------------------------------------------------------------------------------------------------------- Annualized cost at 3% discount Annualized cost at 7% discount rate rate Option --------------------------------------------------------------- Low cost High cost Low cost High cost scenario scenario scenario scenario----------------------------------------------------------------------------------------------------------------Final Rule: Elementary Schools/Licensed Child $12,582,000 $12,960,000 $14,461,000 $14,969,000 Cares: Mandatory Program for one round of monitoring followed by On Request Program.. Secondary Schools: On Request Program.Proposed LCRR: Mandatory Program................ 27,751,000 28,268,000 27,221,000 27,875,000Other Option Considered: On Request Program..... 9,501,000 9,729,000 9,279,000 9,567,000----------------------------------------------------------------------------------------------------------------2. Lead Tap Sampling Requirements for Water Systems With Lead Service Lines The final LCRR requires that water systems with LSLs ***collect*** all compliance tap samples from sites served by LSLs as opposed to a minimum of 50 percent as required by the previous rule. As noted in section III.G of this preamble, tap sample sites served by an LSL are at the highest risk for elevated lead levels in drinking water, therefore, EPA revised the tap sample site selection criteria to ensure water systems with LSLs use those sites for lead tap sampling. The final rule requires that fifth liter sample be ***collected*** and analyzed at LSL tap sampling sites. EPA determined that a fifth liter tap sample better captures water that has been in contact with the LSL, and sample results would result in more protective measures. The sampling methodology associated with ***collecting*** a fifth liter sample (using five one-liter bottles returning the first, for copper analysis, and the fifth, for lead analysis) is more complicated and may introduce error, such as misidentifying the correct liter to be analyzed. Thus, EPA also considered requiring the ***collection*** of a first liter sample, essentially retaining the sampling procedure from the 1991 LCR because the first draw approach has been effectively implemented by water systems. Exhibits 6-25 and 6-26 provide the national annualized rule costs and benefits, under the low cost scenario, discounted at 3 and 7 percent, for the previous rule, the final LCRR, and the first liter option. Exhibits 6-27 and 6-28 provide the high cost scenario national annualized rule costs and benefits at the 3 and 7 percent discount rates. At a 3 percent discount rate, EPA estimates lower total benefits, based on estimated avoided IQ point decrements, under the first liter option ($121 to $699 million) compared to the final LCRR ($229 to $803 million). The first liter option provides greater benefits than the previous rule ($6 to $158 million). EPA estimates that the total cost of the rule will be lower under the first liter option ($521 to $756 million) compared to the final LCRR ($554 to $808 million) but still greater than the previous rule ($394 to 473 million). The lower cost and benefit of the first liter option, compared to the fifth liter final rule requirement, is primarily the result of fewer water systems with LSLs exceeding the trigger and action levels and being required to conduct additional tap sampling and treatment requirements in the EPA cost-benefit model. In addition to lower quantified benefits, the first liter option is expected to result in lower unquantified benefits than the fifth liter option as the overall expected reductions in exposure to lead in drinking water would be less. At a 7 percent discount rate, EPA estimates lower total benefits, based on estimated IQ point decrements, under the first liter option ($21 to $131 million) compared to the final LCRR ($40 to $150 million). Benefits of the first liter option are higher than the previous rule ($1 to $30 million). EPA estimates that the total cost of the rule will be lower under the first liter option ($502 to $780 million) compared to the final LCRR ($539 to $839 million) but greater than the previous rule ($371 to $467 million). Again, fewer water systems under the first liter option are required to conduct additional tap sampling and treatment requirements in response to trigger and action level exceedances producing lower costs and benefits as compared to the fifth liter requirement. And, the fifth liter option is expected to result in higher unquantified benefits resulting from greater reductions exposure to lead in drinking water. Exhibit 6-25--Estimated National Annualized Rule Costs and Benefits for the Low Cost Scenario at 3% Discount Rate Previous Rule, Final LCRR, and First Liter Option [2016$]---------------------------------------------------------------------------------------------------------------- Final LCRR First liter option Benefit/cost category Previous LCR --------------------------------------------------------------- total Total Incremental Total Incremental----------------------------------------------------------------------------------------------------------------Total Annual Rule Costs......... $393,904,000 $554,475,000 $160,571,000 $520,724,000 $126,819,000Total Annual PWS Costs.......... 387,417,000 519,210,000 131,792,000 489,058,000 101,641,000Total Annual Benefits........... 5,719,000 229,062,000 223,344,000 120,792,000 116,828,000----------------------------------------------------------------------------------------------------------------[[Page 4270]] Exhibit 6-26--Estimated National Annualized Rule Costs and Benefits for the Low Cost Scenario at 7% Discount Rate Previous Rule, LCRR, and First Liter Option [2016$]---------------------------------------------------------------------------------------------------------------- Final LCRR First liter option Benefit/cost category Previous LCR --------------------------------------------------------------- total Total Incremental Total Incremental----------------------------------------------------------------------------------------------------------------Total Annual Rule Costs......... $371,188,000 $538,521,000 $167,333,000 $502,337,000 $131,149,000Total Annual PWS Costs.......... 364,711,000 501,316,000 136,605,000 469,123,000 104,412,000Total Annual Benefits........... 1,032,000 40,385,000 39,353,000 21,059,000 20,353,000---------------------------------------------------------------------------------------------------------------- Exhibit 6-27--Estimated National Annualized Rule Costs and Benefits for the High Cost Scenario at 3% Discount Rate Previous Rule, Final LCRR, and First Liter Option [2016$]---------------------------------------------------------------------------------------------------------------- Final LCRR First liter option Benefit/cost category Previous LCR --------------------------------------------------------------- total Total Incremental Total Incremental----------------------------------------------------------------------------------------------------------------Total Annual Rule Costs......... $472,821,000 $808,301,000 $335,481,000 $756,384,000 $283,609,000Total Annual PWS Costs.......... 459,523,000 758,343,000 298,820,000 699,766,000 241,286,000Total Annual Benefits........... 157,946,000 803,222,000 645,276,000 699,463,000 566,338,000---------------------------------------------------------------------------------------------------------------- Exhibit 6-28--Estimated National Annualized Rule Costs and Benefits for the High Cost Scenario at 7% Discount Rate Previous Rule, Final LCRR, and First Liter Option [2016$]---------------------------------------------------------------------------------------------------------------- Final LCRR First liter option Benefit/cost category Previous LCR --------------------------------------------------------------- total Total Incremental Total Incremental----------------------------------------------------------------------------------------------------------------Total Annual Rule Costs......... $466,523,000 $838,983,000 $372,460,000 $780,202,000 $313,725,000Total Annual PWS Costs.......... 450,316,000 781,224,000 330,908,000 713,442,000 261,177,000Total Annual Benefits........... 30,497,000 149,599,000 119,102,000 131,155,000 105,772,000----------------------------------------------------------------------------------------------------------------3. Reporting of LSL-Related Information EPA is requiring in the final LCRR that water systems make their inventory publicly available and systems with LSLs must include a locational identifier associated with each LSL. EPA is not requiring that address-level information be provided (see section III.C.3 of this preamble). Public disclosure of the LSL inventory would increase transparency and consumer awareness of the extent of LSLs in the distribution system. EPA, during the development of the final rule, considered an additional option in which systems with LSLs would be required to make the address associated with each LSL publicly available. Available information indicates that prospective buyers and renters value reductions in risks associated with LSLs. Public disclosure of LSL locations can create an incentive, through increased property values or home sale incentives, to replace LSLs. EPA anticipates that the costs between the final rule requirement and this option would be similar because the system would use the same method for publicly providing and maintaining information regarding its LSL information and LSL locational information, e.g , posting information to the water system's website. EPA anticipates the benefits between the address-level option and location identifier rule requirement would be similar. EPA expects that unquantified benefits of the address-level option may be higher due to the potential impacts on real estate transactions, although this is uncertain.4. Small System Flexibility As discussed in section III.E of this preamble, the final LCRR includes significant flexibility for CWSs that serve 10,000 or fewer persons, and all NTNCWSs. If these PWSs have an action level exceedance, they can choose from four options to reduce the concentration of lead in their water. The first three options which are modeled in the cost-benefit analysis are: (1) Replace seven percent of their baseline number of LSLs per year until all LSLs are replaced; (2) optimize existing CCT or install new CCT; (3) Provide POU devices to all customers. The LCRR provides a fourth option (not modeled), for CWSs and NTNCWSs that do not have LSLs and have control of all of the plumbing materials in their system. PWSs meeting these criteria may choose to replace all lead bearing plumbing on a schedule specified by the state and not to exceed one year. This additional option will give small entities more flexibility but because of the requirement that a system must have control of all plumbing materials it is unlikely large numbers of PWSs would select this compliance alternative. EPA, therefore, does not model this option in the cost analysis. As part of the development of the final rule EPA also considered limiting small system flexibility to CWSs that serve 3,300 or fewer people and all NTNCWSs. Exhibits 6-29 and 6-30 provide the range of the estimated incremental annualized rule costs and benefits, under both the low and high cost scenarios, for the final LCRR and the alternative small system flexibility threshold option at a 3 percent and 7 percent discount rate, respectively.[[Page 4271]] Exhibit 6-29--Estimated National Annualized Incremental Rule Costs and Benefits at 3% Discount Rate for the Final LCRR and the Alternative Small System Flexibility Threshold Considered in the Rulemaking [2016$]---------------------------------------------------------------------------------------------------------------- Final LCRR: Small system Small system flexibility: CWSs flexibility for CWSs serving serving <= 3,300 people and <= 10,000 people and all all NTNCWSs Benefit/cost category NTNCWSs ------------------------------- -------------------------------- Low cost High cost Low cost High cost scenario scenario scenario scenario----------------------------------------------------------------------------------------------------------------Total Annual Rule Costs......................... $160,571,000 $335,481,000 $163,460,000 $363,607,000Total Annual PWS Costs.......................... 131,792,000 298,820,000 134,013,000 322,711,000Total Annual Benefits........................... 223,344,000 645,276,000 226,970,000 675,533,000----------------------------------------------------------------------------------------------------------------Exhibit 6-30--National Annualized Incremental Rule Costs and Benefits at 7% Discount Rate for the Final LCRR and the Alternative Small System Flexibility Threshold Considered in the Rulemaking [2016$]---------------------------------------------------------------------------------------------------------------- Final LCRR: Small system Small system flexibility: CWSs flexibility for CWSs serving serving <= 3,300 people and <= 10,000 people and all all NTNCWSs Benefit/cost category NTNCWSs ------------------------------- -------------------------------- Low cost High cost Low cost High cost scenario scenario scenario scenario----------------------------------------------------------------------------------------------------------------Total Annual Rule Costs......................... $167,333,000 $372,460,000 $170,418,000 $408,500,000Total Annual PWS Costs.......................... 136,605,000 330,908,000 138,993,000 361,732,000Total Annual Benefits........................... 39,353,000 119,102,000 40,038,000 125,285,000----------------------------------------------------------------------------------------------------------------VII. Administrative RequirementsA. Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review This action is an economically significant regulatory action that was submitted to the Office of Management and Budget (OMB) for review. Any changes made during interagency review in response to OMB recommendations have been documented in the docket. EPA prepared an analysis of the potential costs and benefits associated with this action. This analysis, the Economic Analysis of the Final Lead and Copper Rule Revisions (USEPA, 2020a), is available in the docket and is summarized in section VI of this preamble.B. Executive Order 13771: Reducing Regulations and Controlling Regulatory Cost This action is an Executive Order 13771 regulatory action. Details on the estimated costs of this final rule can be found in EPA's analysis of the potential costs and benefits associated with this action summarized in section VI.C. Paperwork Reduction Act (From the Office of Mission Support's Information ***Collection*** Request Center) (PRA) The information ***collection*** activities in this rule have been submitted for approval to the OMB under the PRA. The Information ***Collection*** Request (ICR) document that EPA prepared has been assigned the control number 2040-0297. You can find a copy of the ICR in the docket for this rule (EPA-HQ-OW-2017-0300), and it is briefly summarized here. The information ***collection*** requirements are not enforceable until OMB approves them. The burden reflects the time needed to conduct state and public water system information ***collections*** and recordkeeping during the first three years after promulgation, as described in Chapter 8 from the Economic Analysis of the Final Lead and Copper Rule Revisions (USEPA, 2020a). Burden means the total time, effort, or financial resources expended by people to generate, maintain, retain, disclose, or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology, and systems for the purposes of ***collecting***, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a ***collection*** of information; search ***data*** sources; complete and review the ***collection*** of information; and transmit or otherwise disclose the information. The PRA requires EPA to estimate the burden for public water systems and primacy agencies to comply with the final rule. EPA assumes there is one response per respondent per requirement. EPA anticipates public water systems will be involved in several implementation activities for the first three years after publication of the final LCRR. During the implementation period, one of the burdens that public water systems will incur is the burden to read and understand the LCRR. EPA estimates the average burden hours per response per respondent to read and understand the LCRR to be 4 hours. Another burden public water systems will incur is the burden of assigning personnel and devoting resources necessary to carry out the implementation of the final rule. EPA estimates the average burden hours per response per respondent to assign personnel and devote resources to be 8 hours. In addition, public water systems will need to participate in training sessions and receive technical assistance from their state during implementation of the LCRR. EPA estimates the average burden hours per response per respondent to conduct training and receive technical assistance to be 8 hours. Furthermore, public water systems will have to develop an LSL inventory or submit a demonstration to[[Page 4272]]the state that they do not have LSLs. EPA estimates the average burden hours per response per respondent to develop an LSL inventory to be 20 to 400 hours. EPA estimates the average burden hours per response per respondent to submit a demonstration of no LSLs to be 5 to 40 hours. Public water system systems will also have to confer with their primacy agency on initial planning for LSLR and prepare a LSLR plan. EPA estimates the average burden hours per response per respondent for initial planning and preparing a LSLR plan to be 12 to 52 hours. Likewise, primacy agencies will face burdens due to the promulgation of the final rule. Primacy agencies will have to adopt the more stringent portions of the rule and develop programs to implement the LCRR. Primacy agencies are allowed to implement and develop more stringent requirements than the LCRR. EPA estimates the average burden hours per response per respondent to adopt the rule and develop a program for LCRR to be 1,920 hours. While primacy agencies are implementing the LCRR, there may be a need to modify their ***data*** system. EPA estimates the average burden hours per response per respondent to modify the ***data*** system to implement the LCRR to be 2,220 hours. Also, primacy agencies will need to provide training and technical assistance for their internal staff as well as for the staff of public water systems. EPA estimates the average burden hours per response per respondent to provide internal primacy agency staff with training for implementation of the LCRR to be 588 hours. EPA estimates the average burden hours per response per respondent to train and provide technical assistance to the staff of public water systems to be 2,400 hours. The primacy agencies are also responsible for assisting public water systems in developing an LSL inventory and reviewing submissions. EPA estimates the average burden hours per response per respondent to assist with developing a LSL inventory and review submissions to be 4 to 8 hours. In addition, primacy agencies will also have to review demonstrations of no LSLs from public water systems. EPA estimates the average burden hours per response per respondent to review demonstrations to be 2 hours. Primacy agencies will also have to confer on and review the initial LSLR plan from public water systems. EPA estimates the average burden hours per response per respondent to review demonstrations to be 6 to 26 hours. The information ***collected*** under the ICR is critical to states and other authorized entities that have been granted primacy (i.e , primary enforcement authority) for the Lead and Copper Rule (LCR). These authorized entities are responsible for overseeing the LCR implementation by certain public water systems within their jurisdiction. Primacy agencies would utilize these ***data*** to determine compliance, designate additional treatment controls to be installed, and establish enforceable operating parameters. The ***collected*** information is also necessary for public water systems. Public water systems would use these ***data*** to demonstrate compliance, assess treatment options, operate and maintain installed treatment equipment, and communicate water quality information to consumers served by the water system. Primacy agencies would also be required to report a subset of these ***data*** to EPA. EPA would utilize the information to protect public health by ensuring compliance with the LCR, measuring progress toward meeting the LCR's goals, and evaluating the appropriateness of state implementation activities. No confidential information would be ***collected*** as a result of this ICR. Respondents/affected entities: ***Data*** associated with this final ICR would be ***collected*** and maintained at the public water system, and by Federal and state governments. Respondents would include owners and operators of public water systems, who must report to their primacy agency(s). Respondent's obligation to respond: Under this rule the respondent's obligation to respond is mandatory. Section 1401(1)(D) of the Safe Drinking Water Act (SDWA) requires that ``criteria and procedures to assure a supply of drinking water which dependably complies with such maximum contaminant levels [or treatment techniques promulgated in lieu of a maximum contaminant level]; including accepted methods for quality control and testing procedures to insure compliance with such levels and to insure proper operation and maintenance of the system . . .'' Furthermore, section 1445(a)(1)(A) of the SDWA requires that ``[e]very person who is subject to any requirement of this subchapter or who is a grantee, shall establish and maintain such records, make such reports, conduct such monitoring, and provide such information as the Administrator may reasonably require by regulation to assist the Administrator in establishing regulations under this subchapter, in determining whether such person has acted or is acting in compliance with this subchapter . . .'' In addition, section 1413(a)(3) of the SDWA requires states to ``keep such records and make such reports . . . as the Administrator may require by regulation.'' Estimated number of respondents: The total number of respondents for the ICR would be 67,712. The total reflects 56 primacy agencies and 67,656 public water systems. Frequency of Response: During the initial three year period, public water systems will conduct one-time startup activities. The one-time burden associated with reading and understanding the rule, assigning personnel and resources, and attending training is estimated to be an average of 20 hours per system. These activities will be undertaken by all 67,656 CWSs and NTNCWSs that must comply with the LCRR. The total burden for these activities, for the three year period, for all systems is estimated to be 1,353,120 hours. During the initial three year period, primacy agencies will incur burdens associated with one-time startup activities. The burden associated with adopting the rule, modifying ***data*** systems, and providing training for internal staff and the staff of public water systems during the first three years is estimated at an average of 7,128 hours per primacy agency. The total burden for these activities, for the three year period, for the 56 primacy agencies is estimated to be 399,168 hours. Average estimated burden: The average burden per response (i.e , the amount of time needed for each activity that requires a ***collection*** of information) is estimated to be 9.16 to 9.63 hours; the average cost per response is $333-351. Total estimated burden: For the first three years after the final rule is published, water systems and primacy agencies will implement several requirements. Since the first three years of the rule focuses on the creation of inventories for LSLs, households are not faced with costs. The public water systems burden will include the following activities: Reading and understanding the revised rule, personnel time for attending trainings, clarifying regulatory requirements with the primacy agency during rule implementation. Public water systems will also be required to create an LSL materials inventory and develop an initial LSLR plan. The total burden hours for public water systems ranges from 2.51 to 2.69 million hours. The total cost for public water systems ranges from $77.5 to $83.4 million. For additional information on the public water systems activity burden see sections VI.D of this preamble. The state burden for the first three years of rule implementation would include the following: Adopting the rule[[Page 4273]]and developing an implementation program; modifying ***data*** recording systems; training staff; providing water system staff with initial and on-going technical assistance and training; coordinating annual administration tasks with EPA; reporting ***data*** to SDWIS/Fed; reviewing public water system (PWS) inventory ***data***; and conferring with LSL water systems on initial planning for LSLR program activities. The total burden hours for primacy agencies is 657,034 to 698,096 hours. The total cost for primacy agencies is $37.6 to $40.0 million. See section VI.D.8 of this preamble for additional discussion on burden and cost to the primacy agency. The net change burden associated with moving from the information requirements of the previous rule to those in the final LCRR over the three years covered by the ICR is 3.17 to 3.4 million hours, for an average of 1.06 to 1.13 million hours per year. The range reflects the upper- and lower-bound estimates of the number of systems that need to develop LSL inventories. The total net change in costs over the three-year clearance period are $115.2 to $123.3 million, for an average of $38.4 to $41.1 million per year (simple average over three years). An agency may not conduct or sponsor, and a person is not required to respond to, a ***collection*** of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations in 40 CFR are listed in 40 CFR part 9. When OMB approves this ICR, the Agency will announce that approval in the Federal Register and publish a technical amendment to 40 CFR part 9 to display the OMB control number for the approved information ***collection*** activities contained in this final rule.D. Regulatory Flexibility Act as Amended by the Small Business Regulatory Fairness Act (RFA) Pursuant to sections 603 and 609(b) of the RFA, EPA prepared an initial regulatory flexibility analysis (IRFA) for the proposed rule and convened a Small Business Advocacy Review (SBAR) Panel to obtain advice and recommendations from small entity representatives that potentially would be subject to the rule's requirements. Summaries of the IFRA and Panel recommendations are presented in the proposed rule at 84 FR 61684, November 13, 2019. As required by section 604 of the RFA, EPA prepared a final regulatory flexibility analysis (FRFA) for this action. The FRFA addresses the issues raised by public comments on the IRFA for the proposed rule. The complete FRFA is available for review in Chapter 8, section 8.4 of the final rule EA and is summarized here. For purposes of assessing the impacts of this final rule on small entities, EPA considered small entities to be water systems serving 10,000 people or fewer. This is the threshold specified by Congress in the 1996 Amendments to the SDWA for small water system flexibility provisions. As required by the RFA, EPA proposed using this alternative definition in the Federal Register (FR) (US EPA, 1998b, 63 FR 7620, February 13, 1998), sought public comment, consulted with the Small Business Administration, and finalized the small water system threshold in the Agency's Consumer Confidence Report regulation (USEPA, 1998a, 63 FR 44524, August 19, 1998). As stated in that document, the alternative definition would apply to this regulation. Under the SDWA, EPA sets public health goals and enforceable standards for drinking water quality. As previously described, the LCR requires water systems to take actions to address lead and copper contamination in drinking water, including corrosion control treatment, public education, and LSLR. EPA regulatory revisions in the final rule strengthen public health protection and improve implementation in the following areas: Tap sampling, corrosion control treatment, LSLR, public notification and public education. EPA took a number of steps to solicit small entity stakeholder input during the development of the final LCRR. Chapter 2, Section 2.2 of the final rule EA contains detailed information on stakeholder outreach during the rulemaking process, including material on the Federalism and Tribal consultation processes (also outlined in Sections VII.F and VII.G of this preamble). EPA also specifically sought input from small entity stakeholders through the Small Business Advocacy Review Panel (SBAR) process under Section 609(b) of the RFA, as amended by the SBREFA. On August 14, 2012, the EPA's Small Business Advocacy Chairperson convened an SBAR Panel. In addition to its chairperson, the SBAR Panel consisted of the Director of the Standards and Risk Management Division within the EPA's Office of Ground Water and Drinking Water, the Administrator of the Office of Information and Regulatory Affairs within the OMB, and the Chief Counsel for Advocacy of the SBA. Detailed information on the overall panel process can be found in the panel report titled, The Small Business Advocacy Review Panel on EPA's Planned Proposed Rule to Public Water System Requirements available in the LCRR docket (EPA-HQ-OW-2017-0300). The Agency also received comment on the proposed rule revisions that provided small CWSs, serving 10,000 or fewer persons, and all NTNCWSs greater flexibility to comply with the requirements of the LCRR. The detailed public comment summaries including EPA's detailed responses are provided in Section III.E.2 of this preamble. EPA identified over 63,324 small public water systems that may be impacted by the final LCR revisions. A small public water system serves between 25 and 10,000 people. These water systems include over 45,758 CWSs that serve year-round residents and more than 17,566 NTNCWSs that serve the same persons over six months per year (e.g , a public water system that is an office park or church). The final rule revisions to the LCR include requirements for: Conducting an LSL inventory that is updated annually; installing or re-optimizing corrosion control treatment when water quality declines; enhanced water quality parameter monitoring; establishment of a ``find-and-fix'' provision to evaluate and remediate elevated lead at a site where the tap sample exceeds the lead action level; and improved customer outreach. These final rule revisions also include reporting and recordkeeping requirements. States are required to implement operator certification (and recertification) programs under SDWA section 1419 to ensure operators of CWSs and NTNCWSs, including small water system operators, have the appropriate level of certification. As a mechanism to reduce the burden of the final rule requirements on small entities EPA has promulgated compliance flexibilities for small CWSs serving 10,000 or fewer persons, and all NTNCWS with a 90th percentile lead value above the lead trigger level or action level. These systems may choose between LSLR; CCT installation; POU device installation and maintenance; and replacement of lead-bearing materials as the compliance option. As part of the FRFA analysis, EPA is estimating low and high cost scenarios to characterize uncertainty in the cost model results. These scenarios are functions of assigning different, low and high, input values to a number of variables that affect the relative cost of the small system compliance options. As indicated in Exhibit 7-1, under the previous LCR, EPA estimates that, under the low cost scenario, 26,013 small CWSs will have annual total LCR related costs of more than one percent of revenues, and that 13,339 of these[[Page 4274]]small CWSs will have annual total costs of three percent or greater of revenue. Under the final LCRR, the number of small CWSs that will experience annual total costs of more than one percent of revenues increases by 11,873 to 37,885 and the number of small CWSs that will have annual total costs exceeding three percent of revenues increases by 8,521 to 21,860. Under the high cost scenario, EPA estimates that under the previous LCR, 27,719 small CWSs will have annual total costs of more than one percent of revenues, and that 15,472 of these small CWSs will have annual total costs of three percent or greater of revenue. Under the final LCRR, the number of small CWSs that will experience annual total costs of more than one percent of revenues increases by 13,221 to 40,940 and the number of small CWSs that will have annual total costs of more than three percent of revenues increases by 9,994 to 25,466. Exhibit 7-1--Number of Small Community Water Systems With Annual LCR- Related Costs of Above 1 Percent or 3 Percent of Annual Revenue for the Previous Rule and Final LCRR Under the Low Cost and High Cost Scenarios------------------------------------------------------------------------ Number of small CWSs with: Previous rule Final LCRR------------------------------------------------------------------------ Low Cost Scenario------------------------------------------------------------------------Annual LCR-related costs >1 percent of 26,013 37,885 revenue................................Annual LCR-related costs >3 percent of 13,339 21,860 revenue................................------------------------------------------------------------------------ High Cost Scenario------------------------------------------------------------------------Annual LCR-related costs >1 percent of 27,719 40,940 revenue................................Annual LCR-related costs >3 percent of 15,472 25,466 revenue................................------------------------------------------------------------------------ EPA also assessed the degree to which the final LCRR small system flexibilities would mitigate compliance costs. The Agency estimated the cost of the LCRR if no compliance alternatives were available to small systems. The annual incremental cost of the LCRR without the small system compliance alternatives ranges from $174 to $419 million at a 3 percent discount rate, and from $180 to $474 million at a 7 percent discount rate in 2016 dollars. This demonstrates a cost savings, from allowing CWSs that serve 10,000 or fewer persons, and all NTNCWSs compliance flexibilities, of between $13 million and $101 million across discount rates and low/high cost scenarios. See Chapter 8, section 8.4 of the final LCRR Economic Analysis (USEPA, 2020a) for more information on the characterization of the impacts under the final rule. EPA has considered an alternative approach to provide regulatory flexibility to small water systems. Section 8.4 of the final LCRR Economic Analysis contains an assessment of impacts for an alternative option that sets the threshold for system compliance flexibility at systems serving 3,300 or fewer persons. See section III.E of this preamble for the detailed explanation of the rationale for EPA's selection of systems serving 10,000 or fewer persons for the CWS small systems flexibilities threshold. In addition, EPA is preparing a Small Entity Compliance Guide to help small entities comply with this rule. The Small System Compliance Guide would be developed the first 3 years after promulgation.E. The Unfunded Mandates Reform Act (UMRA) This action contains a Federal mandate under UMRA, 2 U.S.C 1531-1538, that may result in expenditures of $100 million or more for state, local and tribal governments, in the aggregate, or the private sector in any one year. Accordingly, EPA has prepared a written statement required under section 202 of UMRA. The statement is included in the docket for this action (see Chapter 8 in the Economic Analysis of the Final Lead and Copper Rule Revisions (USEPA, 2020a)) and is briefly summarized here. Consistent with the intergovernmental consultation provisions of UMRA section 204, EPA consulted with governmental entities affected by this rule. EPA describes the government-to-government dialogue and comments from state, local, and tribal governments in section VII.F Executive Order 13132: Federalism and section VII.G Executive Order 13175: Consultation and Coordination with Indian Tribal Governments of this preamble. Consistent with UMRA section 205, EPA identified and analyzed a reasonable number of regulatory alternatives to determine the treatment technique requirements in the final LCR revisions. Sections III, IV, and V of this preamble describe the final options. See section VI.F of this preamble and Chapter 9 in the Economic Analysis of the Final Lead and Copper Rule Revisions (USEPA, 2020a) for alternative options that were considered. This action may significantly or uniquely affect small governments. EPA consulted with small governments concerning the regulatory requirements that might significantly or uniquely affect them. EPA describes this consultation above in the Regulatory Flexibility Act (RFA), section VIII.D of this preamble.F. Executive Order 13132: Federalism EPA has concluded that this action has Federalism implications, as specified in Executive Order 13132 (64 FR 43255, August 10, 1999), because it imposes substantial direct compliance costs on state or local governments. EPA provides the following federalism summary impact statement. EPA consulted with state and local officials early in the process of developing the proposed action to permit them to have meaningful and timely input into its development. EPA held federalism consultations on November 15, 2011, and on January 8, 2018. EPA invited the following national organizations representing state and local elected officials to a meeting on January 8, 2018, in Washington DC: The National Governors' Association, the National Conference of State Legislatures, the Council of State Governments, the National League of Cities, the U.S Conference of Mayors, the National Association of Counties, the International City/County Management Association, the National Association of Towns and Townships, the County Executives of America, and the Environmental Council of the States. Additionally, EPA invited the Association of State Drinking Water Administrators, the Association of Metropolitan Water Agencies, the[[Page 4275]]National Rural Water Association, the American Water Works Association, the American Public Works Association, the National School Board Association, the American Association of School Administrators, and the Western Governors' Association to participate in the meeting. EPA also provided the associations' membership an opportunity to provide input during follow-up meetings. EPA held five follow up meetings between January 8, 2018, and March 8, 2018. In addition to input received during the meetings, EPA provided an opportunity to receive written input within 60 days after the initial meeting. A summary report of the views expressed during Federalism consultations is available in the Docket (EPA-HQ-OW-2017-0300).G. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments This action has tribal implications, since it may impose substantial direct compliance costs on tribal governments, and the Federal Government will not provide the funds necessary to pay those costs. There are 996 public water systems serving tribal communities, 87 of which are federally owned. The economic analysis of the final LCRR requirements estimated that the total annualized incremental costs placed on all systems serving tribal communities ranges from $1-$2.4 million. While the average annual incremental cost increase per tribal system is estimated to range from $1,027 to $2,362, EPA notes that these estimated impacts will not fall evenly across all tribal systems. The final LCRR does offer regulatory relief by providing flexibility for CWSs serving 10,000 or fewer people and all NTNCWSs to choose CCT, LSLR, POU devices, and replacement of lead-bearing materials to address lead in drinking water. This flexibility may result in LCR implementation cost savings for many tribal systems since 98 percent of tribal CWSs serve 10,000 or fewer people and 17 percent of all tribal systems are NTNCWSs. EPA consulted with tribal officials under EPA's Policy on Consultation and Coordination with Indian Tribes early in the process of developing this regulation to permit them to have meaningful and timely input into its development. A summary of that consultation is provided in the Docket (EPA-HQ-OW-2017-0300). EPA held consultations with federally-recognized Indian Tribes in 2011 and 2018. The 2018 consultations with federally-recognized Indian Tribes began on January 16, 2018 and ended March 16, 2018. The first national webinar was held January 31, 2018, while the second national webinar was held February 15, 2018. A total of 48 tribal representatives participated in the two webinars. Updates on the consultation process were provided to the National Tribal Water Council upon request at regularly scheduled monthly meetings during the consultation process. Also, upon request, informational webinars were provided to the National Tribal Toxics Council's Lead Subcommittee on January 30, 2018, and EPA Region 9's Regional Tribal Operations Committee (RTOC) on February 8, 2018. Additionally, EPA received written comments from the following Tribes and tribal organizations: The Navajo Tribal Utility Authority, the National Tribal Water Council, the United South and Eastern Tribes Sovereignty Protection Fund, and the Yukon River Inter-Tribal Watershed Council. EPA has reviewed the estimated cost ***data***, the comments received from tribal groups, and the quantified and non-quantified benefits associated with the revision to the LCR and determined that the regulatory burden placed on tribes is outweighed by the positive benefits. Given that the majority of tribal systems serve fewer than 10,000 persons, EPA has provided regulatory relief in the form of small system compliance flexibilities. For additional information on these compliance flexibilities and their estimated impacts see sections III.E and VII.D of this preamble and Chapter 8, section 8.4 of the final LCRR Economic Analysis (USEPA, 2020a). As required by section 7(a) of the Executive order, EPA's Tribal Official has certified that the requirements of the executive order have been met in a meaningful and timely manner. A copy of the certification is included in the docket for this action.H. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks This action is subject to Executive Order 13045 because it is an economically significant regulatory action as defined by Executive Order 12866, and, based on the record, EPA finds that the environmental health or safety risk addressed by this action has a disproportionate effect on children. Accordingly, EPA has evaluated the environmental health and safety effects of lead found in drinking water on children and estimated the exposure reduction, risk reduction and health endpoint impacts to children associated with the adoption and optimization of corrosion control treatment technologies and the replacement of LSLs. There are non-quantified lead health benefits to children that will be realized as a result of this rulemaking, including from testing in schools and child care facilities. EPA assessed benefits of the LCRR in terms of avoided losses in the intelligence quotient (IQ) in children that result from the additional actions required under the LCRR. The results of these evaluations are contained in the Economic Analysis of the Final Lead and Copper Rule Revisions (USEPA, 2020a) and described in section VI.D.2 of this preamble. Copies of the Economic Analysis of the Final Lead and Copper Rule Revisions and supporting information are available in the Docket (EPA-HQ-OW-2017-0300).I. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use This action is not a ``significant energy action'' because it is not likely to have a significant adverse effect on the supply, distribution or use of energy. The public and private water systems affected by this action do not, as a rule, generate power. This action does not regulate any aspect of energy distribution as the water systems that are regulated by the LCR already have electrical service. Finally, EPA has determined that the incremental energy used to implement corrosion control treatment at drinking water systems in response to the final regulatory requirements is minimal. As such, EPA does not anticipate that this rule will have a significant adverse effect on the supply, distribution, or use of energy.J. National Technology Transfer and Advancement Act of 1995 This action involves technical standards. EPA may use existing voluntary consensus standards as it relates to additional monitoring for lead and copper, since monitoring and sample analysis methodologies are often based on voluntary consensus standards. However, the final LCRR does not change any methodological requirements for monitoring or sample analysis. EPA's approved monitoring and sampling protocols generally include voluntary consensus standards that are in accordance with applicable standards established by an organization accredited for that purpose such as the American National Standards Institute (ANSI), and other such accrediting bodies deemed appropriate for compliance monitoring by the Administrator. EPA notes that in some cases, this rule revises the required frequency and number of lead tap samples.[[Page 4276]]K. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations EPA believes that this action does not have disproportionately high and adverse human health or environmental effects on minority populations, low-income populations and/or indigenous peoples, as specified in Executive Order 12898 (59 FR 7629, February 16, 1994). The documentation for this decision is contained in the Environmental Justice Analysis for the Final Lead and Copper Revision Rule Report, which can be found in the docket ID EPA-HQ-OW-2017-0300. Executive Order 12898 (59 FR 7629, February 16, 1994) establishes Federal executive policy on environmental justice. Its main provision directs Federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission. Agencies must do this by identifying and addressing as appropriate any disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States. In evaluating baseline exposure to lead in drinking water, ***data*** indicate that the possibility of a disproportionately high and adverse human health risk among minority populations and low-income populations exist. Higher than expected proportions of children in minority households and/or low-income households live in housing built during decades of higher LSL usage. The final rule seeks to reduce the health risks of exposure to lead in drinking water provided by CWSs and NTNCWSs. Since water systems with LSLs are more likely to have an action level exceedance or a trigger level exceedance and, therefore, engage in actions to reduce lead concentrations, the final rule should help improve the baseline environmental justice concerns. The final rule is not expected to have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. The final rule should result in CCT and LSLR changes at water systems with higher baseline lead concentrations. It increases the level of health protection for all affected populations. The LSLR provision may be less likely than the CCT provision to address baseline health risk disparity among low-income populations because LSLR may not be affordable for low-income households. However, there are Federal and state programs that may be used to fund LSLR programs including the cost of LSLR for customer-owned LSLs. These include but are not limited to the Drinking Water State Revolving Fund (DWSRF), Water Infrastructure Finance and Innovation Act (WIFIA) Program, Water Infrastructure Improvements for the Nation (WIIN) Act of 2016 grant programs, and U.S Department of Housing and Urban Development's (HUD) Community Development Block Grant (CDBG) Program. The benefit-cost analysis of the final rule indicates that CCT changes will account for most of the benefits. Therefore, health risk reduction benefits will be more uniformly distributed among populations with high baseline health risks including minority and low-income households. Also, given the availability of Federal and state funding sources to support full LSLR, the final rule meets the intent of the Federal policy requiring incorporation of environmental justice into Federal agency missions.L. Consultations With the Science Advisory Board and the National Drinking Water Advisory Council1. Consultation With the Science Advisory Board (SAB) Under SDWA Section 1412(e) As required by section 1412(e) of the SDWA, in 2011, EPA sought an evaluation of current scientific ***data*** to determine whether partial LSLR effectively reduce water lead levels. When the LCR was promulgated in 1991, large water systems, serving greater than 50,000 people, were required to install CCT and small and medium water systems, serving 50,000 or fewer people if samples exceeded the action level for lead. If the action level was not met after installing CCT, water systems are required to replace 7 percent of its LSLs annually. However, in 2000, revisions to the LCR allowed water systems, if they exceeded the action level, to replace only the portion of the LSL that the water system owned and to replace the customer's portion of the LSL at the customer's expense. This practice is known as a partial LSLR. EPA asked the SAB to evaluate the current scientific ***data*** on the following five partial LSLR issues: (1) Associations between partial LSLR and blood lead levels in children; (2) lead tap water sampling ***data*** before and after partial LSLR; (3) comparisons between partial and full LSLR; (4) partial LSLR techniques; and (5) the impact of galvanic corrosion. EPA identified several studies for the SAB to review while the SAB selected additional studies for their evaluation. The SAB deliberated and sought input from public meetings held on March 30 and 31, 2011, and during a public conference call on May 16, 2011. The SAB's final report, titled ``SAB Evaluation of the Effectiveness of Partial Lead Service Line Replacements'' was approved by the SAB on July 19, 2011, and transmitted to the EPA Administrator on September 28, 2011. The SAB determined that the quality and quantity of ***data*** was inadequate to fully evaluate the effectiveness of partial LSLR in reducing drinking water lead concentrations. Both the small number of studies and the limitations within these studies (i.e , lack of comparability between studies, small sample size) barred a comprehensive assessment of partial LSLR efficacy. However, despite the limitations, the SAB concluded that partial LSLR's have not been shown to reliably reduce drinking water lead levels in the short-term of days to months, and potentially even longer. Additionally, partial LSLR is often associated with elevated drinking water lead levels in the short-term. The available ***data*** suggested that the elevated drinking water lead levels after the partial LSLR tend to stabilize over time to lower than or to levels similar to before the partial LSLR. Therefore, the SAB concluded that available ***data*** suggest that partial LSLR's may pose a risk to the population due to short-term elevations in drinking water lead concentrations after a partial LSLR, which last for an unknown period. Considering the SAB's findings on partial LSLR, EPA determined that partial replacements should no longer be required when water systems exceed the action level for lead, but EPA still considers full replacement of the LSL as beneficial (USEPA, 2011b). Following the proposal, the SAB elected to review the scientific and technical basis of the proposed rule, on March 30, 2020. A work group took the lead in SAB deliberations on this topic at a public teleconference held on May 11, 2020. The SAB provided advice and comments in its June 12, 2020 report. Similar comments that were raised by the SAB were also raised by public commenters. As a result, the comments have been addressed by EPA in the final rule, supporting documents and throughout this notice.2. Consultation With National Drinking Water Advisory Council Under SDWA Section 1412(d) The National Drinking Water Advisory Council (NDWAC) is a Federal Advisory Committee that supports EPA[[Page 4277]]in performing its duties and responsibilities related to the national drinking water program and was created as a part of SDWA in 1974. EPA sought advice from the NDWAC as required under Section 1446 of the SDWA. EPA consulted with NDWAC on July 21-22, 2011, to provide updates on the proposed LCR revisions and solicit feedback on potential regulatory options under consideration. In November 2011, NDWAC held deliberations on LSLR requirements after they received the SAB's final report on the effectiveness of partial LSLR. In December 2011, a public meeting was held where NDWAC provided EPA with major recommendations on the potential LCR regulatory revisions, which are outlined in a letter dated December 23, 2011. In 2014, the NDWAC formed the Lead and Copper Rule Working Group (LCRWG) to provide additional advice to EPA on potential options for long-term regulatory revisions. EPA held meetings from March of 2014 until June 2015 where NDWAC LCRWG members discussed components of the rule and provided EPA with advice for addressing the following issues: Sample site ***collection*** criteria, lead sampling protocols, public education for copper, and measures to ensure optimal CCT and LSLR. NDWAC provided the Agency with their final recommendations and findings in a report submitted to the Administrator in December 2015. In the report, NDWAC acknowledged that reducing lead exposure is a shared responsibility between consumers, the government, public water systems, building owners, and public health officials. In addition, they recognized that creative financing is necessary to reach the LSL removal goals, especially for disparate and vulnerable communities. The NDWAC advised EPA to maintain the LCR as a treatment technique rule but with enhanced improvements. NDWAC qualitatively considered costs before finalizing its recommendations, emphasizing that public water systems and states should focus efforts where the greatest public health protection can be achieved, incorporating their anticipated costs in their capital improvement program or the requests for Drinking Water State Revolving Funds. The LCRWG outlined an extensive list of recommendations for the LCR revisions, including establishing a goal-based LSLR program, strengthening CCT requirements, and tailoring water quality parameters to the specific CCT plan for each water system. The report NDWAC provided for EPA also included recommendations for renewed collaborative commitments between government and all levels of the public from state and local agencies, to other stakeholders and consumers while recognizing EPA's leadership role in this area. These complementary actions as well as a detailed description of the provisions for NDWAC's recommendations for the long-term revisions to the LCR can be found in the ``Report of the Lead and Copper Rule Working Group to the National Drinking Water Advisory Council'' (NDWAC, 2015). EPA took into consideration NDWAC's recommendations when developing these revisions to the LCR. On December 4-5, 2019, EPA held a NDWAC meeting in Washington, DC where EPA presented the proposed Lead and Copper Rule Revisions (LCRR). In the presentation, the major LCRR revisions were highlighted such as the LSL inventory, the new trigger level of 10 ppb, and new sampling protocols. The presentation focused on six key areas: Identifying areas most impacted, strengthening treatment requirements, replacing LSLs, increasing sampling reliability, improving risk communication, and protecting children in schools. EPA reiterated that the LCRR was developed with extensive consultation from state, local and tribal partners to identify avenues that would reduce elevated levels of lead in drinking water. EPA reaffirmed its commitment to transparency and improved communication to the public.M. Consultation With the Department of Health and Human Services Under SDWA Section 1412(d) On June 12, 2019, EPA consulted with the Department of Health and Human Services (HHS) on the proposed LCRR. On July 22, 2020, EPA consulted with the Department of Health and Human Services (HHS) on the final rule. EPA received and considered comments from the HHS for both the proposal and final rules through the inter-agency review process described in section VII.A of this preamble.N. Congressional Review Act (CRA) This action is subject to the CRA, and the EPA will submit a rule report to each House of the Congress and to the Comptroller General of the United States. This action is a ``major rule'' as defined by 5 U.S.C 804(2).VIII. ReferencesAAP COUNCIL ON ENVIRONMENTAL HEALTH, 2016. Prevention of Childhood Lead Toxicity. Pediatrics. 2016;138(1):e20161493ANSI. (November 1, 2017). Replacement and Flushing of Lead Service Lines. AWWA C810-17 43810. First Edition. Denver, CO: AWWA, 2017.Association of State Drinking Water Administrators (ASDWA). 2020. Costs of States Transactions Study (CoSTS) for EPA's Proposed LCRR. February 6, 2020.Association of State Drinking Water Administrators. 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Pediatric Research 12(1):29-34.List of Subjects40 CFR Part 141 Environmental protection, Copper, Indians--lands, Intergovernmental relations, Lead, Lead service line, National Primary Drinking Water Regulation, Reporting and recordkeeping requirements, Water supply.40 CFR Part 142 Environmental protection, Administrative practice and procedure, Copper, Indians--lands, Intergovernmental relations, Lead, Lead service line, National Primary Drinking Water Regulation, Reporting and recordkeeping requirements, Water supply.Andrew Wheeler,Administrator. For the reasons stated in the preamble, the Environmental Protection Agency amends 40 CFR parts 141 and 142 as follows:PART 141--NATIONAL PRIMARY DRINKING WATER REGULATIONS01. The authority citation for part 141 continues to read as follows: Authority: 42 U.S.C 300f, 300g-1, 300g-2, 300g-3, 300g-4, 300g-5, 300g-6, 300j-4, 300j-9, and 300j-11.02. Amend Sec. 141.2 by:0a. Revising the definition of ``Action level'';0b. Adding in alphabetical order the definitions of ``Aerator'', ``Child care facility'', ``Elementary schools'', ``Fifth liter sample'', and ``Find-and-fix'';0c. Revising the definition for ``First draw sample'';0d. Adding in alphabetical order the definitions of ``Full lead service line replacement,'' ``Galvanized service line'', and ``Gooseneck, pigtail, or connector'';0e. Revising the definition of ``Lead service line'';[[Page 4281]]0f. Adding in alphabetical order the definitions of ``Lead status unknown service line'' and ``Lead trigger level'';0g. Revising the definition of ``Medium-size water system'';0h. Adding in alphabetical order the definitions of ``Method detection limit (MDL)'', ``Partial lead service line replacement'', and ``Pitcher filter'';0i. Removing the definition of ``Point-of-use treatment device (POU)'';0j. Adding in alphabetical order the definitions ``Point-of-use treatment device or point of use device (POU),'' ``Practical quantitation limit (PQL)'', ``Pre-stagnation flushing'', ``School'', and ``Secondary school''.0k. Removing the definition ``Service line sample''. l. Adding in alphabetical order the definitions ``System without corrosion control treatment'', ``Tap sampling monitoring period'', ``Tap sampling period'', ``Tap sampling protocol'', and ``Wide-mouth bottles''. The revisions and additions read as follows:Sec. 141.2 Definitions.\* \* \* \* \* Action level means the concentrations of lead or copper in water as specified in Sec. 141.80(c) which determines requirements under subpart I of this part. The action level for lead is 0.015 mg/L and the action level for copper is 1.3 mg/L. Aerator means the device embedded in the water faucet to enhance air flow with the water stream and to prevent splashing.\* \* \* \* \* Child care facility means a location that houses a licensed provider of child care, day care, or early learning services to children, as determined by the State, local, or tribal licensing agency.\* \* \* \* \* Elementary school, for the purposes of subpart I of this part only, means a school classified as elementary by state and local practice and composed of any span of grades (including pre-school) not above grade 8.\* \* \* \* \* Fifth liter sample, for purposes of subpart I of this part, means a one-liter sample of tap water ***collected*** in accordance with Sec. 141.86(b).\* \* \* \* \* Find-and-fix means the requirements under subpart I of this part that water systems must perform at every tap sampling site that yielded a lead result above 15 [mu]g/L.\* \* \* \* \* First draw sample means the first one-liter sample of tap water ***collected*** in accordance with Sec. 141.86(b)(2).\* \* \* \* \* Full lead service line replacement means the replacement of a lead service line (as well as galvanized service lines requiring replacement), as defined in this section, that results in the entire length of the service line, regardless of service line ownership, meeting the Safe Drinking Water Act (SDWA) Section 1417 definition of lead free applicable at the time of the replacement. A full lead service line replacement includes a replacement where only one portion of the service line is lead, such as where a partial lead service line was previously conducted, as long as, upon completion of the replacement, the entire service line meets the SDWA Section 1417 definition of lead-free applicable at the time of the replacement. Galvanized service lines that are or were downstream of a lead service line must also be replaced for a service line to be a full lead service line replacement. A lead service line that is left in place in the ground but remains out-of-service may be full lead service line replacement where a new non-lead service line is installed for use instead of the out-of-service lead service line.\* \* \* \* \* Galvanized service line means iron or steel piping that has been dipped in zinc to prevent corrosion and rusting. Gooseneck, pigtail, or connector is a short section of piping, typically not exceeding two feet, which can be bent and used for connections between rigid service piping. For purposes of this subpart, lead goosenecks, pigtails, and connectors are not considered to be part of the lead service line but may be required to be replaced pursuant to Sec. 141.84(c).\* \* \* \* \* Lead service line means a portion of pipe that is made of lead, which connects the water main to the building inlet. A lead service line may be owned by the water system, owned by the property owner, or both. For the purposes of this subpart, a galvanized service line is considered a lead service line if it ever was or is currently downstream of any lead service line or service line of unknown material. If the only lead piping serving the home is a lead gooseneck, pigtail, or connector, and it is not a galvanized service line that is considered a lead service line the service line is not a lead service line. For purposes of Sec. 141.86(a) only, a galvanized service line is not considered a lead service line. Lead status unknown service line means a service line that has not been demonstrated to meet or not meet the SDWA Section 1417 definition of lead free. It is not necessary to physically verify the material composition (for example, copper or plastic) of a service line for its lead status to be identified (e.g , records demonstrating the service line was installed after a municipal, State, or Federal lead ban). Lead trigger level means a particular concentration of lead in water that prompts certain activities under subpart I of this part. The trigger level for lead is a concentration of 10 [mu]g/L.\* \* \* \* \* Medium-size water system, for the purpose of subpart I of this part only, means a water system that serves greater than 10,000 persons and less than or equal to 50,000 persons.\* \* \* \* \* Method detection limit (MDL) means the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.\* \* \* \* \* Partial lead service line replacement means replacement of any portion of a lead service line or galvanized service line requiring replacement, as defined in this section, that leaves in service any length of lead service line or galvanized service line requiring replacement upon completion of the work. Partial lead service line replacements are permitted under limited circumstances under Sec. 141.84(d) but do not count towards the mandatory or goal-based lead service line replacement rate.\* \* \* \* \* Pitcher filter means a non-plumbed water filtration device which consists of a gravity fed water filtration cartridge and a filtered drinking water reservoir that is certified by an American National Standards Institute accredited certifier to reduce lead in drinking water.\* \* \* \* \* Point-of-use treatment device or point of use device (POU) is a water treatment device physically installed or connected to a single fixture, outlet, or tap to reduce or remove contaminants in drinking water. For the purposes of subpart I of this part, it must be certified by an American National Standards Institute accredited certifier to reduce lead in drinking water. Practical quantitation limit (PQL) means the minimum concentration of an analyte (substance) that can be[[Page 4282]]measured with a high degree of confidence that the analyte is present at or above that concentration.\* \* \* \* \* Pre-stagnation flushing is the opening of tap(s) to flush standing water from plumbing prior to the minimum 6-hour stagnation period in anticipation of lead and copper tap sampling under subpart I of this part.\* \* \* \* \* School, for the purpose of subpart I of this part only, means any building(s) associated with public, private, or charter institutions that primarily provides teaching and learning for elementary or secondary students.\* \* \* \* \* Secondary school, for the purpose of subpart I of this part only, means a school comprising any span of grades beginning with the next grade following an elementary or middle school (usually 7, 8, or 9) and ending with or below grade 12. Both junior high schools and senior high schools are included.\* \* \* \* \* System without corrosion control treatment means a public water system that does not have or purchases all of its water from a system that does not have: (1) An optimal corrosion control treatment approved by the State; or (2) Any pH adjustment, alkalinity adjustment, and/or corrosion inhibitor addition resulting from other water quality adjustments as part of its treatment train infrastructure. Tap sampling monitoring period, for the purposes of subpart I of this part, means the period of time during which each water system must conduct tap sampling for lead and copper analysis. A tap sampling monitoring period is determined by lead and copper concentrations in tap samples and the frequency can range from every six months (i.e , semi-annual) up to once every nine years. Water systems on semi-annual tap sampling monitoring must ***collect*** samples no less frequently than every six months while those on annual monitoring must sample no less frequently than every year. Water systems on triennial monitoring must ***collect*** samples no less frequently than every three years; and those on monitoring waivers must sample no less frequently than every nine years. The start of each new tap sampling monitoring period, with the exception of semi-annual monitoring, must begin on January 1. Tap sampling period, for the purpose of subpart I of this part only, means the time period, within a tap sampling monitoring period, during which the water system is required to ***collect*** samples for lead and copper analysis. For systems monitoring at a reduced frequency, the tap sampling period must be between the months of June and September, unless a different 4-month period of time is approved in writing to be more appropriate by the State. Tap sampling protocol means the instructions given to residents or those sampling on behalf of the water system to conduct tap sampling under subpart I of this part.\* \* \* \* \* Wide-mouth bottles, for the purpose of subpart I of this part only, means bottles configured with a mouth that is at least 55 mm wide that are one liter in size.03. Amend Sec. 141.28 by revising paragraph (a) to read as follows:Sec. 141.28 Certified laboratories. (a) For the purpose of determining compliance with Sec. 141.21 through 141.27, 141.30, 141.40, 141.74, 141.89 and 141.402, samples may be considered only if they have been analyzed by a laboratory certified by the State except that measurements of alkalinity, disinfectant residual, orthophosphate, pH, silica, temperature, and turbidity may be performed by any person acceptable to the State.\* \* \* \* \*04. Amend Sec. 141.31 by revising paragraph (d) to read as follows:Sec. 141.31 Reporting requirements.\* \* \* \* \* (d)(1) The public water system, within 10 days of completing the public notification requirements under subpart Q of this part for the initial public notice and any repeat notices, must submit to the primary agency a certification that it has fully complied with the public notification regulations. For Tier 2 and 3 notices, the public water system must include with this certification a representative copy of each type of notice distributed, published, posted, and made available to the persons served by the system and to the media. (2) For Tier 1 notices for a lead action level exceedance, public water systems must provide a copy of any Tier 1 notice to the Administrator and the head of the primacy agency as soon as practicable, but not later than 24 hours after the public water system learns of the violation or exceedance.\* \* \* \* \*05. Amend Sec. 141.80 by:0a. Revising paragraphs (a), (b), (c), and (d)(1);0b. Adding paragraphs (d)(3) and (4);0c. Revising paragraphs (e), (f), (g), and (k); and0d. Adding paragraph (l). The revisions and additions read as follows:Sec. 141.80 General requirements. (a) Applicability, effective date, and compliance deadlines. The requirements of this subpart constitute the national primary drinking water regulations for lead and copper. (1) The provisions of this subpart apply to community water systems and non-transient, non-community water systems (in this subpart referred to as ``water systems'' or ``systems'') as defined at Sec. 141.2 (2) The requirements of this subpart are effective as of March 16, 2021. (3) Community water systems and non-transient, non-community water systems must comply with the requirements of this subpart no later than January 16, 2024, except where otherwise specified at Sec. Sec. 141.81, 141.84, 141.85, 141.86, and 141.90, or where an exemption in accordance with 40 CFR part 142, subpart C or F, has been established by the Administrator. (4)(i) Between March 16, 2021 and January 16, 2024, community water systems and non-transient, non-community water systems must comply with 40 CFR 141.80 through 141.91, as codified on July 1, 2020. (ii) If an exemption from subpart I of this part has been issued in accordance with 40 CFR part 142, subpart C or F, prior to March 16, 2021, then the water systems must comply with 40 CFR 141.80 through 141.91, as codified on July 1, 2020, until the expiration of that exemption. (b) Scope. The regulations in this subpart establish a treatment technique that includes requirements for corrosion control treatment, source water treatment, lead service line inventory, lead service line replacement, public notice, monitoring for lead in schools and child care facilities, and public education. Several of the requirements in this subpart are prompted by the lead and copper action levels or the lead trigger level, specified in paragraph (c) of this section, as measured in samples ***collected*** at consumers' taps. The requirements for sampling for lead in schools and child care facilities and public education requirements in this subpart apply to all community water systems regardless of the results of the compliance tap sampling. (c) Lead trigger level, lead action level, and copper action level. Trigger levels and action levels must be determined based on tap water samples ***collected*** in accordance with the tap sampling[[Page 4283]]monitoring requirements of Sec. 141.86 for the purpose of calculating the 90th percentile and tested using the analytical methods specified in Sec. 141.89 The trigger level and action levels described in this paragraph (c) are applicable to all sections of subpart I of this part. Trigger level and action levels for lead and copper are as follows: (1) The lead trigger level is exceeded if the 90th percentile concentration of lead as specified in paragraph (c)(4) of this section is greater than 10 [mu]g/L. (2) The lead action level is exceeded if the 90th percentile concentration of lead as specified in paragraph (c)(4) of this section is greater than 15 [mu]g/L. (3) The copper action level is exceeded if the 90th percentile concentration of copper as specified in paragraph (c)(4) of this section is greater than 1.3 mg/L. (4) For purposes of this subpart, the 90th percentile concentration shall be computed as follows: (i) For systems that do not have lead service line sites and only have sites identified as Tier 3, 4, or 5 under Sec. 141.86(a). (A) The results of all lead or copper samples taken during a tap sampling period shall be placed in ascending order from the sample with the lowest concentration to the sample with the highest concentration. Each sampling result shall be assigned a number, ascending by single integers beginning with the number 1 for the sample with the lowest contaminant level. The number assigned to the sample with the highest contaminant level shall be equal to the total number of samples taken. (B) The number of samples taken during the tap sampling period shall be multiplied by 0.9 (C) The contaminant concentration in the numbered sample yielded by the calculation in paragraph (c)(4)(i)(B) of this section is the 90th percentile concentration. (D) For water systems serving fewer than 100 people that ***collect*** 5 samples per tap sampling period, the 90th percentile concentration is the average of the highest and second highest concentration. (E) For a public water system that has been allowed by the State to ***collect*** fewer than five samples in accordance with Sec. 141.86(c), or has failed to ***collect*** five samples, the sample result with the highest concentration is considered the 90th percentile value. (ii) For public water systems with lead service lines with sites identified as Tier 1 or 2 under Sec. 141.86(a) with enough Tier 1 or 2 sites to meet the minimum number of sites listed in Sec. 141.86(c): (A) The results of all lead or copper samples taken at Tier 1 or Tier 2 sites during a tap sampling period shall be placed in ascending order from the sample with the lowest concentration to the sample with the highest concentration. Sample results from Tier 3, 4, or 5 sites shall not be included in this calculation. Each sampling result shall be assigned a number, ascending by single integers beginning with the number 1 for the sample with the lowest contaminant level. The number assigned to the sample with the highest contaminant level shall be equal to the total number of samples taken. (B) The number of samples taken at Tier 1 or Tier 2 sites during the tap sampling period shall be multiplied by 0.9 (C) The contaminant concentration in the numbered sample yielded by the calculation in paragraph (c)(4)(ii)(B) of this section is the 90th percentile concentration. (D) For water systems serving fewer than 100 people that ***collect*** 5 samples per tap sampling period, the 90th percentile concentration is the average of the highest and second highest concentration. (E) For a public water system that has been allowed by the State to ***collect*** fewer than five samples in accordance with Sec. 141.86(c), or has failed to ***collect*** five samples, the sample result with the highest concentration is considered the 90th percentile value. (iii) For systems with lead service lines with sites identified as Tier 1 or 2 under Sec. 141.86(a) with insufficient number of Tier 1 or 2 sites to meet the minimum number of sites listed in Sec. 141.86(c): (A) The results of all lead or copper samples taken at Tier 1 or Tier 2 sites along with the highest results from Tier 3, 4, or 5 sites sufficient to meet the minimum number of sites shall be placed in ascending order from the sample with the lowest concentration to the sample with the highest concentration. Sample results from any remaining Tier 3, 4, and 5 sites shall not be included in this calculation. Each sampling result shall be assigned a number, ascending by single integers beginning with the number 1 for the sample with the lowest contaminant level. The number assigned to the sample with the highest contaminant level shall be equal to the total minimum number of sites listed in Sec. 141.86(c). (B) The required minimum number of sites listed in Sec. 141.86(c) shall be multiplied by 0.9 (C) The contaminant concentration in the numbered sample yielded by the calculation in paragraph (c)(4)(iii)(B) is the 90th percentile concentration. (D) For water systems serving fewer than 100 people that ***collect*** 5 samples per tap sampling period, the 90th percentile concentration is the average of the highest and second highest concentration. (E) For a public water system that has been allowed by the State to ***collect*** fewer than five samples in accordance with Sec. 141.86(c), or has failed to ***collect*** five samples, the sample result with the highest concentration is considered the 90th percentile value. (d) Corrosion control requirements. (1) All water systems shall install and operate corrosion control treatment in accordance with Sec. Sec. 141.81 and 141.82, and that meets the definition of optimal corrosion control treatment at Sec. 141.2 \* \* \* \* \* (3) Any small or non-transient non-community water system that complies with the applicable small system compliance flexibility requirements specified by the State under Sec. Sec. 141.81(a)(3) and 141.93 is deemed to be in compliance with the treatment requirement in paragraph (d)(1) of this section. (4) Any water system shall notify the State in writing pursuant to Sec. 141.90(a)(3) of any upcoming long-term change in treatment or addition of a new source as described in Sec. 141.90(a)(3). The State must review and approve the addition of a new source or long-term change in water treatment before it is implemented by the water system. The State may require any such water system to conduct additional monitoring or to take other action the State deems appropriate to ensure that such water system maintains minimal levels of corrosion control in its distribution system. (e) Source water requirements. (1) Any system exceeding the lead or copper action level shall implement all applicable source water treatment requirements specified by the State under Sec. 141.83 (2) Any system that changes their source water or makes long-term treatment changes shall submit written documentation to the State describing the change in accordance with Sec. Sec. 141.81(a)(3), 141.86(d)(2)(iv), and 141.90(a)(3). The State must review and approve the change before it is implemented by the water system. (f) Lead service line replacements and inventory. Lead service line replacements must be conducted as follows: (1) Any water system exceeding the lead action level specified at paragraph[[Page 4284]](c) of this section must complete mandatory lead service line replacement. Lead service line replacement must be conducted in accordance with Sec. 141.84(g) and must include public education pursuant to Sec. 141.85(a) and (b). (2) Any water system exceeding the lead trigger level specified at paragraph (c) of this section must complete goal-based lead service line replacement pursuant to Sec. 141.84(f) and public education pursuant to Sec. 141.85(g) and (h). (3) All water systems must prepare an inventory of service lines connected to its distribution system, whether or not they are owned or controlled by the water system, to identify those service lines that are made of lead or of unknown material. The inventory must be prepared in accordance with Sec. 141.84(a). (g) Public education and notification requirements. Pursuant to Sec. 141.85(d), all water systems must provide notification of lead tap water monitoring results to persons served at the sites (taps) that are tested. All community water systems must conduct annual outreach to local and State health agencies pursuant to Sec. 141.85(i). In addition: (1) Any water system exceeding the lead action level specified at paragraph (c) of this section shall implement the public education requirements in accordance with Sec. 141.85(a) and (b). (2) Any water system exceeding the lead trigger level specified at paragraph (c) of this section shall provide notification to all customers with a lead service line in accordance with Sec. 141.85(g). (3) Any water system exceeding the lead action level specified at paragraph (c) of this section shall notify the public in accordance with the public notification requirements in subpart Q of this part. (4) Any water system with lead service lines, galvanized requiring replacement or lead status unknown service lines in their inventory as specified in Sec. 141.84(a) shall inform all consumers with a lead service line, galvanized requiring replacement, or a lead status unknown service line in accordance with Sec. 141.85(e). (5) Any water system that fails to reach its goal lead service line replacement rate as required under Sec. 141.84(f) shall conduct outreach activities in accordance with Sec. 141.85(h).\* \* \* \* \* (k) Violation of national primary drinking water regulations. Failure to comply with the applicable requirements of this section and Sec. Sec. 141.81 through 141.93, including requirements established by the State pursuant to the provisions in this subpart, is a violation of the national primary drinking water regulations for lead and copper. (l) Testing in schools and child care facilities. All community water systems must ***collect*** samples from all schools and child care facilities within its distribution system in accordance with Sec. 141.92 06. Revise Sec. 141.81 to read as follows:Sec. 141.81 Applicability of corrosion control treatment steps to small, medium, and large water systems. (a) Corrosion control treatment. This section sets forth when a system must complete the corrosion control treatment steps for systems in paragraph (d) or (e) of this section to optimize or re-optimize corrosion control treatment based on size, whether the system has corrosion control treatment, and whether it has exceeded the lead trigger and/or action level and/or the copper action level. (1) Large water system (serving 50,000 people). (i) Large water systems with corrosion control treatment that exceed either the lead trigger level or copper action level shall complete the corrosion control treatment steps specified in paragraph (d) of this section. (ii) Large water systems without corrosion control treatment with 90th percentile results as calculated in accordance with Sec. 141.80(c)(4) that exceed either the lead practical quantitation level of 0.005 mg/L or the copper action level shall complete the corrosion control treatment steps specified in paragraph (e) of this section. (iii) Large water systems with corrosion control treatment with 90th percentile results as calculated in accordance with Sec. 141.80(c)(4) that exceed the lead practical quantitation level but do not exceed lead trigger level or the copper action level may be required by the State to complete the corrosion control treatment steps in paragraph (d) of this section. (2) Medium-size water systems (serving 10,000 and <=50,000 people). (i) Medium-size water systems with corrosion control treatment that exceed either the lead trigger level or copper action level shall complete the corrosion control treatment steps specified in paragraph (d) of this section. (ii) Medium-size water systems without corrosion control treatment that exceed either the lead or copper action level shall complete the corrosion control treatment steps specified in paragraph (e) of this section. (iii) Medium-size water systems without corrosion control treatment that exceed the lead trigger level but do not exceed the lead or copper action levels shall complete the treatment recommendation step specified in paragraph (e)(1) of this section (Step 1). The water system shall complete the remaining steps in paragraph (e) of this section if it subsequently exceeds either the lead or copper action level. (3) Small water systems (serving <=10,000 people) and non-transient, non-community water systems. (i) Small and non-transient non-community water systems with corrosion control treatment that exceed the lead trigger level or the lead action level but do not exceed the copper action level, shall complete the corrosion control treatment steps specified in paragraph (d) of this section, if corrosion control treatment is approved by the State as a compliance option under Sec. 141.93(a). (ii) Small and non-transient, non-community water systems with corrosion control treatment that exceed the copper action level shall complete the corrosion control treatment steps specified in paragraph (d) of this section. (iii) Small and non-transient, non-community water systems without corrosion control treatment that exceed the lead action level shall complete the corrosion control treatment steps specified in paragraph (e) of this section if corrosion control treatment is approved by the State as a compliance option under Sec. 141.93 (iv) Small and non-transient, non-community water systems without corrosion control treatment that exceed the copper action level shall complete the corrosion control treatment steps specified in paragraph (e) of this section. (b) Systems deemed to have optimized corrosion control. A system is deemed to have optimal corrosion control treatment (OCCT) or re-optimized OCCT if the system satisfies one of the criteria specified in paragraphs (b)(1) through (3) of this section. Any such system deemed to have OCCT under this paragraph and which has corrosion control treatment in place shall continue to operate and maintain that treatment and meet any additional requirements that the State determines to be appropriate to ensure optimal corrosion control treatment is maintained. (1) A small or medium-size water system without corrosion control treatment is deemed to have optimal[[Page 4285]]corrosion control if the water system does not exceed the lead action level and copper action level during two consecutive 6-month tap sampling monitoring periods and thereafter remains at or below the lead trigger level and copper action level in all tap sampling periods conducted in accordance with Sec. 141.86 (2) A small or medium-size water system with corrosion control treatment is deemed to have optimal corrosion control treatment if the water system does not exceed the lead trigger level and copper action level during two consecutive 6-month monitoring periods conducted in accordance with Sec. 141.86 and thereafter remains at or below the lead trigger level and copper action level in all tap sampling periods conducted in accordance with Sec. 141.86 Small or medium-size systems with corrosion control treatment that exceed the lead trigger level but do not exceed the lead and copper action levels during two consecutive 6-month monitoring periods and thereafter remains at or below the lead and copper action levels in all tap sampling periods conducted in accordance with Sec. 141.86 are deemed to have re-optimized optimal corrosion control treatment if the system meets the requirements of this section. Where the State has set optimal water quality parameters (OWQPs) under paragraph (d) or (e) of this section a system will not be eligible to be deemed to have optimized or re-optimized OCCT pursuant to paragraph (b) of this section. (3) Any water system is deemed to have optimized or re-optimized corrosion control if it submits results of tap water monitoring in accordance with Sec. 141.86 demonstrating that the 90th percentile tap water lead level is less than or equal to the lead practical quantitation level of 0.005 mg/L and does not exceed the copper action level for two consecutive 6-month tap sampling monitoring periods, and does not have optimal water quality parameters that were set by the State under paragraph (d) or (e) of this section. Any such system with 90th percentile tap sample results that thereafter exceeds the lead practical quantitation level or copper action level during any tap sampling period shall not be eligible to be deemed to have optimized OCCT in accordance with this paragraph (b)(3) without first completing the treatment steps specified in paragraph (d) or (e) of this section (i) [Reserved] (ii) Any water system deemed to have optimized corrosion control in accordance with this paragraph (b)(3) shall continue monitoring for lead and copper at the tap no less frequently than once every three calendar years using the reduced number of sites specified in Sec. 141.86(c) and ***collecting*** samples at times and locations specified in Sec. 141.86(d)(4)(v). (iii) through (v) [Reserved] (c) Corrosion control steps completion for small and medium-size water systems without corrosion control treatment. Any small or medium-sized system without corrosion control treatment required to complete the corrosion control steps in paragraph (e) of this section due to its exceedance of the lead or copper action level that does not exceed either the lead or copper action levels during each of two consecutive 6-month tap sample monitoring periods pursuant to Sec. 141.86 prior to the start of Step 3 in paragraph (e)(3) of this section or Step 5 in paragraph (e)(5) of this section may cease completing the steps and is not required to complete Step 3 or Step 5, respectively, except that medium-sized systems with lead service lines and small systems with lead service lines that choose the corrosion control option pursuant to Sec. 141.93 must complete a corrosion control treatment study under paragraph (e)(3)(i) of this section. Any system that initiates Step 5 must complete all remaining steps in paragraphs (e)(6) through (8) of this section and is not permitted to cease the steps. Any system that ceases the steps either prior to Step 3 or Step 5 and thereafter exceeds either the lead or copper action level shall not be permitted to cease the steps a second time and shall complete the applicable treatment steps beginning with the first treatment step which was not previously completed in its entirety. The State may require a water system to repeat treatment steps previously completed by the water system when the State determines that this is necessary to implement the treatment requirements of this section. The State must notify the system in writing of such a determination and explain the basis for its decision. (d) Treatment steps and deadlines for water systems re-optimizing corrosion control treatment. Except as provided in paragraph (b) of this section or Sec. 141.93, water systems with corrosion control treatment shall complete the following corrosion control treatment steps (described in the referenced portions of Sec. Sec. 141.82, 141.86, and 141.87) by the indicated time periods. (1) Step 1. (i) A water system other than those covered in paragraph (d)(1)(ii) of this section shall recommend re-optimized optimal corrosion control treatment (Sec. 141.82(c)) within six months after the end of the tap sampling period during which it exceeds either the lead trigger level or copper action level. States may approve modifications of the existing corrosion control treatment without a study for systems that exceed the lead trigger level, but do not exceed the lead or copper action level. The State shall specify re-optimized corrosion control treatment within six months of receiving the treatment recommendation. The system shall complete modifications to corrosion control treatment to have re-optimized corrosion control treatment installed within six months of the State specifying re-optimized corrosion control treatment. (ii) A water system with lead service lines that exceeds the lead action level must harvest lead pipes from the distribution system and construct flow-through pipe loops and operate the loops with finished water within one year after the end of the tap sampling period during which it exceeds the lead action level. These water systems must proceed to Step 3 in paragraph (d)(3) of this section and conduct the corrosion control studies for re-optimization under paragraph (d)(3)(i) of this section using the pipe loops. (2) Step 2. (i) Large water systems shall conduct the corrosion control studies for re-optimization under paragraph (d)(3) of this section (Step 3) unless the system is at or below the lead action level and the State has approved the modification of the existing corrosion control treatment made under paragraph (d)(3)(i) of this section (Step 1). (ii) Within 12 months after the end of the tap sampling period during which a small or medium-size water system with corrosion control treatment exceeds the lead trigger level or copper action level, the State may require the water system to perform corrosion control studies for re-optimization (Sec. 141.82(c)(2) or (3)). If the State does not require the system to perform such studies, the State must specify re-optimized corrosion control treatment (Sec. 141.82(d)(2)) within the timeframes specified in paragraphs (d)(2)(ii)(A) and (B) of this section. The State must provide its determination to the system in writing. (A) For medium-size water systems, within 12 months after the end of the tap sampling period during which such water system exceeds the lead trigger level or copper action level. (B) For small water systems, within 18 months after the end of the tap sampling period during which such water system exceeds the lead trigger level or copper action level.[[Page 4286]] (3) Step 3. (i) Any water system with lead service lines that exceeded the lead action level shall complete the corrosion control treatment studies for re-optimization within 30 months after the end of the tap sampling period during which it exceeds the lead action level. (ii) If the water system is required to perform corrosion control studies under paragraph (d)(2) of this section (Step 2), the water system shall complete the studies (Sec. 141.82(c)(2)) within 18 months after the State requires that such studies be conducted. (4) Step 4. (i) The State shall designate re-optimized corrosion control treatment (Sec. 141.82(d)(3)) within six months after completion of paragraph (d)(3)(i) of this section (Step 3). (ii) If the water system has performed corrosion control studies under paragraph (d)(2) of this section (Step 2), the State shall designate re-optimized corrosion control treatment (Sec. 141.82(d)(2) or (4)) within six months after completion of paragraph (d)(3)(ii) of this section (Step 3). (5) Step 5. (i) Large water systems shall complete modifications to corrosion control treatment to have re-optimized corrosion control treatment installed within 12 months after completion of paragraph (d)(4)(i) of this section (Step 4). (ii) Small or medium-size water systems shall install re-optimized corrosion control treatment (Sec. 141.82(e)(1)) within 12 months after completion of paragraph (d)(4)(ii) of this section (Step 4). (6) Step 6. Water systems must complete follow-up sampling (Sec. Sec. 141.86(d)(2) and 141.87(c)) within 12 months after completion of paragraph (d)(5)(i) or (ii) of this section (Step 5). (7) Step 7. The State must review the water system's installation of treatment and designate optimal water quality control parameters (Sec. 141.82(f)(1)) within six months of completion of paragraph (d)(6) of this section (Step 6). (8) Step 8. The water system must operate in compliance with the State-designated optimal water quality control parameters (Sec. 141.82(g)) and continue to conduct tap sampling (Sec. 141.86(d)(3) and water quality parameter monitoring under Sec. 141.87(d)). (e) Treatment steps and deadlines for systems without corrosion control treatment. Except as provided in paragraph (b) of this section or Sec. 141.93, water systems without corrosion control treatment must complete the following corrosion control treatment steps (described in the referenced portions of Sec. Sec. 141.82, 141.86, and 141.87) by the indicated time periods. (1) Step 1. (i) A water system other than those covered in paragraph (e)(1)(ii) or (iii) of this section must recommend optimal corrosion control treatment (Sec. 141.82(a)(1), (2), (3), or (4)) within six months after the end of the tap sampling period during which it exceeds either the lead trigger level or copper action level. (ii) A water system with lead service lines that exceeds the lead action level must harvest lead pipes from the distribution system and construct flow-through pipe loops and operate the loops with finished water within one year after the end of the tap sampling period during which it exceeds the lead action level. These water systems must proceed to Step 3 in paragraph (e)(3) of this section and conduct the corrosion control studies for optimization under paragraph (e)(3)(i) of this section using the pipe loops. (iii) Large water systems under paragraph (a)(1)(ii) of this section must conduct the corrosion control studies for optimization under paragraph (e)(3) of this section (Step 3). (2) Step 2. Within 12 months after the end of the tap sampling period during which a water system exceeds the lead or copper action level, if not otherwise required by this rule, the State may require the water system to perform corrosion control studies (Sec. 141.82(b)(1)). The State must notify the system in writing of this requirement. If the State does not require the system to perform such studies, the State must specify optimal corrosion control treatment (Sec. 141.82(d)(1) or (2)) within the timeframes established in paragraphs (e)(2)(i) and (ii) of this section. The State must provide its determination to the system in writing. (i) For medium-size water systems, within 18 months after the end of the tap sampling monitoring period during which such water system exceeds the lead trigger level or copper action level. (ii) For small water systems, within 24 months after the end of the tap sampling monitoring period during which such water system exceeds the lead trigger level or copper action level. (3) Step 3. (i) Large water systems with or without lead service line and medium or small systems with lead service lines that exceed the lead action level shall complete the corrosion control treatment studies for optimization within 30 months after the end of the tap sampling period during which it exceeds the lead action level. (ii) If the State requires a water system to perform corrosion control studies under paragraph (e)(2) of this section (Step 2), the water system must complete the studies (Sec. 141.82(c)(1)) within 18 months after the State notifies the system in writing that such studies must be conducted. (4) Step 4. (i) The State shall designate re-optimized corrosion control treatment (Sec. 141.82(d)(3)) within six months after completion of paragraph (d)(3)(i) of this section (Step 3). (ii) If the water system has performed corrosion control studies under paragraph (e)(2) of this section (Step 2), the State must designate optimal corrosion control treatment (Sec. 141.82(d)(1)) within six months after completion of paragraph (e)(3) of this section (Step 3). (5) Step 5. The water system must install optimal corrosion control treatment (Sec. 141.82(e)(1)) within 24 months after the State designates optimal corrosion control treatment under paragraph (e)(2) or (4) of this section (Step 2 or Step 4). (6) Step 6. The water system shall complete follow-up sampling (Sec. Sec. 141.86(d)(2)(i) and 141.87(c)) within 12 months after completion of paragraph (e)(5) of this section (Step 5). (7) Step 7. The State must review the water system's installation of treatment and designate optimal water quality control parameters (Sec. 141.82(f)(1)) within six months of completion of paragraph (e)(6) of this section (Step 6). (8) Step 8. The water system must operate in compliance with the State-designated optimal water quality control parameters (Sec. 141.82(g)(1)) and continue to conduct tap sampling (Sec. 141.86(d)(3) and water quality parameter monitoring under Sec. 141.87(d)). (f) Treatment steps and deadlines for small community water systems and non-transient non-community water systems electing corrosion control treatment (CCT) as a compliance option under Sec. 141.93, or as required by the State. Water systems selecting the corrosion control small system compliance flexibility option must complete the following steps by the indicated time periods. (1) Step 1. A water system recommends corrosion control treatment as a small system compliance flexibility option under Sec. 141.93(a)(2) within six months after the end of the tap sampling period during which it exceeds either the lead trigger level or the lead action level. (2) Step 2. The State approves in writing the recommendation of corrosion control treatment as a small system compliance flexibility option or designates an alternative option in accordance with Sec. 141.93(a) within six months of the recommendation by the water system in paragraph (f)(1) of this[[Page 4287]]section (Step 1). Water systems required by the State to optimize or re-optimize corrosion control treatment must follow the schedules in paragraph (d) or (e) of this section, beginning with Step 3 in paragraph (d)(3) or (e)(3) of this section unless the State specifies optimal corrosion control treatment pursuant to either paragraph (d)(2)(ii) or (e)(2)(ii) of this section, as applicable.07. Revise Sec. 141.82 to read as follows:Sec. 141.82 Description of corrosion control treatment requirements. This section sets forth the requirements applicable to systems and states in the designation of optimal corrosion control treatment for a system that is optimizing or reoptimizing corrosion control treatment. Each system must complete the corrosion control treatment requirements in this section as applicable to such system under Sec. 141.81 (a) System recommendation regarding corrosion control treatment for systems that do not contain lead service lines and systems with lead service lines that do not exceed the lead action level. (1) Any system under this paragraph (a) without corrosion control treatment that is required to recommend a treatment option in accordance with Sec. 141.81(e) must, based on the results of lead and copper tap sampling and water quality parameter monitoring, recommend designation of one or more of the corrosion control treatments listed in paragraph (c)(1)(i) of this section. Small community water systems and non-transient non-community water systems that exceed the copper action level must comply with this paragraph (a)(1). The State may require the system to conduct additional water quality parameter monitoring to assist the State in reviewing the system's recommendation. (2) Any small community water system or non-transient non-community water system in this paragraph (a) without corrosion control treatment that chooses to pursue a small water system compliance flexibility option and is required to recommend an option in accordance with Sec. 141.81(f) must, based on the results of lead tap sampling and water quality parameter monitoring, recommend designation of one of the options listed in Sec. 141.93 Systems with no lead service lines that exceed the lead action level and select corrosion control under Sec. 141.93(a)(2) must recommend designation of one or more of the corrosion control treatments listed in paragraph (c)(1) of this section as the optimal corrosion control treatment for that system. (3) Any system under this paragraph (a) that exceeds the lead action level and selects corrosion control under Sec. 141.93(a)(2) must recommend designation of one or more of the corrosion control treatments listed in paragraph (c)(1)(i) of this section as the optimal corrosion control treatment for that system. A corrosion control study under paragraph (c) of this section is not required for medium and small systems that exceed the lead trigger level but do not exceed the lead and copper action levels, unless required by the state. (4) Any small community water system or non-transient, non-community water system with corrosion control treatment that that exceeds the lead action level and selects corrosion control under Sec. 141.93(a)(2) must recommend designation of one or more of the corrosion control treatments listed in paragraph (c)(2) of this section as the optimal corrosion control treatment for that system. (5) States may waive the requirement for a system to recommend OCCT if the State requires the system, in writing, to complete a corrosion control study within 3 months after the end of the tap sampling period during which the exceedance occurred. Such systems shall proceed directly to paragraph (c) of this section and complete a corrosion control study. (b) State decision to require studies to identify initial optimal corrosion control treatment and re-optimized optimal corrosion control treatment except for large systems and small and medium systems with lead service lines that exceed the lead action level. Corrosion control treatment studies are always required for large systems that exceed the lead action level, large water systems without corrosion control treatment with 90th percentile results that exceed either the lead practical quantitation level of 0.005 mg/L or the copper action level, medium sized systems with lead service lines that exceed the lead action level, and small systems with lead service lines that exceed the lead action level and select the corrosion control treatment option under Sec. 141.93(a). (1) The State may require any small or medium-size system without corrosion control that exceeds either the lead or copper action level to perform corrosion control treatment studies under paragraph (c)(1) of this section to identify optimal corrosion control treatment for the system. (2) The State may require any small or medium-size system without corrosion control that exceeds the lead trigger level but not the lead or copper action level to perform corrosion control treatment studies under paragraph (c)(1) of this section to identify optimal corrosion control treatment for the system. This corrosion control treatment shall be installed if the lead or copper action level is subsequently exceeded. (3) The State may require any small or medium-size water systems with corrosion control treatment exceeding either the lead trigger level or copper action level to perform corrosion control treatment studies under paragraph (c)(2) of this section to identify re-optimized optimal corrosion control treatment for the system (i.e , optimal corrosion control treatment after a re-optimization evaluation). (c) Performance of corrosion control studies. (1) Water systems without corrosion control treatment that are required to conduct corrosion control studies must complete the following: (i) Any water system without corrosion control treatment must evaluate the effectiveness of each of the following treatments, and if appropriate, combinations of the following treatments to identify the optimal corrosion control treatment for the system: (A) Alkalinity and pH adjustment; (B) The addition of an orthophosphate- or silicate-based corrosion inhibitor at a concentration sufficient to maintain an effective corrosion inhibitor residual concentration in all test samples; (C) The addition of an orthophosphate-based corrosion inhibitor at a concentration sufficient to maintain an orthophosphate residual concentration of 1 mg/L (as PO4) in all test samples; and (D) The addition of an orthophosphate-based corrosion inhibitor at a concentration sufficient to maintain an orthophosphate residual concentration of 3 mg/L (as PO4) in all test samples. (ii) The water system must evaluate each of the corrosion control treatments using either pipe rig/loop tests, metal coupon tests, partial-system tests, or analyses based on documented analogous treatments with other systems of similar size, water chemistry, and distribution system configurations. Large and medium systems and small community water systems and non-transient non-community water systems that select the corrosion control treatment option under Sec. 141.93 with lead service lines that exceed the lead action level must conduct pipe rig/loop studies using harvested lead service lines from their distribution systems to assess the effectiveness of corrosion control treatment options on the existing pipe scale. For these systems,[[Page 4288]]metal coupon tests can be used as a screen to reduce the number of options that are evaluated using pipe rig/loops to the current conditions and two options. (iii) The water system must measure the following water quality parameters in any tests conducted under this paragraph (c)(1)(iii) before and after evaluating the corrosion control treatments listed in paragraphs (c)(1)(i) and (ii) of this section: (A) Lead; (B) Copper; (C) pH; (D) Alkalinity; (E) Orthophosphate as PO4 (when an orthophosphate-based inhibitor is used); and (F) Silicate (when a silicate-based inhibitor is used). (iv) The water system must identify all chemical or physical constraints that limit or prohibit the use of a particular corrosion control treatment and document such constraints with one of the following: (A) ***Data*** and documentation showing that a particular corrosion control treatment has adversely affected other drinking water treatment processes when used by another water system with comparable water quality characteristics. Systems using coupon studies to screen and/or pipe loop/rig studies to evaluate treatment options must not exclude treatment strategies from the studies based on the constraints identified in this section. (B) ***Data*** and documentation demonstrating that the water system has previously attempted to evaluate a particular corrosion control treatment and has found that the treatment is ineffective or adversely affects other drinking water quality treatment processes. Systems using coupon studies to screen and/or pipe loop/rig studies to evaluate treatment options must not exclude treatment strategies from the studies based on the constraints identified in this section unless the treatment was found to be ineffective in a previous pipe loop/rig study. (v) The water system must evaluate the effect of the chemicals used for corrosion control treatment on other drinking water quality treatment processes. Systems using coupon studies to screen and/or pipe loop/rig studies to evaluate treatment options shall not exclude treatment strategies from the studies based on the effects identified in this section. (vi) On the basis of an analysis of the ***data*** generated during each evaluation, the water system must recommend to the State in writing the treatment option that the corrosion control studies indicate constitutes optimal corrosion control treatment for that system as defined in Sec. 141.2 The water system must provide a rationale for its recommendation along with all supporting documentation specified in paragraphs (c)(2)(i) through (v) of this section. (2) Systems with corrosion control treatment that are required to conduct corrosion control studies to determine re-optimized OCCT must complete the following: (i) The water system must evaluate the effectiveness of the following treatments, and if appropriate, combinations of the following treatments to identify the re-optimized optimal corrosion control treatment for the system: (A) Alkalinity and/or pH adjustment, or re-adjustment; (B) The addition of an orthophosphate- or silicate-based corrosion inhibitor at a concentration sufficient to maintain an effective corrosion inhibitor residual concentration in all test samples if no such inhibitor is utilized; (C) The addition of an orthophosphate-based corrosion inhibitor at a concentration sufficient to maintain an orthophosphate residual concentration of 1 mg/L (PO4) in all test samples unless the current inhibitor process already meets this residual; and (D) The addition of an orthophosphate-based corrosion inhibitor at a concentration sufficient to maintain an orthophosphate residual concentration of 3 mg/L (PO4) in all test samples unless the current inhibitor process already meets this residual. (ii) The water system must evaluate each of the corrosion control treatments using either pipe rig/loop tests, metal coupon tests, partial-system tests, or analyses based on documented analogous treatments with other systems of similar size, water chemistry, and distribution system configurations. If the water system has lead service lines and exceeds the lead action level, it must conduct pipe rig/loop studies using harvested lead service lines from their distribution systems to assess the effectiveness of corrosion control treatment options on the existing pipe scale. For these systems, metal coupon tests can be used as a screen to reduce the number of options that are evaluated using pipe rig/loops to the current conditions and two options. (iii) The water system must measure the following water quality parameters in any tests conducted under this paragraph (c)(2)(iii) before and after evaluating the corrosion control treatments listed in paragraphs (c)(2)(i) and (ii) of this section: (A) Lead; (B) Copper; (C) pH; (D) Alkalinity; (E) Orthophosphate as PO4 (when an orthophosphate-based inhibitor is used); and (F) Silicate (when a silicate-based inhibitor is used). (iv) The water system must identify all chemical or physical constraints that limit or prohibit the use of a particular corrosion control treatment and document such constraints with one of the following: (A) ***Data*** and documentation showing that a particular corrosion control treatment has adversely affected other drinking water treatment processes when used by another water system with comparable water quality characteristics. Systems using coupon studies to screen and/or pipe loop/rig studies to evaluate treatment options must not exclude treatment strategies from the studies based on the constraints identified in this section. (B) ***Data*** and documentation demonstrating that the water system has previously attempted to evaluate a particular corrosion control treatment and has found that the treatment is ineffective or adversely affects other drinking water quality treatment processes. Systems using coupon studies to screen and/or pipe loop/rig studies to evaluate treatment options shall not exclude treatment strategies from the studies based on the constraints identified in this section unless the treatment was found to be ineffective in a previous pipe loop/rig study. (v) The water system must evaluate the effect of the chemicals used for corrosion control treatment on other drinking water quality treatment processes. Systems using coupon studies to screen and/or pipe loop/rig studies to evaluate treatment options shall not exclude treatment strategies from the studies based on the effects identified in this section. (vi) On the basis of an analysis of the ***data*** generated during each evaluation, the water system must recommend to the State in writing the treatment option that the corrosion control studies indicate constitutes optimal corrosion control treatment for that system as defined in Sec. 141.2 The water system must provide a rationale for its recommendation along with all supporting documentation specified in paragraph (c)(1)(i) through (v) of this section.[[Page 4289]] (d) State designation of optimized optimal corrosion control treatment and re-optimized optimal corrosion control treatment. When designating optimal corrosion control treatment, the State must consider the effects that additional corrosion control treatment will have on water quality parameters and on other drinking water quality treatment processes. The State must notify the water system of its designation of optimal corrosion control treatment in writing and explain the basis for this determination. If the State requests additional information to aid its review, the water system must provide the information. (1) Designation of OCCT for systems without corrosion control treatment. Based upon considerations of available information including, where applicable, studies conducted under paragraph (c)(1) of this section and/or a system's recommended corrosion control treatment option, the State must either approve the corrosion control treatment option recommended by the system or designate alternative corrosion control treatment(s) from among those listed in paragraph (c)(1)(i) of this section or, where applicable, an alternate small water system compliance flexibility option under Sec. 141.93(a). (2) Designation of re-optimized OCCT for systems with corrosion control treatment. Based upon considerations of available information including, where applicable, studies conducted under paragraph (c)(2) of this section and/or a system's recommended treatment alternative, the State must either approve the corrosion control treatment option recommended by the water system or designate alternative corrosion control treatment(s) from among those listed in paragraph (c)(2)(i) of this section or, where applicable, an alternate small water system compliance flexibility option under Sec. 141.93 (e) Installation of optimal corrosion control treatment and re-optimization of corrosion control treatment. Each system must properly install and operate throughout its distribution system the optimal corrosion control treatment designated by the State under paragraph (d) of this section. (f) State review of treatment and specification of optimal water quality control parameters for optimal corrosion control treatment and re-optimized corrosion control treatment. The State must evaluate the results of all lead and copper tap sampling and water quality parameter sampling submitted by the water system and determine whether the water system has properly installed and operated the optimal corrosion control treatment designated by the State in paragraph (d)(1) or (2) of this section, respectively. Upon reviewing the results of tap water and water quality parameter monitoring by the water system, both before and after the water system installs optimal corrosion control treatment, the State must designate: (1) A minimum value or a range of values for pH measured at each entry point to the distribution system. (2) A minimum pH value measured in all tap samples. Such a value shall be equal to or greater than 7.0, unless the State determines that meeting a pH level of 7.0 is not technologically feasible or is not necessary for the system to optimize corrosion control. (3) If a corrosion inhibitor is used, a minimum concentration or a range of concentrations for orthophosphate (as PO4) or silicate measured at each entry point to the distribution system. (4) If a corrosion inhibitor is used, a minimum orthophosphate or silicate concentration measured in all tap samples that the State determines is necessary to form a passivating film on the interior walls of the pipes of the distribution system. When orthophosphate is used, such an orthophosphate concentration shall be equal to or greater than 0.5 mg/L (asPO4) for OCCT designations under paragraph (d)(1) of this section and 1.0 mg/L for OCCT designations under paragraph (d)(2) of this section, unless the State determines that meeting the applicable minimum orthophosphate residual is not technologically feasible or is not necessary for optimal corrosion control treatment. (5) If alkalinity is adjusted as part of optimal corrosion control treatment, a minimum concentration or a range of concentrations for alkalinity, measured at each entry point to the distribution system and in all tap samples. (6) The values for the applicable water quality control parameters, previously listed in this section, shall be those that the State determines to reflect optimal corrosion control treatment for the water system. The State may designate values for additional water quality control parameters determined by the State to reflect optimal corrosion control treatment for the water system. The State must notify the system in writing of these determinations and explain the basis for its decisions. (g) Continued operation and monitoring for optimal corrosion control treatment and re-optimized optimal corrosion control treatment. All systems optimizing or re-optimizing corrosion control must continue to operate and maintain optimal corrosion control treatment, including maintaining water quality parameters at or above minimum values or within ranges designated by the State under paragraph (f) of this section, in accordance with this paragraph (g) for all samples ***collected*** under Sec. 141.87(d) through (f). The requirements of this paragraph (g) apply to all systems, including consecutive systems that distribute water that has been treated to control corrosion by another system, and any water system with corrosion control treatment, optimal corrosion control treatment, or re-optimized OCCT that is not required to monitor water quality parameters under Sec. 141.87 Compliance with the requirements of this paragraph (g) shall be determined every six months, as specified under Sec. 141.87(d). A water system is out of compliance with the requirements of this paragraph (g) for a six-month period if it has excursions for any State-specified parameter on more than nine days, cumulatively, during the period. An excursion occurs whenever the daily value for one or more of the water quality parameters measured at a sampling location is below the minimum value or outside the range designated by the State. Daily values are calculated as set out in paragraphs (g)(1) through (3) of this section. States have discretion to not include results of obvious sampling errors from this calculation. Sampling errors must still be recorded even when not included in calculations. (1) On days when more than one measurement for the water quality parameter is ***collected*** at the sampling location, the daily value must be the average of all results ***collected*** during the day regardless of whether they are ***collected*** through continuous monitoring, grab sampling, or a combination of both. If EPA has approved an alternative formula under Sec. 142.16(d)(1)(ii) of this chapter in the State's application for a program revision submitted pursuant to Sec. 142.12 of this chapter, the State's formula shall be used to aggregate multiple measurements taken at a sampling point for the water quality parameters in lieu of the formula in this paragraph (g)(1). (2) On days when only one measurement for the water quality parameter is ***collected*** at the sampling location, the daily value shall be the result of that measurement. (3) On days when no measurement is ***collected*** for the water quality parameter at the sampling location, the daily value shall be the daily value calculated on the most recent day on which the water quality parameter was measured at the sampling location. (h) Modification of State treatment decisions for optimal corrosion control[[Page 4290]]and re-optimized corrosion control. Upon its own initiative or in response to a request by a water system or other interested party, a State may modify its determination of the optimal corrosion control treatment under paragraph (d) of this section, or optimal water quality control parameters under paragraph (f) of this section. A request for modification by a system or other interested party shall be in writing, explaining why the modification is appropriate, and providing supporting documentation. The State may modify its determination where it concludes that such change is necessary to ensure that the water system continues to optimize corrosion control treatment. A revised determination must be made in writing, set forth the new treatment requirements and/or water quality parameters, explain the basis for the State's decision, and provide an implementation schedule for completing the treatment modifications for re-optimized corrosion control treatment. (i) Treatment decisions by EPA in lieu of the State on optimal corrosion control treatment and re-optimized corrosion control treatment. Pursuant to the procedures in Sec. 142.19 of this chapter, EPA Regional Administrator may review optimal corrosion control treatment determinations made by a State under paragraph (d)(1) or (2), (f), or (h) of this section and issue Federal treatment determinations consistent with the requirements of paragraph (d)(1) or (2), (f), or (h) of this section where the Regional Administrator finds that: (1) A State has failed to issue a treatment determination by the applicable deadlines contained in Sec. 141.81; (2) A State has abused its discretion in a substantial number of cases or in cases affecting a substantial population; or (3) The technical aspects of a State's determination would be indefensible in a Federal enforcement action taken against a water system. (j) Find-and-fix assessment for tap sample sites that exceed the lead action level. The water system shall conduct the following steps, when a tap sample site exceeds the lead action level under monitoring conducted under Sec. 141.86 (1) Step 1: corrosion control treatment assessment. The water system must sample at a new water quality parameter site that is on the same size water main in the same pressure zone and located within a half mile of the location with the action level exceedance within 5 days of receiving the sample results. Small water systems without corrosion control treatment may have up to 14 days to ***collect*** the samples. The water system must measure the following parameters: (i) pH; (ii) Alkalinity; (iii) Orthophosphate (as PO4), when an inhibitor containing an orthophosphate compound is used; (iv) Silica, when an inhibitor containing a silicate compound is used; and (v) Water systems with an existing water quality parameter location that meets the requirements of this section can conduct this sampling at that location. (vi) All water systems required to meet optimal water quality control parameters but that do not have an existing water quality parameter location that meets the requirement of this section must add new sites to the minimum number of sites as described in Sec. 141.87(g). Sites must be added until a system has twice the minimum number of sites listed in Table 1 to Sec. 141.87(a)(2). When a system exceeds this upper threshold for the number of sites, the State has discretion to determine if the newer site can better assess the effectiveness of the corrosion control treatment and to remove existing sites during sanitary survey evaluation of OCCT. (2) Step 2: Site assessment. Water systems shall ***collect*** a follow-up sample at any tap sample site that exceeds the action level within 30 days of receiving the sample results. These follow-up samples may use different sample volumes or different sample ***collection*** procedures to assess the source of elevated lead levels. Samples ***collected*** under this section must be submitted to the State but shall not be included in the 90th percentile calculation for compliance monitoring under Sec. 141.86 If the water system is unable to ***collect*** a follow-up sample at a site, the water system must provide documentation to the State, explaining why it was unable to ***collect*** a follow-up sample. (3) Step 3. Water systems shall evaluate the results of the monitoring conducted under this paragraph (j)(3) to determine if either localized or centralized adjustment of the optimal corrosion control treatment or other distribution system actions are necessary and submit the recommendation to the State within six months after the end of the tap sampling period in which the site(s) exceeded the lead action level. Corrosion control treatment modification may not be necessary to address every exceedance. Other distribution system actions may include flushing to reduce water age. Water systems must note the cause of the elevated lead level, if known from the site assessment, in their recommendation to the State as site-specific issues can be an important factor in why the system is not recommending any adjustment of corrosion control treatment or other distribution system actions. Systems in the process of optimizing or re-optimizing optimal corrosion control treatment under paragraphs (a) through (f) of this section do not need to submit a treatment recommendation for find-and-fix. (4) Step 4. The State shall approve the treatment recommendation or specify a different approach within six months of completion of Step 3 as described in paragraph (j)(3) of this section. (5) Step 5. If the State-approved treatment recommendation requires the water system to adjust the optimal corrosion control treatment process, the water system must complete modifications to its corrosion control treatment within 12 months after completion of Step 4 as described in paragraph (j)(4) of this section. Systems without corrosion control treatment required to install optimal corrosion control treatment must follow the schedule in Sec. 141.81(e). (6) Step 6. Water systems adjusting its optimal corrosion control treatment must complete follow-up sampling (Sec. Sec. 141.86(d)(2) and 141.87(c)) within 12 months after completion of Step 5 as described in paragraph (j)(5) of this section. (7) Step 7. For water systems adjusting its optimal corrosion control treatment, the State must review the water system's modification of corrosion control treatment and designate optimal water quality control parameters (Sec. 141.82(f)(1)) within six months of completion of Step 6 as described in paragraph (j)(6) of this section. (8) Step 8. For a water system adjusting its optimal corrosion control treatment, the water system must operate in compliance with the State-designated optimal water quality control parameters (Sec. 141.82(g)) and continue to conduct tap sampling (Sec. Sec. 141.86(d)(3) and 141.87(d)).08. Revise Sec. 141.84 to read as follows:Sec. 141.84 Lead service line inventory and replacement requirements. (a) Lead service line inventory. All water systems must develop an inventory to identify the materials of service lines connected to the public water distribution system. The inventory must meet the following requirements: (1) All water systems must develop an initial inventory by January 16, 2024,[[Page 4291]]and submit it to the primacy agency in accordance with Sec. 141.90 (2) The inventory must include all service lines connected to the public water distribution system regardless of ownership status (e.g , where service line ownership is shared, the inventory would include both the portion of the service line owned by the water system and the customer-owned portion of the service line). (3) A water system must use any information on lead and galvanized iron or steel that it has identified pursuant to Sec. 141.42(d) when conducting the inventory of service lines in its distribution system for the initial inventory under paragraph (a)(1) of this section. The water system must also review the sources of information listed in paragraphs (a)(3)(i) through (iv) of this section to identify service line materials for the initial inventory. The water system may use other sources of information not listed in paragraphs (a)(3)(i) through (iv) of this section if approved by the State. (i) All construction and plumbing codes, permits, and existing records or other documentation which indicates the service line materials used to connect structures to the distribution system. (ii) All water system records, including distribution system maps and drawings, historical records on each service connection, meter installation records, historical capital improvement or master plans, and standard operating procedures. (iii) All inspections and records of the distribution system that indicate the material composition of the service connections that connect a structure to the distribution system. (iv) Any resource, information, or identification method provided or required by the State to assess service line materials. (4) Each service line, or portion of the service line where ownership is split, must be categorized in the following manner: (i) ``Lead'' where the service line is made of lead. (ii) ``Galvanized Requiring Replacement'' where a galvanized service line is or was at any time downstream of a lead service line or is currently downstream of a ``Lead Status Unknown'' service line. If the water system is unable to demonstrate that the galvanized service line was never downstream of a lead service line, it must presume there was an upstream lead service line. (iii) ``Non-lead'' where the service line is determined through an evidence-based record, method, or technique not to be lead or galvanized requiring replacement. The water system may classify the actual material of the service line (i.e , plastic or copper) as an alternative to classifying it as ``Non-lead.'' (iv) ``Lead Status Unknown'' where the service line material is not known to be lead, galvanized requiring replacement, or a non-lead service line, such as where there is no documented evidence supporting material classification. The water system may classify the line as ``Unknown'' as an alternative to classifying it as ``Lead Status Unknown,'' however, all requirements that apply to ``Lead Status Unknown'' service lines must also apply to those classified as ``Unknown.'' Water systems may elect to provide more information regarding their unknown lines as long as the inventory clearly distinguishes unknown service lines from those where the material has been verified through records or inspection. (5) Water systems shall identify and track service line materials in the inventory as they are encountered in the course of its normal operations (e.g , checking service line materials when reading water meters or performing maintenance activities). (6) Water systems must update the inventory based on all applicable sources described in paragraphs (a)(3) and (5) of this section and any lead service line replacements or service line material inspections that may have been conducted. The water system may use other sources of information if approved by the State and must use other sources of information provided or required by the State. Water systems must submit the updated inventory to the State in accordance with Sec. 141.90(e). The inventory updates must be reflected in the publicly accessible inventory no less frequently than when required to be submitted to the State. (i) Water systems whose inventories contain only non-lead service lines are not required to provide inventory updates to the State or to the public. If, in the future, such a water system finds a lead service line within its system, it must prepare an updated inventory in accordance with paragraph (a) of this section on a schedule established by the State. (ii) [Reserved] (7) To calculate the number of service line replacements applicable to paragraphs (f) and (g) of this section, the replacement rate must be applied to the sum of known lead and galvanized requiring replacement service lines when the system first exceeds the trigger or action level plus the number of lead status unknown service lines in the beginning of each year of a system's annual goal or mandatory lead service line replacement program. (i) Each service line shall count only once for purposes of calculating the required number of service line replacements, even where the ownership of the service line is split and both the customer-owned and system-owned portions require replacement. (ii) The number of service lines requiring replacement must be updated annually to subtract the number of lead status unknown service lines that were discovered to be non-lead and to add the number of non-lead service lines that were discovered to be a lead or galvanized requiring replacement service line. (iii) Verification of a lead status unknown service line as non-lead in the inventory does not count as a service line replacement. (8) The service line materials inventory must be publicly accessible. (i) The inventory must include a location identifier, such as a street address, block, intersection, or landmark, associated with each lead service line and galvanized requiring replacement service line. Water systems may, but are not required to, include a locational identifier for lead status unknown service lines or list the exact address of each service line. (ii) Water systems serving greater than 50,000 persons must make the publicly accessible inventory available online. (9) When a water system has no lead, galvanized requiring replacement, or lead status unknown service lines (regardless of ownership) in its inventory, it may comply with the requirements in paragraph (a)(8) of this section using a written statement, in lieu of the inventory, declaring that the distribution system has no lead service lines or galvanized requiring replacement service lines. The statement must include a general description of all applicable sources described in paragraphs (a)(3), (5), and (6) of this section used to make this determination. (10) Instructions to access the service line inventory (including inventories consisting only of a statement in accordance with paragraph (a)(9) of this section) must be included in Consumer Confidence Report in accordance with Sec. 141.153(d)(4)(xi). (b) Lead service line replacement plan. All water systems with one or more lead, galvanized requiring replacement, or lead status unknown service lines in their distribution system must, by January 16, 2024, submit a lead service line replacement plan to the[[Page 4292]]State in accordance with Sec. 141.90(e). The lead service line replacement plan must be sufficiently detailed to ensure a system is able to comply with the lead service line replacement requirements in accordance with this section. The plan must include a description of: (1) A strategy for determining the composition of lead status unknown service lines in its inventory; (2) A procedure for conducting full lead service line replacement; (3) A strategy for informing customers before a full or partial lead service line replacement; (4) For systems that serve more than 10,000 persons, a lead service line replacement goal rate recommended by the system in the event of a lead trigger level exceedance; (5) A procedure for customers to flush service lines and premise plumbing of particulate lead; (6) A lead service line replacement prioritization strategy based on factors including but not limited to the targeting of known lead service lines, lead service line replacement for disadvantaged consumers and populations most sensitive to the effects of lead; and (7) A funding strategy for conducting lead service line replacements which considers ways to accommodate customers that are unable to pay to replace the portion they own. (c) Operating procedures for replacing lead goosenecks, pigtails, or connectors. (1) The water system must replace any lead gooseneck, pigtail, or connector it owns when encountered during planned or unplanned water system infrastructure work. (2) The water system must offer to replace a customer-owned lead gooseneck, pigtail, or connector; however, the water system is not required to bear the cost of replacement of the customer-owned parts. (3) The water system is not required to replace a customer-owned lead gooseneck, pigtail, or connector if the customer objects to its replacement. (4) The replacement of a lead gooseneck, pigtail, or connector does not count for the purposes of meeting the requirements for goal-based or mandatory lead service line replacements, in accordance with paragraphs (f) and (g) of this section, respectively. (5) Upon replacement of any gooseneck, pigtail, or connector that is attached to a lead service line, the water system must follow risk mitigation procedures specified in Sec. 141.85(f)(2). (6) The requirements of paragraphs (c)(1), (2), (3), and (5) of this section do not apply if state law includes lead connectors in the definition of lead service lines, prohibits partial lead service line replacements, and requires systems to remove all lead service lines irrespective of a system's 90th percentile lead level. (d) Requirements for conducting lead service line replacement that may result in partial replacement. (1) Any water system that plans to partially replace a lead service line (e.g , replace only the portion of a lead service line that it owns) in coordination with planned infrastructure work must provide notice to the owner of the affected service line, or the owner's authorized agent, as well as non-owner resident(s) served by the affected service line at least 45 days prior to the replacement. The notice must explain that the system will replace the portion of the line it owns and offer to replace the portion of the service line not owned by the water system. The water system is not required to bear the cost of replacement of the portion of the affected service line not owned by the water system. (i) Before the affected service line is returned to service, the water system must provide notification meeting the content requirements of Sec. 141.85(a) explaining that consumers may experience a temporary increase of lead levels in their drinking water due to the replacement, information about the health effects of lead, and actions consumers can take to minimize their exposure to lead in drinking water. In instances where multi-family dwellings are served by the affected service line to be partially replaced, the water system may elect to post the information at a conspicuous location instead of providing individual notification to all residents. (ii) The water system must provide information about service line flushing in accordance with the procedure developed in paragraph (b)(5) of this section before the affected service line is returned to service. (iii) The water system must provide the consumer with a pitcher filter or point-of-use device certified by an American National Standards Institute accredited certifier to reduce lead, six months of replacement cartridges, and instructions for use before the affected service line is returned to service. If the affected service line serves more than one residence or non-residential unit (e.g , a multi-unit building), the water system must provide a filter, six months of replacement cartridges and use instructions to every residence in the building. (iv) The water system must offer to ***collect*** a follow up tap sample between three months and six months after completion of any partial replacement of a lead service line. The water system must provide the results of the sample in accordance with Sec. 141.85(d). (2) Any water system that replaces the portion of the lead service line it owns due to an emergency repair, must provide notice and risk mitigation measures to the persons served by the affected service line in accordance with paragraphs (d)(1)(i) through (iii) of this section before the affected service line is returned to service. (3) When a water system is notified by the customer that the customer's portion of the lead service line will be replaced, the water system must make a good faith effort to coordinate simultaneous replacement of its portion of the service line. If simultaneous replacement cannot be conducted, the water system must replace its portion as soon as practicable but no later than 45 days from the date the customer replaces its portion of the lead service line. The water system must provide notification and risk mitigation measure in accordance with paragraphs (d)(1)(i) through (iii) of this section. If the water system fails to replace its portion of the lead service line within 45 days from the date the customer replaces the customer's portion of the lead service line, the water system must notify the State within 30 days of failing to meet the deadline in accordance with Sec. 141.90(e) and complete the replacement no later than 180 days of the date the customer replaces its portion. (4) When a water system is notified or otherwise learns that replacement of a customer-owned lead service line has occurred within the previous six months and left in place a system-owned lead service line, the water system must replace its portion within 45 days from the day of becoming aware of the customer replacement. The water system must provide notification and risk mitigation measures in accordance with paragraphs (d)(1)(i) through (iii) of this section within 24 hours of becoming aware of the customer replacement. If the water system fails to replace its portion of the affected service line within 45 days of becoming aware of the customer replacement, it must notify the State within 30 days of failing to meet the deadline in accordance with Sec. 141.90(e). The water system must complete the replacement no later than 180 days after the date the customer replaces its portion. (5) When a water system is notified or otherwise learns of a replacement of a customer-owned lead service line which has occurred more than six months in the past, the water system is not[[Page 4293]]required to complete the lead service line replacement of the system-owned portion under this paragraph (d)(5), however the system-owned portion must still be included in the calculation of a lead service line replacement rate under paragraph (a)(7) of this section. (e) Requirements for conducting full lead service line replacement. Any water system that conducts a full lead service line replacement must provide notice to the owner of the affected service line, or the owner's authorized agent, as well as non-owner resident(s) served by the affected service line within 24 hours of completion of the replacement. The water system is not required to bear the cost of replacement of the portion of the lead service line not owned by the water system. (1) The notification must meet the content requirements of Sec. 141.85(a) explaining that consumers may experience a temporary increase of lead levels in their drinking water due to the replacement, information about the health effects of lead, and actions consumers can take to minimize their exposure to lead in drinking water. In instances where multi-family dwellings are served by the lead service line to be replaced, the water system may elect to post the information at a conspicuous location instead of providing individual notification to all residents. (2) The water system must provide information about service line flushing in accordance with the procedure developed under paragraph (b)(5) of this section before the replaced service line is returned to service. (3) The water system must provide the consumer with a pitcher filter or point-of-use device certified by an American National Standards Institute accredited certifier to reduce lead, six months of replacement cartridges, and instructions for use before the replaced service line is returned to service. If the lead service line serves more than one residence or non-residential unit (e.g , a multi-unit building), the water system must provide a filter and six months of replacement cartridges and use instructions to every residence in the building. (4) The water system must offer to the consumer to take a follow up tap sample between three months and six months after completion of any full replacement of a lead service line. The water system must provide the results of the sample to the consumer in accordance with paragraph (d) of this section. (f) Goal-based full lead service line replacement for water systems whose 90th percentile lead level is above the trigger level but at or below the lead action level. Water systems that serve more than 10,000 persons whose 90th percentile lead level from tap samples taken pursuant to Sec. 141.86 is above the lead trigger level but at or below the lead action level must conduct goal-based full lead service line replacement at a rate approved by the state. (1) The water system must calculate the number of full lead service line replacements it must conduct annually in accordance with paragraph (a)(7) of this section. (2) Replacement of lead service lines must be conducted in accordance with the requirements of paragraph (d) or (e) of this section. (3) Only full lead service line replacements count towards a water system's annual replacement goal. Partial lead service line replacements do not count towards the goal. (4) The water system must provide information to customers with lead, galvanized requiring replacement, or lead status unknown service lines as required in Sec. 141.85(g). (5) Any water system that fails to meet its lead service line replacement goal must: (i) Conduct public outreach activities pursuant to Sec. 141.85(h) until either the water system meets its replacement goal, or tap sampling shows the 90th percentile of lead is at or below the trigger level for two consecutive one-year monitoring periods. (ii) Recommence its goal-based lead service line replacement program pursuant to this paragraph (f)(5)(ii) if the 90th percentile lead level anytime thereafter exceeds the lead trigger level but is at or below the lead action level. (6) The first year of lead service line replacement shall begin on the first day following the end of the tap sampling period in which the lead trigger level was exceeded. If sampling is required annually or less frequently, the end of the tap sampling monitoring period is September 30 of the calendar year in which the sampling occurs. If the State has established an alternate monitoring period, then the end of the monitoring period will be the last day of that period. (g) Mandatory full lead service line replacement for water systems whose 90th percentile lead level exceeds the lead action level. Water systems serving more than 10,000 persons that exceed the lead action level in tap samples taken pursuant to Sec. 141.86 must conduct mandatory full lead service line replacement at an average annual rate of at least three percent, calculated on a two-year rolling basis. (1) The average annual number of full lead service line replacements must be calculated in accordance with paragraph (a)(7) of this section. (2) Lead service line replacement must be conducted in accordance with the requirements of paragraphs (d) and (e) of this section. (3) Only full lead service line replacement count towards a water system's mandatory replacement rate of at least three percent annually. Partial lead service line replacements do not count towards the mandatory replacement rate. (4) Water systems must provide information to customers with lead, galvanized requiring replacement, or lead status unknown service lines consistent with Sec. 141.85(g). (5) Community water systems serving 10,000 or fewer persons and Non-transient non-community water systems for which the state has approved or designated lead service line replacement as a compliance option must conduct lead service line replacement as described in Sec. 141.93(a)(1). Replacement of lead service lines must be conducted in accordance with the requirements of paragraphs (d) and (e) of this section. (6) A water system may cease mandatory lead service line replacement when it has conducted a cumulative percentage of replacements greater than or equal to 3%, or other percentage specified in paragraph (g)(9) of this section, of the service lines specified in paragraph (a)(7) of this section multiplied by the number of years that elapsed from when the system most recently began mandatory lead service line replacement and the date on which the system's 90th percentile lead level, in accordance with Sec. 141.80(c)(4), has been calculated to be at or below the lead action level during each of four consecutive six-month tap sampling monitoring periods. If tap samples ***collected*** in any such system thereafter exceed the lead action level, the system shall recommence mandatory lead service line replacement at the same two-year rolling average rate, unless the State has designated an alternate replacement rate under paragraph (g)(9) of this section. (7) The water system may also cease mandatory lead service line replacement if the system has no remaining lead status unknown service lines in its inventory and obtains refusals to conduct full lead service line replacement or non-responses from every remaining customer in its distribution system served by either a full or partial lead service line, or a galvanized requiring replacement service line. For purposes of this paragraph (g)(7) and in accordance with Sec. 141.90(e), a water system must provide[[Page 4294]]documentation to the State of customer refusals including a refusal signed by the customer, documentation of a verbal statement made by the customer refusing replacement, or documentation of no response from the customer after the water system made a minimum of two good faith attempts to reach the customer regarding full lead service line replacement. If the water system's 90th percentile exceeds the lead action level again, it must contact all customers served by a full or partial lead service line or a galvanized requiring replacement service line with an offer to replace the customer-owned portion. Nothing in this paragraph (g)(7) requires the water system to bear the cost of replacement of the customer-owned lead service line. (8) The first year of lead service line replacement shall begin on the first day following the end of the tap sampling period in which lead action level was exceeded. (9) The State shall require a system to replace lead service lines on a shorter schedule than that required by this section, taking into account the number of lead service lines in the system, where the State determines a shorter replacement schedule is feasible. The State shall make this determination in writing and notify the system of its finding within six months after the system is required to begin lead service line replacement under paragraph (g) of this section. (h) Reporting to demonstrate compliance to State. To demonstrate compliance with paragraphs (a) through (g) of this section, a system shall report to the State the information specified in Sec. 141.90(e).09. Amend Sec. 141.85 by:0a. Revising the section heading, introductory text, and paragraphs (a)(1) introductory text and (a)(1)(ii);0b. Adding paragraph (a)(1)(vii);0c. Revising paragraphs (b)(2) introductory text, (b)(2)(ii)(B) introductory text, and (b)(2)(ii)(B)(1);0c. Adding paragraph (b)(2)(ii)(B)(7);0d. Removing paragraph (b)(2)(ii)(C);0e. Revising paragraphs (b)(2)(vii), (b)(4) introductory text, (b)(4)(iii), (b)(6), and (d)(1), (2), and (4); and0f. Adding paragraphs (e) through (j). The revisions and additions read as follows:Sec. 141.85 Public education and supplemental monitoring and mitigation requirements. All water systems must deliver a consumer notice of lead tap water monitoring results to persons served by the water system at sites that are sampled, as specified in paragraph (d) of this section. A water system with lead, galvanized requiring replacement, or lead status unknown service lines must deliver public education materials to persons with a lead, galvanized requiring replacement, or lead status unknown service line as specified in paragraphs (e) through (g) of this section. All community water systems must conduct annual outreach to local and State health agencies as outlined in paragraph (i) of this section. A community water system serving more than 10,000 persons that fails to meet its annual lead service line replacement goal as required under Sec. 141.84(f) shall conduct outreach activities as specified in paragraph (h) of this section. A water system that exceeds the lead action level based on tap water samples ***collected*** in accordance with Sec. 141.86 shall deliver the public education materials contained in paragraph (a) of this section and in accordance with the requirements in paragraph (b) of this section. Water systems that exceed the lead action level shall offer to sample the tap water of any customer who requests it in accordance with paragraph (c) of this section. All small community water systems and non-transient non-community water systems that elect to implement POU devices under Sec. 141.93 must provide public education materials to inform users how to properly use POU devices in accordance with paragraph (j) of this section. (a) \* \* \* (1) Community water systems and non-transient non-community water systems. Water systems must include the following elements in printed materials (e.g , brochures and pamphlets) in the same order as listed in paragraphs (a)(1)(i) through (vii) of this section. In addition, language in paragraphs (a)(1)(i), (ii), and (vi) of this section must be included in the materials, exactly as written, except for the text in brackets in paragraphs (a)(1)(i), (ii), and (vi) of this section for which the water system must include system-specific information. Any additional information presented by a water system must be consistent with the information in paragraphs (a)(1) through (vii) of this section and be in plain language that can be understood by the general public. Water systems must submit all written public education materials to the State prior to delivery. The State may require the system to obtain approval of the content of written public materials prior to delivery. Water systems may change the mandatory language in paragraphs (a)(1)(i) and (ii) of this section only with State approval.\* \* \* \* \* (ii) Health effects of lead. Exposure to lead in drinking water can cause serious health effects in all age groups. Infants and children can have decreases in IQ and attention span. Lead exposure can lead to new learning and behavior problems or exacerbate existing learning and behavior problems. The children of women who are exposed to lead before or during pregnancy can have increased risk of these adverse health effects. Adults can have increased risks of heart disease, high blood pressure, kidney or nervous system problems.\* \* \* \* \* (vii) Information on lead service lines. For systems with lead service lines, discuss opportunities to replace lead service lines and explain how to access the service line inventory so the consumer can find out if they have a lead service line. Include information on programs that provide financing solutions to assist property owners with replacement of their portion of a lead service line, and a statement that the water system is required to replace its portion of a lead service line when the property owner notifies them they are replacing their portion of the lead service line.\* \* \* \* \* (b) \* \* \* (2) A community water system that exceeds the lead action level on the basis of tap water samples ***collected*** in accordance with Sec. 141.86, and that is not already conducting public education tasks under this section, must conduct the public education tasks under this section within 60 days after the end of the tap sampling period in which the exceedance occurred:

**Load-Date:** January 18, 2021

**End of Document**



[***Identification of bacterial endospores and targeted detection of foodborne viruses in industrially reared insects for food***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H841-F129-P4D4-00000-00&context=1516831)

Nature Food

July 2020

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**Section:** Pg. 511-516; Vol. 1; No. 8; ISSN: 2662-1355

**Length:** 5117 words

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**Body**

Main

Although entomophagy has been associated with certain African, Latin American and Asian cultures for decades, edible insects and insect-derived food products only entered the European markets in the past few years. The International Platform of Insects for Food and Feed reports that 6,000 t of insect proteins were produced by its European members in 2019, and predicts that approximately 3 Mt will be produced in 2030. Owing to the expansion of the edible insect sector, microbiological risk assessments and food safety research have been initiated by bodies such as the European Food Safety Authority (EFSA) and several research groups.

As is clear from literature, freshly reared insects may be contaminated by a diversity of microorganisms. Although insects are not likely to be consumed in a raw form, it is necessary to characterize the presence of organisms that should be targeted by processing treatments to assure food safety. For yellow mealworms (Tenebrio molitor), lesser mealworms (Alphitobius diaperinus) and tropical house crickets (Gryllodes sigillatus), the high numbers of fungi and bacteria present can easily be reduced by, for example, applying a mild heat treatment, but the endospore fraction of bacteria (such as Clostridiales and Bacillales) can survive heat treatments, which may pose food safety risks.

DNA-based studies have already identified, among others, the spore-forming genera Bacillus, Brevibacillus, Clostridium, Lysinibacillus and Paenibacillus in edible insects and insect products produced in Europe–. Yet, it is generally not clear which specific species were found and whether or not they were present in spore form. Here, we identify bacterial endospores present in raw samples of the yellow mealworm and the house cricket (Acheta domesticus), the insect species mostly widely reared for human consumption. Bacillus cereus-related isolates, which may present important food safety risks in edible insects, were further characterized with quantitative real-time polymerase chain reaction (qPCR).

The possibility that foodborne viruses such as hepatitis A virus (HAV), hepatitis E virus (HEV) or norovirus (NoV) could be present in insects or insect-derived foodstuffs was proposed by the EFSA in 2015. These are the most commonly transmitted viruses through foodstuffs and are relevant for study in edible insects and insect-based food matrices, yet they remain uninvestigated in this context. Here we determine the presence of HAV, HEV and NoV genogroup II (GII, responsible for the majority of norovirus cases) in raw mealworm and cricket species.

It is plausible that the organisms present in the gut and on the exoskeleton differ between insects cultivated in the laboratory and the same species reared at industrial scale and so, with consumer safety as our priority, insect samples for this study were obtained from commercial industrial insect producers in Belgium and the Netherlands.

Results

Bacterial endospore counts

Bacterial endospore and total viable counts were performed on raw yellow mealworm and house cricket samples (Fig. ). Total viable aerobic and anaerobic counts (Fig. ) were similar to those previously reported for raw yellow mealworms (7.5–9.3 log(colony-forming units (c.f.u.) g−1)) and house crickets (7.9–8.8 log(c.f.u. g−1)),. Aerobic and anaerobic total counts were highly comparable to each other, which may indicate that a large fraction of both counts comprises facultative anaerobic species. The total viable counts for house crickets were higher than those for yellow mealworms, which substantiates what has previously been proposed: that microbiological findings of particular insect species should not be generalized for all edible insects.

Microbial counts of samples assessed for bacterial endospores.

***Data*** are presented as mean diamond plots. a,b, Total viable aerobic (a) and anaerobic (b) counts. c,d, Aerobic (c) and anaerobic (d) bacterial endospore counts. ***Data*** points represent the three replicates of yellow mealworms (YM; brown circles, n = 4 biologically independent samples) and house crickets (HC; blue triangles, n = 4 biologically independent samples). Sample names consist of the insect species followed by the rearing company number and the batch number. Anaerobic bacterial endospore counts for YM 1.1 were not determined. The horizontal black line represents the mean of all samples. The top and bottom points of each diamond represent the 100% confidence intervals for each sample and the lines across the middle of each diamond represent the sample mean. 95% confidence marks appear as horizontal lines above and below the sample mean. Mean counts from different samples with the same superscript letters are not statistically different (P > 0.05) based on one-way ANOVA with Tukey–Kramer HSD post-hoc tests. $Only two replicates were displayed.

Compared with the total viable counts, significant variations in bacterial endospore counts (which represent the fraction of the total viable counts present as spore form) were observed between samples from the same insect species (Fig. ). This variation is common for insects and may result from differences in rearing environment (for example in hygiene) and/or the feed (composition and/or quality),,. Again, anaerobic and aerobic endospore counts were similar to each other (Fig. ).

In the commercial sector, edible insects are typically subjected to a heat treatment, such as boiling and/or oven drying, before processing and consumption. However, bacterial endospores can survive these treatments, remaining present and viable in insects for human consumption,. The highest endospore count observed in this study was 5.0 log(c.f.u. g−1), for a raw house cricket sample (Fig. , sample HC 4.2). Although no legal European Union (EU) microbiological criteria exist specifically for edible insects, this endospore count surpasses the lower action limit for Bacillus cereus counts in edible insects as published by the Belgian Federal Agency for the Safety of the Food Chain. If a large fraction of the spores encountered were found to be B. cereus, a health risk for human consumption may be present. No criteria or action limits exist for Clostridia, but we advise that this issue receives greater attention.

Identification of bacterial endospores

Pathogenic bacteria present in their spore form are of major concern for edible insects. In total, 142 endospore-forming isolates were ***collected*** from the bacterial endospore count plates obtained from yellow mealworm and house cricket samples. These isolates were present as endospores in the raw insect matrix and survived the pasteurization treatment during analysis (as part of the ISO-based endospore count). By homogenizing the sample before the isolation of endospores, it was possible to obtain a complete view of the presence of endospores both in and on the surface of the insect, which is processed and consumed completely.

The isolates were assigned to four different genera of endospore-forming bacteria, including Bacillus, Lysinibacillus, Brevibacillus and Clostridium. On the basis of further identification, the Bacillus genus was further divided into Bacillus cereus group (also B. cereus sensu lato (s.l.)) and Bacillus sp. (non-cereus) (Fig. ; Supplementary Table ). Of the 50 isolates obtained from yellow mealworms, 20 were identified as a member of the B. cereus group. For house crickets, 79 out of 92 isolates were identified as B. cereus group members. This suggests that house crickets are highly susceptible to colonization with B. cereus group members.

Identification and characterization of bacterial endospore isolates.

a, Number of bacterial endospore isolates from yellow mealworms and house crickets corresponding to the bacterial genera identified by 16S rRNA gene sequencing. b, Presence/absence of cesA in B. cereus group isolates as determined by qPCR.

The B. cereus group consists, along with a few recently described species, of the closely related bacteria B. cereus sensu stricto (s.s.), B. thuringiensis, B. weihenstephanensis, B. wiedmannii, B. anthracis, B. mycoides, B. pseudomycoides, B. cytotoxicus and B. toyonensis,. Most isolates assigned to the B. cereus group were identified as B. cereus s.s. or B. paramycoides (proposed novel member). Owing to the close genetic relationships within the B. cereus group, however, it is challenging to distinguish between the different species compiled in this group based on the 16S ribosomal RNA gene.

Several species of the B. cereus group are relevant to human health, ***agriculture*** and food safety. In the case of edible insects, the presence of the pathogen B. cereus s.s. may pose a severe food safety risk for consumers, but some B. weihenstephanensis and B. cytotoxicus strains have also been reported as potential human (foodborne) pathogens,. B. cereus s.s., B. cytotoxicus, B. thuringiensis and B. weihenstephanensis have previously been identified in edible processed insects,. For insect rearing, B. thuringiensis may be harmful because of its insecticidal properties. Given that the B. cereus group contains psychrotrophic strains,, chilled preservation of heat-treated insects could allow the growth (and toxin production) of food pathogens such as B. cereus s.s. before consumption.

The second most abundant endospore-forming bacteria were members of the genus Lysinibacillus (21 out of 142 isolates; Fig. ) and the majority was identified as L. fusiformis (Supplementary Table ). This spore former, previously named Bacillus fusiformis, rarely acts as a human pathogen, but its relative L. sphaericus has been reported as a potent insect pathogen. Lysinibacillus sp. was previously detected in edible insects and is a potential proteolytic spoilage organism that can alter product quality,.

Besides members of the B. cereus group, non-cereus Bacillus spp. were also detected (16 of the 142 isolates; Fig. ). The genus Bacillus has regularly been found in edible insects,,, but it has rarely been described at the species level. According to the identification results (Supplementary Table ), non-cereus Bacillus sp. isolates may correspond to several species including B. pumilus, B. altitudinis, B. siamensis, B. licheniformis, B. vallismortis and B. subtilis. The latter three species are closely related and, comparable to the B. cereus group, they are members of the B. subtilis group. As was also the case for the B. cereus group, the 16S rRNA gene does not allow for species-level identification for B. subtilis group members. B. subtilis and its relatives are considered as spoilage organisms rather than human food pathogens, but were linked to toxin production and a few cases of foodborne illness,. On the other hand, they are also frequently described as beneficial for plants and/or animals (as biocontrol organisms or probiotics,, for example), which may afford opportunities for industrial valorization in the insect sector, among others.

Six isolates (Fig. ) obtained only from yellow mealworms, but not house crickets, were ascribed to the genus Brevibacillus and identified as either B. laterosporus or B. halotolerans (Supplementary Table ). In previous research, a Brevibacillus species was detected in yellow mealworms at abundances of up to 28%. B. laterosporus has been reported as insect pathogen. Together with B. thuringiensis of the B. cereus group and L. sphaericus, a realistic risk for edible insect rearing exists when these entomopathogenic bacteria are present. Furthermore, Brevibacillus spp. can act as spoilage organisms and impact the quality of insect food products.

Although both aerobic and anaerobic bacterial endospore counts were performed and isolates were picked randomly from all plates from all samples, it is striking that almost solely aerobic and/or facultative anaerobic organisms were identified. Anaerobic spore formers such as specific Clostridium spp. were detected in edible insects in previous studies, including yellow mealworms and house crickets,,,. Here, however, only one isolate was assigned to the genus Clostridium, and with a low sequence identity (69.4%, Supplementary Table ). The genus Clostridium is of concern in food safety, as it contains the food pathogens C. perfringens and C. botulinum. They produce potent toxins that cause gastroenteritis and botulism, respectively. Food poisoning caused by C. perfringens, however, generally requires the ingestion of 108 cells that can then sporulate and release their toxin in the intestine. The total viable anaerobic counts observed in this study may exceed 8 log(c.f.u. g−1), but probably do not consist solely of Clostridium cells.

qPCR detection of B. cereus-related genes

The extreme similarity of the 16S rRNA gene between all B. cereus group members, required additional genetic markers (panC and cesA genes) to be evaluated to characterize and discriminate the B. cereus group isolates. Assessing those genes enabled confirmation of the B. cereus group identification and evaluation of the potential for each isolate to act as a human pathogen of the emetic type, regardless of its taxonomic classification.

Of the 98 B. cereus group isolates assessed for the panC gene, only 3 were found to be negative. Consequently, the identification of 95 B. cereus group isolates was considered reliable. The cesA gene was detected in 64 of the 98 isolates (Fig. ). This indicates that those isolates may be able to produce the cereulide toxin under suitable conditions. Influencing factors include temperature, the food matrix (for example water activity (aw)) and the number of B. cereus cells present,. Although the precise impact of water activity is not fully understood, a minimal aw value of 0.953 has been proposed for the production of cereulide. The aw values of raw edible mealworms and crickets, as used in this study, range between 0.95 and 0.98 (ref.) and are consequently suitable for cereulide production. The amount of B. cereus required to be present for toxin production to take place is typically reported as 3 to 5 log(c.f.u. g−1) (ref.). B. cereus counts were not assessed in this study, but in literature, presumptive B. cereus counts of up to 6.6 log(c.f.u. g−1) were detected in processed edible mole crickets.

The presence of the cereulide plasmid in B. cereus poses an increased food safety risk, as this toxin constitutes the most severe risk associated with B. cereus,. This virulence plasmid has so far only been encountered in B. cereus s.s. and B. weihenstephanensis, and it was not reported to be present in B. thuringiensis, B. mycoides and B. pseudomycoides strains,. In the insect sector, the distinction between foodborne pathogen (B. cereus s.s. or B. weihenstephanensis) and insect-borne pathogen (B. thuringiensis) is of major interest, and the presence or absence of the cesA gene provides additional information in this regard. The number of bacterial endospores in the samples investigated was maximally 5.0 log(c.f.u. g−1) and did not relate solely to the B. cereus group. Nevertheless, a risk is still present because after heat treatment the endospores can germinate in the insect matrix and, in absence of competition, multiply and produce cereulide. A second heating step would not be sufficient to destroy the toxin, and thus eliminate the risk.

Presence of foodborne viruses

Three different reverse transcription qPCR assays (RT-qPCR) were optimized to detect and quantify HAV, HEV and NoV GII in insect RNA extracts and assessed for their reliability. On the basis of the recovery of the reference virus cDNA fragments, the detection limit for each assay was set at 100 copies per μl of undiluted RNA extract. The systematic recovery of internal amplification controls (IACs), the consistent amplification of positive controls (Ct values ±31) and the absence of qPCR signals for negative controls contributed to the conclusion that the RT-qPCR assays were reliable.

The viruses HAV, HEV or NoV GII were not detected in any of the samples—the viruses were either not present or the samples contained less than 100 viral RNA copies per μl of extract. Consequently, the transmission risk for HAV, HEV and NoV GII via yellow and lesser mealworm and (tropical) house cricket to humans is low.

Conclusions

In a ***collection*** of industrially produced edible insects, we demonstrate a high risk of foodborne illnesses originating from bacterial spores and a low risk of human viruses in edible mealworms and crickets. The largest fraction of isolates from bacterial endospores was identified as members of the B. cereus group, which contains foodborne and insect-borne pathogens: 65% of the B. cereus group isolates contained the cereulide plasmid, which can enable the production of a heat-resistant toxin. The presence of the insect pathogens Brevibacillus laterosporus and Lysinibacillus sp. may result in production losses. Mitigation strategies to lower the risks regarding pathogenic bacterial endospores include the use of substrates that do not contain these species, which requires a thorough quality control; decontamination of the insects via the hurdle or combination strategy (for example steam, combining heat with pressure, pulsed electric fields, irradiation) or prevention of spores from germinating (for example by reducing water activity, pH and/or temperature of the matrix). The presence of foodborne viruses in edible insects was investigated, and HAV, HEV and NoV GII were not detected. Hence, the food safety risks related to these viruses can be stated to be very low.

The set-up used in this study did not include tracking of the origin of the microorganisms, such as whether they were introduced via the substrate, via the rearing environment or during packaging and/or transport. The elucidation of transmission routes is, however, necessary to determine appropriate hygiene measurements for the sector. The location of the microorganisms within the insect body or on the surface was not investigated in detail because insects were homogenized during sample preparation.

Limitations in the random selection of isolates and/or the strict anaerobic conditions necessary for cultivating certain Clostridium species may have hampered the detection of anaerobic species that might have been present in the samples investigated. Accordingly, the specific isolation and identification of anaerobic bacterial spore formers would form an interesting addition to this research. The exact conditions required for (and extent of) toxin production (for example, cereulide) that can occur in edible insects and derived food products is a future research need.

As industrial insect production methods are evolving due to automation and upscaling, we advise that virus detection is continued and also performed for other virus and insect species than those considered in this study.

Methods

Sample ***collection*** and preparation

For the identification of bacterial endospores in edible insects, four samples of living yellow mealworms (T. molitor) and four samples of living house crickets (A. domesticus) were ***collected*** at the end of their rearing cycle, without further processing. For each insect species, two different industrial rearing companies in Belgium (yellow mealworms) or Belgium and the Netherlands (house crickets) were sampled two times each (2 samples × 2 rearers × 2 sampling moments or batches). All living insect samples were packed by the producer in a closed tray or box and transported at ambient temperature.

For the detection of foodborne viruses in edible insects, the same 17 untreated (raw) mealworm and cricket samples previously investigated, for their bacterial composition (yellow mealworm, house cricket and tropical house cricket (G. sigillatus) samples from different rearing companies and batches) were employed, as well as an extra sample of lesser mealworms (A. diaperinus) obtained in another study, where it was used to study microbial dynamics during rearing (larvae day 35, post-harvest).

Samples were treated aseptically from arrival in the laboratory. Before analysis, dead specimens were removed with sterile tweezers and remaining insects were sedated by cooling for approximately 1 h at 4 °C. Subsequently, samples were homogenized by pulverization with a sterilized hand-held mixer (Bosch CNHR 25) as described in an earlier report.

Bacterial endospore counts and isolation

Samples were subjected to aerobic and anaerobic bacterial endospore counts in triplicate. As previously described, for each analysis, 5 g of pulverized insects were diluted in 45 g peptone physiological salt solution (0.85% NaCl, 0.1% peptone, Biokar Diagnostics) and homogenized in a Bagmixer (Interscience) for 1 min. This primary dilution was pasteurized at 80 °C for 10 min and then further diluted and plated on Plate Count Agar (PCA, Biokar diagnostics) using the spread plate technique to allow colonies to be picked easily later. Both aerobic and anaerobic endospore counts were determined after incubation for 48 h at 37 °C. As a comparison, a similar but unpasteurized dilution series was used to determine the total viable aerobic and anaerobic counts of the samples (pour plate technique, PCA, 72 h at 30 °C). Anaerobic conditions were generated in Anaerocult containers (2.5 l, VWR International) using AnaeroGen 2.5 l atmosphere generation systems (Thermo Fisher Scientific) and evaluated using resazurin indicators (BR0055N, Thermo Fisher Scientific).

For each sample, after incubation, several colonies with various morphologies were picked from the countable plates and streaked on ***nutrient*** agar (NA, Biokar Diagnostics, 24 h at 37 °C, (an)aerobic incubation depending on their origin) to form axenic cultures. Each individual colony was subsequently incubated overnight in ***nutrient*** broth (NB, Biokar Diagnostics, 18 h at 37 °C) and stored at −80 °C after the addition of glycerol to a final concentration of 50% (v/v). 67 and 95 spore-forming isolates were ***collected*** from the yellow mealworm and house cricket samples, respectively.

Identification of bacterial endospores

All 162 endospore isolates were, after recultivation in NB, subjected to phenol/chlorophorm genomic DNA extraction as described earlier and subsequently to PCR (T100 Thermal Cycler, Bio-Rad), amplifying the 16S rRNA gene. The PCR reaction (20 µl) contained 1.25 units of TaKaRa ExTaq Polymerase and 1× ExTaq Buffer (Clontech Laboratories), 312.5 µM of each dNTP, 1.0 µM of each primer (27F and 1492R, Table ) and 5 ng of genomic DNA (measured by a Nanodrop spectrophotometer, Thermo Fisher Scientific). PCR conditions included initial denaturation at 95 °C for 2 min, followed by 34 cycles of 45 s of denaturation at 95 °C, 45 s of annealing at 59 °C and 45 s of elongation at 72 °C, followed by a final elongation for 10 min at 72 °C. Obtained amplicons were sequenced using the same reverse primer as used in the PCR (1492 R, Table ) by Macrogen Europe. Resulting sequences were aligned and trimmed to an average read length of 861 bp. Isolates were subsequently classified using the EzBioCloud 16S rRNA gene database. In this way, a total of 142 isolates (50 from yellow mealworms, 92 from house crickets) were identified.

Primers and probes employed in this study

| **Target** | **Oligonucleotide (name)** | **Sequence (5??3?)** |
| --- | --- | --- |
| 16S rRNA gene | Forward primer (27F) | AGA GTT TGA TCC TGG CTC AG |
| Reverse primer (1492R) | TAC GGY TAC CTT GTT ACG ACT T |  |
| *B. cereus* genes |  |  |
| *panC* | Forward primer (panCF) | TYG GTT TTG TYC CAA CRA TGG |
| Reverse primer (panCR) | CAT AAT CTA CAG TGC CTT TCG |  |
| *cesA* | Forward primer (cesAF) | CAC GCC GAA AGT GAT TAT ACC AA |
| Reverse primer (cesAR) | CAC GAT AAA ACC ACT GAG ATA GTG |  |
| Viruses |  |  |
| HAV | Forward primer (HAV68) | TCA CCG CCG TTT GCC TAG |
| Reverse primer (HAV240) | GGA GAG CCC TGG AAG AAA G |  |
| Probe (HAV150) | 6FAM-CCT GAA CCT GCA GGA ATT AA-MGBNFQ |  |
| HEV | Forward primer (JVHEVF) | GGT GGT TTC TGG GGT GAC |
| Reverse primer (JVHEVR) | AGG GGT TGG TTG GAT GAA |  |
| Probe (JVHEVP) | 6FAM-TGA TTC TCA GCC CTT CGC-BHQ |  |
| NoV GII | Forward primer (QNIF2d) | ATG TTC AGR TGG ATG AGR TTC TCW GA |
| Reverse primer (COG2R) | TCG ACG CCA TCT TCA TTC ACA |  |
| Probe (QNIFS) | 6FAM-AGC ACG TGG GAG GGC GAT CG-BHQ |  |
| IAC | IAC probe (PrfAP) | VIC-CCA TAC ACA TAG GTC AGG-MGBNFQ |

6FAM, 6-carboxyfluorescein; MGB-NFQ, minor groove binder non-fluorescent quencher; BHQ, black hole quencher; VIC, 2′-chloro-7′-phenyl-1,4-dichloro-6-carboxyfluorescein.

qPCR detection of B. cereus-related genes panC and cesA

For 99 isolates classified as B. cereus group members, two additional genes were traced using qPCR. For each extract, a qPCR assay targeting the panC gene, encoding a pantothenate-β-alanine ligase, was applied first. The presence of that gene enabled the assignment of the isolates to the B. cereus group to be confirmed. Next, presence of the cereulide toxin pathway plasmid was investigated by assessing the cesA gene. All qPCR reactions (10 µl) were executed in a QuantStudio 3 qPCR system (Applied Biosystems, Thermo Fisher Scientific) and contained 5 µl PowerUp SYBR Green Master Mix with UNG (uracil-N glycosylase, to prevent carryover contamination; Thermo Fisher Scientific), 1 µM (panC) or 0.4 µM (cesA) of each primer (Table ) and 60 ng of DNA (measured by a MySpec spectrophotometer, VWR International). qPCR reaction conditions for the panC detection followed the master mix supplier’s protocol: 2 min at 50 °C (UNG activation) and 2 min of initial denaturation at 95 °C, followed by 40 cycles of 15 s denaturation at 95 °C and combined annealing and elongation for 1 min at 60 °C. The same conditions were applied for the cesA detection, except that the initial denaturation step was shortened to 20 s (ref. ). Each qPCR was followed by a melt curve analysis by raising the temperature gradually from 60 to 95 °C (0.1 °C s−1) while continuously monitoring fluorescence. Positive (B. cereus emetic type, LMG 17603, Belgian Coordinated ***Collections*** of Microorganisms (BCCM)) and negative (no template, sterile ultrapure water instead) controls were included. ***Data*** analysis was executed using the online application Design and Analysis in the qPCR DataConnect cloud software (Thermo Fisher Scientific). A detection was considered successful when the melt curve analysis revealed a single peak at the expected melting temperature, and when the obtained Ct values did not exceed these of the negative control (33 for cesA and 35 for panC).

RT-qPCR quantification of selected viruses

To detect and quantify HAV, HEV and NoV GII, previously described methods were optimized and used to screen the insect samples. Standard quantification curves and IACs were included to assess quantification and reliability. Corresponding virus reference cDNA was used as a standard, either obtained from an RNA transcript (NoV GII after RT-PCR, see below) or plasmids containing virus genome fragments (HAV and HEV after PCR targeting the reference fragment). IAC RNAs were generated by transforming IAC-containing plasmids into chemically competent Escherichia coli cells (One Shot TOP10, Thermo Fisher Scientific) and subsequent transcription to RNA using the T7 High Yield Transcription kit (Thermo Fisher Scientific).

Two total RNA extractions were performed on the homogenized insect samples using the Mo Bio RNA PowerSoil kit (manufacturer’s protocol, Carlsbad, CA, USA). Next, each RNA extract was subjected to a two-step RT-qPCR assay for each target virus separately. First, a tenfold RNA extract dilution was used to translate target virus RNA into cDNA (Table ). In this step, the IAC corresponding to the target virus was added to exclude false negative results. Each reaction (20 µl) was performed using the High Capacity cDNA Reverse Transcription kit (Applied Biosystems, Thermo Fisher Scientific) and contained 2.0 µl RT Buffer, 1.0 µl MultiScribe reverse transcriptase, 2 µM reverse primer (Table ), 0.8 µl dNTP Mix (100 mM), 0.5 µl RNase Inhibitor, 1,000 IAC copies and 40 ng RNA (as measured by a MySpec spectrophotometer). Reaction conditions (iCycler Thermal Cycler, Bio-Rad) were as described by the supplier: 10 min at 25 °C, 2 h at 37 °C and 5 min at 85 °C. Positive (108 IAC copies) and negative (no template, sterile ultrapure water) controls were included for all virus assays. Next, for each sample, the obtained cDNA was used as a template in the subsequent qPCR, which aimed to detect and quantify HAV, HEV or NoV GII, as well as to detect the corresponding IAC at the same time. The three virus assays were conducted according to protocols described earlier. All analyses were performed in duplicate and each reaction (20 µl) contained 1× TaqMan Universal Master Mix with UNG (Applied Biosystems, Thermo Fisher Scientific), 0.25 µM of each primer (Table ), 0.25 µM of the virus probe (FAM-labelled, Table ) and 0.10 µM of the IAC probe (VIC-labelled, Table ). All reactions were executed using a QuantStudio 3 qPCR system. The qPCR conditions were as follows: 2 min at 50 °C, 10 min at 95 °C and 40 cycles of 15 s denaturation at 95 °C and 60 s combined annealing and elongation at 60 °C. Virus quantities and standard curve parameters were calculated in the qPCR DataConnect cloud software. Again, positive (1,000 virus cDNA copies) and negative (no template, sterile ultrapure water) controls were included. The RT-qPCR was considered successful only when the IAC was detected below the negative control Ct.

Statistical analyses

To determine differences in microbial counts between samples in the bacterial endospore experiment, results were subjected to one-way ANOVA with all-pairs Tukey–Kramer HSD post-hoc tests. Normality and homoscedasticity assumptions were tested for the analysed datasets using the Shapiro–Wilk W test and Levene’s test, respectively. In the cases for which homoscedasticity was not confirmed, Welch’s ANOVA was used instead. Results were displayed as mean diamond plots with proportional x axes. JMP Pro 14.0.0 (ref. ) was used for the statistical tests (significance level of P < 0.05) and the creation of plots.

Reporting Summary

Further information on research design is available in the linked to this article.

**Acknowledgements**

Virus references and IACs were provided by I. Di Bartolo from the Italian Istituto Superiore di Sanità (ISS) and N. Cook from Fera Science Ltd. We thank A. Paeleman (Scientia Terrae Research Institute) for her expertise and assistance in designing and optimizing the qPCR protocols, S. Crauwels (KU Leuven) for processing the sequencing results and R. Smets (KU Leuven) for help with the ***statistics***. J. Franciotti, L. De Vrindt, N. Huybrechts, M. Gerits, S. Machtajiw, J. Plas and E. Van Vossole are acknowledged for their assistance in the lab. This research was financially supported by Flanders Innovation & Entrepreneurship (VLAIO) (Project 141129) as well as Internal Funds KU Leuven (grant number PDM/18/159).

**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s43016-020-0120-z.Publisher’s*](https://doi.org/10.1038/s43016-020-0120-z.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

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[***UK inflation rises to 0.6%; London average house price exceeds £500,000 – business live***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61TC-9RS1-DY4H-K1KK-00000-00&context=1516831)

The Guardian (London)

January 20, 2021 Wednesday 7:59 AM GMT

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**Section:** BUSINESS; Version:16

**Length:** 10221 words

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**Highlight:** Rolling coverage of the latest economic and financial newsLatest: London house prices hit fresh record over £500kExperts: Stamp duty holiday fuels prices, for now....Earlier:Transport, clothing and recreation costs lift inflationSoftware and laptop prices upFood prices fell in December, thoughEconomists predict inflation will rise as pandemic eases

**Body**

block-time published-time 3.21pm GMT

A flurry of stocks are touching new record highs on Wall Street today, as the technology boom continue:

enltr33 S&P 500 RECORD HIGHS so far today, incl: Alphabet [*$GOOGL*](https://twitter.com/search?q=%24GOOGL&src=ctag&ref_src=twsrc%5Etfw) Netflix [*$NFLX*](https://twitter.com/search?q=%24NFLX&src=ctag&ref_src=twsrc%5Etfw) Chipotle [*$CMG*](https://twitter.com/search?q=%24CMG&src=ctag&ref_src=twsrc%5Etfw) [*$ETSY*](https://twitter.com/search?q=%24ETSY&src=ctag&ref_src=twsrc%5Etfw) General Motors [*$GM*](https://twitter.com/search?q=%24GM&src=ctag&ref_src=twsrc%5Etfw) Discover [*$DFS*](https://twitter.com/search?q=%24DFS&src=ctag&ref_src=twsrc%5Etfw) Johnson & Johnson [*$JNJ*](https://twitter.com/search?q=%24JNJ&src=ctag&ref_src=twsrc%5Etfw) Eli Lilly [*$LLY*](https://twitter.com/search?q=%24LLY&src=ctag&ref_src=twsrc%5Etfw) Mettler-Toledo [*$MTD*](https://twitter.com/search?q=%24MTD&src=ctag&ref_src=twsrc%5Etfw) Applied Materials [*$AMAT*](https://twitter.com/search?q=%24AMAT&src=ctag&ref_src=twsrc%5Etfw) Analog Devices [*$ADI*](https://twitter.com/search?q=%24ADI&src=ctag&ref_src=twsrc%5Etfw) Qualcomm [*$QCOM*](https://twitter.com/search?q=%24QCOM&src=ctag&ref_src=twsrc%5Etfw) Texas Instruments [*$TXN*](https://twitter.com/search?q=%24TXN&src=ctag&ref_src=twsrc%5Etfw) etc [*@cnbc*](https://twitter.com/CNBC?ref_src=twsrc%5Etfw)

— Dominic Chu (@TheDomino) [*January 20, 2021*](https://twitter.com/TheDomino/status/1351911722198720519?ref_src=twsrc%5Etfw)

block-time published-time 3.21pm GMT

enltrNear Record Performance! Since election day, the S&P 500 has rallied 12.8% into inauguration. This marks the second strongest performance from election day to inauguration day dating back to 1929. [*pic.twitter.com/U7LK2rwVhl*](https://t.co/U7LK2rwVhl)

— Larry Adam (@LarryAdamRJ) [*January 20, 2021*](https://twitter.com/LarryAdamRJ/status/1351911996799803392?ref_src=twsrc%5Etfw)

block-time published-time 2.47pm GMT

Nasdaq hits fresh record high

In New York, stocks have opened higher as traders watch [*Donald Trump depart the White House*](https://www.theguardian.com/us-news/live/2021/jan/20/joe-biden-inauguration-donald-trump-impeachment-kamala-harris-washington-covid-coronavirus-live-updates) , ahead of Joe Biden’s inauguration as the next US president.

The Dow Jones industrial average is up 85 points, or 0.3%, at 31,016 points, with the broader S&P 500 up 26 points, or 0.7%, at 3,825.

The tech-focused Nasdaq has soared to a fresh all-time high, up 1.2% or 160 points at 13,357.

enltrThe S&P opens up 0.6%, the Nasdaq opens at a record

— Michael Brown (@MrMBrown) [*January 20, 2021*](https://twitter.com/MrMBrown/status/1351899929036414980?ref_src=twsrc%5Etfw)

Netflix is leading the charge, up 15% after reporting new subscriber additions that exceeded Wall Street estimates last night.

Marketwatch points out that Wall Street has soared since the election back in November, and is on track for the best post-election rally in over 90 years.

* Biden aims for best stock-market rally in 92 years ahead of inauguration

Shares certainly did rise sharply as it became clear that Joe Biden had won the White House race, raising hopes of a larger stimulus programme and investment in green technology.

But that rally also reflects optimism that the pandemic can be overcome; Pfizer’s vaccine results were released just days after Biden won the presidency.

enltrIn the 11 weeks between the Nov. 3 election and Tuesday, the S&P 500 was up a dazzling 12.76%. [*https://t.co/DeJszdd7gF*](https://t.co/DeJszdd7gF)

— MarketWatch (@MarketWatch) [*January 20, 2021*](https://twitter.com/MarketWatch/status/1351683949148459014?ref_src=twsrc%5Etfw)

block-time published-time 2.26pm GMT

EU hauliers reject UK jobs over Brexit rules

A British freight company director with more than over 20 years’ experience has told how EU hauliers and transport companies are turning their backs on UK business because they are being asked to provide tens of thousands of pounds in guarantees to cover VAT or potential tariffs on arrival in Britain.

The financial guarantee requirement did not exist before [*Brexit*](https://www.theguardian.com/politics/eu-referendum) and EU transport companies who previously provided a shipping service for small and medium-sized firms have decided they do not want the extra financial burden, according to Colin Jeffries, who runs Key Cargo International in Manchester.

Jeffries says:

“We’ve got people that are trying to bring textiles in from Italy but we are being told there is no haulage availability on that. Nobody’s willing to touch anything because of these guarantees. In Poland, we’re trying to get masks in for PPE in the workplace and we can’t get anyone to bring them over.”

Related: [*'Absolute carnage': EU hauliers reject UK jobs over Brexit rules*](https://www.theguardian.com/politics/2021/jan/20/absolute-carnage-eu-hauliers-reject-uk-jobs-over-brexit-rules)

block-time published-time 2.15pm GMT

Back on the UK housing market.... Nicky Stevenson, Managing Director at national estate agent group [*Fine & Country*](https://www.fineandcountry.com/uk) , says confidence has “taken some punches” since the blowout price rises in November.

One factor, she points out, is [*new figures showing the population has fallen in the last year*](https://www.ft.com/content/def33cfe-45c7-4323-bd08-d4fc42051f09) :

There’s been a negativity soup served up this week, with the stamp duty deadline now too close for comfort, but let’s not forget that when the pandemic erupted some were predicting massive house price falls in 2020. They never materialised and that wasn’t just down to the stamp duty holiday, which many now think was either unnecessary or rolled out too early, but rather a dramatic shift in the type of property people wanted to live in and its location.

“The hunger to move because of repeated lockdowns is being underpriced and levels of agreed sales reported since November do still point to a resilient market. We will only have to wait a couple of weeks to see if this has continued through January, which is when most buyers could no longer really hope to transact in time.

“It remains to be seen how many buyers really will pull out of purchases if they can’t claim the relief. Widespread renegotiations up and down chains are probably a more realistic outcome. When you’ve found the perfect house, it’s easy to say you’ll walk away but it’s much harder to do. Remember that most first-time buyers already benefited from a significant stamp duty discount even before the scheme began.

“One headwind for the market that has been largely ignored concerns a huge drop in the UK’s population. In the past week, the Economic ***Statistics*** Centre of Excellence said official ***statistics*** had missed the fact that the population hadn’t grown last year but had actually fallen 1.3m since the pandemic began, aided by an exodus of over half a million foreign-born residents. It said that this represented the largest fall in the UK resident population since World War 2. This could have a dramatic impact on demand, even if that loss first makes itself felt in the rental market, with better value rentals reducing overall purchase demand.”

block-time published-time 1.39pm GMT

Morgan Stanley profits jump

Morgan Stanley has joined the ranks of Wall Street firms posting strong results during the pandemic.

Earnings jumped by over 60% in the final quarter of 2020, up to $4,430m from $2,733m a year earlier, lifting total earnings last year to $14,418m from $11,301m.

Investment banking, wealth management and equity and bond trading were all strong, lifting net revenue to a new annual record, and underlining that the financial sector did well despite the impact of Covid-19.

CEO James P. Gorman says:

“The Firm produced a very strong quarter and record full-year results, with excellent performance across all three businesses and geographies.

I am extremely proud of how our employees came together to support each other and our communities and deliver for our clients in an incredibly challenging year.

enltr [*$MS*](https://twitter.com/search?q=%24MS&src=ctag&ref_src=twsrc%5Etfw) 4Q 2020 earnings: Morgan Stanley reports fourth quarter net revenues of $13.6 billion, net income of $3.4 billion, EPS of $1.81 and ROTCE of 17.7%. Release: [*https://t.co/k7XK0SwulS*](https://t.co/k7XK0SwulS) (1/5) [*pic.twitter.com/XyLKd2EqQD*](https://t.co/XyLKd2EqQD)

— Morgan Stanley (@MorganStanley) [*January 20, 2021*](https://twitter.com/MorganStanley/status/1351878792994844672?ref_src=twsrc%5Etfw)

enltrI realize earnings are not the center of anyone's attention today. But FWIW, Morgan Stanley posted a solid report this morning. Just like Goldman Sachs and JPMorgan Chase. [*$MS*](https://twitter.com/search?q=%24MS&src=ctag&ref_src=twsrc%5Etfw) up 2% [*#premarket*](https://twitter.com/hashtag/premarket?src=hash&ref_src=twsrc%5Etfw). [*$GS*](https://twitter.com/search?q=%24GS&src=ctag&ref_src=twsrc%5Etfw) [*$JPM*](https://twitter.com/search?q=%24JPM&src=ctag&ref_src=twsrc%5Etfw)

— Paul R. La Monica (@LaMonicaBuzz) [*January 20, 2021*](https://twitter.com/LaMonicaBuzz/status/1351885974180147205?ref_src=twsrc%5Etfw)

block-time updated-timeUpdated at 2.04pm GMT

block-time published-time 1.17pm GMT

Full story: UK inflation jumped in December as shoppers returned to high street

Here’s my colleague Phillip Inman on [*the rise in UK inflation last month*](https://www.theguardian.com/business/live/2021/jan/20/uk-inflation-transport-clothing-computers-stock-markets-ftse-joe-biden-business-live?page=with:block-6007d1c88f08db44cd79b8b2#block-6007d1c88f08db44cd79b8b2).

The annual rate of inflation rose to 0.6% in December from 0.3% in the previous month as shoppers returned to the high street in most parts of the UK after the end of the second lockdown.

The [*Office for National* ***Statistics***](https://www.theguardian.com/uk/office-for-national-statistics) said an increase in transport costs and a rise in computer games console prices as Christmas approached was only partially offset by cheaper takeaway food and lower furniture and household equipment prices.

With the [*economy battered by the coronavirus pandemic*](https://www.theguardian.com/business/economicgrowth) and most consumers restricted by the government’s regional tiers, the relatively weak rise in prices as the festive period approached was in line with City analyst expectations of a 0.5% increase.

Related: [*UK inflation jumped in December as shoppers returned to high street*](https://www.theguardian.com/business/2021/jan/20/uk-inflation-jumped-in-december-as-shoppers-returned-to-high-street-covid)

block-time published-time 12.49pm GMT

Bitcoin is not enjoying a Biden Bounce today, though.

It’s fallen over 5%, or nearly $2,000, to around $34,500 after Treasury secretary nominee Janet Yellen warned that cryptocurrencies could be used for illicit activities such as terrorist financing.

Yellen was speaking during her Senate confirmation hearing yesterday.

[*Business Insider has more details*](https://markets.businessinsider.com/currencies/news/bitcoin-price-cryptocurrency-should-be-curtailed-terrorism-concerns-yellen-2021-1-1029985692).

Senator Maggie Hassan yesterday asked Yellen about the dangers of terrorists using cryptocurrencies during the latter’s Treasury confirmation hearing.

Yellen said: You’re absolutely right that the technologies to accomplish this change over time, and we need to make sure that our methods for dealing with these matters, with terrorist financing, change along with changing technology.

“Cryptocurrencies are a particular concern. I think many are used - at least in a transaction sense - mainly for illicit financing.

“And I think we really need to examine ways in which we can curtail their use and make sure that money laundering doesn’t occur through those channels.”

enltr [*#Bitcoin*](https://twitter.com/hashtag/Bitcoin?src=hash&ref_src=twsrc%5Etfw) plunges >5% on latest sign lawmakers & regulators could get tough on cryptocurrencies. Janet Yellen suggested lawmakers 'curtail' use of Bitcoin amid terrorism concerns. Yellen said cryptocurrency transactions mainly used for 'illicit financing'. [*https://t.co/0aEsQchlkW*](https://t.co/0aEsQchlkW) [*pic.twitter.com/2Huls8zqXd*](https://t.co/2Huls8zqXd)

— Holger Zschaepitz (@Schuldensuehner) [*January 20, 2021*](https://twitter.com/Schuldensuehner/status/1351866241888243712?ref_src=twsrc%5Etfw)

block-time published-time 12.29pm GMT

European stock markets have had a decent morning, lifted by the prospect of stimulus measures from the new team in the White House and the easing of Covid-19 restrictions this year.

The Europe-wide Stoxx 600 is up 0.5%, with gains in Frankfurt and Paris.

In London, though, the FTSE 100 is flat, with multinational shares being held back by a stronger pound (currently up half a cent at $1.367).

European stock markets at noon today Photograph: Refinitiv

Joshua Mahony, Senior Market Analyst at IG, says investors hope Joe Biden’s inauguration will lead to [*a period of greater stability, as well as fresh stimulus spending*](https://www.ig.com/us/financial-events/us-presidential-election/).

“The pomp and ceremony of inauguration day has come with a similarly chipper outlook from European markets, with traders hoping this marks the beginning of a more stable four years.

“European markets are preparing looking forward with optimism this morning, with Joe Biden’s inauguration marking the end of a four-year period that married up both Brexit and global trade uncertainty.

Related: [*Biden inauguration: Trump to leave White House for Florida before ceremony – live updates*](https://www.theguardian.com/us-news/live/2021/jan/20/joe-biden-inauguration-donald-trump-impeachment-kamala-harris-washington-covid-coronavirus-live-updates)

block-time published-time 12.06pm GMT

Electrical goods retailer Dixons Carphone has benefitted from the boom in home cooking and computer gaming during the pandemic, my colleague Joanna Partridge explains:

Locked-down European consumers bought big-screen TVs, food preparation gadgets and health and beauty appliances, handing [*Dixons Carphone’s*](https://www.theguardian.com/business/dixons-carphone) 11% more revenue from selling electrical items over the Christmas trading period than a year earlier.

The retailer, which owns the Currys PC World brand, said computing and gaming products were also big sellers during the festive period and online sales had grown by more than 120%.....

Related: [*Dixons Carphone has bumper Christmas as online revenues soar*](https://www.theguardian.com/business/2021/jan/20/dixons-carphones-christmas-sales-rise-online-revenues-soar)

block-time published-time 11.36am GMT

UK company failures fall, but struggles lie ahead

The number of UK companies which collapsed into administration slumped to historic lows last year, as the government’s coronavirus support measures proved to be a lifeline for many businesses.

1,112 companies fell into administration during 2020, a 22% fall compared with 2019, according to the restructuring practice at accountant KPMG, which analysed notices in [*The Gazette*](https://www.thegazette.co.uk/).

The coronavirus job retention scheme, rent and tax deferrals, grants and loans all combined to support firms which saw income dry up as a result of Covid restrictions, leading to the lowest annual number of administrations since KPMG started tracking the ***data*** in 2005.

Leisure and hospitality companies, which have struggled the most to trade during restrictions, represented the lion’s share of insolvencies in the final quarter of the year following by building and construction firms, real estate businesses and retailers.

Blair Nimmo, head of restructuring for KPMG in the UK, warned that the figures “provide a distorted view of reality” and that companies will struggle once support measures are eased:

“Those businesses that remain in hibernation due to ongoing lockdown measures, such as those in the leisure and hospitality and travel and tourism sectors, continue to accrue liabilities while seeing precious little cash flow into the business.

At some point, rent and tax deferrals and loans will need to be repaid. The job retention scheme will unwind. Weaning off these support schemes is going to be a massive challenge for many.”

block-time published-time 11.35am GMT

Eurozone inflation sticks at -0.3%

[*While inflation rose in the UK last month*](https://www.theguardian.com/business/live/2021/jan/20/uk-inflation-transport-clothing-computers-stock-markets-ftse-joe-biden-business-live?page=with:block-6007d1c88f08db44cd79b8b2#block-6007d1c88f08db44cd79b8b2) , it remains elusive in the eurozone.

Consumer prices fell by 0.3% year-on-year in December, for the fourth month running, according to ***statistics*** body ***Eurostat***.

Cheaper energy kept inflation below zero, it says:

In December, the highest contribution to the annual euro area inflation rate came from services (+0.30 percentage points, pp), followed by food, alcohol & tobacco (+0.25 pp), non-energy industrial goods (-0.14 pp) and energy (-0.68 pp)

enltrEuro area annual [*#inflation*](https://twitter.com/hashtag/inflation?src=hash&ref_src=twsrc%5Etfw) stable at -0.3% in December 2020 [*https://t.co/YLhzuo1mpw*](https://t.co/YLhzuo1mpw) [*pic.twitter.com/2WosWPRLnH*](https://t.co/2WosWPRLnH)

— EU\_***Eurostat*** (@EU\_***Eurostat***) [*January 20, 2021*](https://twitter.com/EU_Eurostat/status/1351831840013783040?ref_src=twsrc%5Etfw)

block-time published-time 11.31am GMT

Estate agency Chestertons has confirmed that the housing market was busy in November -- even though England was [*under its second national lockdown*](https://www.bbc.co.uk/news/uk-54763956).

It carried out 44% more valuations and brought 76% more new properties to the market than in November 2019 (when the looming general election and Brexit uncertainty may have dampened demand).

Guy Gittins, Chestertons MD says:

“The second lockdown no doubt encouraged some people to put their property search on hold, but we didn’t notice a big difference and activity levels were still a lot higher than we anticipated for this time of year.

Part of this was driven by the incentive of the stamp duty saving, but we believe the main driver was that people just wanted to move as quickly as possible while conditions were favourable.”

block-time published-time 11.01am GMT

Good Move: Housing market will calm down in 2021

[*The 7.6% jump in UK house prices last year*](https://www.theguardian.com/business/live/2021/jan/20/uk-inflation-transport-clothing-computers-stock-markets-ftse-joe-biden-business-live?page=with:block-6007fc378f0883ef5d2b1098#block-6007fc378f0883ef5d2b1098) is a blow to those trying to get onto the housing ladder.

But Ross Counsell, chartered surveyor and director at [*Good Move*](https://goodmove.co.uk/) , suggests 2021 will be better for buyers, as the stamp duty holiday expires:

“So why are the house prices so high? We can put this growth down to the influx of people looking to buy property in 2020, both before the end of the Stamp Duty Holiday in March, and due to many people simply looking for more spacious properties, particularly in rural locations, during lockdown. Mortgage approvals too are at an all-time 13 year high, and with such high demand for properties and mortgages, naturally comes higher average house prices.

“The property market is incredibly competitive, and becoming increasingly more selective for lenders choosing who to lend to. However, it’s not all bad news. Despite these record high house prices, we expect them to fall after the end of the Stamp Duty Holiday in March.

And as the world hopefully resumes some normalcy this year, we do not expect 2021 to follow 2020’s footsteps with the staggeringly high house prices, and we therefore expect 2021 to be a solid year for buyers.”

Some campaigners have been pushing chancellor [*Rishi Sunak to extend the stamp duty holiday*](https://metro.co.uk/2021/01/17/rishi-sunak-urged-to-scrap-council-tax-and-stamp-duty-13918077/) in his March budget, or even to replace council tax and stamp duty with ‘a proportional property tax (PPT).

block-time published-time 10.46am GMT

Jamie Durham, economist at PwC, says the stamp duty holiday drove prices up in London:

“Prices in the capital rose by nearly 10% on an annual basis, adding £45,000 to the average home in 12 months, and [*pushing the average house price to over £500,000 for the first time*](https://www.theguardian.com/business/live/2021/jan/20/uk-inflation-transport-clothing-computers-stock-markets-ftse-joe-biden-business-live?page=with:block-6007fc378f0883ef5d2b1098#block-6007fc378f0883ef5d2b1098). The stamp duty holiday is a particular benefit in London and is likely to have played a significant part in this strong price growth, as the higher average house prices means that more stamp duty is typically due.”

“Despite a weak economy and the considerable impact of COVID-19, this ***data*** shows that the housing market has continued to perform strongly, buoyed by the stamp duty holiday, pent up demand and preference changes brought about by the pandemic.”

“There continues to be a lot of uncertainty in the outlook. The vaccine rollout could help to support the economic recovery and in turn the housing market. However, there is a risk that activity could drop off over the next couple of months as the stamp duty holiday comes to an end. Assuming the Chancellor does not extend the holiday in the March budget, that could feed through to weaker price growth in the coming quarters.”

Property website Rightmove warned on Monday that time is running out to avoid stamp duty, and some buyers could be hit with a tax bill if they can’t complete in time....

Related: [*Home buyers face unexpected tax bill when stamp duty kicks in*](https://www.theguardian.com/money/2021/jan/18/home-buyers-face-unexpected-tax-bill-when-stamp-duty-kicks-in)

block-time published-time 10.30am GMT

Here’s Noble Francis, economics director at the Construction Products Association, on [*the jump in London house prices in the last year*](https://www.theguardian.com/business/live/2021/jan/20/uk-inflation-transport-clothing-computers-stock-markets-ftse-joe-biden-business-live?page=with:block-6007fc378f0883ef5d2b1098#block-6007fc378f0883ef5d2b1098) :

enltr... & the increases in house prices in £ in the year to November 2020 according to the ONS/Land Registry. The £45,240 increase in London house prices was compared with a relative low point in November 2019 due to political (Brexit & General Election) uncertainty... [*#ukhousing*](https://twitter.com/hashtag/ukhousing?src=hash&ref_src=twsrc%5Etfw) [*pic.twitter.com/RQSwCzcX1h*](https://t.co/RQSwCzcX1h)

— Noble Francis (@NobleFrancis) [*January 20, 2021*](https://twitter.com/NobleFrancis/status/1351829441790570498?ref_src=twsrc%5Etfw)

enltrThe updated chart of average London house prices (that in November 2020 were 9.7% or £45,240 higher than a year ago according to the ONS/Land Registry) & mortgage rates between January 2004 & November 2020. [*#ukhousing*](https://twitter.com/hashtag/ukhousing?src=hash&ref_src=twsrc%5Etfw) [*#london*](https://twitter.com/hashtag/london?src=hash&ref_src=twsrc%5Etfw) [*#ukhouseprices*](https://twitter.com/hashtag/ukhouseprices?src=hash&ref_src=twsrc%5Etfw) [*pic.twitter.com/puCmns9LzH*](https://t.co/puCmns9LzH)

— Noble Francis (@NobleFrancis) [*January 20, 2021*](https://twitter.com/NobleFrancis/status/1351834980998066176?ref_src=twsrc%5Etfw)

block-time published-time 10.08am GMT

London’s average house price exceeds £500,000 for the first time

The average London house price has risen over £500,000 for the first time, as the stamp duty holiday helped to fuel demand for property during the pandemic.

New figures from the Office for National ***Statistics*** show that the average price in the capital hit £514,000 in November 2020, a jump of 9.7% over the last year.

That’s a record high and the first time London’s average house prices have surpassed £500,000.

The ONS reports that the temporary suspension of stamp duty (on the first £500,000 of a house purchase in England) was one factor driving the market.

It also cites pent-up demand following the first lockdown, and changes in housing preferences (as some families seek homes with more space due to rising remote working).

London’s annual house price growth has followed a sharp upward trend seen in most regions in recent months, likely reflecting a range of factors including pent-up demand, changes in housing preferences and the temporary reduction in property transaction taxes, which are due to end on 31 March 2021.

Looking at the picture within London, house prices have grown more quickly in Inner London than Outer London for some time. In November 2020, two London boroughs had annual house price growth above 20%, one is in Inner London (Kensington and Chelsea, at 28.6%), while the Outer London borough of Brent had annual price growth of 23.9%.

The annual growth rate in Brent is partly caused by a base effect as the average house price decreased by 11.9% between October and November 2019 and increased by 2.8% between October and November 2020.

The ONS also points to demand for investors, and [*people looking to move to the UK from Hong Kong*](https://www.theguardian.com/uk-news/2020/oct/22/over-1m-people-could-come-to-uk-from-hong-kong-within-five-years-official-estimate) following China’s clampdown on the city state.

Demand for property in Inner London may be particularly responsive to temporary property tax changes as property prices are high and therefore so is the corresponding tax to be paid. In addition, compared with other regions of the UK, London has a relatively high proportion of properties bought for investment, including from cash buyers and overseas investors.

As such, demand for property in Inner London is likely influenced by a broader range of factors than the rest of the UK, including the forthcoming introduction of [*additional property tax for non-UK residents*](https://www.gov.uk/government/publications/new-rates-of-stamp-duty-land-tax-for-non-uk-residents-from-1-april-2021) and geopolitical circumstances such as [*the new route to UK citizenship for British Nationals Overseas in Hong Kong*](https://www.gov.uk/guidance/british-nationals-overseas-in-hong-kong) , being introduced in January 2021, both of which may push up demand for properties in Inner London.

Across the country, prices rose by 7.6% in the last year - their fastest rate since June 2016 - to hit a new record.

* UK average house prices increased by 7.6% over the year to November 2020, up from 5.9% in October 2020, to stand at a record high of £250,000; this is the highest annual growth rate the UK has seen since June 2016.

1. Average house prices increased over the year in England to £267,000 (7.6%), Wales to £180,000 (7.0%), Scotland to £166,000 (8.6%) and Northern Ireland to £143,000 (2.4%).

The lowest annual growth was in the East of England, where average prices increased by 4.8% over the last year.

block-time updated-timeUpdated at 10.09am GMT

block-time published-time 10.00am GMT

enltrCommenting on today’s figures, Deputy National Statistician for Economic ***Statistics*** [*@jathers\_ONS*](https://twitter.com/jathers_ONS?ref_src=twsrc%5Etfw) said: (1/2) [*pic.twitter.com/nYUEFgVOd3*](https://t.co/nYUEFgVOd3)

— Office for National ***Statistics*** (ONS) (@ONS) [*January 20, 2021*](https://twitter.com/ONS/status/1351788341092614145?ref_src=twsrc%5Etfw)

enltr. [*@jathers\_ONS*](https://twitter.com/jathers_ONS?ref_src=twsrc%5Etfw) continued: (2/2) [*pic.twitter.com/ANpKhlsfOz*](https://t.co/ANpKhlsfOz)

— Office for National ***Statistics*** (ONS) (@ONS) [*January 20, 2021*](https://twitter.com/ONS/status/1351788347396657152?ref_src=twsrc%5Etfw)

block-time published-time 9.47am GMT

A JD Wetherspoons in Henley on Thames, Oxfordshire Photograph: Geoffrey Swaine/REX/Shutterstock

Shares in UK pub chain JD Wetherspoon have jumped 6% this morning, after it raised over £93m to strengthen its balance sheet...and buy up struggling pubs.

Wetherspoons announced the share placement last night, saying that the money would offset the impact of the pandemic, and also “facilitate the acquisition of new properties, which are likely to be available at favourable prices, as a result of the pandemic”.

My colleague Rob Davies explains:

It is targeting pubs in central London, which have been particularly hard-hit due to the loss of tourist traffic and office workers.

Many have also been closed for longer than large, rural pubs because they cannot meet social distancing standards.

Separately, former [*Greene King*](https://www.theguardian.com/business/greeneking) boss Rooney Anand is leading a new venture ready to spend £200m on pubs, in anticipation of a recovery after a miserable 2020:

Related: [*Wetherspoon moves to buy up smaller pubs on the cheap amid Covid crisis*](https://www.theguardian.com/business/2021/jan/19/most-non-food-pubs-england-still-awaiting-1000-covid-grants)

block-time published-time 9.18am GMT

Robert Alster, CIO at wealth manager Close Brothers Asset Management, reckons Britin is “extremely vulnerable” to a jump in prices this year:

[*“The rate of inflation doubled in December*](https://www.theguardian.com/business/live/2021/jan/20/uk-inflation-transport-clothing-computers-stock-markets-ftse-joe-biden-business-live?page=with:block-6007d1c88f08db44cd79b8b2#block-6007d1c88f08db44cd79b8b2) , but ongoing lockdowns and consumer uncertainty, accompanied by falling global oil prices, meant it remained far below the Bank of England’s 2 percent target.

“With Government debt soaring and individual purse strings tightening, Britain is extremely vulnerable to a rise in inflation in the year ahead. Short-term fluctuations caused by Brexit disruption and exchange rate shifts may not yet concern the Bank, but all eyes will be on when and how wages recover from Covid.

Paul Donovan of UBS Wealth Management flags up that the lockdown has driven demand for computer gaming:

Computer consoles and games helped push up prices—perhaps inevitable when confronted with the prospect of an extended period of time at home with one’s family.

block-time published-time 9.02am GMT

Burberry scores with Rashford campaign The Burberry store in Chadstone Shopping Centre during the Boxing Day shopping in Melbourne, Australia. Photograph: Alexander Bogatyrev/SOPA Images/REX/Shutterstock

A “highly successful festive campaign” featuring campaigning England football star Marcus Rashford has helped luxury fashion chain Burberry ride out the pandemic.

Burberry reported a 9% drop in “retail comparable store sales” in the three months to Boxing Day, partly due to reduced tourism during the pandemic.

Sales were particularly weak in Europe, the Middle East and Africa, as Covid-19 restrictions continued.

* Asia Pacific: +11% with strong growth in Mainland China and Korea

1. EMEIA: -37% due to fewer tourists and COVID-19 related store closures
2. Americas: -8% as mid-teen increase in full-price sales was more than offset by planned reductions in markdown activities

But Burberry also benefitted from “new, younger clientele”, and reports that teaming up with Rashford was a success:

In November, we launched our Festive campaign, partnering with Marcus Rashford MBE, the English international footballer who has taken a prominent role against child poverty during the pandemic, and global charities championing youth-related causes.

The consumer response to the campaign was exceptional, with engagement on our Instagram campaign posts more than double our Q2 average, and imagery featuring Marcus becoming our most liked Instagram post of all time. Marcus’ work to support the UK’s youth sits at the heart of our partnership and embodies our commitment to community and going beyond.

Related: [*Marcus Rashford: the making of a food superhero*](https://www.theguardian.com/football/2021/jan/17/marcus-rashford-the-making-of-a-food-superhero-child-hunger-free-school-meals)

Shares in Burberry have jumped 5% this morning, with CEO Marco Gobbetti saying the company is ‘well placed’ for the pandemic to ease:

“Despite the challenging external environment, we made good progress on our strategic priorities in the quarter. We saw a strong increase in full-price sales as our ***collections*** and communication resonated well with new, younger clientele as well as existing customers.

Our localised plans and digital capabilities helped drive growth in rebounding markets and we implemented our planned reduction in markdown. While the short-term outlook remains uncertain due to COVID-19, we are well placed to accelerate when the pandemic eases.”

enltrWe are proud to support [*@marcusrashford*](https://twitter.com/MarcusRashford?ref_src=twsrc%5Etfw) ’s heroic work to help young people. This is part of our commitment to youth, community and creativity [*#BurberryVoices*](https://twitter.com/hashtag/BurberryVoices?src=hash&ref_src=twsrc%5Etfw) [*pic.twitter.com/KFywzKjmrh*](https://t.co/KFywzKjmrh)

— Burberry (@Burberry) [*November 2, 2020*](https://twitter.com/Burberry/status/1323191899025530881?ref_src=twsrc%5Etfw)

enltrBurberry ad celebrates creativity with Marcus Rashford [*https://t.co/6ex8FuWgjY*](https://t.co/6ex8FuWgjY) [*pic.twitter.com/vKrw4mAsji*](https://t.co/vKrw4mAsji)

— Campaign (@Campaignmag) [*November 11, 2020*](https://twitter.com/Campaignmag/status/1326445818551955456?ref_src=twsrc%5Etfw)

block-time published-time 8.44am GMT

Despite picking up last month, UK inflation is still relatively low - having [*hit a five-year trough in September*](https://www.theguardian.com/business/2014/oct/14/uk-inflation-falls-five-year-low-what-economists-say).

UK inflation rate Photograph: ONS

block-time published-time 8.30am GMT

UK inflation: What the experts say

Several economists are predicting that inflation will keep rising as the UK economy reopens later this year, following [*December’s increase*](https://www.theguardian.com/business/live/2021/jan/20/uk-inflation-transport-clothing-computers-stock-markets-ftse-joe-biden-business-live?page=with:block-6007d1c88f08db44cd79b8b2#block-6007d1c88f08db44cd79b8b2).

Thomas Pugh of Capital Economics s uggests CPI inflation could rise over the Bank of England’s 2% target by the end of this year, before dipping in 2022.

Inflation will probably start to rise more sharply from April when the temporary VAT cut for the hospitality sector is reversed and the recent rises in ***agricultural*** and energy commodities start to make themselves felt. T

Together these forces could lift inflation to more than 2% by the end of the year. But ample spare capacity means it will probably settle at close to 1.5% by the end of next year. Further ahead, inflation may creep higher if the authorities keep monetary and fiscal policy loose after all the spare capacity in the economy has been absorbed.

Suren Thiru, head of economics at the British Chambers of Commerce, says prices could also rise if ‘the current post-Brexit disruption persists’:

enltr [*@ONS*](https://twitter.com/ONS?ref_src=twsrc%5Etfw) ***data*** shows [*#UK*](https://twitter.com/hashtag/UK?src=hash&ref_src=twsrc%5Etfw) CPI [*#inflation*](https://twitter.com/hashtag/inflation?src=hash&ref_src=twsrc%5Etfw) rate doubled to 0.6% in December 2020 (from 0.3% in Nov) but still the 17th successive month of below [*@bankofengland*](https://twitter.com/bankofengland?ref_src=twsrc%5Etfw) target inflation. Rise in inflation in December was mostly driven by rising transport costs and clothing & recreation prices. [*pic.twitter.com/sAclP9qgzh*](https://t.co/sAclP9qgzh)

— Suren Thiru (@Suren\_Thiru) [*January 20, 2021*](https://twitter.com/Suren_Thiru/status/1351788977125265409?ref_src=twsrc%5Etfw)

enltrWhile the short-term outlook for UK inflation is relatively subdued amid a contracting economy, if the current post-Brexit disruption persists this could increase the upward pressure on prices, especially if the mass vaccine rollout triggers a surge in consumer demand.

— Suren Thiru (@Suren\_Thiru) [*January 20, 2021*](https://twitter.com/Suren_Thiru/status/1351792918873387008?ref_src=twsrc%5Etfw)

Tom Stevenson, investment director for personal investing at Fidelity International, says investors should prepare for a more inflationary environment:

“The doubling in the CPI measure of inflation in December to 0.6% is a reminder of the need to remain vigilant about the price threat. Inflation never seems to be a problem until suddenly it requires firm action to tame it again. The combination of unprecedented government spending, pent up consumer demand and low productivity is a recipe for rising prices. Transport, recreation and clothing were the biggest contributors.

“The challenge facing UK policy makers is that historically high debt levels will make it hard for us to rein in inflation with higher interest rates as and when they become necessary. Servicing our high borrowings is expensive enough with rates on the floor.

block-time published-time 8.11am GMT

Meat and vegetable prices dipped during December, the ONS reports, with cooked ham and cauliflowers having the largest downward impact.

But today’s inflation report won’t capture the impact of shortages caused by disruption at UK ports last month:

The December 2020 price ***collection*** was completed on or around 15 December 2020, so our price quotes were not influenced by the reported stock shortages in supermarkets as we approached the end of the year.

block-time published-time 8.04am GMT

Computer game downloads also nudged inflation up last month, along with “smaller upward contributions from computer game consoles, equipment for sport, and plants and flowers”.

But the prices of pre-school activity toys and board games fell in the run up to Christmas, the Office for National ***Statistics*** adds.

block-time published-time 7.32am GMT

Introduction: UK inflation picks up to 0.6%

Good morning, and welcome to our rolling coverage of the world economy, the financial markets, the eurozone and business.

The reflation trade is one of the key drivers of the markets right now, as investors bet that stimulus packages and a post-lockdown boom will drive prices higher.

And the latest figures show that inflation across the UK rose in December.

The UK consumer prices index rose by 0.6% in the year to December, up from 0.3% in November, the Office for National ***Statistics*** reports.

Transport costs picked up during the month -- as restrictions on travel were briefly lifted over the Christmas period (before the latest lockdown was brought in).

Clothing prices were also higher, along with recreation activities (such are possible during a pandemic, anyway).

The ONS says:

Rising transport costs contributed 0.11 percentage points to the monthly change, while increasing prices for clothing, and recreation and culture items both contributed 0.10 percentage points to help increase inflation; these were partially offset by a downward contribution from falling food and non-alcoholic beverage prices.

UK inflation to December 2020 Photograph: ONS

Air fares rose by more than usual during November and December, the ONS reports, with fuel prices also picking up --prices at petrol pumps rose by 1.5 pence per litre last month.

Women’s and men’s clothing prices also rose, as the Black Friday discounts ended.

Technology prices were also higher than usual, the ONS adds:

The largest upward contribution [in the recreation and culture grouping] came from ***data*** processing equipment, where prices for computer software, PC peripherals and laptops were overall largely unchanged between November and December 2020, but fell between the same two months in 2019.

Food prices fell by 0.4% during December, though, bringing some help to households suffering from the impact of the Covid-19 lockdown.

enltr [*#UK*](https://twitter.com/hashtag/UK?src=hash&ref_src=twsrc%5Etfw) [*#consumer*](https://twitter.com/hashtag/consumer?src=hash&ref_src=twsrc%5Etfw) price [*#inflation*](https://twitter.com/hashtag/inflation?src=hash&ref_src=twsrc%5Etfw) rose slightly more than expected to 0.6% in December (consensus: 0.5%) from 0.3% in November. Main upward impact on inflation from clothing prices, transport costs & recreation & culture. Core inflation up to 1.4% from 1.1%. Food had downward impact

— Howard Archer (@HowardArcherUK) [*January 20, 2021*](https://twitter.com/HowardArcherUK/status/1351793586199736321?ref_src=twsrc%5Etfw)

Inflation is still below the Bank of England’s 2% target, but this move could be a signal that prices are going to keep pushing higher in 2021, as the Covid-19 lockdown eases.

enltr2021 is all about reflation expectations—— Britain's annual inflation rate accelerated more than expected to 0.6% in December on the back of rising fuel costs and more stable trends in apparel prices. Core CPI also beat, rising 1.4%.

— Anneka Treon (@AnnekaTreon) [*January 20, 2021*](https://twitter.com/AnnekaTreon/status/1351791792384053249?ref_src=twsrc%5Etfw)

We also get eurozone inflation figures later this morning, plus the latest UK house prices and US mortgage figures.

Investors will also be watching Joe Biden be sworn in as America’s 46th president, and assessing his chances of ‘going big’ with a new stimulus package and green energy policies.

Kyle Rodda of [*IG*](https://www.ig.com/uk) says:

The conversation in the market has generally remained on US politics and the incoming Biden-administrations fiscal stimulus plans.

Subdued price action in bond markets suggest little new information has come about on either front in recent days. Nevertheless, ahead of President-elect Biden’s inauguration this evening, where there remains some concern regarding civil unrest and violent protests, the drama enveloping US politics and the US economy remains the most attention grabbing news.

The agenda

* 7am GMT: UK inflation report for December

1. 9.30am GMT: UK house price index for November
2. 10am GMT: Eurozone inflation report for December
3. Noon GMT: US weekly mortgage applications
4. 3pm GMT: Bank of Canada interest rate decision

block-time updated-timeUpdated at 7.59am GMT

4355 2021-01-23T07:45:00Z true 2021-01-20T07:43:34Z false false 2021-01-20T15:21:14Z true UK theguardian.com [*https://gu.com/p/g6e3e*](https://gu.com/p/g6e3e)

false true [*https://media.guim.co.uk/b8bc3f6dcde02e28ec5e5aeabb7d3b3dc8df282e/0\_221\_5285\_3172/500.jpg*](https://media.guim.co.uk/b8bc3f6dcde02e28ec5e5aeabb7d3b3dc8df282e/0_221_5285_3172/500.jpg) false en true A flurry of stocks are touching new record highs on Wall Street today, as the technology boom continue: In New York, stocks have opened higher as traders watch Donald Trump depart the White House, ahead of Joe Biden’s inauguration as the next US president. The Dow Jones industrial average is up 85 points, or 0.3%, at 31,016 points, with the broader S&P 500 up 26 points, or 0.7%, at 3,825. The tech-focused Nasdaq has soared to a fresh all-time high, up 1.2% or 160 points at 13,357. Netflix is leading the charge, up 15% after reporting new subscriber additions that exceeded Wall Street estimates last night. Marketwatch points out that Wall Street has soared since the election back in November, and is on track for the best post-election rally in over 90 years. Biden aims for best stock-market rally in 92 years ahead of inauguration Shares certainly did rise sharply as it became clear that Joe Biden had won the White House race, raising hopes of a larger stimulus programme and investment in green technology. But that rally also reflects optimism that the pandemic can be overcome; Pfizer’s vaccine results were released just days after Biden won the presidency. A British freight company director with more than over 20 years’ experience has told how EU hauliers and transport companies are turning their backs on UK business because they are being asked to provide tens of thousands of pounds in guarantees to cover VAT or potential tariffs on arrival in Britain. The financial guarantee requirement did not exist before Brexit and EU transport companies who previously provided a shipping service for small and medium-sized firms have decided they do not want the extra financial burden, according to Colin Jeffries, who runs Key Cargo International in Manchester. Jeffries says: “We’ve got people that are trying to bring textiles in from Italy but we are being told there is no haulage availability on that. Nobody’s willing to touch anything because of these guarantees. In Poland, we’re trying to get masks in for PPE in the workplace and we can’t get anyone to bring them over.” Back on the UK housing market.... Nicky Stevenson, Managing Director at national estate agent group Fine & Country, says confidence has “taken some punches” since the blowout price rises in November. One factor, she points out, is new figures showing the population has fallen in the last year: There’s been a negativity soup served up this week, with the stamp duty deadline now too close for comfort, but let’s not forget that when the pandemic erupted some were predicting massive house price falls in 2020. They never materialised and that wasn’t just down to the stamp duty holiday, which many now think was either unnecessary or rolled out too early, but rather a dramatic shift in the type of property people wanted to live in and its location. “The hunger to move because of repeated lockdowns is being underpriced and levels of agreed sales reported since November do still point to a resilient market. We will only have to wait a couple of weeks to see if this has continued through January, which is when most buyers could no longer really hope to transact in time. “It remains to be seen how many buyers really will pull out of purchases if they can’t claim the relief. Widespread renegotiations up and down chains are probably a more realistic outcome. When you’ve found the perfect house, it’s easy to say you’ll walk away but it’s much harder to do. Remember that most first-time buyers already benefited from a significant stamp duty discount even before the scheme began. “One headwind for the market that has been largely ignored concerns a huge drop in the UK’s population. In the past week, the Economic ***Statistics*** Centre of Excellence said official ***statistics*** had missed the fact that the population hadn’t grown last year but had actually fallen 1.3m since the pandemic began, aided by an exodus of over half a million foreign-born residents. It said that this represented the largest fall in the UK resident population since World War 2. This could have a dramatic impact on demand, even if that loss first makes itself felt in the rental market, with better value rentals reducing overall purchase demand.” Morgan Stanley has joined the ranks of Wall Street firms posting strong results during the pandemic. Earnings jumped by over 60% in the final quarter of 2020, up to $4,430m from $2,733m a year earlier, lifting total earnings last year to $14,418m from $11,301m. Investment banking, wealth management and equity and bond trading were all strong, lifting net revenue to a new annual record, and underlining that the financial sector did well despite the impact of Covid-19. CEO James P. Gorman says: “The Firm produced a very strong quarter and record full-year results, with excellent performance across all three businesses and geographies. I am extremely proud of how our employees came together to support each other and our communities and deliver for our clients in an incredibly challenging year. Here’s my colleague Phillip Inman on the rise in UK inflation last month. The annual rate of inflation rose to 0.6% in December from 0.3% in the previous month as shoppers returned to the high street in most parts of the UK after the end of the second lockdown. The Office for National ***Statistics*** said an increase in transport costs and a rise in computer games console prices as Christmas approached was only partially offset by cheaper takeaway food and lower furniture and household equipment prices. With the economy battered by the coronavirus pandemic and most consumers restricted by the government’s regional tiers, the relatively weak rise in prices as the festive period approached was in line with City analyst expectations of a 0.5% increase. Bitcoin is not enjoying a Biden Bounce today, though. It’s fallen over 5%, or nearly $2,000, to around $34,500 after Treasury secretary nominee Janet Yellen warned that cryptocurrencies could be used for illicit activities such as terrorist financing. Yellen was speaking during her Senate confirmation hearing yesterday. Business Insider has more details. Senator Maggie Hassan yesterday asked Yellen about the dangers of terrorists using cryptocurrencies during the latter’s Treasury confirmation hearing. Yellen said: You’re absolutely right that the technologies to accomplish this change over time, and we need to make sure that our methods for dealing with these matters, with terrorist financing, change along with changing technology. “Cryptocurrencies are a particular concern. I think many are used - at least in a transaction sense - mainly for illicit financing. “And I think we really need to examine ways in which we can curtail their use and make sure that money laundering doesn’t occur through those channels.” European stock markets have had a decent morning, lifted by the prospect of stimulus measures from the new team in the White House and the easing of Covid-19 restrictions this year. The Europe-wide Stoxx 600 is up 0.5%, with gains in Frankfurt and Paris. In London, though, the FTSE 100 is flat, with multinational shares being held back by a stronger pound (currently up half a cent at $1.367). Joshua Mahony, Senior Market Analyst at IG, says investors hope Joe Biden’s inauguration will lead to a period of greater stability, as well as fresh stimulus spending. “The pomp and ceremony of inauguration day has come with a similarly chipper outlook from European markets, with traders hoping this marks the beginning of a more stable four years. “European markets are preparing looking forward with optimism this morning, with Joe Biden’s inauguration marking the end of a four-year period that married up both Brexit and global trade uncertainty. Electrical goods retailer Dixons Carphone has benefitted from the boom in home cooking and computer gaming during the pandemic, my colleague Joanna Partridge explains: Locked-down European consumers bought big-screen TVs, food preparation gadgets and health and beauty appliances, handing Dixons Carphone’s 11% more revenue from selling electrical items over the Christmas trading period than a year earlier. The retailer, which owns the Currys PC World brand, said computing and gaming products were also big sellers during the festive period and online sales had grown by more than 120%..... The number of UK companies which collapsed into administration slumped to historic lows last year, as the government’s coronavirus support measures proved to be a lifeline for many businesses. 1,112 companies fell into administration during 2020, a 22% fall compared with 2019, according to the restructuring practice at accountant KPMG, which analysed notices in The Gazette. The coronavirus job retention scheme, rent and tax deferrals, grants and loans all combined to support firms which saw income dry up as a result of Covid restrictions, leading to the lowest annual number of administrations since KPMG started tracking the ***data*** in 2005. Leisure and hospitality companies, which have struggled the most to trade during restrictions, represented the lion’s share of insolvencies in the final quarter of the year following by building and construction firms, real estate businesses and retailers. Blair Nimmo, head of restructuring for KPMG in the UK, warned that the figures “provide a distorted view of reality” and that companies will struggle once support measures are eased: “Those businesses that remain in hibernation due to ongoing lockdown measures, such as those in the leisure and hospitality and travel and tourism sectors, continue to accrue liabilities while seeing precious little cash flow into the business. At some point, rent and tax deferrals and loans will need to be repaid. The job retention scheme will unwind. Weaning off these support schemes is going to be a massive challenge for many.” While inflation rose in the UK last month, it remains elusive in the eurozone. Consumer prices fell by 0.3% year-on-year in December, for the fourth month running, according to ***statistics*** body ***Eurostat***. Cheaper energy kept inflation below zero, it says: In December, the highest contribution to the annual euro area inflation rate came from services (+0.30 percentage points, pp), followed by food, alcohol & tobacco (+0.25 pp), non-energy industrial goods (-0.14 pp) and energy (-0.68 pp) Estate agency Chestertons has confirmed that the housing market was busy in November -- even though England was under its second national lockdown. It carried out 44% more valuations and brought 76% more new properties to the market than in November 2019 (when the looming general election and Brexit uncertainty may have dampened demand). Guy Gittins, Chestertons MD says: “The second lockdown no doubt encouraged some people to put their property search on hold, but we didn’t notice a big difference and activity levels were still a lot higher than we anticipated for this time of year. Part of this was driven by the incentive of the stamp duty saving, but we believe the main driver was that people just wanted to move as quickly as possible while conditions were favourable.” The 7.6% jump in UK house prices last year is a blow to those trying to get onto the housing ladder. But Ross Counsell, chartered surveyor and director at Good Move, suggests 2021 will be better for buyers, as the stamp duty holiday expires: “So why are the house prices so high? We can put this growth down to the influx of people looking to buy property in 2020, both before the end of the Stamp Duty Holiday in March, and due to many people simply looking for more spacious properties, particularly in rural locations, during lockdown. Mortgage approvals too are at an all-time 13 year high, and with such high demand for properties and mortgages, naturally comes higher average house prices. “The property market is incredibly competitive, and becoming increasingly more selective for lenders choosing who to lend to. However, it’s not all bad news. Despite these record high house prices, we expect them to fall after the end of the Stamp Duty Holiday in March. And as the world hopefully resumes some normalcy this year, we do not expect 2021 to follow 2020’s footsteps with the staggeringly high house prices, and we therefore expect 2021 to be a solid year for buyers.” Some campaigners have been pushing chancellor Rishi Sunak to extend the stamp duty holiday in his March budget, or even to replace council tax and stamp duty with ‘a proportional property tax (PPT). Jamie Durham, economist at PwC, says the stamp duty holiday drove prices up in London: “Prices in the capital rose by nearly 10% on an annual basis, adding £45,000 to the average home in 12 months, and pushing the average house price to over £500,000 for the first time. The stamp duty holiday is a particular benefit in London and is likely to have played a significant part in this strong price growth, as the higher average house prices means that more stamp duty is typically due.” “Despite a weak economy and the considerable impact of COVID-19, this ***data*** shows that the housing market has continued to perform strongly, buoyed by the stamp duty holiday, pent up demand and preference changes brought about by the pandemic.” “There continues to be a lot of uncertainty in the outlook. The vaccine rollout could help to support the economic recovery and in turn the housing market. However, there is a risk that activity could drop off over the next couple of months as the stamp duty holiday comes to an end. Assuming the Chancellor does not extend the holiday in the March budget, that could feed through to weaker price growth in the coming quarters.” Property website Rightmove warned on Monday that time is running out to avoid stamp duty, and some buyers could be hit with a tax bill if they can’t complete in time.... Here’s Noble Francis, economics director at the Construction Products Association, on the jump in London house prices in the last year: The average London house price has risen over £500,000 for the first time, as the stamp duty holiday helped to fuel demand for property during the pandemic. New figures from the Office for National ***Statistics*** show that the average price in the capital hit £514,000 in November 2020, a jump of 9.7% over the last year. That’s a record high and the first time London’s average house prices have surpassed £500,000. The ONS reports that the temporary suspension of stamp duty (on the first £500,000 of a house purchase in England) was one factor driving the market. It also cites pent-up demand following the first lockdown, and changes in housing preferences (as some families seek homes with more space due to rising remote working). London’s annual house price growth has followed a sharp upward trend seen in most regions in recent months, likely reflecting a range of factors including pent-up demand, changes in housing preferences and the temporary reduction in property transaction taxes, which are due to end on 31 March 2021. Looking at the picture within London, house prices have grown more quickly in Inner London than Outer London for some time. In November 2020, two London boroughs had annual house price growth above 20%, one is in Inner London (Kensington and Chelsea, at 28.6%), while the Outer London borough of Brent had annual price growth of 23.9%. The annual growth rate in Brent is partly caused by a base effect as the average house price decreased by 11.9% between October and November 2019 and increased by 2.8% between October and November 2020. The ONS also points to demand for investors, and people looking to move to the UK from Hong Kong following China’s clampdown on the city state. Demand for property in Inner London may be particularly responsive to temporary property tax changes as property prices are high and therefore so is the corresponding tax to be paid. In addition, compared with other regions of the UK, London has a relatively high proportion of properties bought for investment, including from cash buyers and overseas investors. As such, demand for property in Inner London is likely influenced by a broader range of factors than the rest of the UK, including the forthcoming introduction of additional property tax for non-UK residents and geopolitical circumstances such as the new route to UK citizenship for British Nationals Overseas in Hong Kong, being introduced in January 2021, both of which may push up demand for properties in Inner London. Across the country, prices rose by 7.6% in the last year - their fastest rate since June 2016 - to hit a new record. UK average house prices increased by 7.6% over the year to November 2020, up from 5.9% in October 2020, to stand at a record high of £250,000; this is the highest annual growth rate the UK has seen since June 2016. Average house prices increased over the year in England to £267,000 (7.6%), Wales to £180,000 (7.0%), Scotland to £166,000 (8.6%) and Northern Ireland to £143,000 (2.4%). The lowest annual growth was in the East of England, where average prices increased by 4.8% over the last year. Shares in UK pub chain JD Wetherspoon have jumped 6% this morning, after it raised over £93m to strengthen its balance sheet...and buy up struggling pubs. Wetherspoons announced the share placement last night, saying that the money would offset the impact of the pandemic, and also “facilitate the acquisition of new properties, which are likely to be available at favourable prices, as a result of the pandemic”. My colleague Rob Davies explains: It is targeting pubs in central London, which have been particularly hard-hit due to the loss of tourist traffic and office workers. Many have also been closed for longer than large, rural pubs because they cannot meet social distancing standards. Separately, former Greene King boss Rooney Anand is leading a new venture ready to spend £200m on pubs, in anticipation of a recovery after a miserable 2020: Robert Alster, CIO at wealth manager Close Brothers Asset Management, reckons Britin is “extremely vulnerable” to a jump in prices this year: “The rate of inflation doubled in December, but ongoing lockdowns and consumer uncertainty, accompanied by falling global oil prices, meant it remained far below the Bank of England’s 2 percent target. “With Government debt soaring and individual purse strings tightening, Britain is extremely vulnerable to a rise in inflation in the year ahead. Short-term fluctuations caused by Brexit disruption and exchange rate shifts may not yet concern the Bank, but all eyes will be on when and how wages recover from Covid. Paul Donovan of UBS Wealth Management flags up that the lockdown has driven demand for computer gaming: Computer consoles and games helped push up prices—perhaps inevitable when confronted with the prospect of an extended period of time at home with one’s family. A “highly successful festive campaign” featuring campaigning England football star Marcus Rashford has helped luxury fashion chain Burberry ride out the pandemic. Burberry reported a 9% drop in “retail comparable store sales” in the three months to Boxing Day, partly due to reduced tourism during the pandemic. Sales were particularly weak in Europe, the Middle East and Africa, as Covid-19 restrictions continued. Asia Pacific: +11% with strong growth in Mainland China and Korea EMEIA: -37% due to fewer tourists and COVID-19 related store closures Americas: -8% as mid-teen increase in full-price sales was more than offset by planned reductions in markdown activities But Burberry also benefitted from “new, younger clientele”, and reports that teaming up with Rashford was a success: In November, we launched our Festive campaign, partnering with Marcus Rashford MBE, the English international footballer who has taken a prominent role against child poverty during the pandemic, and global charities championing youth-related causes. The consumer response to the campaign was exceptional, with engagement on our Instagram campaign posts more than double our Q2 average, and imagery featuring Marcus becoming our most liked Instagram post of all time. Marcus’ work to support the UK’s youth sits at the heart of our partnership and embodies our commitment to community and going beyond. Shares in Burberry have jumped 5% this morning, with CEO Marco Gobbetti saying the company is ‘well placed’ for the pandemic to ease: “Despite the challenging external environment, we made good progress on our strategic priorities in the quarter. We saw a strong increase in full-price sales as our ***collections*** and communication resonated well with new, younger clientele as well as existing customers. Our localised plans and digital capabilities helped drive growth in rebounding markets and we implemented our planned reduction in markdown. While the short-term outlook remains uncertain due to COVID-19, we are well placed to accelerate when the pandemic eases.” Despite picking up last month, UK inflation is still relatively low - having hit a five-year trough in September. Several economists are predicting that inflation will keep rising as the UK economy reopens later this year, following December’s increase. Thomas Pugh of Capital Economics suggests CPI inflation could rise over the Bank of England’s 2% target by the end of this year, before dipping in 2022. Inflation will probably start to rise more sharply from April when the temporary VAT cut for the hospitality sector is reversed and the recent rises in ***agricultural*** and energy commodities start to make themselves felt. T Together these forces could lift inflation to more than 2% by the end of the year. But ample spare capacity means it will probably settle at close to 1.5% by the end of next year. Further ahead, inflation may creep higher if the authorities keep monetary and fiscal policy loose after all the spare capacity in the economy has been absorbed. Suren Thiru, head of economics at the British Chambers of Commerce, says prices could also rise if ‘the current post-Brexit disruption persists’: Tom Stevenson, investment director for personal investing at Fidelity International, says investors should prepare for a more inflationary environment: “The doubling in the CPI measure of inflation in December to 0.6% is a reminder of the need to remain vigilant about the price threat. Inflation never seems to be a problem until suddenly it requires firm action to tame it again. The combination of unprecedented government spending, pent up consumer demand and low productivity is a recipe for rising prices. Transport, recreation and clothing were the biggest contributors. “The challenge facing UK policy makers is that historically high debt levels will make it hard for us to rein in inflation with higher interest rates as and when they become necessary. Servicing our high borrowings is expensive enough with rates on the floor. Meat and vegetable prices dipped during December, the ONS reports, with cooked ham and cauliflowers having the largest downward impact. But today’s inflation report won’t capture the impact of shortages caused by disruption at UK ports last month: The December 2020 price ***collection*** was completed on or around 15 December 2020, so our price quotes were not influenced by the reported stock shortages in supermarkets as we approached the end of the year. Computer game downloads also nudged inflation up last month, along with “smaller upward contributions from computer game consoles, equipment for sport, and plants and flowers”. But the prices of pre-school activity toys and board games fell in the run up to Christmas, the Office for National ***Statistics*** adds. Good morning, and welcome to our rolling coverage of the world economy, the financial markets, the eurozone and business. The reflation trade is one of the key drivers of the markets right now, as investors bet that stimulus packages and a post-lockdown boom will drive prices higher. And the latest figures show that inflation across the UK rose in December. The UK consumer prices index rose by 0.6% in the year to December, up from 0.3% in November, the Office for National ***Statistics*** reports. Transport costs picked up during the month -- as restrictions on travel were briefly lifted over the Christmas period (before the latest lockdown was brought in). Clothing prices were also higher, along with recreation activities (such are possible during a pandemic, anyway). The ONS says: Rising transport costs contributed 0.11 percentage points to the monthly change, while increasing prices for clothing, and recreation and culture items both contributed 0.10 percentage points to help increase inflation; these were partially offset by a downward contribution from falling food and non-alcoholic beverage prices. Air fares rose by more than usual during November and December, the ONS reports, with fuel prices also picking up --prices at petrol pumps rose by 1.5 pence per litre last month. Women’s and men’s clothing prices also rose, as the Black Friday discounts ended. Technology prices were also higher than usual, the ONS adds: The largest upward contribution [in the recreation and culture grouping] came from ***data*** processing equipment, where prices for computer software, PC peripherals and laptops were overall largely unchanged between November and December 2020, but fell between the same two months in 2019. Food prices fell by 0.4% during December, though, bringing some help to households suffering from the impact of the Covid-19 lockdown. Inflation is still below the Bank of England’s 2% target, but this move could be a signal that prices are going to keep pushing higher in 2021, as the Covid-19 lockdown eases. We also get eurozone inflation figures later this morning, plus the latest UK house prices and US mortgage figures. Investors will also be watching Joe Biden be sworn in as America’s 46th president, and assessing his chances of ‘going big’ with a new stimulus package and green energy policies. Kyle Rodda of IG says: The conversation in the market has generally remained on US politics and the incoming Biden-administrations fiscal stimulus plans. Subdued price action in bond markets suggest little new information has come about on either front in recent days. Nevertheless, ahead of President-elect Biden’s inauguration this evening, where there remains some concern regarding civil unrest and violent protests, the drama enveloping US politics and the US economy remains the most attention grabbing news. The agenda 7am GMT: UK inflation report for December 9.30am GMT: UK house price index for November 10am GMT: Eurozone inflation report for December Noon GMT: US weekly mortgage applications 3pm GMT: Bank of Canada interest rate decision 26756 false false Graeme Wearden Oxford Street in London, Britain, on Boxing Day. European stock markets at noon today A JD Wetherspoons in Henley on Thames, Oxfordshire The Burberry store in Chadstone Shopping Centre during the Boxing Day shopping in Melbourne, Australia. UK inflation rate UK inflation to December 2020

**Load-Date:** January 20, 2021

**End of Document**



[***We need reliable statistics on forestry***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61HF-JP21-DYS1-00J2-00000-00&context=1516831)

The Irish Times

December 14, 2020 Monday

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**Section:** LETTERS; Pg. 13

**Length:** 194 words

**Body**

Sir, - The inadequacy of current forestry ***data*** was recognised by the announcement of the formation of a Forest ***Statistics*** Liaison Group in 2015, as reporting of forest ***statistics*** to the two ***Eurostat*** ***data*** ***collections*** was inadequate.

Furthermore, according to National Council for Forest Research and Development's 2018 Forest Policy Review Group Report, "There are no national ***statistics*** on employment in the forest sector."

Details of the Forest ***Statistics*** Liaison Group are given on the CSO website. It states under "frequency of meetings" that, "The Liaison Group meets at least annually". Its existence was confirmed by a Central ***Statistics*** Office internal customer service meeting of September, 24th, 2019, as one of the CSO's "liaison groups".

A recent request under access to information on the environment for the minutes said that this committee had never been established and had never met.

Perhaps before any decisions are made as to the future of the regulation of the industry, the Minister for ***Agriculture*** would ensure that we have reliable and up-to-date ***statistics*** in front of us? - Yours, etc,

TONY LOWES,

Friends of the

Irish Environment,

Eyeries,

Co Cork.

**Load-Date:** December 13, 2020

**End of Document**



[***Why has Japan become the world’s most long-lived country: insights from a food and nutrition perspective***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2C1-JCWX-C1M7-00000-00&context=1516831)

European Journal of Clinical Nutrition

July 2020

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**Section:** Pg. 921-928; Vol. 75; No. 6; ISSN: 0954-3007,1476-5640

**Length:** 3331 words

**Byline:** [*stsugane@ncc.go.jp*](mailto:stsugane@ncc.go.jp)

**Body**

International comparison and annual trends of life expectancy and mortality

International comparison

Recent mortality-related ***statistics*** for the group of seven (G7) countries (Canada, France, Germany, Italy, Japan, United Kingdom (UK), and United States (US) in alphabetical order) from a World Health Organization (WHO) database are shown in Table [, ]. Life expectancy and healthy life expectancy are both longest in Japan, in both men and women; longevity is particularly high in women. Age-standard mortality rate is also the lowest, at about two-thirds that of the US. By cause of death, the lowest mortalities from cancer (in particular, breast and prostate cancer) and ischemic heart disease are notable. In contrast, mortalities from cerebrovascular and infectious respiratory disease are relatively high.

Mortality ***statistics*** in selected countries.

|  | **Canada** | **France** | **Germany** | **Italy** | **Japan** | **UK** | **US** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Life expectancy at birth (years) in 2016a |  |  |  |  |  |  |  |
| ?Men | 80.9 | 80.1 | 78.7 | 80.5 | **81.1** | 76.0 | 79.7 |
| ?Women | 84.7 | 85.7 | 83.3 | 84.9 | **87.1** | 81.0 | 83.2 |
| Healthy life expectancy (HALE) at birth (years) in 2016a |  |  |  |  |  |  |  |
| ?Men | 72.0 | 71.8 | 70.2 | 72.0 | **72.6** | 66.9 | 70.9 |
| ?Women | 74.3 | 74.9 | 73.0 | 74.3 | **76.9** | 70.1 | 72.9 |
| Age-standardized death rates per 100,000 world standard population in 2016b |  |  |  |  |  |  |  |
| All causes | 341 | 338 | 409 | 343 | **299** | 390 | 493 |
| ?Cancer | 111 | 125 | 120 | 113 | **103** | 122 | 114 |
| ??Stomach | 3 | 4 | 5 | 7 | **13** | 4 | 3 |
| ??Colon and rectum | 13 | 13 | 13 | 13 | **14** | 13 | 11 |
| ??Lung | 30 | 28 | 26 | 23 | **20** | 27 | 28 |
| ??Breast | 9 | 11 | 10 | 10 | **5** | 10 | 9 |
| ??Prostate | 5 | 5 | 6 | 4 | **3** | 8 | 6 |
| ?Cardiovascular diseases | 76 | 71 | 132 | 103 | **73** | 91 | 133 |
| ??Ischemic Heart Diseases | 46 | 31 | 73 | 51 | **32** | 48 | 79 |
| ??Stroke | 15 | 17 | 22 | 27 | **26** | 22 | 23 |
| ?Respiratory infections | 8 | 8 | 9 | 6 | **24** | 19 | 11 |

Bold values are focusing on Japan.

aWHO: life expectancy and healthy life expectancy ***data*** by country ([*http://apps.who.int/gho/****data****/node.main.SDG2016LEX?lang=en*](http://apps.who.int/gho/data/node.main.SDG2016LEX?lang=en)).

bWHO: Global Health Estimates 2016: deaths by cause, age, sex, by country and by region, 2000–2016. ([*https://www.who.int/healthinfo/global\_burden\_disease/estimates/en/*](https://www.who.int/healthinfo/global_burden_disease/estimates/en/)).

Since 1981, the leading cause of death in Japan has been cancer, which accounted for 27% of total deaths in 2018, followed by heart disease at 15% []. The recent longevity of Japanese is due to the low mortality rate of these diseases, which account for nearly half of total deaths.

Annual trends

Figure shows changes in life expectancy in the G7 countries according to health ***statistics*** generated by the Organization for Economic Cooperation and Development (OECD) []. Whereas Japan had the shortest life expectancy in the early 1960s, Japanese men had the longest in the late 1960s and women in the mid-1970s. These rankings have been maintained despite increases in life expectancy in the other countries. Average life expectancy in Japan in 2016 was 81 in males and 87 in females, a record high. Women have enjoyed world-leading longevity since the 1980s.

Annual trends of life expectancy at birth (years) in selected countries.

The figure was prepared by the author using datafrom “OECD Health ***Statistics*** 2019” ([*https://www.oecd.org/health/health-****data****.htm*](https://www.oecd.org/health/health-data.htm)).

Time-course trends in major causes of death according to the WHO Mortality Database [] show that age-adjusted mortality rates for ischemic heart disease, cerebrovascular disease, and cancer are steadily decreasing in all countries, and that this has resulted in an increase in life expectancy worldwide (Figs. , ). In Japan, mortality from ischemic heart disease and cancer was originally low, while that from cerebrovascular disease—which was extremely high—has steadily declined to a level comparable with that of Western countries. This pattern greatly contributed to Japan’s achieving the world’s highest life expectancy in the 1980s.

Annual trends in age-standardized circulatory diseases mortality rates per 100,000 world standard population in selected countries.

The figure was prepared by the author using datafrom “WHO Mortality Database” ([*http://apps.who.int/healthinfo/****statistics****/mortality/whodpms/*](http://apps.who.int/healthinfo/statistics/mortality/whodpms/)).

Annual trends in age-standardized cancer mortality rates per 100,000 world standard population in selected countries.

The figure was prepared by the author using datafrom “WHO Mortality Database” ([*http://apps.who.int/healthinfo/****statistics****/mortality/whodpms/*](http://apps.who.int/healthinfo/statistics/mortality/whodpms/)).

Today, ischemic heart disease and cancer in women continue to decline, and remain at the lowest levels. In men, in contrast, cancer mortality was lowest but rose until the mid-1990s, and then began to decline. Lowest levels are now found in US and Canadian men, whose levels have been declining since the 1980s.

Although the increase in life expectancy after World War II is in large part due to the dramatic decrease in infant mortality (30.7 per 1000 live births in 1960 vs 2.0 in 2016) in Japan, the steady increase after the war has been attributed to reduced mortality from major causes in adulthood. Looking at annual trends in age-adjusted mortality (1985 model Japanese population) by cause of death (Fig. ), there was a marked decrease in infectious diseases such as pneumonia and tuberculosis after the war, followed by a decrease in cerebrovascular disease mortality that is characterized by a sharp decline from a peak in the mid-1960s. In addition, heart disease and women’s cancer have been on a gradual decline, while men’s cancer began to decline in the mid-1990s.

Annual trends in age-standardized mortality rate per 100,000 Japan 1985 model population for leading causes of death.

The figure was prepared by the author using datafrom “Vital ***Statistics***, Ministry of Health, Labour and Welfare” ([*https://www.e-stat.go.jp/*](https://www.e-stat.go.jp/)).

The decrease in cerebrovascular disease mortality can be largely explained by the decrease in that due to cerebral hemorrhage, which was dominant around 1950 (Supplementary Fig. ). Cerebral infarction also increased after the war, but has been decreasing since the mid-1970s. As for cancer mortality (Supplementary Fig. ), cancers of the stomach and uterus decreased consistently after the war, while liver cancer increased at this time but then declined from the mid-1990s. On the other hand, so-called Western-type cancers such as colon, lung, pancreas, prostate, ovary, and breast tended to increase after the war but have declined since the mid-1990s, except for breast cancer, which until recently continued to increase.

International comparison and annual trends of major risk factors and dietary factors

Major risk factors

The prevalence of major risk factors for noncommunicable diseases in G7 countries is shown in Table []. Daily cigarette smoking is most prevalent in Japanese men but lowest in Japanese women. Meanwhile, the prevalence of hypertension (SBP ≥ 140 or DBP ≥ 90) is intermediate in both sexes compared with other countries while that of obesity and body mass index is markedly lower.

Prevalence of major risk factors in selected countriesa.

| **Risk factors** | **Year** | **Canada** | **France** | **Germany** | **Italy** | **Japan** | **UK** | **US** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Men |  |  |  |  |  |  |  |  |
| ?Daily cigarette smoking, 15+ years, age standardized (%) | 2013 | 13.7 | 22.3 | 25.9 | 24.5 | **28.6** | 21.1 | 16.1 |
| ?Raised blood pressure (SBP ? 140 or DBP ? 90), 18+ years, age standardized (%) | 2015 | 15.6 | 27.7 | 24.3 | 25.2 | **22.5** | 17.9 | 15.3 |
| ?Obesity (BMI ? 30), 18+ years, age standardized (%) | 2016 | 29.5 | 22.0 | 24.2 | 20.1 | **4.8** | 26.9 | 35.5 |
| ?Mean body mass index trends, age standardized (kg/m²) | 2016 | 27.3 | 25.9 | 27.3 | 26.5 | **23.6** | 27.3 | 28.8 |
| Women |  |  |  |  |  |  |  |  |
| ?Daily cigarette smoking, 15+ years, age standardized (%) | 2013 | 9.7 | 18.1 | 20.4 | 18.1 | **8.4** | 19.5 | 12.6 |
| ?Raised blood pressure (SBP ? 140 or DBP ? 90), 18+ years, age standardized (%) | 2015 | 10.8 | 16.4 | 15.5 | 17.1 | **12.6** | 12.4 | 10.5 |
| ?Obesity (BMI ? 30), 18+ years, age standardized (%) | 2016 | 29.3 | 21.1 | 20.4 | 19.5 | **3.7** | 28.6 | 37.0 |
| ?Mean body mass index trends, age standardized (kg/m²) | 2016 | 26.6 | 24.2 | 25.8 | 24.7 | **21.8** | 27.0 | 28.9 |

Bold values are focusing on Japan.

aWHO: Global Health Observatory ***data*** repository: noncommunicale diseases, risk factors ([*http://apps.who.int/gho/****data****/node.main.A867?lang=en*](http://apps.who.int/gho/data/node.main.A867?lang=en)).

Japanese tobacco consumption increased sharply beginning in 1920 and, after a temporary decline during World War II, peaked in the mid-1970s and has since steadily declined []. Smoking rates in men of around 80% in 1970 now compare with around 30% in 2013. In contrast, rates in women have remained constantly low, at around 15% and 8%, respectively [] (Supplementary Fig. ).

Dietary factors

Table shows food supply (food supply quantity) in G7 countries from a database of the Food and ***Agriculture*** Organization (FAO) of the United Nations []. Among characteristics, Japan consumes less meat (particularly red meat such as beef), milk and dairy products, sugar and sweeteners, and fruits and potatoes, but more fish and seafood, rice, soybeans, and tea (mostly green tea).

Food supply quantity (kg/capita/year) in selected countries in 2013a.

| **Item** | **Canada** | **France** | **Germany** | **Italy** | **Japan** | **UK** | **US** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Livestock and fish |  |  |  |  |  |  |  |
| ?Meat | 90.75 | 86.76 | 85.94 | 84.04 | **49.45** | 81.48 | 115.13 |
| ??Beef | 30.25 | 23.81 | 13.16 | 18.60 | **9.15** | 18.12 | 36.24 |
| ??Pork | 22.81 | 33.05 | 51.81 | 40.28 | **20.62** | 25.79 | 27.64 |
| ??Poultry | 36.68 | 22.93 | 17.75 | 18.61 | **19.42** | 31.55 | 50.01 |
| ?Fish, seafood | 22.52 | 33.48 | 12.56 | 25.08 | **48.60** | 20.76 | 21.51 |
| ?Milk?excluding butter | 187.77 | 241.31 | 258.70 | 246.88 | **72.06** | 232.20 | 254.69 |
| Crops |  |  |  |  |  |  |  |
| ?Cereals?excluding beer | 119.37 | 127.24 | 111.11 | 158.17 | **113.44** | 115.85 | 105.64 |
| ??Rice (milled equivalent) | 12.65 | 4.88 | 3.34 | 5.74 | **59.85** | 6.39 | 6.88 |
| Starchy roots | 73.49 | 53.95 | 61.46 | 38.43 | **30.79** | 104.05 | 56.14 |
| ?Potatoes and products | 71.07 | 53.79 | 61.46 | 38.16 | **20.95** | 103.86 | 51.88 |
| Sugar & sweeteners | 48.26 | 39.22 | 48.49 | 32.12 | **27.08** | 41.28 | 63.76 |
| Fruits?excluding wine | 135.65 | 114.34 | 88.46 | 139.79 | **52.85** | 127.41 | 104.53 |
| Vegetables | 108.47 | 97.32 | 92.91 | 128.87 | **102.29** | 96.99 | 113.96 |
| ?Soyabeans | 0.94 | 0.05 | 0.88 | 0.01 | **7.34** | 0.05 | 0.04 |
| Tea (including mate) | 0.45 | 0.27 | 0.71 | 0.14 | **0.95** | 1.84 | 0.52 |

Bold values are focusing on Japan.

aFAO: FAOSTAT (Food balance ***data***) ([*http://www.fao.org/faostat/en/#home*](http://www.fao.org/faostat/en/#home)).

Looking at changes in energy intake from the National Health and Nutrition Survey [] (Fig. , left), intake was 1903 kcal per person in 1946, the beginning of the postwar period. It then surged to 2125 kcal in 1951, remained flat for a while, then began to increase again during the period of high economic growth, peaking at 2287 kcal in 1971. In response to the end of high economic growth following the 1973 oil crisis, energy intake also continued to decline, reaching a postwar low of 1840 kcal in 2011.

Annual trend of average energy and ***nutrient*** intakes in Japan.

The figure was prepared by the author using datafrom “National Health and Nutrition Survey, Ministry of Health, Labour and Welfare” ([*https://www.mhlw.go.jp/bunya/kenkou/kenkou\_eiyou\_chousa.html*](https://www.mhlw.go.jp/bunya/kenkou/kenkou_eiyou_chousa.html)).

Breaking down the changes in energy intake by the three macronutrients of carbohydrates, fats, and proteins (Fig. , right) reveals qualitative changes in the diet of Japanese people. The postwar increase in energy intake was mainly due to an increase in the intake of fasts and proteins from animal foods. In contrast, the intake of carbohydrates continued to decrease throughout this period, mainly due to a decrease in the intake of rice, a staple of the Japanese diet. The increase in fat intake after the war is due to a significant increase in the intake of meat, milk, and dairy products.

Energy intake depends on the balance with the amount of physical activity. The recent decline in energy intake in Japan may represent a response to the decrease in physical activity following widespread worksite automation and automobile use. As a result, men—whose BMI increased after the war but whose working environment significantly improved—continued to gain weight (although balanced in recent years and, most recently, on a declining trend). Among women, a high percentage of whom are full-time housewives, BMI has tended to decrease, some ages excluded, in parallel with the decrease in energy intake (Supplementary Fig. ). Although BMI has tended to increase in men, it nevertheless remains significantly much lower than in Western countries (Supplementary Fig. ).

Japan has an international reputation for high salt intake, levels have steadily decreased, from 14.5 g in 1973 to 9.5 g in 2017 []. Levels were estimated to be even higher before 1973.

Why longevity in Japan: a perspective from international comparison

The dietary patterns, as characterized by low intake of red meat, high intakes of fish, plant foods, and nonsugar-sweetened beverages, are thought to be linked to relatively low mortality from cancer and ischemic heart disease and low prevalence of obesity, as follows.

Red meat and fish

The dietary pattern of lower red meat, milk and dairy products, and higher fish and seafoods results in the lower consumption of saturated fatty acids and higher consumption of n-3 marine polyunsaturated fatty acids in Japan. Dietary intake of saturated fatty acids is associated with increased risk of ischemic heart disease, versus a decreased risk of cerebrovascular disease [, ]. In addition, dietary intake of n-3 marine polyunsaturated fatty acids is inversely associated with the risk of ischemic heart disease [, ]. Japan’s lower red meat and higher fish consumption may be related to its relatively low mortality from ischemic heart disease, but high mortality from cerebrovascular disease.

Soybeans and nonstarchy vegetables

Soybeans are mostly consumed in Asian countries, including Japan, and are the sole source of isoflavones, which are known to have anticancer [] and anticardiovascular [] effects. Isoflavone intake in the amounts consumed in Asian populations is associated with lower risks of breast [, ] and prostate cancer [, ]. The relatively higher soy intake may account for the low breast and prostate cancer mortality in Japan. Soy and isoflavone intake have also been inversely associated with risk of cardiovascular diseases, especially cerebral and myocardial infarctions [, ]. In a prospective study, we showed that intake of fermented soy products was inversely associated with total and cardiovascular mortalities []. Soybeans are also major source of plant protein. In another prospective study, we also showed that higher plant protein intake was associated with lower total and cardiovascular disease mortalities, and that isocaloric substitution of 3% of energy from plant protein for red meat protein was associated with lower total, cancer and cardiovascular disease mortalities []. This higher intake of plant protein may also be related to Japanese longevity.

Less sugar and nonsweetened green tea

Low consumption of sugar sweeteners, and potatoes, and high consumption of green tea (which is not generally sweetened with sugar) may be partly related to a globally lower prevalence of obesity and lower rates of obesity-related diseases such as ischemic heart disease and breast cancer [, ]. Our prospective study showed that intake of green tea was inversely associated with all-cause mortality and cardiovascular mortality [, ].

Dietary diversity

In addition, Japanese tend to consume a variety of foods such as grain, vegetable, fruit, fish and meat, and milk dishes, and this dietary pattern might be partly related to Japanese longevity. Our prospective study showed that dietary diversity [] and adherence to the Japanese Food Guide Spinning Top that encourages the balanced diet [] were inversely associated with all-cause mortality.

Why the change to longevity: a perspective from annual trends in Japan

Considering the changes in average life expectancy and mortality of Japanese together with their changes in food and nutrition intake, it is clear that the improvement in nutritional status after the war significantly reduced mortality from infectious diseases such as tuberculosis and pneumonia, and cerebral hemorrhage. This improvement can be considered to have produced a continuous extension of average life expectancy. The suppressed severity of infectious disease and faster recovery in well-nourished persons is well known. With cerebrovascular disease, the increased risk of intracerebral hemorrhage, in which blood vessels rupture, is increased in the face of insufficient cholesterol, an important constituent of the blood vessel wall. The increase in animal foods, milk and dairy products, and consequently in saturated fatty acids, strengthened blood vessel walls; and calcium, together with the decrease in salt intake and spread of antihypertensive drugs, led to decreases in blood pressure and consequent cerebrovascular disease [–]. Further, the decreased intake of salt and highly salted foods appeared to have produced a decrease in stomach cancer [, ].

On the other hand, if the increase in animal fats and proteins improved nutritional status, it is also presumed to have produced increases in cerebral infarction and ischemic heart diseases, diabetes, and so-called Western-type cancers, such as the colorectum, pancreas, prostate, ovary, and breast. Risk of these diseases is in fact known to increase with overnutrition and the resulting obesity, lack of exercise, and consumption of red meat such as beef, pork, and mutton [, ]. However, fat and protein intakes leveled off in the mid-1970s, followed by a decrease in energy intake (Fig. ). As if linked to this, first, the increase in cerebral infarction stopped and incidence began to decrease and, after a time lag of several decades, the so-called Western-type cancers tended to flat-line or decrease. Cancer takes a long time to develop, and there is a substantial time lag between changes in causal factors and changes in incidence.

From the above, the westernization of diet—an increase in ***nutrients*** such as energy, an increase in animal foods, and decrease in salt intake—can be considered to have generally made postwar Japanese people healthier. The convergence of westernization—first detected after World War II, began accelerating in the 1970s due to the economic situation. At this time, the consumption of seafood, plant proteins such as soybeans, and cereals and vegetables were higher than in Western countries, and a lower fat energy ratio (National Health and Nutrition Survey 2017, adult average: 27.4%) has been maintained. Although BMI has tended to increase in men, it nevertheless remains significantly much lower than in Western countries, where obesity is a major health problem (Supplementary Fig. ).

The decreases in cancers of the stomach, uterus and liver are largely due to decreases in persistent infection with Helicobacter pylori, human papilloma virus, and hepatitis viruses, respectively, which are essential risk factors for these cancers []. Because smoking accounts for about 30% of male cancer mortality [], it is speculated that the decline in male age-adjusted cancer mortality, which began in the mid-1990s represents a time lag of about 20 years from the 1970 peak in tobacco consumption. On the other hand, in Europe and North America, the decline in tobacco consumption and smoking rates began about 10 years earlier, so it is estimated that the decrease in age-adjusted mortality rate of cancer in these countries began about 10 years earlier than in Japan.

Conclusion

Japanese people have remarkably low mortality rates from ischemic heart disease and cancer (particularly breast and prostate), and relatively high rates from cerebrovascular disease and respiratory infection. The world’s longest life expectancy is due to a significant decrease in mortality from infectious diseases, cerebrovascular disease, and pneumonia, which were high in the past, while keeping cancer and ischemic heart disease mortality low.

Low obesity, low intake of saturated fatty acids, and high intakes of marine n-3 polyunsaturated fatty acids, plant foods such as soybeans and nonsugar-sweetened beverages such as green tea may contribute to low cancer and ischemic heart disease mortality. In the past, cerebrovascular disease and stomach cancer mortality rates were extremely high, probably due to a relatively high salt intake and low intake of saturated fatty acids and calcium.

The typical Japanese diet as characterized by plant food and fish as well as modest Westernized diet such as meat, milk, and dairy products might be associated with longevity in Japan.

**Funding**

This study was supported by the National Cancer Center Research and Development Fund and a grant from commissioned project study, Ministry of ***Agriculture***, Fishery and Forestry, Japan (MAFF-CPS-2016-1-1). The funders had no role in the study design, ***data*** ***collection*** and analysis, decision to publish, or preparation of the paper.

**Notes**

Supplementary informationThe online version of this article ([*https://doi.org/10.1038/s41430-020-0677-5*](https://doi.org/10.1038/s41430-020-0677-5)) contains supplementary material, which is available to authorized users.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***Oviposition of Aedes japonicus japonicus (Diptera: Culicidae) and associated native species in relation to season, temperature and land use in western Germany***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H7S1-F129-P35X-00000-00&context=1516831)

Parasites Vectors

December 2020

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**Section:** Vol. 13; No. 1; ISSN: 1756-3305

**Length:** 8540 words

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**Body**

Background

The necessity to explore the ecology of the Asian bush mosquito (Asian rock pool mosquito) Aedes (Hulecoeteomyia) japonicus japonicus (Theobald, 1901) is predominantly based on its possible role as a vector of pathogens, including chikungunya virus, West Nile virus (WNV), Zika virus and various other encephalitis viruses [–]. Due to its opportunistic biting behaviour [], Ae. japonicus japonicus is a possible bridge vector, which is able to transmit avian-borne zoonotic disease agents such as WNV to mammals including humans. Its vector potential and its natural dispersal capabilities may pose serious risks to human and animal health [, ].

The area of origin of Ae. japonicus japonicus covers eastern Russia, eastern China, Korea and Japan [, ]. The species comprises four subspecies [], which were recently discussed to be separate species []. Until now, only the subspecies Ae. japonicus japonicus has been demonstrated to occur outside of its native area. This subspecies started to spread in North America in the late 1990s [] and to colonise Europe from 2000 onwards []. The most recent findings were reported from Spain [], Serbia and Bosnia and Herzegovina []. Due to its geographic origin, this mosquito is well adapted to the moderate climate of Germany, where it has been considered established since 2008 []. The genetic mixing of the populations by new introduction events [] includes the possibility of a higher adaptation capacity and is of concern [, ]. On the other hand, the development of larvae of Ae. japonicus japonicus is limited at water temperatures higher than 30 °C [, ]. In the USA, larval populations of the Asian bush mosquito have an advantage over those of native species like Aedes triseriatus (Say, 1823) and Aedes atropalpus (Coquillett, 1902) when developing at lower water temperatures and limited resources []. However, larvae of Ae. japonicus japonicus are more sensitive to higher water temperatures than those of native species, e.g. Aedes atropalpus in the USA [], which should prevent displacement of the latter.

Several studies have investigated the distribution of Ae. japonicus japonicus on a regional scale in its native area [, , ], as well as outside of its area of origin [–]. However, knowledge gaps exist with respect to its occurrence and spread at the local level. Questions remain regarding the effect of land use types on oviposition and larval habitat quality and stability as well as population dynamics of the subspecies, particularly in relation to native mosquito taxa. As the distribution of the Asian bush mosquito is patchy in Germany, factors promoting or inhibiting its dispersal might exist at the landscape level [, ]. This has been documented in other countries, with Ae. japonicus japonicus showing a preference for rural areas in the USA [] and avoidance of large forests (bigger than 500 ha) and large areas of arable land in Hungary [].

Observations on mosquito oviposition and larval habitat preference conducted decades ago identified euryoecious, e.g. Culex pipiens s.l. and Culiseta annulata (Schrank, 1776), and rather specialised taxa, e.g. Anopheles plumbeus Stephens, 1828 and Aedes geniculatus (Olivier, 1791), whose larvae are primarily found in tree holes [, ]. As these taxa are also known to use artificial containers for oviposition [–] their developmental stages can be expected to be found syntopically with the Asian bush mosquito. Habitat sharing of Ae. japonicus japonicus larvae and pupae with native taxa, however, has not been studied before in Germany. Transitional areas between different land use types generally have a special significance for the occurrence of adult mosquitoes due to their high structural diversity [], but were not considered in previous studies on the oviposition habitat preference of mosquito species [, ].

Hence, the aim of the present study was to investigate the ecology of Ae. japonicus japonicus and co-occurring native taxa with the focus on trapping sites selected for oviposition and larval site characteristics. In particular, we hoped to elucidate whether the seasonal mean air temperature influences oviposition phenology, and thus induces differences in the seasonal presence of mosquito taxa. Another aim of this study was to check if specific water temperature ranges regulate the occurrence of larvae of Ae. japonicus japonicus and/or native species. Furthermore, it was tested if land use type affects oviposition activity, resulting in different abundances of ovitraps positive for the specific mosquito taxa at and around transition zones between forest (types), arable land and settlements. Finally, we studied if water temperature, tree species, land use-dependent trap location and co-occurrence of native mosquitoes can be used in a generalised linear model as predictors for the occurrence of Ae. japonicus japonicus-positive oviposition traps.

More detailed information on the oviposition and larval habitat preference of Ae. japonicus japonicus should provide a basis for more targeted monitoring measures, occurrence and dispersal models, risk analyses and integrated control measures for this subspecies [, , ].

Materials and methods

Study sites

The field studies were conducted in western Germany in several areas close to the river Rhine in the federal state of North Rhine-Westphalia. The 2017 study sites were located in and around the cities of Dormagen and Alfter (Additional file : Figs. S1 and S2). The landscape of Dormagen is shaped by arable land, settlement and commercial areas as well as by small forest patches. Alfter is almost completely surrounded by a large forest, opening only to the east to areas dominated by arable land. In 2018, the study sites were located in the Rhein-Sieg-Kreis district in the south of the federal state of North Rhine-Westphalia, specifically in Alfter, Bonn Süd, Heimerzheim, Buschhoven, Siegburg, Lohmar and Troisdorf (Fig. ).

a Study sites in the south of North Rhine-Westphalia, Germany in 2018. Forest types (different shades of green) follow Authorised Topographic-Cartographic Information System ***data*** []. b Details of study site Bonn Süd, with three transects and their respective trap locations (different colours represent different land use types). See Additional file : dataset S1 for coordinates of trap locations. Background map from [*http://www.openstreetmap.org*](http://www.openstreetmap.org) (OpenStreetMap contributors). The map was produced with QGIS version 3.2

Trap installation

In 2017, one hundred black plastic cups (400 ml volume, 12 cm high, 8 cm wide) (Bamaplast, Pieve a Nievole, Italy) and one hundred drilled logs of European beech (Fagus sylvatica) were distributed as possible oviposition habitats for mosquito species whose larvae can be found in artificial containers or tree holes. The beech logs [constructed from trees from a forest in Schönholz, Brandenburg (52.7950N, 13.7609E)] were approximately 20 cm long and 15 cm wide with a drilled hole 12 cm deep and eight cm wide, comparable to the dimensions of the plastic cups. The logs were sealed on the bottom with sealant (silyl modified polymer; Master-Fix; Toom, Cologne, Germany) to prevent drainage of the water. Both types of container, henceforth referred to as ‘ovitraps’, were filled with 400 ml water, ***collected*** from a nearby quarry pond in Dormagen (51.0938N, 6.7831E) and filtered through a microstrainer with a mesh size of 0.03 cm × 0.03 cm. Each plastic cup was equipped with a masonite stick as an additional oviposition substrate, the function of which was met by small cracks and crevices inside the bore hole of the wooden logs. The two types of ovitrap were placed along 20 transects; there were five trap sites per transect, and one cup and one log were placed at each site in 2017. To mitigate the effect of missing or toppled traps on the analysis of the results, three cups were set per site in 2018. Each 200 m-transect spanned two adjacent land use types, with half (100 m) of the transect in each (Fig. ), following the method of Reiskind et al. [].

Setup of the transects. Trap locations range from oviposition habitat 1 (land use types—arable land, forest or settlement) through the transition zone into oviposition habitat 2 (land use types—forest, settlement or arable land). F100 Forest, 100 m from the transition zone; F10 forest, 10 m from the transition zone; F/S transition zone; S10 settlement, 10 m from the transition zone; S100 settlement, 100 m from the transition zone

Three different types of transects—arable land–forest, forest–settlement, and arable land–settlement—were established three times each in the same way at the study sites Dormagen (Additional file : Fig. S1) and Alfter (Additional file : Fig. S2).

In order for an area to qualify as representative of one of the required land use types, at least 90% of the area had to comprise that specific land use type (100 m radius). One transect was located in the centre of each study site (settlement–settlement), which to our knowledge did not contain, and was at least 500 m away from, natural oviposition sites (i.e. forested areas), to check if specimens of Ae. japonicus japonicus colonised the settlement area. Due to difficulty in finding an appropriate location for the third transect—arable land–settlement—in Dormagen, the ovitraps were placed in an urban park, resulting in two settlement–settlement transects at this site. After they were set up on 28 April, the ovitraps were examined at intervals of 3 weeks, six times in total (18 May to 31 August).

In 2018, two hundred and seventy ovitraps with masonite sticks were placed on 18 transects (Fig. ). Based on the 2017 field study results, transects were selected with transition zones between settlement areas and three different types of forest. The forested areas were pre-selected using QGIS based on Authorative Topographic-Cartographic Information System ***data*** [] and were included when more than 90% of the transect was covered by a specific type of tree, i.e. deciduous or coniferous. Mixed forests were defined as consisting of approximately 50:50 deciduous:coniferous tree species. Following the guidelines of the European Centre for Disease Prevention and Control [], three ovitraps in each trapping site within the transects were filled with water, which was taken from a spring in Alfter (50.72722N, 7.00944E). After they were set up on 10 April, the ovitraps were examined every 3 weeks, ten times in total (30 April to 6 November). The species and number of trees were noted in a 10 m-radius around the individual trap sites. Air temperature was monitored hourly for all field studies using ***data*** loggers (EBI 20-TH1; Xylem Analytics, Ingolstadt, Germany), which were fixed with wire onto the stem of a shrub or trunk of a tree or on a stick at a height of approximately 30 cm, close to a trap. One ***data*** logger was placed at each trap location on three selected transects of all transect types. Maximum, minimum and mean air temperatures were calculated from hourly measurements taken in the week before sampling until the sampling date. As the ***data*** loggers on two transects produced errors, we used ***data*** from the third transect (site Bonn Süd, 50.69317N, 7.05195E). As the temperature differences between the trap locations were small, we calculated the mean from the ***data*** loggers of this transect. Water temperature was measured in each ovitrap with a digital thermometer (scaling 0.1 °C; Sainlogic, London, United Kingdom) during the process of sampling (8 a.m. until 8 p.m.).

Sampling procedure

The examination of a trap location is herein referred to as ‘sampling’, independent of the presence or absence of mosquito eggs, larvae or pupae. Dried or toppled ovitraps were excluded from further analysis, while missing traps were replaced. If the trap water contained any larvae or pupae, these were transferred to a glass jar along with the remaining trap water which, if necessary, was adjusted to 100 ml volume (positive sample). Otherwise, the trap water was discharged, and the ovitraps were refilled with fresh water (negative sample). The masonite sticks were checked for eggs in the field; when present, the eggs were taken to the laboratory and put into water for the larvae to hatch (the sample was considered positive when larvae hatched). Removed sticks were replaced. The larvae and pupae were maintained in the laboratory until the emergence of adults, which were captured and stored in vials at −20 °C. All adults and dead larvae were identified morphologically using the keys of Becker et al. [] and Schaffner et al. []. For comparative analysis, the numbers of adults hatched from ***collected*** eggs, larvae and/or pupae per trap were recorded. A sample in which many eggs collapsed or all of the larvae died during transport or in the laboratory was included in the dataset as positive for the specific mosquito taxa. Twenty-two Cx. pipiens s.l. individuals of randomly selected samples of all studied land use types were determined genetically to species and biotype level by real-time polymerase chain reaction (PCR) targeting the ace2 and CQ11 microsatellite loci [].

The number of ovitraps colonised by mosquito specimens related to the total number of ovitraps indicated the occurrence of the respective species {container index (CI), also known as deposit index []}. We followed Focks [] in the interpretation of these ***data***, who categorised the CI according to density, i.e. a CI of 1–9 indicates a low density, 10–27 a medium density and > 27 a high density. The distribution of land use (the proportions of arable land, forest or settlement in a 100 m-radius around the trap location) was calculated using QGIS version 3.2 (with functions buffer and union). This was also used for the figures showing the trap locations at the respective study sites. Differences between land use types and trap locations were tested using Fisher’s exact test with post hoc adjustment using the Benjamini and Yekutieli correction []. ***Data*** management, ***statistics*** and diagrams were done using Microsoft Excel 2010, IBM SPSS 22.0 and R Studio 1.1.383 with R version 3.6.0 [] using the packages foreign [], readxl [] and rcompanion [].

Statistical analysis

The distribution of mosquito taxa along the environmental gradients was analysed with a canonical correspondence analysis (CCA) using R package vegan [], applying the environmental ***data*** (proportions of arable land, forest, settlement area) as the predictors and site-specific mosquito occurrence ***data*** as the response in linear combinations. The gradient axes represent linear combinations of the environmental variables, and maximum abundance of the taxa is represented by points calculated near the corresponding axes [].

To test the effects of several predictor variables on Ae. japonicus japonicus occurrence, we firstly pre-selected different models (Gaussian, Poisson, negative binomial and zero-inflated) and tested model fit by comparing Akaike information criterion (AIC) values and rootogram output [, ]. As predictors, information ***collected*** during field studies, such as water temperature, occurrence of native taxa, location of the trap according to land use type and number of tree species in a 10 m-radius of the trap locations was used (for the full list of variables, see Table ).

The test for multicollinearity by calculation of variance inflation factors returned values of < 4 for all predictor variables. For the most accurate model, R2- and adjusted R2-values were calculated following Nagelkerke []. Logistic regression of the proportional occurrence of Ae. japonicus japonicus vs. the most abundant native taxa was calculated after the method of Byrd et al. [] with quasibinomial distribution. Models and visualisations were conducted with R packages car [], countreg [], cowplot [], ggplot2 [], MuMIn [] and pscl [].

Results

Trap type preference and co-occurrence of mosquito taxa

As we did not obtain a statistically significant effect of trap type on the frequency of Ae. japonicus japonicus-positive ovitraps (Fisher’s exact test: two sided, P = 0.093), respective counts were summarised for each trap location. In 2017, we did 1000 samplings, of which 372 were excluded from further analysis as the traps contained no water, mostly due to high temperatures and desiccation during the summer. As the first examination revealed no mosquito-positive ovitraps, all samplings from this date were excluded from further analysis, resulting in valid samplings from five examination dates. We discovered eggs, larvae and pupae of four different mosquito taxa in 381 ovitraps, resulting in 60.7% mosquito-positive traps of all analysable traps. Ae. japonicus japonicus was found in 85 and 12 samplings in Alfter and Dormagen, respectively, totalling 15.4% of all analysable samplings (Table ). Cx. pipiens s.l. was detected in 199 samplings, corresponding to 31.7% of all samples, and significantly more frequently in plastic cups (36% traps positive) than in wood blocks (25% traps positive) (Fisher’s exact test: P = 0.004). Furthermore, 47 ovitraps contained An. plumbeus (7.5% of all samples) and 38 Ae. geniculatus (6.1% of all samples). Eighty ovitraps (21.0% of all analysable traps) were colonised by more than one species (Table ). In most cases (n = 24), Cx. pipiens s.l. and Ae. japonicus japonicus were found in the same trap, followed by the combinations Cx. pipiens s.l. and An. plumbeus (n = 12), and Ae. japonicus japonicus and An. plumbeus (n = 10) (Additional file : Table S1).

Total number and percentages of positive samples and occurrence of mosquito species per trap

| **Study** |  | ***Aedes japonicus japonicus*** | ***Culex pipiens* s.l.** | ***Anopheles plumbeus*** | ***Aedes geniculatus*** | **Total** |
| --- | --- | --- | --- | --- | --- | --- |
| 2017 | Total positive traps (*n*) | 97 | 199 | 47 | 38 | 381 |
| Positive traps/analysable traps (%) | 15.4 | 31.7 | 7.5 | 6.1 | 60.7 |  |
| Traps multiple species (*n*) | 56 | 58 | 39 | 25 | 80 |  |
| Multiple species/positive traps (%) | 57.7 | 29.1 | 83 | 65.8 | 21 |  |
| 2018 | Total positive traps (*n*) | 441 | 285 | 137 | 19 | 882 |
| Positive traps/analysable traps (%) | 20.3 | 13.1 | 6.3 | 0.9 | 40.7 |  |
| Traps multiple species (*n*) | 180 | 139 | 113 | 11 | 206 |  |
| Multiple species/positive traps (%) | 40.8 | 48.8 | 82.5 | 57.9 | 23.4 |  |

Calculations based on a total of 628 samples in 2017 and 2168 samples in 2018. The number of positive ovitraps with more than one species divided by the total number of positive ovitraps represents the portion of positive ovitraps with multiple species. See Additional file : Table S1 for all combinations of species and Additional file : dataset S1 for all samplings

In the 2018 field study, 532 of the 2700 samplings were discarded from the analysis because the ovitraps dried up, were knocked over by animals or removed by humans. Ae. japonicus japonicus was the most frequently trapped mosquito taxon and found in 441 (20.3%), Cx. pipiens s.l. in 284 (13.1%), An. plumbeus in 137 (6.3%) and Ae. geniculatus in 19 (0.9%) out of 2168 samples (Table ). Of 882 positive ovitraps (40.7% of all analysable traps), 175 contained two and 31 three different mosquito taxa (23.4% of all analysable traps). Syntopic occurrence was observed most frequently for An. plumbeus (83.0 and 82.5% in 2017 and 2018, respectively), followed by Ae. geniculatus (65.8 and 57.9%), Ae. japonicus japonicus (57.7 and 40.8%) and Cx. pipiens s.l. (29.1 and 48.8%) as additional species (Table ). In most cases (n = 84), Cx. pipiens s.l. and Ae. japonicus japonicus were found in the same trap, followed by the combinations Ae. japonicus japonicus and An. plumbeus (n = 58), and Cx. pipiens s.l. and An. plumbeus (n = 24) (Additional file : Table S1). Habitat sharing was most common in the forest–settlement transect, with the combination Cx. pipiens s.l. and Ae. japonicus japonicus [n = 19 at the forest trap location 10 m from the transition zone (F10) and at the settlement trap location 10 m from the transition zone (S10), respectively] and the combination Ae. japonicus japonicus and An. plumbeus [n = 18 at trap location F10 and n = 20 at the forest trap location 100 m from the transition zone (F100)] (Additional file : Table S1).

Effects of air temperature on oviposition

To analyse the seasonal occurrence of the mosquito taxa, we used mosquito ***collection*** ***data*** from April to November 2018, as the field study in that year started earlier and ended later than the 2017 field study. A warm January with an above-average mean temperature (3.8 °C) in North Rhine-Westphalia with large frost-free regions in the study area was followed by an unusually sunny and dry February with a mean temperature of −0.9 °C []. The mean temperature in March was 3.8 °C; there were two periods of frost in March, at the beginning and in the middle of the month []. With the warmest April since records started in 1881 (mean of 12.8 °C in North Rhine-Westphalia) []), spring and summer began almost simultaneously. May was also warmer than usual (compared to the mean of the international reference period from 1961 to 1990), and some thunderstorms provided the region with plenty of rain []. The summer (June–September) was characterised by low precipitation (115 l/m2; cf. 240 l/m2 for 1961–1990), a lot of sunshine (740 h; cf. 554 h for 1961–1990) and a mean temperature of 19.3 °C (cf. 16.3 °C for 1961–1990) []. This trend continued into the beginning of October. By the end of October the temperatures dropped considerably and reached below zero between 16 October and 6 November (authors’ measurements; Fig. ).

Percentages of mosquito-positive ovitraps (Traps positive), and air temperatures. Air temperature was calculated in the week before sampling in 2018. Sampling dates and the number of analysable ovitraps from a total of 270 ovitraps (in brackets) are shown on the x-axis. There was no statistically significant difference between the numbers of Aedes japonicus japonicus-positive ovitraps sampled in spring (April–May) and in autumn (October–November) (identical lowercase letters). By contrast, the numbers of Ae. japonicus japonicus-positive ovitraps in the summer (12 June to 25 September) were statistically significantly higher than in spring and autumn (different lowercase letters) (Fisher’s exact test: P < 0.0001. For all P-values, see Additional file : Table S2. For total numbers of emerged adults, see Additional file : dataset S1

After two inspections in April and May where no or very few mosquito eggs, larvae or pupae were recorded, a considerable increase in the number of positive traps was recorded in early summer, which peaked at the end of July (Fig. ). The maximum air temperature, 36.6 °C, was never measured for more than 1 h at Ae. japonicus japonicus-positive trap locations. In spite of air temperatures of ca. 40 °C, water temperatures of up to 30 °C, and 60% of the ovitraps drying up, many of the ovitraps were colonised by all four mosquito taxa in August, before the proportion of native mosquitoes declined till late September, in contrast to Ae. japonicus japonicus. When the mean temperature dropped below 14 °C, Ae. japonicus japonicus numbers also decreased, until only two ovitraps were found to be occupied by this subspecies during the last trap inspection.

The seasonal occurrence of Ae. japonicus japonicus eggs, larvae or pupae showed two major, statistically significantly different groups (Fisher’s exact test: P < 0.0001): spring (April/May) and autumn (October/November) [low numbers of positive ovitraps (< 5%)]; and summer (from 12 June until 25 September) [high numbers of positive ovitraps (> 25%)]. P-values of comparisons for sampling dates which indicated no significant differences are included in Additional file : Table S2.

Effects of land use type on oviposition: 2017 field study

The CI of the forest–settlement transect showed the highest number of ovitraps positive for Ae. japonicus japonicus at both study sites (43% in Alfter, 10% in Dormagen) (Additional file : Table S3). The transition zone in this transect featured the most Ae. japonicus japonicus-positive ovitraps, with 66% in Alfter and 28% in Dormagen (Additional file : Table S3). Significantly fewer Ae. japonicus japonicus-positive ovitraps were detected along the arable land–forest (Fisher’s exact test: P = 0.0045; 27% in Alfter, 3% in Dormagen), and arable land–settlement transects (Fisher’s exact test: P < 0.0001; 3% in Alfter, 2% in Dormagen) and none along the settlement–settlement transect.

The most frequent mosquito taxon in the ovitraps, Cx. pipiens s.l., was found at almost every location (mean CI 15–50%), with no significant differences between trap locations related to transect types (Fisher’s exact test: P = 1.00 for arable land–forest, arable land–settlement and forest–settlement). The real-time PCR of selected Cx. pipiens s.l. samples indicated seven Culex pipiens biotype pipiens Linnaeus 1758 and 15 Culex torrentium Martini 1925, with the first originating from traps in arable land, forest or transition zones between forest and arable land or forest and settlements. The Cx. torrentium samples were from trap locations in all studied land use types, including the centre of the settlement areas. Both taxa occurred in samples taken in June, July and August.

The transition zone in the forest–settlement transect and a trap site 10 m into the forest exhibited the highest numbers of An. plumbeus-positive ovitraps. Similarly high numbers were found along the arable land–forest transect at the trap locations 100 m into the forest and 10 m into the forest. Ae. geniculatus constituted the least frequent mosquito species in the ovitraps at the study sites. It occurred mainly at trap locations in the forest (Additional file : Table S3). Despite the large-scale landscape differences, the mosquito-positive ovitraps were similarly distributed on a smaller scale between the study sites (i.e. on the specific transects), according to the CCA (Fig. ). In summary, Ae. japonicus japonicus mainly occurred in the forest–settlement transition zone, An. plumbeus and Ae. geniculatus in the forest and Cx. pipiens s.l. closer to arable land and the settlement area.

Canonical correspondence analysis of land use types and mosquito taxa. Ae. j. japonicus occupied significantly more positive ovitraps in the settlement–forest transition zone than in other trap locations (Fisher’s exact test: P = 0.0045 tested against arable land–forest, P < 0.0001 tested against arable land–settlement)

Effects of land use type on oviposition: 2018 field study

Ae. japonicus japonicus-positive ovitraps occurred significantly more frequently (Fisher’s exact test: P = 0.0021) in the forest–settlement transition zone than in the settlement area, irrespective of forest type (Fig. ).

Occurrence of mosquito taxa in relation to trap location. The number of analysable traps is given in brackets. For abbreviations, see Fig.

We found 10–15% ovitraps positive for Cx. pipiens s.l., with no significant differences between trap locations [Fisher’s exact test: P = 1.00 for F100 vs. F10, F100 vs. F/S, F10 vs F/S, F100 vs. settlement trap location 10 m from the transition zone (S100), S10 vs. S100; P = 0.78 for F/S vs. S100; P = 0.53 for F100 vs. S10; P = 0.29 for F10 vs. S100; P = 0.23 for F/S vs. S10; P = 0.07 for F10 vs. S10]. The ovitraps positive for An. plumbeus and Ae. geniculatus were mainly located in the forest, with significantly fewer ovitraps positive in the settlement area (there were only sufficient numbers of samples for statistical analysis for An. plumbeus; Fisher’s exact test: P = 0.0009 for S10 and S100 compared to F100, F10 and F/S). According to heatmaps showing the seasonal variance of the land use-dependent occurrence of the mosquito taxa (Additional file : Fig. S3), the first Ae. j. japonicus-positive ovitraps were found in S10 and in the forest, Cx. pipiens s.l. was recorded first in the settlement area, and An. plumbeus in the forest and the transition zone. From 24 July to 4 September, the three taxa occurred in all land use types. In autumn, Ae. j. japonicus appeared mainly in the transition zone, whereas the last few ovitraps positive for Cx. pipiens s.l. were found in the settlement area and those positive for An. plumbeus primarily in the forest. The occurrence of mosquito taxa differed only slightly between trap locations in different forest types, and no taxon showed a significant preference (Fisher’s exact test: P = 0.72 for Ae. japonicus japonicus in deciduous vs. coniferous, P = 0.41 for coniferous vs. mixed, P = 0.16 for mixed vs. deciduous forest; P = 1.00 for Cx. pipiens s.l. irrespective of forest type; P = 1.00 for An. plumbeus in deciduous vs. coniferous and mixed vs. deciduous forest, P = 0.39 for coniferous vs. mixed forest).

High numbers of positive ovitraps were observed for Ae. japonicusjaponicus during the summer along the forest–settlement transect, with very high CIs in the transition zone (Additional file : Fig. S3). Medium numbers were found at the end of September 2018 and along the forest–arable land transect. Analysis of ovitraps sampled in May, October and November and along the arable land–settlement and settlement–settlement transects showed low CIs (Additional file : Table S3 and Fig. S3).

Effects of water temperature on oviposition

The maximum water temperature of Ae. japonicus japonicus-positive ovitraps amongst all measurements (2017–2018) was 28.6 °C on 24 July 2018 (Table ). Cx. pipiens s.l. occurred more frequently in ovitraps with higher water temperature compared to Ae. japonicus japonicus and vice versa. The lowest observed water temperature in Ae. japonicus japonicus-positive ovitraps was 5.3 °C on 25 September 2018. In total, 39 Ae. japonicus japonicus-positive ovitraps were recorded with a water temperature < 10 °C. According to the 2017 ***data*** of the forest–settlement transect and 2018 ***data*** ***collected*** from 23 May to 25 September, the probability of oviposition by Cx. pipiens s.l. increased with rising temperatures, and the odds of ***collecting*** Ae. japonicus japonicus decreased by 0.48/1 °C (t-test, t(683) = − 3.98, P < 0.0001). At 25 °C, the regression lines of the two taxa cross, with a probability proportion of 0.5 (Fig. ).

Maximum temperature of water (°C) in the mosquito-positive ovitraps during the field studies at the different study sites

| **Study** | **Site** | ***Ae. japonicus japonicus*** | ***Cx. pipiens* s.l.** | ***An. plumbeus*** | ***Ae. geniculatus*** |
| --- | --- | --- | --- | --- | --- |
| 2017 | Alfter | 26.8 | 34.7 | 31.3 | 20.3 |
| Dormagen | 22.1 | 27.2 | 17.3 | 21.7 |  |
| 2018 | Alfter | 22.6 | 19.8 | 20.6 | n.n. |
| Bonn Süd | 24.7 | 24 | 17.3 | n.n. |  |
| Heimerzheim | 24.3 | 24.6 | 23.2 | 22.7 |  |
| Lohmar | 28.6 | 25.8 | 28.6 | 16.6 |  |
| Siegburg | 25.8 | 30 | 27 | 23.1 |  |
| Troisdorf | 26.8 | 27.7 | 25.2 | n.n. |  |

n.n. Species not present

Logistic regression of probability proportion of adults hatched from larvae of Cx. pipiens s.l. vs. Ae. japonicus japonicus ***collected*** at the specified temperatures. ***Data*** from 2017 and 2018 (23 May to 25 September) for ovitraps located along the forest–settlement transect. Function jitter was used for taxa proportion ***data*** to improve visibility []

Effects of water temperature, tree species, trap location and native mosquitoes on oviposition of Ae. japonicus japonicus

The negative binomial model returned the lowest AIC results relative to the other methods (for AIC-values and rootograms see Additional file : Fig. S4) and was used further. Four significant predictors (R2 = 0.2773, adjusted R2 = 0.2785) were positively associated with Ae. japonicus japonicus counts: mean temperature, use of the same microhabitat as an oviposition site by An. plumbeus, and two trap locations—one in a transition zone (F/S) and one 10 m from the transition zone towards a settlement (10S) (Table ). Hence, with increasing mean water temperature the expected count of ovitraps positive for Ae. japonicus japonicus increased (by e0.2126 = 1.2369) and the use of a trap location for oviposition by An. plumbeus multiplied the expected count (by the factor e0.5999 = 1.8219). Similarly, positive effects were caused by trap location at or near a transition zone, 10 m into the settlement area.

Coefficients and statistically significant output of predictor variables as calculated by the generalised linear model

|  | **Estimate** | **SE** | ***Z*-value** | ***P*** |
| --- | --- | --- | --- | --- |
| (Intercept) | ? 29.890 | 15.100 | ? 19.790 | 0.0478\* |
| Temp\_mean | 0.2126 | 0.0933 | 22.800 | 0.0226\* |
| Cxbin | 0.2732 | 0.3148 | 0.868 | 0.3854 |
| Plbbin | 0.5999 | 0.2253 | 26.630 | 0.0077\* |
| F100 | 0.4931 | 0.4826 | 10.220 | 0.3068 |
| F10 | 0.7486 | 0.4127 | 18,140 | 0.0697 |
| F/S | 0.8715 | 0.3728 | 23.380 | 0.0194\* |
| S10 | 10.770 | 0.3347 | 32.170 | 0.0013\* |
| Ngbi | 0.0412 | 0.1157 | 0.356 | 0.722 |
| Nhbu | 0.0001 | 0.0251 | 0.003 | 0.9972 |
| Ngki | 0.0295 | 0.0432 | 0.684 | 0.4941 |
| Nsei | ? 0.0362 | 0.0609 | ? 0.594 | 0.5528 |
| Ntei | ? 0.0845 | 0.0917 | ? 0.922 | 0.3566 |
| Ngfi | 0.1002 | 0.0832 | 12.050 | 0.2283 |
| Nrbu | 0.0648 | 0.0456 | 14.200 | 0.1557 |

Characteristics: negative binomial, link = log, z-values calculated by Wald-test. Response variable: total of Ae. japonicus japonicus-positive ovitraps per location

Predictors: Temp\_mean = Mean water temperature, binary native taxa occurrence: Cxbin = Cx. pipiens s.l., PlbbinAn. plumbeus, land use ***data***: percentage forest: F100 = 100% forest, F10 = 60% forest, F/S = 50% forest, S10 = 40% forest, number of tree species in a 10 m radius of the trap locations (the tree species occurred in more than five transects): Nrbu: Fagus sylvatica, Nhbu: Carpinus betulus, Ngbi: Betula pendula, Nsei: Quercus robur, Ntei: Quercus petreae, Ngfi: Picea abies, Ngki: Pinus sylvestris

\* P < 0.05

The numbers of the most abundant tree species had no significant effect on the frequency of ovitraps containing Ae. japonicus japonicus (Table ). Thus, specific tree species did not have an effect on the oviposition of the Asian bush mosquito in this study.

Discussion

The taxa that most frequently colonised the traps in this study were Cx. pipiens s.l. and Ae. japonicus japonicus, followed by An. plumbeus and Ae. geniculatus (Table ). Whereas Cx. pipiens s.l. occurred mainly in the summer without showing a preference for land use-related oviposition, An. plumbeus and Ae. geniculatus were found almost exclusively at trap locations in the forest (Fig. ). When the numbers of native mosquitoes dropped at the end of September, up to 30% of all traps were still found to be Ae. japonicus japonicus-positive (Fig. ). This invasive subspecies occurred more frequently at rural compared to suburban sites and was more prevalent in the transition zone between forest and settlement areas compared to trap locations in other land use types (Additional file : Table S3). An. plumbeus shared an oviposition and larval microhabitat more often with Ae. japonicus japonicus than with the other native species (Table ; Additional file : Table S1). Temperatures higher than 30 °C and the arable land and settlement land use types seemed to have a negative effect on the occurrence of Ae. japonicus japonicus (Fig. ; Additional file : Table S3).

Ae. japonicus japonicus has spread across large regions of Germany in the 11 years since its first known occurrence in the country [, , ]. This subspecies is regularly reported during active or passive monitoring in densely populated regions like North Rhine-Westphalia [, ]. This is reflected in our transect ***data*** for 2018, where Ae. japonicus japonicus occurred at all the study sites at least once during the sampling period. However, our results indicate large differences in the occurrence of the Asian bush mosquito on a regional and local scale, depending on the degree of rurality or suburban character of a region, and especially regarding the mosquito’s preference for, and avoidance of, specific land use types.

Phenology

The low numbers of mosquito-positive traps in spring (Fig. ; Additional file : dataset S1) were probably due to two late frost events in March, during which emerging adults from overwintering larvae or larvae hatched from overwintering eggs of Ae. japonicus japonicus could have been killed. The month of April was very warm but too dry to induce egg hatching. Only in May did thunderstorms with intense rainfall occur, which presumably refilled natural and artificial oviposition habitats sufficiently to enable comprehensive hatching of overwintering eggs.

The maximum number of traps positive for mosquito taxa ovipositing in containers were counted in summer, at the end of July 2018. Ae. japonicus japonicus was found in 50% of all samples and remained the most common mosquito taxon at the study sites until the end of September. By that time, native taxa were much less common, presumably due to the decreasing temperatures in autumn. Our research corroborates previous findings [, , ] that Ae. japonicus japonicus is well adapted to temperate climates (temperate oceanic and humid continental climate after improved Köppen-Geiger classification []) and better able to develop at lower temperatures than many native taxa [, ]. This adaption gives this newcomer an advantage over competing indigenous mosquito taxa. The numbers of Cx. pipiens s.l.-positive traps decreased with falling temperatures in the end of summer (Fig. ), which was also observed in a study from Italy [].

Land use

According to the results of the present study, Ae. japonicus japonicus appears to prefer the transition zone between forest and settlement area as an oviposition habitat (Figs. , ). Traps in the centre of settlement areas, 500 m away from natural oviposition sites, as well as at locations on arable land and settlement areas at a distance of 100 m from the forest were never or only occasionally colonised (Additional file : Table S3). Far fewer ovitraps were occupied by Ae. japonicus japonicus at the rather suburban site of Dormagen compared to the more rural site of Alfter (Additional file : Table S3). Ovitraps in mixed forests seemed to be more frequently colonised, but the differences were not significant. The first Ae. japonicus japonicus-positive traps identified in May were in locations in land use types S10 and F100, and were presumably due to oviposition by females that had developed from eggs overwintering in vases, rain barrels or tree holes. With increasing temperatures, the number of positive traps increased in all land use types, with a maximum at the end of July in the transition zone. Based on the decreasing numbers of positive traps, we assume that the temperatures in August were above optimum for this subspecies at some trap locations (Fig. ; Additional file : Fig. S3). In September and October, most traps were colonised in the transition zone, continuing the trend from July.

These ***data*** correlate well with previous studies. Results from Japan indicated oviposition mainly in rural and more densely vegetated areas [], but also in ovitraps on concrete on the ground close to forests consisting mainly of bamboo and oak []. In a study carried out in the USA, higher numbers of eggs were deposited in ovitraps at the forest edge compared to the forest interior [], and higher abundances of pupae occurred in rural compared to urban and suburban areas []. In a recent study from Hungary, forest patches (smaller than 500 ha) and vineyards were positively correlated with the occurrence of Ae. japonicus japonicus, and it was assumed that these areas represent corridors and larger continuous forests and arable land barriers for the spread of the subspecies []. This conjecture, together with the results from our study, could be an explanation for the slow spread of the subspecies in the federal state of Lower Saxony [], whose landscape is mostly shaped by ***agriculture***, and its absence in the federal state of Brandenburg [], whose landscape is dominated by large coniferous forests.

Spatial gradients in transition zones influence biotic and abiotic conditions such as microclimate (e.g. forest interiors are cooler than forest edges, and winds are weaker and less turbulent) or biotic factors (e.g. more leaf litter is found in forest interiors compared to forest edges) []. Some of these indirect effects of different land use types may be the main reasons for the oviposition preferences of mosquitoes. Hot areas in arable land and settlements could act as a temperature barrier for the distribution of Ae. japonicus japonicus, as the subspecies was only rarely found in the present study in these types of land use. The increased number of positive traps in the forest and in transition zones compared to arable land and settlement area suggests that Ae. japonicus japonicus is a forest-related taxon. However, oviposition at places penetrating 10 m into apparently unsuitable areas (arable land, settlement area) indicates the readiness of Ae. japonicus japonicus to use artificial oviposition sites that are more distant from the forest, which could give the introduced subspecies an advantage over more conservative native forest species like An. plumbeus and Ae. geniculatus.

In the present study, Ae. japonicus japonicus showed no preference for artificial (plastic cups) or natural (logs of beech) trap types, but Cx. pipiens s.l. was found significantly more frequently in artificial traps. Cx. torrentium was found at trap locations in all land use types. This could be due to the eurytopic character [] or the strong dispersal capacity of this species []. Based on the genetic differentiation of Cx. pipiens samples, a preference of Cx. pipiens biotype pipiens can be assumed for ovitrap locations in (semi)natural environments. In Portugal, Cx. pipiens biotype pipiens was observed feeding in shelters used for animals and sylvan habitats [], whereas Cx. pipiens biotype molestus Forskal, 1775 shows more stenogamous and anthropophilic behaviour []. As only a small sample of Cx. pipiens s.l. was tested for species and biotype, further research regarding the land use preferences of the biotypes of this species complex should clarify if the above assumption points in the right direction.

The presence of specific tree species had no effect on the number of Ae. japonicus japonicus-positive ovitraps. The effects of leaf litter on mosquito larvae depend on the tree species, and can be beneficial (e.g. when quickly decomposing leaves are available) or detrimental (e.g. the presence of plant tannins or other phenolics to which some mosquito species are sensitive) [, ]. We hypothesise that taxa like Ae. japonicus japonicus and An. plumbeus, whose larvae are regularly found in tree holes, are relatively tolerant to many secondary plant compounds (tannins etc.), which would explain that there was no observable effect of tree species in the present study.

The use of CI to estimate yellow fever risk [] has been criticised because it does not consider the size and, thus, the different productivity potential of containers []. Despite this, ecological studies use CI as a measure of mosquito abundance patterns, preference of oviposition conditions (shady vs. sunlit areas) or preference of container material (e.g. []). The fact that the highest CIs for Ae. japonicus japonicus were during the summer and along the forest–settlement transect underpins the preference of this subspecies for this season and land use type. Based on these findings, further studies should incorporate sampling of available oviposition sites (e.g. rain water barrels, discarded tyres, flower vases) to give a more accurate estimation of oviposition habitat preference.

Temperature and co-occurrence

In the present study, larvae of Ae. japonicus japonicus were never found in traps with water temperatures higher than 29 °C. The maximum constant water temperature for the development of larvae of a North American Ae. japonicus japonicus strain in the laboratory was 28 °C, and larvae survived until the third instar at 34 °C []. In a recent laboratory study from Germany, the mean mortality rate of larvae at a constant maximum of 31 °C was 87.5% [].

The logistic regression analysis of the water temperature-dependent proportion of Ae. japonicus japonicus vs. Cx. pipiens s.l. revealed a preference of the introduced subspecies for colder temperatures, in contrast to warmer water temperatures with significantly higher proportions of the native taxon (Fig. ). Depending on the oviposition and larval habitat, this can result in an advantage for Ae. japonicus japonicus (in the transition zone between forest and settlement area) at water temperatures up to 25 °C, whereas Cx. pipiens s.l. (in this case presumably Cx. torrentium) is apparently well adapted to other land use types unaffected by temperature, as demonstrated by its corresponding higher proportions. Independent of climate change scenarios, and unlike Ae. japonicus japonicus, Cx. pipiens s.l. generally benefits from warm water temperatures in natural or artificial containers. Depending on the container type (e.g. tree hole at the base of a trunk), the water temperature may be much lower than the air temperature, resulting in a microhabitat offering shelter for eggs and/or larvae from extreme temperatures []. Utilisation of such microhabitats may help Ae. japonicus japonicus to survive hot summers, like those in 2018 and 2019.

So far, studies on competition between Ae. japonicus japonicus and native mosquito species have not been conducted in Germany, but a slight advantage of Cx. pipiens biotype molestus over Aedes albopictus (Skuse, 1895) was detected in one study []. In the present study, co-occurrence was observed for all four mosquito taxa (Table ), and most frequently for An. plumbeus. The results from the generalised linear model (Table ) confirmed that An. plumbeus and Ae. japonicus japonicus use similar types of microhabitats as oviposition sites. In the laboratory, we observed that larvae of Ae. japonicus japonicus usually hatched quickly when the eggs were submerged in water; even contact with moist paper tissue induced eclosion. In contrast, larvae of An. plumbeus were noticed mostly after the pupation of Cx. pipiens s.l. and Ae. japonicus japonicus. During and after the emergence of adult mosquitoes the water became cloudy, probably due to increased microbial activity resulting in a decreasing amount of dissolved oxygen, a known hatching stimulus for many Aedes species ovipositing in artificial and natural containers []. In contrast, the invasive species Aedes aegypti (Linnaeus, 1762), Ae. albopictus and Ae. japonicus japonicus are able to eclose immediately after contact with tap water or deionised water [, , ], although the hatching rate of the two former species is much higher in ***nutrient*** broth []. Their ability to eclose at normal concentrations of oxygen gives them temporal advantage over many native species, in this case An. plumbeus and Ae. geniculatus.

Ae. japonicus japonicus is able to coexist with other mosquito species in many larval habitats. In our study, this invasive subspecies was found frequently in traps with An. plumbeus at trap locations in the forest and with Cx. pipiens s.l. in all land use types except for the arable land–settlement transect (Additional file : Table S1). Co-occurrence of larvae of the Asian bush mosquito was also reported for Culex hortensis Ficalbi, 1889, Cx. pipiens s.l., Ae. albopictus, Culiseta longiareolata (Macquart, 1838), Ae. geniculatus and Culiseta annulata in artificial microhabitats []. The occurrence of Ae. japonicus japonicus seems, separate from its land use preferences, only limited by higher water temperatures (Table ), which can give an advantage to heat-tolerant larvae of native mosquito species (Fig. ). A similar observation was made in the USA, where Ae. atropalpus colonised rock pools with temperatures of up to 39.8 °C, in contrast to Ae. japonicus japonicus, which was significantly more frequent at temperatures of less than 30 °C [].

In the present investigation we trapped native species (Table ) which are potential vectors of disease agents []. Individuals of the ornithophilic Cx. pipiens biotype pipiens as well as hybrids of this taxon and the more anthropophilic Cx. pipiens biotype molestus were recently found to be WNV positive in a wildlife park in Germany []. Although Ae. japonicus japonicus has been shown to be an opportunistic feeder in human environments [] and vector competent for various pathogens [], this subspecies is not more or less dangerous than native species. Yet, it adds to the risk of becoming infected with a pathogen transmitted by a blood-feeding insect in Germany.

Conclusions

The present study revealed the period of main oviposition activity (June–September), the tolerated water temperature range (5–29 °C) and favoured oviposition habitat (forest–settlement transition zone) of the Asian bush mosquito Ae. japonicus japonicus. According to the results of this study, the occurrence of this subspecies is not associated with specific tree species, which suggests that it has a broad tolerance of secondary plant compounds; this may facilitate its spread into areas with plants that do not occur in its area of origin. As the study area lacked large coniferous forests, it is recommended that appropriate areas should be examined for the presence of Ae. japonicus japonicus in Baden-Wuerttemberg or Bavaria, where coniferous forests, dominated by European spruce Picea abies, are larger and more common. In contrast to container-inhabiting native mosquito taxa, Ae. japonicus japonicus was demonstrated to colonise most of the traps in its preferred oviposition habitat in western Germany. Against the background of it being an opportunistic feeder, this underpins its importance as a relevant potential vector of WNV. Co-occurring native mosquito taxa have shorter seasonal oviposition activity, but are able to tolerate higher temperatures (Cx. pipiens s.l.). The frequently co-occurring native species An. plumbeus could be used as an indicator for potentially suitable oviposition sites for Ae. japonicus japonicus in hitherto uncolonised regions. There is no indication that native mosquito species are displaced by Ae. japonicus japonicus. However, this should be studied in natural oviposition sites like tree holes and rock pools where resources are limited in comparison to large artificial containers like rain water barrels or regularly refilled vases in cemeteries. The results reported here for Ae. japonicus japonicus are in accordance with those of studies from other countries, and also confirm some assumptions that have been made for modelling approaches, e.g. that arable land and water temperatures of more than 30 °C represent distribution barriers []. It can be concluded that this subspecies appears to spread and establish where settlements meet areas with small patches of forest, which is the situation in most parts of southern and western Germany. In contrast, less densely populated regions with areas of land dominated by ***agriculture*** or large forests, which is the situation in large regions of northern and eastern Germany, seem to represent distribution barriers to this subspecies. At the present time, this conclusion is supported by the known distribution area of the Asian bush mosquito in Germany []. The new insights presented here related to the land use-dependent occurrence of mosquitoes, especially regarding transition zones, and the consideration of native species, contribute to a better understanding of mosquito ecology and provide ***data*** for more targeted monitoring, distribution modelling and risk management of these species.

**Acknowledgements**

Sebastian Gerhartz from the Department of Methods and ***Statistics***, Faculty of Social Science, Ruhr-Universität Bochum gave valuable advice on the pre-testing of different model types. The suggestions of two anonymous reviewers were highly appreciated and significantly improved the manuscript.

**Notes**

Supplementary informationSupplementary information accompanies this paper at [*https://doi.org/10.1186/s13071-020-04461-z.Publisher's*](https://doi.org/10.1186/s13071-020-04461-z.Publisher's) NoteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

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[***Decoupling livestock and crop production at the household level in China***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2M1-JCWX-C29H-00000-00&context=1516831)

Nature Sustainability

August 2020

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**Section:** Pg. 48-55; Vol. 4; No. 1; ISSN: 2398-9629

**Length:** 5667 words

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**Body**

Main

Feeding an increasingly affluent global population with less pollution is one of the major global challenges integral to the attainment of the United Nations Sustainable Development Goals. Animal products have contributed to over half of the protein supply in developed countries and have shown a sharp increase in developing countries. To produce these animal products, an increasing number of feedlots have been built, which concentrate large numbers of animals. At the same time, rearing livestock on farm backyards has transitioned to industrial livestock farming,, and a decoupling of livestock and croplands at the household level is occurring (Fig. ). The decoupling has substantially reduced the manure-recycling ratio and had detrimental effects on the environment,. Recycling manure to cropland is a challenge not only for developing economies such as China, but also for high-income countries such as the United States and regions in Europe,. Therefore, understanding why such a decoupling occurs and how it affects the sustainability of crop–livestock coupled systems is crucial for rebuilding the linkage between croplands and livestock production.

Decoupling of livestock and cropland.

The top section represents the traditional situation—coupled livestock and cropland. Livestock raising provides manure and draught animals for cropland, while cropland provides feed for livestock. Only small amounts of feed and fertilizer are required from import, and pollutant emissions are insubstantial. The bottom section represents the emerging situation—decoupled livestock and cropland. The recycling between livestock and croplands is no longer intact, and large amounts of imported feed and synthetic fertilizers are needed. Substantial amounts of pollutants are emitted to the environment, leading to air and water pollution, biodiversity loss, soil acidification and global warming.

The demand for and the economic returns from livestock products have been found to be important factors affecting the growth of livestock industries. However, these changes alone may not immediately lead to the decoupling of croplands and livestock and the transition of livestock production from smallholder to industrial farming. In China today, small- and medium-scale livestock farms still play an important role in the supply of animal products. The underlying reasons why smallholder farmers, traditionally the major form of livestock production in China, give up livestock production are still not well understood. Traditionally, small-scale livestock farming was matched with a corresponding amount of cropland cultivation at the household level, fostering within-household manure recycling,. Whether the decoupling of livestock production and croplands at the household level will result in lower manure-recycling ratios has not been robustly quantified to date.

China is the world’s largest market for animal products and the largest consumer of synthetic fertilizers applied to croplands, accounting for about one-third of global total nitrogen fertilizer consumption. Overall, synthetic fertilizer use efficiency (fertilizer ***nutrient*** harvested in crops divided by total fertilizer use) is lower than 50% and the average manure-recycling ratio is lower than 40% in China, indicating that over half of fertilizer and manure ***nutrients*** are lost to the environment. As a consequence, ***agriculture*** has become the dominant source of air and water pollution. Reducing these ***nutrient*** losses has become a grand challenge for China in the context of achieving the Sustainable Development Goals. In contrast to large-scale farming in Europe (>30 ha) or the United States (>150 ha), the average cropland size is only around 0.5 ha per rural household in China. Application patterns of synthetic fertilizers and manure in large-scale farming are substantially different from those on smallholder farms,. How these differences affect the coupling/decoupling of livestock and croplands is not well understood and requires further studies. In this paper, we contribute to a better understanding by basing our research on long-term ***data*** (1986–2017) from a rural household panel survey across China (>20,000 households, Extended ***Data*** Figs. –). We address the following key questions. (1) To what extent does the decoupling between livestock and cropland production occur at the household level? (2) Does such decoupling lead to manure ***nutrient*** loss and increased use of synthetic fertilizers? (3) What are key reasons for such a decoupling to occur and what are the pathways to future recoupling between livestock and croplands?

Results

In this paper, we divided all surveyed households into four key groups: (1) combined crop planting and livestock raising (CPLR), (2) only crop planting, (3) only livestock raising and (4) no crop or livestock. These category 4 households generally engage in ***agricultural*** activities through labour rental such as work on large farms operated by other households or in non-***agricultural*** sectors. We maintain these households in the survey since these farmers still live in the villages and reflect the changes in rural China.

Household share

The overall share of CPLR households declined sharply from 71% in 1986 to 12% in 2017, while households with only crop planting increased from 26% to 57% during the same period (Fig. ). These figures suggest that on-farm decoupling between livestock and cropland at the household level did occur in China to a large extent. Meanwhile, the share of rural households no longer participating in ***agricultural*** production increased substantially from 3% to 31% between 1986 and 2017.

Temporal changes of shares of households and draught animals and machinery use.

a, Four types of household shares. b, Livestock-raising density in CPLR households. c, Machinery use in crop-only and CPLR households. d, Draught-animal share and animal-stocking density in all households. NCL, no crop or livestock; Crop, only crop planting; Livestock, only livestock raising; <15, 15–30, 31–75 and >75 refer to livestock-raising density in pig equivalent per hectare cropland in CPLR households. Error bars refer to standard errors (SEs).

Households with only livestock raising accounted for around 1% of total rural households during the study period (Fig. ). Under the Household Contract Responsibility System (HCRS), each rural household is allocated some cropland area. As a result, there are few households with only livestock raising but no crop planting. However, this decoupling does not indicate the disappearance of livestock production in China; on the contrary, more professional and centralized livestock farms are emerging (Extended ***Data*** Fig. ). The majority of livestock production in 1986 originated from rural households. By contrast, in 2010, approximately half of the livestock production originated from rural households, that is, CPLR and livestock-only households. The remaining 50% of livestock production is derived from industrial-scale livestock farms, which make up less than 1% of total livestock farms in China (Extended ***Data*** Fig. ). These are not normally part of the survey, but industry ***statistics*** specifically for industrial farms are used to reflect the changes of these farms. The survey of rural households used in this study complements these analyses of industrial farms.

Animal-stocking density

In the context of decoupling, we found that livestock density (that is, pig-number equivalent per cropland per household; see ) in CPLR households increased from 9 to 31 pigs per hectare cropland between 1986 and 2017 (Fig. ). The largest livestock farm had over 5,000 pigs from one rural household. Increasing animal-stocking density has resulted in a situation where the average manure amount produced at CPLR households has exceeded the ***nutrient*** requirement of their associated cropland (which is 15 pigs per hectare cropland, equivalent to 75 kg N ha−1) since approximately 2002. In 1986, 90% of CPLR households raised fewer than 15 pigs per hectare cropland, and by 2017 this value had declined to 63% (Fig. ). This means that in 2017, in over one-third of the CPLR households, manure production exceeded the ***nutrient***-carrying capacity of their cropland (total nitrogen required by crops on these croplands). If this manure surplus is not transported to and applied on neighbouring cropland, it leads to ***nutrients*** being lost to the environment. As surplus manure is either discarded as waste or applied as excess manure to cropland fields, the lack of uptake by crops leads to increased losses to the environment.

Mechanization and the decline of draught-animal use

We found an increasing trend of mechanization for both CPLR and crop-only households between 2004 and 2017 (Fig. ). However, the degree of mechanization is much lower for CPLR households compared with crop-only households. Accordingly, we noted that the share of households using draught animals declined sharply from 1995 to 2017, which is consistent with the increase in mechanization (Fig. ).

Manure, fertilizer use and farmland size

Compared with households with only crop production, CPLR households use less synthetic fertilizer and more manure per hectare cropland (Fig. ). This means CPLR households use manure ***nutrients*** instead of synthetic fertilizer input, and the average substitution ratio (calculated on the basis of the difference of synthetic nitrogen fertilizer uses in CPLR and crop-only households) was 11% during the study period. Nevertheless, with the increase of synthetic fertilizer use, the substitution ratio declined from 18% in 1995 to only 10% in 2017. The manure uses in crop-only households also suggest that part of the manure produced from CPLR or livestock-only households is transported to and applied on neighbouring croplands. However, we found that the proportion of manure use in CPLR households is indeed higher than that in households with only crop production, and higher animal-stocking density corresponded with a higher manure recycle ratio (Fig. ). This suggests that the decoupling of livestock and croplands reduces the use of manure and may lead to environmental pollution and decline of cropland soil fertility.

Temporal changes of fertilizer and manure use.

a, Application rates of synthetic nitrogen (N) fertilizer in crop-only and CPLR households. b, Application rates of synthetic N fertilizer in CPLR households with different livestock densities. c, Manure share of total fertilizer use in crop-only and CPLR households. d, Manure share in CPLR households with different livestock densities. <15, 15–30, 31–75 and >75 refer to livestock-raising density in pig equivalent per hectare cropland in CPLR households. Error bars refer to SEs.

However, we found that synthetic nitrogen fertilizer use substantially increases with animal-stocking density (Fig. ). This implies that CPLR households with higher animal-stocking density use not only more manure than CPLR households with low animal-stocking density but also more synthetic fertilizers. Farmland size decreases sharply with the increase of animal-stocking density (Fig. ). This indicates that farmers with smaller farmland size raise more livestock, substituting income from crop yield with income from animal products. Meanwhile, small farmland size leads to more synthetic fertilizer use per hectare, and thus nitrogen application rate substantially increases with animal-stocking density (Fig. ). This is surprising as these farmers have abundant amounts of manure but still use a large amount of synthetic fertilizers. This may occur due to the inconvenience for smallholders to store and apply manure on their small farmland areas. It is easy for smallholders to use more fertilizers to increase yield rather than relying on other inputs, for example, machinery use and advanced knowledge of ***nutrient*** management.

Farmland size, animal-stocking density and synthetic N fertilizer use.

a, Farmland size in households with different livestock densities. b, Application rate of synthetic N fertilizer and farmland size. The blue bars and points represent the crop-only households while the green bars and points represent the CPLR households with different animal-stocking densities. <15, 15–30, 31–75 and >75 refer to livestock-raising density in pig equivalent per hectare cropland in CPLR households. Error bars refer to SEs.

Spatial variation

The share of CPLR households declined for all the villages across China between 1986 and 2017 (Fig. ). The largest decline was observed for the North China Plain, which is the major crop production area in China, and along the East Coast. Western China showed a comparatively smaller decline of the share of CPLR households, especially in the hilly regions, such as in southwestern China. The share of households with draught animals also declined sharply for most villages across China in this period, and ratios of draught-animal use above 5% were found only in some hilly villages by 2017 (Fig. ).

Spatial variations of share of CPLR households and draught animals in all surveyed villages across China.

a, CPLR household share in 1986. b, CPLR household share in 2017. c, Draught-animal share in 1986. d, Draught-animal share in 2017. Base map produced using GADM ***data*** ([*https://gadm.org/*](https://gadm.org/)).

Manure input declined to less than 5% of total ***nutrient*** input to croplands in most crop-only households in 2017. Values above 5% are found mainly in middle and western China. While for most CPLR households manure use is still higher than 5% (Extended ***Data*** Fig. ), a substantial decline was also found in the North China Plain. By contrast, much higher degrees of mechanization were found in crop-only households compared with CPLR households, especially in the North China Plain where CPLR households had become an exception by 2017 (Extended ***Data*** Fig. ).

Discussion

A decoupling between livestock and croplands has been observed at the household level in China. This is illustrated well from two aspects. First, only 5% of rural households keep draught animals, reducing manure production for recycling. Second, only 12% of rural households still pursue combined animal and crop production, while an increasing share of CPLR households now produce manure in excess of the crop requirements of their croplands. The overload of manure leads to a large amount of ***nutrient*** loss to the environment. These findings indicate that manure production has become more concentrated at the household level, leading to a reduced potential for on-farm recycling of manure to croplands. Previous studies deduced that less synthetic fertilizer would be used if coupling of livestock and croplands prevailed,, and our results provide solid evidence to support such conclusions in principle (Fig. ). CPLR households are shown to use fewer synthetic fertilizers and more manure compared with crop-only households. Although the result is based on nitrogen fertilizers, the same findings hold for phosphorus and potassium fertilizers when used for the analysis (Extended ***Data*** Fig. ). This reveals that the conclusion of decoupling between livestock and croplands and its effects on manure use is robust, and more attention should be given to such a decoupling process.

However, as soon as the animal-stocking density exceeds the carrying capacity of cropland associated with the farm, overuse of both synthetic fertilizers and manure is found. While it seems paradoxical that more synthetic fertilizers are used on farms with coupled livestock and croplands, these findings imply that the coupling between livestock and croplands at the household level is functional only when manure production does not exceed the carrying capacity of surrounding croplands. Once animal numbers exceed the threshold, surplus manure would need to be transported far away to other croplands, leading to an increase in transportation costs and resulting in a reduction of manure recycling,. With the increase of livestock production, rebuilding the linkage between livestock and cropland beyond the household level and at the regional level is thus a crucial step towards ***nutrient*** recycling and thus sustainable intensification. We indeed find the crop-only households also use manure that is transferred from their neighbours. However, matching livestock and croplands exactly on their distribution would benefit the manure recycling, just like the CPLR households within which livestock and croplands are tightly coupled. Thus, relocating livestock on the basis of the distribution of croplands will lead to a reduction in transportation cost of manure and increase the manure-recycling ratio,, promoting the recoupling between livestock and croplands on a regional scale.

To quantify the underlying driving forces of decoupling, we estimated the changes of the shares in CPLR farms, the use of draught animals and livestock production per land area using panel models (Table ). Results suggest that mechanization, synthetic fertilizer use and the income share derived from non-***agricultural***-sector activities have notable adverse effects on both draught-animal raising and the CPLR share. Each 1% increase in machinery and fertilizer use corresponds with a reduction of 0.1% and 0.05% of draught-animal raising and CPLR shares, respectively. The degree of mechanization in Chinese ***agriculture*** increased eightfold between 1978 and 2017, and overall mechanization had reached 65% of the farms by 2017. This is similar for synthetic fertilizer use, which has increased sevenfold in the same period. The low transportation and application costs of synthetic fertilizers (per amount of ***nutrient*** applied) largely promote their use in contrast to manure use, despite the fact that manure production also increased substantially since 1978 and is available as a waste product.

Panel model analysis on the decoupling between livestock and cropland

|  | **Model 1: draught animal** | **Model 2: CPLR** | **Model 3: animal density** |
| --- | --- | --- | --- |
| ln[machinery and fertilizer use ($ ha?1)] | ?0.107\*\*\* | ?0.048\*\*\* | ?0.096\*\*\* |
| (0.002) | (0.002) | (0.007) |  |
| Non-***agricultural*** income share (%) | ?0.002\*\*\* | ?0.005\*\*\* | ?0.005\*\*\* |
| (0.000) | (0.000) | (0.001) |  |
| ln[farm size (ha)] | 2.010\*\*\* | 1.026\*\*\* | ? |
| (0.172) | (0.017) |  |  |
| Farm size2 | ?0.272\*\*\* | ?0.108\*\*\* | ? |
| (0.045) | (0.003) |  |  |
| Year | Yes | Yes | Yes |
| Province | Yes | Yes | No |
| *N* | 215,854 | 211,096 | 76,609 |
| Pseudo/adjusted *R*2 | 0.1962 | 0.2209 | 0.6742 |
| Method | LBS | LBS | FEP |

Robust SEs are in parentheses. LBS, logit binary selection; FEP, fixed effect panel. ***Data*** years are from 2004 to 2017 due to availability. The detailed interpretations of variables and models are in , and summary ***statistics*** are listed in Supplementary Table .

\*\*\*P < 0.001.

With the increase in urbanization, over 200 million farmers have been attracted to seek part-time employment in urban areas. Compared with the high income potential from non-***agricultural*** sectors or large industrial farming sectors, smallholder livestock raising and manure recycling are less lucrative for farmers. Due to the increase in part-time jobs, which mainly attract young or middle-aged farmers, the remaining farms with a primary focus on ***agriculture*** are operated mainly by older men or women, who are more likely to reduce the labour-intensive livestock-raising and manure-recycling activities. The labour shortage, combined with the increase in mechanization and synthetic fertilizer application, leads to a substantial decline in draught-animal raising and CPLR shares (Table ).

Farmland size has an inverted U-shaped relationship with livestock raising (Table ). Both increasing and decreasing farmland size can reduce the livestock-raising potential with a turning point at around 3.7–4.8 ha. While farmland size below the turning point will lead to increased uptake of non-***agricultural*** part-time jobs by farmers or a change to livestock-only farming, farmland size above the turning point will promote the professional operation of large-scale crop production units (Table ). According to this analysis, an optimal farmland size at about four hectares may be conducive to increasing the recoupling of livestock and croplands at the household level. With the increase of current average farmland size (~0.5 ha) to such an optimal level, the increase in share of CPLR households and a simultaneous reduction in the livestock density (for example, number of pigs per hectare cropland) could successfully lower manure loading to croplands and consequently reduce ***nutrient*** losses to the environment. Ensuring that livestock-stocking densities are set not to exceed the surrounding farmland’s carrying capacity has been suggested to be crucial for the development of green ***agriculture*** by the Chinese government, labelled as ‘suitable scale farming’ and ‘cropland-based livestock farming’. Our study provides a preliminary quantification of such suitable levels at a national scale, and future research would be required to refine the results on a local scale (for example, county) for a nationwide implementation of scale farming.

In the context of mechanization, synthetic fertilizer use and urbanization, the trend towards decoupling between livestock and croplands is not easy to reverse at the household level. However, the observed response of CPLR share to changes in farmland size and the manure use in crop-only households provide two potential pathways. First, increase farmland size through policy regulation such as the Land Transfer System or reform of the land tenure system. Such a change could trigger increases in farmers’ income with both extra income from livestock production and increase in farm size. Under such a pathway, farm size could increase to around four hectares, eight times larger than current average levels. Labour productivity would probably increase not only from efficiency gains of larger parcels of land managed, but also from extra livestock raising and hence income generation opportunities for farmers. Second, foster recoupling of livestock and croplands on a regional scale. Although the crop-only households do not have their own manure production activities, they can use manure produced by neighbouring farms on their croplands. With a continued increase of farmland size after the turning point, crop-only management for farmers would provide a viable option for farmers to increase income, given the scale effect of farming and specialized production. Therefore, despite a de facto separation of crop and livestock production, rebuilding the linkage between livestock and croplands through cooperation between crop-only and livestock-only households on local and regional scales needs to be facilitated.

Although livestock production from large industrial-scale feedlots has increased dramatically, smallholder farmers still need to play an important role in animal products supply in the long term. Crop production is still dominated by smallholder farms, and their farmland size is much smaller than the optimal farmland size (four hectares). Matching livestock production and cropland is crucial for the recoupling of livestock and cropland in the coming decades. To reduce the water pollution from livestock production, Chinese governments have relocated pigs from South China to North China; however, this relocation may lead to both food insecurity and new pollution by not considering the linkage between livestock and croplands. This highlights the importance of coupling livestock and croplands to mitigation of livestock pollution. Increasing farmland size as a starting point to reduce synthetic fertilizer use, then relocating livestock on the basis of the distribution of croplands and their farm size, can close the ***nutrient*** cycle in ***agriculture*** at the local to regional level. To achieve this, multiple stakeholders need to be involved, including cropland farmers, livestock farmers, governments, enterprises and scientists. Governments play an important role due to the state-owned land tenure system and environmental control criteria require policy regulation in China. Although the central government has implemented measures such as subsidizing manure recycling to rebuild the linkage between livestock and croplands, many of these measures still focus solely on large-scale farms, not including small-scale livestock farms that account for about half of meat production in China. Furthermore, incentive mechanisms are needed to bring together cropland and livestock farmers to facilitate collaboration on either self-organized manure trading or commercial services offering such transfers. Scientists are needed to provide a systematic underpinning for the design of a suitable coupling system, including determining optimal farm size, distribution of feedlots and crop structures and so on. Scientific research can further support the government to determine appropriate environmental control criteria for cropland–livestock coupling systems.

The trend of decoupling between livestock and cropland farming with the increase of industrial livestock farms is a problem faced not only by China. It is also found in other regions around the world with economic growth and increasing urbanization. Similar decoupling processes were observed in developed regions in Europe and the United States decades ago,. These challenges have been partly overcome, and manure recycling has accounted for about half of the ***nutrient*** input to cropland in these regions. Yet, excess ***nutrient*** pollution from manure still contributes to substantial damage and costs to the environment and human health there. However, the situation in emerging economies such as China and India is more serious due to the degree and rapid nature of ***agricultural*** growth, resulting in substantial livestock-related environmental pollution pressure. Recoupling livestock and cropland is thus an urgent and complex challenge to address. In developing countries (for example, countries in Africa), decoupling between livestock and croplands is not a major challenge yet due to the costs and availability of synthetic fertilizers and the low urbanization level. If China could solve this challenge, it could provide an example for these countries of how to avoid the decoupling process during their ***agricultural*** transition. This is important for achieving Sustainable Development Goals not only in China but also in other parts of the world in the context of globalization and international trade.

Methods

In the past, rural households normally had two kinds of livestock (Fig. ). One was a draught animal, such as oxen, horses, donkeys and mules. These animals were used for ploughing and for short-distance transport. Draught animals were mainly fed with straw, which was digested, excreted and returned to croplands as manure to provide important ***nutrient*** input before synthetic fertilizers were commonly used. Other animals, such as pigs, chickens, ducks and others, are reared for meat and other animal products and are mainly grain fed. Their manure is another important organic fertilizer source. Before industrial farming took hold, smallholder households normally engaged in both crop planting and livestock raising and thus could recycle the manure within their household farm operation. With economic growth and urbanization, the linkage between livestock and croplands is broken. Industrial livestock farming is blooming and centralized on small pieces of land far from croplands. Draught animals were gradually replaced by machines and manure by synthetic fertilizers; straw feed was replaced by forages or grains. Non-recycled manure and straw have meanwhile become key contributors to environmental pollution, from eutrophication to air pollution, due to ammonia (NH3) emission from manure and pollutants (for example, fine particles) emission during straw burning in fields.

Household survey

In this paper, the household ***data*** were obtained from the Fixed Observation Rural Survey (FORS), which was established in 1984. At that time, the HCRS had just been established in China, leading to the emergence of smallholder farmers. Before the HCRS was introduced, ***collective*** farms were the major organization form for ***agricultural*** production at the village level. Thus, the FORS at the household level under the HCRS provides the longest and largest dataset of farming survey ***data***, which provides detailed information for scientific research in China.

The FORS formally started in 1986. The management office is in the Research Center for Rural Economy, which belongs to the Ministry of ***Agriculture*** and Rural Affairs, China. The system surveys cover more than 20,000 farming households and more than 300 villages in 31 provinces, including autonomous regions and municipalities, except Hong Kong, Macao and Taiwan (Extended ***Data*** Figs. and ). The sample of farmers was obtained by stratified sampling methods combining classification sampling and random sampling. Once the sample households were confirmed in 1986, they remained unchanged for a long time, and follow-up investigation has been continued. Only when the chosen rural household moves to an urban area permanently or all the household members are deceased is the sample amended; otherwise, they stay in the FORS. Thus, some households that no longer participate in ***agricultural*** activities are still included in our survey to reflect the changes of rural China. Because the FORS surveys only rural households, the independent ***agricultural*** companies such as industrial farming for crops and livestock are not included.

The survey method requires sample households to keep daily accounts (Extended ***Data*** Fig. ), and the investigators regularly visit the households to summarize and collate ***data*** at the end of the year. The surveys include detailed information about the basic demographic characteristics, income and expenditures, and production and operation of farming households. Due to issues of ***data*** continuity and availability, this paper uses the number of draught animals and all livestock species to calculate pig-equivalent numbers for comparison. The cropland area uses the cultivated land operated by farming households.

Coupling calculation

According to key parameters of crop planting and livestock raising, farmers can be divided into four categories: CPLR, only crop planting, only livestock raising, and no crop or livestock. The crop-planting-only household is defined as having an area of cultivated land greater than zero but without livestock raising. The livestock-raising-only household is defined as having a number of draught animals or livestock raised greater than zero, but the cropland area is zero. The no-crop-or-livestock household has neither livestock numbers nor farmland area. The CPLR households are those that have both cropland cultivation and livestock raising.

The coupling of livestock and croplands refers to recycling manure to croplands, and the manure loading is within the carrying capacity of cropland at the household level. For example, environmental legislation has been implemented to limit the animal-stocking density to 2.5 cow units per hectare cropland surrounding the feedlots in the Netherlands. Otherwise, farmers have to pay for manure disposal. In this paper, a ‘pig/farmland ratio’ (PFR) is established to reflect the degree of recoupling between livestock and croplands:

On the basis of The Technical Guidelines for Measuring the Bearing Capacity of Soil Contaminated by Livestock and Poultry Manure issued by the Ministry of ***Agriculture*** and Rural Affairs in 2018 (ref. ), we adopted the standard of PFR = 15 pigs per hectare farmland to measure whether the livestock raising is over the limit. One pig equivalent normally represents manure production with 5 kg nitrogen. When PFR ≤ 15, the recycling of manure to cropland is within the carrying capacity (***nutrient*** requirement by crops) and has no notable environmental pollution effects. However, when PFR > 15, the manure load exceeds the carrying capacity, leading to environmental pollution if manure is only applied on the farm. All other livestock types are converted into pig-number equivalents according to the conversion standard of 100 pigs = 15 cows = 30 beef cattle (draught cattle) = 250 sheep = 2,500 poultry.

Panel model analysis

The long-term survey allows us to estimate the relation between decoupling of livestock and croplands with machinery and synthetic fertilizer use, farmers’ income source and farm size while controlling for compounding factors such as year and location using panel model analysis. The panel model compiles ***data*** on both temporal and spatial scales (1986–2017, over 20,000 households), which can reduce the impact of time-invariant omitted variables and improve the effectiveness of estimates.

We estimated the following equation using ***data*** on households that still have cropland cultivation:where subscript it denotes households i in time t; Y is the draught animal and the decoupling of livestock and croplands for the households in models 1 and 2, respectively. It is a dummy variable; that is, 1 and 0 refer to having livestock or no livestock raising, respectively. Y is a continuous variable in model 3 referring to livestock density in CPLR households (Table ); ‘Input’ is synthetic fertilizer and degree of mechanization for crop production; ‘Income’ is the share of farmers’ income from non-***agricultural*** sectors; ‘farmsize’ is the farmland area of the household; xk’s are various control variables affecting the recoupling of livestock and croplands, including a dummy variable for region and so on; γ, ρ, θ and βk are estimated coefficients; and εi is the error term. The detailed description of the panel model is in the .

**Acknowledgements**

This study was supported by the National Key Research and Development Project of China (2016YFD0201304, 2018YFC0213300), National Natural Science Foundation of China (41822701 and 41773068), National Social Fund of China (18ZD48) and the Fundamental Research Funds for the Central Universities (2019XZZX004-11). S.R.’s contribution was supported by the UK Natural Environment Research Council (NERC) National Capability programme SUNRISE (NE/R000131/1).

**Notes**

Extended datais available for this paper at [*https://doi.org/10.1038/s41893-020-00596-0.Supplementary*](https://doi.org/10.1038/s41893-020-00596-0.Supplementary) informationis available for this paper at [*https://doi.org/10.1038/s41893-020-00596-0.Publisher’s*](https://doi.org/10.1038/s41893-020-00596-0.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***TOPIC PAGE: Construction - impact on chemicals***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60CG-4SM1-JCN4-H1Y8-00000-00&context=1516831)

Global News + ICIS Chemical Business (ICB)

July 16, 2020 Thursday

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**Length:** 5044 words

**Body**

More than 30 petrochemicals and specialty chemicals are key ingredients in products used for modern construction adhesives, ad-mixtures, sealants, coatings, paints, flooring, insulation, water proofing, and many more.

Those materials enjoy good demand when infrastructure development takes place, but the construction industry has been adversely impacted by the coronavirus pandemic, although to a lesser extent than automotive, another key end market for petrochemicals.

Public infrastructure investments can be a major contributor to reviving economies and employment during a crisis.

Petrochemicals used in construction and infrastructure are likely to post higher demand in some regions as governments try to revive their wilted economies post-pandemic.

Construction activity in Asia, where most countries are developing economies, is set to growth healthily as the region ramps up infrastructure spending.

Within Asia, China is planning a major infrastructure development campaign to bolster its slowing economy by spending billions of dollars in projects.

On this topic page we analyse the impact of the coronavirus crisis and efforts by different governments to revive economies by developing infrastructure on the chemicals markets, bringing together the latest news reported by ICIS.

Scroll down to see the latest interactive content and useful resources.

[1]Click here to register for regular updates to help you navigate these challenging times. Image credit: Shutterstock

LATEST HEADLINES

[2]China 2020 H1 real estate development investment rises 1.9% By Fanny Zhang 16-Jul-20 14:37 SINGAPORE (ICIS)--China invested yuan (CNY) 6.28tr ($897bn) on real estate development in the first half of 2020, an increase of 1.9% from the same period in last year, reversing the continuous decrease in previous months, ***data*** from the National Bureau of ***Statistics*** (NBS) showed on Thursday.

[3]US polyester polyol prices decline on weaker feedstock costs By Zachary Moore 16-Jul-20 06:37 HOUSTON (ICIS)--US polyester polyol prices were assessed 2 cents/lb ($44/tonne) lower as key feedstock costs continue to trend lower. Sentiment in major polyester polyol feedstock markets suggests that these markets may be nearing a trough as energy costs move higher and general economic activity is improving from the low points seen in prior months.

Demand from the construction sector has bounced back quicker than many other major consuming sectors of polyols and downstream polyurethane systems, although overall demand levels remain below pre-crisis levels.

[4]US plastic, chemical demand remains soft, margins stay depressed By Al Greenwood 16-Jul-20 03:30 HOUSTON (ICIS)--Demand for plastics and basic chemicals in the US was soft, while margins remained depressed, the Federal Reserve said on Wednesday.

The anecdote was among several that the US central bank ***collected*** in its recent Beige Book, a summary of US economic activity during the past six weeks among the Fed's 12 districts. The latest Beige Book contains information ***collected*** through 6 July. The comments about demand came from the 11th Federal Reserve District, which includes northern Louisiana and all of Texas, and has many of the nation's refineries and petrochemical plants.

[5]China s amines market under pressure on high stocks and weak demand By Yuanlin Koh 15-Jul-20 17:03 SINGAPORE (ICIS)--China s ethanolamines market is looking bearish in the near term on excess supply, as demand continued to struggle. China, hit by the rains, saw a drop in demand, especially in DEA s (diethanolamines) downstream DEIPA (diethanol isopropanolamine) used mainly as cement aids in the construction industry. Demand in this sector was initially picking up after the coronavirus pandemic in the country, as the economy reopened, and with government support, demand for DEA flourished.

[6]Asian epoxy resins export discussions sink deeper on poor demand By Ai Teng Lim 14-Jul-20 15:21 SINGAPORE (ICIS)--Asian epoxy resins export discussions lost more ground this week as sellers lowered offers to boost demand. Epoxy resins is heavily used in automobile and construction sectors, both of which are still struggling to find a firmer footing in the pandemic-ravaged global economy.

[7]INSIGHT: Construction could pave the way for Q3 chemicals recovery in Europe By Morgan Condon 10-Jul-20 23:25 LONDON (ICIS) As with all forms of industry, the coronavirus came in like a wrecking ball, bludgeoning any chances of growth in the construction sector for the first half of 2020. The foundations have been laid for a return to industrial activity, however, as lockdown restrictions across Europe have been eased, which could provide support for chemicals used in the construction industry.

[8]US construction is returning to pre-Covid levels - trade group By Al Greenwood 19-Jun-20 01:37 HOUSTON (ICIS)--In many parts of the US, construction activity is returning to levels that predate the coronavirus (Covid-19), a trade group said on Thursday. The Associated General Contractors of America (AGC) based its finding on its new survey and on ***data*** from Procore, a construction-technology company. Procore analysed workers' hours. Based on that analysis, construction activity has returned to pre-coronavirus levels in 34 US states. Among eight large cities, Dallas, Texas, and Miami, Florida, are back to pre-pandemic levels. Some construction companies are adding new workers, the AGC said. According to its survey, 21% are adding employees. That compares with 25% that were letting workers go between March and May. In June, only 8% of construction companies were forced to furlough or lay off workers, the AGC said.

[9]US housing starts rebound in May By Tracy Dang 18-Jun-20 06:33 HOUSTON (ICIS)--US privately owned housing starts in May rose after three consecutive months of declines, measured on a seasonally adjusted annual rate, the US Census Bureau said in a report. Year on year, new home construction was down. Building permits fell month on month, and housing completions fell. The housing market is a key consumer of chemicals, driving demand for a wide variety of chemicals, resins and derivative products such as plastic pipe, insulation, paints and coatings, adhesives, and synthetic fibres, among many others. The American Chemistry Council (ACC) estimates each new home built represents some $15,000 worth of chemicals and derivatives used in the structure or in the production of component materials.

[10]June EPS demand improving in the US, but remains below pre-crisis levels By Zachary Moore 17-Jun-20 06:27 HOUSTON (ICIS)--US demand for expandable polystyrene (EPS) is improving as economic activity picks up and lockdown measures ease. However, overall activity and EPS consumption both remain below pre-crisis levels. Activity in the construction sector has improved as lockdown measures are eased, although there is some concern that most current activity revolves around the completion of existing projects, rather than the start-up of new projects. Projections from ICIS Analytics suggest that construction activity will rise above 2019 levels in 2021, although creditworthiness concerns may limit the number of new projects.

[11]Eurozone, EU construction continues dropping in April as lockdown limits production By Morgan Condon 17-Jun-20 19:06 LONDON (ICIS)--Construction throughout the EU plummeted in April as countries implemented quarantine restrictions to combat rising coronavirus infection rates, according to first estimates from EU ***statistics*** agency ***Eurostat*** on Wednesday. This has served to weigh on demand for chemicals used in the sector. Production in the construction sector decreased by 14.6% in the eurozone and by 11.7% in the wider EU area in April compared with the previous month and accounting for seasonal adjustment.

[12]China Jan-May real estate investment contracts 0.3% year on year By Fanny Zhang 15-Jun-20 14:22 SINGAPORE (ICIS)--China s real estate development investment in the first five months of 2020 slipped 0.3% year on year to Chinese yuan (CNY) 4.59tr ($647m), official ***data*** showed on Monday. The decline has eased from 3.3% recorded in January to April. Investment in house construction in January-May stood at CNY3.38tn, unchanged from the previous corresponding period. It was an improvement from the 2.8% fall in January-April 2020. Real estate developers house construction acreage in the five-month period increased 2.3% on year to 7.6bn square metres (sqm), slower than the 2.5% growth in January-April.

[13]Europe Melamine Q3 contract talks yet to begin, demand outlook remains uncertain By Melissa Hurley 11-Jun-20 23:54 LONDON (ICIS)--European melamine contract discussions for the third quarter could begin later than usual, as consumers find it challenging to plan volume requirements given the fragile state of the economy as lockdowns ease.

In the spot market, there is increased pressure, and prices have been assessed stable to softer this week. Demand outside contractual requirements is weak, given the demand issues experienced in the market.

The [14]construction industry has been adversely impacted by the coronavirus pandemic, although to a lesser extent than automotive, another key end market for petrochemicals.

[15]Europe PU feedstocks prices hit new lows as demand pickup lags By Fergus Jensen 11-Jun-20 20:28 LONDON (ICIS)--Incremental improvements in demand for polyurethane (PU) products have slowed downward pressure on the Europe isocyanates and polyols markets where supply is abundant, and producers are now hoping for a reversal in the coming months. June contracts for polyols, toluene diisocyanate (TDI), and crude and pure methylene diphenyl diisocyanate (MDI) were all settled below May contract levels, and in some cases at hit new record lows. According to one Europe-based reseller, the construction market in NWE was now at 90% of activity, compared with this time in 2019. Demand for adhesives and wood binding has also improved, as well as that for insulation panels and spray foam, among others.

[16]US MDI, TDI demand remains sluggish even as overall economic activity picks up By Zachary Moore 11-Jun-20 06:27 HOUSTON (ICIS)--Demand for US methylene diphenyl diisocyanate (MDI) and toluene diisocyanate (TDI) remain sluggish even as the broader macro-economy is observing some pick-up in activity. Localities throughout the US are gradually easing lockdown measures, leading to some improvement in broader economic indicators. The construction sector has been performing better than most of the other major sectors of polyurethane demand, although participants feel that the success of the sector may be temporary.

Much of the activity in the sector is being driven by work to complete projects that had been underway prior to the recent crisis. There are concerns that activity might slow down once these projects are completed. US housing starts fell 29.7% year on year in April 2020, according to ***data*** from the US Census Bureau.

[17]US epoxy players monitoring demand amid economic reopening By Tarun Raizada 10-Jun-20 05:21 HOUSTON (ICIS)--US epoxy is facing some uncertainty in June amid the economic reopening. Q2 demand has softened during the pandemic, with typical seasonal trends not materialising so far. There is stronger demand from architectural do-it-yourself (DIY) and packaging coatings, which is being more than offset by softer demand from architectural do-it-for-me (DIFM), automotive and industrial coatings. The US building and construction sector could prove to be far more resilient than the automotive sector. But the pandemic is creating a volatile backdrop for chemical companies as they navigate the road to recovery. Epoxy resins are used as adhesives on metals and construction materials, as well as in coatings and automobiles.

[18]Asian MA afloat on some buying, but demand uncertainties loom By Ai Teng Lim 05-Jun-20 09:52 SINGAPORE (ICIS)--As post-coronavirus production recovery commences gingerly across Asia this week, buying tempo also picked up in Asia s maleic anhydride (MA) market to keep spot prices afloat. But with longer-term global economic outlook still clouded by many uncertainties, from geopolitical tensions to macro-level demand-supply imbalances, it remains to be seen if the buying could sustain for long.

[19]North American PS sales drop 21.8% year on year in April By Zachary Moore 05-Jun-20 05:49 HOUSTON (ICIS)--North American total sales and captive use of polystyrene (PS) fell by 21.8% in April 2020 compared with the same month of the prior year, according to ***data*** recently released by the American Chemistry Council (ACC) and Vault Consulting. The coronavirus outbreak and subsequent containment measures caused a sharp drop in overall economic activity in April, impacting production and sales of PS across most consumption segments.

[20]US manufacturing contracts again in May but overall economy expands - ISM By Tracy Dang 02-Jun-20 06:53 HOUSTON (ICIS)--US manufacturing activity contracted for the third consecutive month in May, but at a slower pace from April, the Institute of Supply Management (ISM) said on Monday. The overall economy returned to expansion after a month of contraction, the report said.

Three months into the manufacturing disruption caused by the coronavirus pandemic, comments from the panel were cautious (two cautious comments for every one optimistic comment) regarding the near-term outlook, said Tim Fiore, chair of the ISM.

[21]European plasticizers see slightly better demand in June, but still very mixed By Jane Massingham 04-Jun-20 23:24 LONDON (ICIS)--The first days of June are continuing to portray a rather mixed picture in terms of demand for plasticizers. Various countries are seeing lockdown restrictions that are allowing some businesses to return to work. One seller noted it is still challenging and said: Demand is not so great and continues to be like that, but it is building up slowly and should be better as June progresses and July should be more. The automotive sector continues to be the hardest hit but there are sectors of the construction industry starting to come back.

[22]Europe chemicals to gain from EU green deal spending plans - bank By Tom Brown 04-Jun-20 21:10 LONDON (ICIS)--European chemicals players are expecting to see increased business momentum on the back of the EU s green deal expected to unlock hundreds of billions of euros of investment in sustainability projects, according to Credit Suisse. A virtual conference organised by the bank hosted management teams from 20 chemicals, ***agriculture***, packaging and cement firms address investors, with all chemicals firms present noting expectations for an increase in sales on the back of the mooted EU green investment plan.

However, little visibility on uplift from the measures is expected over the next 12-18 months.

[23]Thailand greenlights $9bn airport project to BBS consortium By Fanny Zhang 04-Jun-20 14:48 SINGAPORE (ICIS)--Thailand s cabinet approved a bid by BBS consortium to develop a $9bn U-Tapao Airport and Eastern Aviation City project at the country s southeastern coast, according to local media reports.The winning bid was approved on 2 June and the government is expected to sign the contract with BBS consortium on 19 June, these reports added. The announcement follows the passage of $58bln economic support package on 31 May by Thailand s parliament to ease the impact of the coronavirus on the economy and people.

[24]Australia launches A$680m stimulus for residential construction By Pearl Bantillo 04-Jun-20 12:33 SINGAPORE (ICIS)--Australia has launched a stimulus package worth Australian dollar (A$) 680m ($470m) to boost activity in the construction sector, which was hit by the coronavirus pandemic. Dubbed the HomeBuilder program , the funds will help support 140,000 direct jobs in the residential construction sector, Australian Prime Minister Scott Morrison said on Thursday.

Under the programme, all eligible owner-occupiers will receive a grant of A$25,000 either to build a new home or renovate an existing home. Construction must start within three months of the contract date. Based on eligibility criteria for applicants and price caps on new home builds (A$750,000) and renovation (A$150,000-750,000), the government expects to hand out 27,000 of such grants under the programme.

[25]INTERVIEW: US construction outlook far more positive than automotive - Huntsman CEO By Joseph Chang 03-Jun-20 06:56 NEW YORK (ICIS)--The US building and construction market is recovering and proving far more resilient than the automotive sector, the CEO of Huntsman Corp said on Tuesday. In homebuilding, DIY [do it yourself] and OSB [oriented strand board] are doing quite well. It s down from a year ago but nowhere near what we expected a month or two ago, said Peter Huntsman, CEO of Huntsman Corp, in an interview with ICIS amid the American Chemistry Council (ACC) virtual annual meeting.

Building products, furniture, insulation, and OSB are showing some resilience, he added. Huntsman is a major producer of methylene diphenyl diisocyanate (MDI), heavily used in the construction market in insulation, binding and coatings, and in the automotive sector in bumpers, conveyor belts and other parts, as well as coatings. Polymeric MDI is used as a binder in OSB, an engineered wood used in construction. Pure MDI is used in coatings, adhesives, sealants and elastomers (CASE).

[26]Covestro volumes down sharply in April-May, improvement expected for June By Tom Brown 29-May-20 00:46 LONDON (ICIS)--Covestro's core volumes dropped 30% in April and May, but order book levels point to an improvement in June, according to the company and analysts at Baader Bank. April automotive sector customer demand fell 60% in the EU and North America, with furniture market demand falling 45% year on year a 30% increase in medical polycarbonates (PC) demand unable to offset the scale of the falls elsewhere.

Overall polyurethanes (PU) volumes fell 40% in April while moves to channel PC material to less affected markets mitigated the volume decline in that division to 20%. Coatings, adhesives and sealants (CAS) sales dropping at a similar level, Baader said, citing an investor call chaired by Covestro CEO and CFO, Markus Steilemann and Thomas Toepfer, respectively.

[27]INSIGHT: Asia phenol market unlikely to recover until 2021 By Angeline Soh 25-May-20 19:02 SINGAPORE (ICIS)--Asia s phenol market is unlikely to make a full recovery in the second half of this year as the coronavirus pandemic has caused end-market demand to plummet. The International Monetary Fund (IMF) has predicted the global economy will shrink by 3% this year, describing the current crisis as the worst the world has faced since the Great Depression in the 1930s.

There has been a boom in end-use products heavily used during the pandemic such as packaging, disinfectants like hand sanitisers, and face masks. However, other segments like automobile and construction have been underperforming.

[28]China downplays pollution issue; still hopes to meet emission targets By Fanny Zhang 25-May-20 16:40 SINGAPORE (ICIS)--China has not emphasized pollution issues at its parliamentary sessions this year, toning down its commitment to emissions targets, as it places top priority to getting businesses back to normal amid the coronavirus pandemic.

Employment, poverty alleviation, control on financial risk, consumption growth and business recoveries are key topics of discussions at the country s biggest political gathering in Beijing, which kicked off on 22 May. The National People s Congress (NPC) and the Chinese People s Political Consultative Conference (CPPCC) are holding their annual meeting until 28 May.

[29]US May oxo-alcohols prices continue to trend weaker By Larry Terry 22-May-20 06:23 HOUSTON (ICIS)--Weaker pricing for US May oxo-alcohols free market contract ranges continues to be more evident, but the magnitude of declines is not yet clear. Major downstream construction- and automobile-coatings demand has yet to gain any seasonal momentum, with easing coronavirus strictures still in the early stages.

[30]US PVC contracts for June nominated higher as demand creeps back amid lower operating rates By Bill Bowen 22-May-20 06:09 HOUSTON (ICIS)--US producers of polyvinyl chloride (PVC) have separately nominated June contracts higher by 3 cent/lb ($66/tonne) as lower operating rates limit supply and demand begins to creep back. The announcements come as a bit of a surprise and some market participants say that the outcome will certainly depend on how demand recovers as coronavirus lockdowns ease.

US spot export prices have fallen sharply in recent weeks as coronavirus precautions destroyed demand in key exporting markets, including China, Turkey, India, Malaysia, Peru and Argentina, among others.

[31]US existing home sales fall to lowest level in 10 years By Stefan Baumgarten 21-May-20 22:55 HOUSTON (ICIS)--US existing-home sales fell to their lowest level in April since July 2010 amid the lockdowns and restrictions authorities imposed from mid-March through April to contain the coronavirus (Covid-19) pandemic.

Existing home sales fell 17.8% from March to a seasonally-adjusted annual rate of 4.33m in April, and they were down 17.2% year on year from April 2019, the National Association of Realtors (NAR) reported on Thursday.

[32]Weak soda ash demand in Asia may continue to offset output cuts in China By Helen Lee 20-May-20 16:31 SINGAPORE (ICIS)--Asia s soda ash market remains under pressure amid rising inventory pressure in China, on the back of weak downstream demand due to extended social isolation measures. Supply remained more than sufficient despite ongoing and impending shutdowns at several soda ash plants in China.

China s domestic demand was just as downbeat on account of liquidity issues and high inventories faced by downstream glass producers on the back of poor performance in the construction/real estate sector.

[33]BASF to work with a China university on infrastructure solutions By Fanny Zhang 20-May-20 13:50 SINGAPORE (ICIS)--BASF and China s Harbin Institute of Technology (HIT) have signed a cooperation agreement to jointly conduct research on material solutions for sustainable infrastructure applications, according to a statement from BASF.

According to the agreement, research teams from BASF and the HIT will work together on the testing of new applications for BASF s advanced materials to cut emissions and energy costs to the construction industry.

[34]Long-term outlook for Asia airport construction still strong - Fitch By Fanny Zhang 15-May-20 16:25 SINGAPORE (ICIS)--Long-term prospects for Asia s airport construction funded by public investment are expected to remain largely intact despite the ongoing coronavirus pandemic that crippled the aviation market, credit ratings firm Fitch said in a report.

We remain optimistic about the eventual recovery of the aviation sector in the medium to long term, and hence, continue to be bullish on the growth of Asia s airports sector, it said.

[35]China real estate development investment down 3.3% in Jan-Apr By Fanny Zhang 15-May-20 14:50 SINGAPORE (ICIS)--China s real estate development investment totalled yuan (CNY) 3.3 trillion in January-April, a decrease of 3.3% from the same period in last year, the National Bureau of ***Statistics*** (NBS) said on Friday. Investment in housing projects stood at CNY2.4tn in January-April, down by 2.8% year on year.

In January-April, real estate developers house construction acreage increased 2.5% on year to 7.4bn square metres (sqm), down from a 2.6% expansion in January-March period.

[36]US plasticizers ranges holding steady amid weak fundamentals By Larry Terry 15-May-20 07:18 HOUSTON (ICIS)--US diisononyl phthalate (DINP), dioctyl terephthalate (DOTP) and dioctyl phthalate (DOP) prices were unchanged amid continued pressure from softer April propylene and flat-to-weaker downstream demand so far in May. Some near-term upward price pressure may stem from higher 2-ethylhexanol (2-EH) spot prices in east Asia this week. The effect was expected to be mostly nominal, but enough to exert some counter pressure.

[37]Europe May ethanolamines talks ongoing amid mixed downstream demand, balanced supply By Jane Gibson 14-May-20 00:57 LONDON (ICIS)--May ethanolamines contract talks continued in Europe this week - with sellers looking for rollovers and buyers seeking lower prices.

[38]China PO prices rise in traditional off-season By Jady Ma 14-May-20 23:05 SINGAPORE (ICIS)--Propylene oxide (PO) prices in China have gained ground on higher feedstock prices and firm fundamentals, although the industry has entered its traditional off-season. On 14 May, PO prices in east China were assessed at yuan (CNY) 9,400/tonne, up by 20.1% compared with the prices on 17 April, according to ICIS ***data***

[39]US MMDI prices slide on falling downstream demand By Zachary Moore 14-May-20 06:46 HOUSTON (ICIS)--US prices for monomeric methylene diphenyl diisocyanate (MMDI) were assessed 4 cents/lb ($88/tonne) lower, as demand remains poor during the economic slowdown created by the coronavirus outbreak and subsequent containment measures.

Construction demand has been weak, as many projects have slowed or suspended operations owing to economic uncertainty, along with public health concerns.

RESOURCES

China's government is expected to focus on large-scale infrastructure and other development projects as ways to bolster economic growth and generate employment, especially more so now because of the fall out of the coronavirus pandemic.

ICIS has compiled a list of key existing projects that different provincial authorities have announced.

More than half of these are construction and infrastructure projects, while some are manufacturing plants and research and development (R&D) initiatives.

The source for the interactive is local NDRC. The list is incomplete and will be updated regularly by ICIS. Changes will happen as the government authorities and companies revise their development plans.

Construction in China - Asia s biggest and the world s second-largest economy - slumped at an annualized double-digit rate in the first quarter of 2020 as overall economic output shrank for the first time in two decades amid the coronavirus pandemic.

In 2019, the sector accounted for 7.2% of the country s GDP.

US April new home sales rise from March

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Status: Registered

Class/es: Class 29Abalones [not live]; Abalones, not live; Abura-age [pieces of fried tofu]; Acidophilus milk; Agar-agar for culinary purposes; Air-dried sausages; Ajvar [preserved peppers]; Albumen for culinary purposes; Albumin milk; Algae prepared for human foods; Alginates for culinary purposes; Almond butter; Almond jelly; Almond milk; Almond milk for culinary purposes; Almond milk-based beverages; Almonds, ground; Almonds (Prepared -); Aloe vera prepared for human consumption; Anchovy; Anchovy fillets; Anchovy, not live; Anchovy paste; Andouillettes; Animal fats for food; Animal kidneys [offal]; Animal marrow for food; Animal oils for food; Antipasto salads; Apple butter; Apple chips; Apple flakes; Apple puree; Apple purée; Apple sauce (compote); Ark shells, not live; Ark-shells [not live]; Ark-shells, not live; Aromatized fruit; Arrangements of cut fruit; Arrangements of processed fruit; Artichoke paste; Artichokes, preserved; Artificial cream; Artificial cream (dairy product substitutes); Artificial fish roes; Artificial milk based desserts; Artificial sausage skins; Aspic; Aubergine paste; Bacon; Bacon bits; Bacon rinds; Baked beans; Banana chips; Bean curd; Bean dip; Beancurd sticks; Beans; Beans cooked in soy sauce (Kongjaban); Beans, preserved; Beef; Beef bouillon; Beef fat; Beef jerky; Beef meatballs; Beef slices; Beef steaks; Beef stew; Beef tallow [for food]; Beef tripe; Beefburgers; Berries, preserved; Beverages consisting primarily of milk; Beverages consisting principally of milk; Beverages having a milk base; Beverages made from milk; Beverages made from yoghurt; Beverages made from yogurt; Beverages made with yoghurt; Beverages made with yogurt; Birds eggs and egg products; Bisques; Black caviar; Black currants, processed; Black pudding; Black pudding [blood sausage]; Blackberry jam; Black-bone chickens, not live; Blackcurrants, processed; Blanched nuts; Blended butter; Blended cheese; Blended oil [for food]; Blended oil for food; Blended vegetable oils for culinary purposes; Blocks of boiled, smoked and then dried bonitos (katsuo-bushi); Blood sausage; Blue cheese; Blue mussels [not live]; Blue mussels, not live; Blueberry jams; Boiled and dried fish; Boiled potatoes; Bologna; Bombay mix; Bone oil, edible; Bone oil [for food]; Bone oil for food; Botifarra sausages; Bottled cooked meat; Bottled fish; Bottled fish products; Bottled fruits; Bottled sliced fruits; Bottled vegetables; Bouillon; Bouillon concentrates; Bouillon (Preparations for making -); Bratwurst; Brawn; Breaded and fried jalapeno peppers; Broad beans; Broccoli; Broth; Broth concentrates; Broth [soup]; Bulgogi; Bulgogi [Korean beef dish]; Bulgogi [Korean dish consisting of sliced and seasoned barbecued beef]; Bullfrog meat; Bullfrogs, not live; Burgers; Butter; Butter (Chocolate nut -); Butter (Cocoa -); Butter (Coconut -); Butter for use in cooking; Butter made of nuts; Butter oil; Butter (Peanut -); Butter preparations; Butter substitutes; Butter with herbs; Buttercream; Buttermilk; Cabbage rolls stuffed with meat; 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Fermented milk; Fermented soybeans; Fermented soybeans (natto); Fermented tofu; Fermented vegetable foods [kimchi]; Fermented vegetables; Fermented vegetables (kimchi); Ferments (Milk -) for culinary purposes; Filled potato skins; Fillets (Fish -); Fish; Fish balls; Fish cakes; Fish, canned; Fish crackers; Fish croquettes; Fish eggs for human consumption; Fish extracts; Fish fillets; Fish fingers; Fish floss; Fish (Food products made from -); Fish in olive oil; Fish jellies; Fish maw; Fish meal for human consumption; Fish mousses; Fish, not live; Fish paste; Fish, preserved; Fish preserves; Fish products being frozen; Fish products prepared for human consumption; Fish roe, prepared; Fish (Salted -); Fish sausages; Fish, seafood and molluscs, not live; Fish, seafood and molluscs spreads; Fish spawn (Processed -); Fish spread; Fish steak; Fish steaks; Fish sticks; Fish stock; Fish, tinned; Fish, tinned [canned (Am.)]; Fish with chips; Fish-based foodstuffs; Fishmeal for human consumption; Flakes of dried fish meat (kezuri-bushi); Flakes (Potato -); Flavored nuts; Flavoured edible oils; Flavoured milk; Flavoured milk beverages; Flavoured milk drinks; Flavoured milk powder for making drinks; Flavoured nuts; Flavoured oils; Flavoured yoghurts; Flaxseed oil for culinary purposes; Flaxseed oil for food; Flounders, not live; Foie gras; Food pastes made from meat; Food preparations predominantly of milk; Food products made from fish; Foods made from fish; Foods prepared from fish; Formed textured vegetable protein for use as a meat substitute; Frankfurters; Freeze-dried meat; Freeze-dried tofu pieces (kohri-dofu); Freeze-dried vegetables; French fries; Fresh chicken; Fresh meat; Fresh poultry; Fresh turkey; Fresh unripened cheeses; Fried chicken; Fried meat; Fried platano; Fried potatoes; Fried tofu pieces (abura-age); Frittatas; Fritters; Fromage frais; Frosted fruits; Frozen appetizers consisting primarily of chicken; Frozen appetizers consisting primarily of seafood; Frozen bamboo shoots; Frozen brackens (Gosari); Frozen celery cabbages; Frozen chicken; Frozen chips; Frozen cooked fish; Frozen eggs; Frozen fish; Frozen french fries; Frozen frog legs; Frozen fruits; Frozen meals consisting primarily of chicken; Frozen meals consisting primarily of fish; Frozen meals consisting primarily of meat; Frozen meals consisting primarily of poultry; Frozen meals consisting primarily of vegetables; Frozen meat; Frozen meat products; Frozen poultry; Frozen pre-packaged entrees consisting primarily of seafood; Frozen prepared meals consisting principally of vegetables; Frozen seafood; Frozen shellfish; Frozen spinach; Frozen sweet corn; Frozen turkey; Frozen vegetables; Fruit- and nut-based snack bars; Fruit based snack foods; Fruit chips; Fruit conserves; Fruit desserts; Fruit flavoured yoghurts; Fruit jams; Fruit jellies; Fruit jellies [not being confectionery]; Fruit juices for cooking; Fruit leathers; Fruit marmalade; Fruit paste; Fruit pectin; Fruit peel; Fruit pie fillings; Fruit Powders; Fruit, preserved; Fruit preserved in alcohol; Fruit preserves; Fruit, processed; Fruit pulp; Fruit pulps; Fruit purees; Fruit rinds; Fruit salads; Fruit snacks; Fruit spread; Fruit spreads; Fruit, stewed; Fruit-based concentrate for cooking; Fruit-based fillings for cakes and pies; Fruit-based fillings for cobblers; Fruit-based meal replacement bars; Fruit-based snack food; Fruits, canned; Fruits (Crystallized -); Fruits in preserved form; Fruits preserved in alcohol; Fruits, tinned; Fruits, tinned [canned (Am.)]; Galbi [grilled meat dish]; Game; Game, not live; Garlic butter; Garlic paste; Garlic [preserved]; Garlic-based spreads; Gelatine; Ghee; Gherkins; Ginger jam; Ginger, preserved; Glazed fruits; Goat cheese; Goat milk; Goose liver pate; Got-gam [dried persimmons]; Grapeseed oil; Grapeseed oil for food; Grated potato nuggets; Green split-peas; Grilled chicken (Yakitori); Grilled fish fillets; Grilled pork belly (samgyeopsal); Grilled vegetables; Ground almond; Ground almonds; Ground meat; Ground nuts; Groundnut oil; Guacamole; Guacamole [mashed avocado]; Guava paste; Gumbo; Gut for making sausage casings; Gut for making sausages; Haggis; Ham; Ham hocks; Hamburgers; Hard cheese; Hardened oils for food; Hardened oils [hydrogenated oil for food]; Hash brown potatoes; Hash browns; Haw slices; Hawthorn flakes; Hazelnut spread; Hazelnut spreads; Hazelnuts, prepared; Hemp milk used as a milk substitute; Hen eggs; Herrings, not live; Herrings [not live]; Honey butter; Honeyed peanuts; Hot dog sausages; Hotdog sausages; Hummus; Hummus chick pea paste; Hummus [chickpea paste]; Hydrogenated oils for food; Imitation crab meat; Infused raisins; Instant mashed potato; Instant miso soup; Instant soup; Instant stew; Isinglass for food; Jams; Jellies; Jellies [bread spreads]; Jellies for food; Jellies, jams, compotes, fruit and vegetable spreads; Jelly made from devils' tongue root (konnyaku); Jerky; Juices (Vegetable -) for cooking; Kale chips; Kanten [dried pieces of agar jelly]; Kefir; Kefir [milk beverage]; Kelp [processed]; Kephir; Kephir [milk beverage]; Kielbasa; Kimchi; Kimchi [fermented vegetable dish]; Kimchi jjigae [Korean dish consisting primarily of fermented vegetables, pork and tofu]; King boletes, dried; Kipper fillets; Kiwifruit flakes; Kkakdugi [Korean fermented radish dish]; Klipfish [salted and dried cod]; Knockwurst; Knuckle of ham; Koumiss; Koumiss [kumiss] [milk beverage]; Koumiss [milk beverage]; Krill, not live; Kumiss [milk beverage]; Kumys; Kumys [kumyss] [milk beverage]; Kumys [milk beverage]; Kumyss [milk beverage]; Lactic acid bacteria drinks; Lactic acid drinks; Lamb products; Lamb skewers; Lard; Lard [for food]; Lard for food; Laver; Laver, preserved; Laver (Toasted -); Lecithin for culinary purposes; Legume salads; Legume-based snacks; Legume-based spreads; Lemon curd; Lemon juice for culinary purposes; Lemon spread; Lentils; Lentils, preserved; Linseed oil for culinary purposes; Linseed oil for food; Linseed oils [edible]; Liquid eggs; Liver; Liver pastes; Liver pate; Liver pâté; Lobsters, not live; Lobsters (Spiny -), not live; Lotus seed paste; Low fat cheese; Low fat dairy spreads; Low fat yoghurts; Low-fat potato chips; Low-fat potato crisps; Luncheon meats; Lyophilised meat; Lyophilised vegetables; Lyophilized meat; Lyophilized vegetables; Maize oil; Maize oil for food; Maraschino cherries; Margarine; Margarine substitutes; Marinated eggs; Marmalade; Marmalades; Marrow (Animal -) for food; Marrowfat peas; Mascarpone; Mashed potato; Mashed potatoes; Matzo ball soup; Meat; Meat and meat products; Meat boiled down in soy sauce (tsukudani meat); Meat burgers; Meat, canned; Meat extract; Meat extracts; Meat floss; Meat, frozen; Meat gelatines; Meat jellies; Meat paste; Meat, preserved; Meat [preserved]; Meat preserves; Meat products being in the form of burgers; Meat spreads; Meat stocks; Meat substitutes; Meat, tinned; Meat, tinned [canned (Am.)]; Meatballs; Meat-based mousses; Meat-based snack foods; Meats; Meats (Salted -); Milk; Milk (Albumin -); Milk based beverages [milk predominating]; Milk based drinks [milk predominating]; Milk beverages; Milk beverages containing fruits; Milk beverages, milk predominating; Milk beverages with cocoa; Milk beverages with high milk content; Milk curds; Milk drinks; Milk drinks containing fruits; Milk ferments for culinary purposes; Milk of almonds for culinary purposes; Milk powder; Milk powder for food purposes; Milk powder for foodstuffs; Milk powder for nutritional purposes; Milk products; Milk shakes; Milk solids; Milk substitutes; Milk tea, milk predominating; Milk-based beverages; Milk-based beverages containing coffee; Milk-based beverages containing fruit juice; Milk-based beverages flavored with chocolate; Milk-based snacks; Milkshakes; Minced meat; Mincemeat [chopped meat]; Mincemeat made from fruits; Mincemeat [preserved fruit]; Miso soup; Mixed pickles; Mixed vegetables; Mixes for making broths; Mixes for making soup; Mixtures of fruit and nuts; Mold-ripened cheese; Mold-ripened cheeses; Molluscs, not live; Mollusks, not live; Mortadella; Mould-ripened cheese; Mousses (Fish -); Mousses (Vegetable -); Mozzarella sticks; Mullet roe salad; Mushrooms, prepared; Mushrooms, preserved; Mushrooms puree; Mussels, not live; Mutton slices; Natto [fermented soybeans]; Non-alcoholic egg nog; Non-alcoholic eggnog; Non-dairy creamer; Non-living crustaceans; Non-living molluscs; Noodle soup; Nut and seed-based snack bars; Nut oils; Nut oils for food; Nut paste spreads; Nut toppings; Nut-based food bars; Nut-based meal replacement bars; Nut-based snack foods; Nut-based spreads; Nuts being cooked; Nuts being dried; Nuts being preserved; Nuts, prepared; Oat milk; Oat-based beverages [milk substitute]; Octopuses [not live]; Octopuses, not live; Offal; Oils and fats; Oils and fats for food; Oils for food; Olive oil; Olive oil for food; Olive oil [for food]; Olive oils; Olive paste; Olive pastes; Olive puree; Olives, [prepared]; Olives, preserved; Olives stuffed with almonds; Olives stuffed with feta cheese in sunflower oil; Olives stuffed with pesto in sunflower oil; Olives stuffed with red peppers; Olives stuffed with red peppers and almonds; Omelets; Omelettes; Omlettes; Onion rings; Onions, preserved; Orange and ginger marmalade; Organic coconut oil for culinary purposes; Organic milk; Organic nut and seed-based snack bars; Ox bone based broth (seolleongtang); Oyster mushrooms, dried; Oysters, not live; Oysters [not live, for human consumption]; Packaged meats; Palm hearts, processed; Palm kernel oil for food; Palm oil for food; Palm oil [for food]; Pastes (Liver -); Pastes made from nuts; Pastrami; Pâté (Liver -); Peach flakes; Peanut butter; Peanut milk; Peanut milk for culinary purposes; Peanut milk-based beverages; Peanut oil [for food]; Peanut oil for food; Peanut paste; Peanut spread; Peanuts, prepared; Peanuts, processed; Peas, preserved; Peas, processed; Pecans, prepared; Pectin for culinary purposes; Peel (Fruit -); Peeled carrots; Peeled potatoes; Peeled tomatoes; Peeled vegetables; Pepperoni; Perches, not live; Perilla oil for culinary purposes; Pickled cucumbers; Pickled dried Spanish mackerel; Pickled eggs; Pickled fish; Pickled fruits; Pickled gherkins; Pickled ginger; Pickled hot peppers; Pickled jalapenos; Pickled kohlrabi; Pickled onions; Pickled peppers; Pickled pigs' feet; Pickled radishes; Pickled vegetables; Pickled watermelon rind; Pickles; Pie fillings of meat; Pieces of chicken for use as a filling in sandwiches; Pine pollen prepared as foodstuff; Plaices, not live; Plum jam; Pollen prepared as foodstuff; Pork; Pork cutlets; Pork loin; Pork preserves; Pork rinds; Pork steaks; Pork tripe; Potato cakes; Potato chips; Potato crisps; Potato crisps in the form of snack foods; Potato dumplings; Potato flakes; Potato fries; Potato fritters; Potato pancakes; Potato salad; Potato salads; Potato snack foods; Potato snacks; Potato sticks; Potato-based dumplings; Potato-based gnocchi; Potato-based salads; Potato-based snack foods; Poultry; Poultry extracts; Poultry meatballs; Poultry, not live; Poultry salads; Poultry substitutes; Powdered cream; Powdered egg whites; Powdered eggs; Powdered fruits; Powdered goat milk; Powdered milk; Powdered milk for food purposes; Powdered nut butters; Powdered soya milk; Prawns, not live; Pre-cooked curry stew; Pre-cooked miso soup; Pre-cooked soup; Pre-cut vegetable salads; Pre-cut vegetables; Pre-cut vegetables for salads; Pre-packaged dinners consisting primarily of game; Pre-packaged dinners consisting primarily of seafood; Preparations for making bouillon; Preparations for making broths; Preparations for making soup; Preparations for making soups; Preparations for making yoghurt; Prepared almonds; Prepared beef; Prepared coconut; Prepared dishes consisting primarily of fishcakes, vegetables, boiled eggs, and broth (oden); Prepared dishes consisting principally of meat; Prepared dried fruit mixes; Prepared entrees consisting primarily of seafood; Prepared fish dishes; Prepared fruits; Prepared insects and larvae; Prepared macadamia nuts; Prepared meals consisting primarily of chicken; Prepared meals consisting primarily of duck; Prepared meals consisting primarily of fish; Prepared meals consisting primarily of kebab; Prepared meals consisting primarily of meat; Prepared meals consisting primarily of meat substitutes; Prepared meals consisting primarily of poultry; Prepared meals consisting primarily of turkey; Prepared meals consisting primarily of vegetables; Prepared meals consisting principally of game; Prepared meals consisting principally of vegetables; Prepared meals consisting substantially of seafood; Prepared meals containing [principally] bacon; Prepared meals containing [principally] chicken; Prepared meals containing [principally] eggs; Prepared meals made from meat [meat predominating]; Prepared meals made from poultry [poultry predominating]; Prepared meat; Prepared meat dishes; Prepared nuts; Prepared onions; Prepared peppers; Prepared pine nuts; Prepared pistachio; Prepared pistachios; Prepared rootstocks; Prepared salads; Prepared snails [escargot]; Prepared torreya nuts; Prepared vegetable dishes; Prepared vegetable products; Prepared walnuts; Prepared watermelon seeds; Preserved and flattened oranges; Preserved balloon flower root (Doraji); Preserved beans; Preserved chilli peppers; Preserved chopped chilli peppers, not being seasonings or flavorings; Preserved fish; Preserved fruits; Preserved garlic; Preserved jujubes; Preserved meat; Preserved mushrooms; Preserved nuts; Preserved olives; Preserved peas; Preserved peppers; Preserved plums; Preserved potatoes; Preserved pulses; Preserved sausages; Preserved soy beans for food; Preserved soya beans; Preserved soya beans for food; Preserved soybeans for food; Preserved truffles; Preserved vegetables; Preserved vegetables (in oil); Preserves made from vegetables; Preserves of game; Preserves of poultry; Preserves, pickles; Pressed fruit paste; Pressed salted ducks; Processed algae for human consumption; Processed almonds; Processed apples; Processed apricots; Processed artichokes; Processed asparagus; Processed avocados; Processed bean sprouts; Processed beans; Processed bee pupae for human consumption; Processed bee pupae, for human consumption; Processed beetroots; Processed beets; Processed betel nuts; Processed black currants; Processed blackcurrants; Processed blueberries; Processed brussel sprouts; Processed brussels sprouts; Processed cabbage; Processed cactus for food; Processed cheese; Processed cherries; Processed chia seed for food; Processed chia seeds; Processed chickpeas; Processed coconut; Processed collard greens; Processed dates; Processed edible cordyceps; Processed edible flowers; Processed edible flowers in crystallised form; Processed edible flowers in crystallized form; Processed, edible seaweed; Processed edible seaweed; Processed edible seeds; Processed eggplant; Processed eggs; Processed fish; Processed fish products for human consumption; Processed fish roe; Processed fish spawn; Processed fruits; Processed fruits, fungi, vegetables, nuts and pulses; Processed grape leaves; Processed lamb; Processed legumes; Processed lemongrass; Processed lemons; Processed lychee fruit; Processed mangos; Processed meat; Processed meat products; Processed mustard greens; Processed nuts; Processed olive puree; Processed olives; Processed onions; Processed oranges; Processed papayas; Processed parsnips; Processed peaches; Processed peanuts; Processed peas; Processed pepperoncinis; Processed peppers; Processed pignoli; Processed pimientos; Processed plantain seeds; Processed potatoes; Processed Pulses; Processed pumpkin seeds; Processed quinces; Processed roots; Processed scallions; Processed seafood; Processed seafood products; Processed seeds; Processed shallots [used as a vegetable, not seasoning]; Processed soya beans; Processed soybeans; Processed spirulina; Processed sunflower seeds; Processed sweet corn; Processed sweet potatoes; Processed tiger nuts; Processed tomatoes; Processed vegetables; Processed walnuts; Processed watermelon seeds; Processed yams; Prosciutto; Prostokvasha; Prostokvasha [soured milk]; Protein milk; Prunes; Pudding (Black -) [blood sausage]; Puffed pork rind; Pulled beef; Pulled chicken; Pulled pork; Pulp (Fruit -); Pumpkin seed oil for food; Purple sweet potato chips; Quail eggs; Quark; Quenelles; Quenelles [fish]; Quenelles [meat]; Quick-frozen vegetable dishes; Radish cubed kimchi (kkakdugi); Ragouts; Raisins; Rape oil [for food]; Rape oil for food; Rapeseed oil for food; Raspberry jam; Ratatouille; Ready cooked meals consisting primarily of chicken; Ready cooked meals consisting primarily of meat; Ready cooked meals consisting primarily of poultry; Ready cooked meals consisting primarily of turkey; Ready cooked meals consisting wholly or substantially wholly of game; Ready cooked meals consisting wholly or substantially wholly of meat; Ready cooked meals consisting wholly or substantially wholly of poultry; Ready grated cheese; Refried beans; Relishes [pickles]; Rennet; Rhubarb in syrup; Rhubarb jam; Rice bran oil [for food]; Rice bran oil for food; Rice milk; Rice milk for culinary purposes; Rice milk for use as a milk substitute; Rice milk [milk substitute]; Ripened cheese; Ripened cheeses; Roast beef; Roast beef flavoured extract; Roast chestnuts; Roast chicken; Roast ducks; Roast goose; Roast lamb; Roast meat; Roast nuts; Roast pork; Roast poultry; Roast turkey; Roasted nuts; Roasted peanuts; Rosti [fried grated potato cakes]; Ryazhenka; Ryazhenka [fermented baked milk]; Salad oil; Salads (Fruit -); Salads (Vegetable -); Salami; Salmon caviar; Salmon croquettes; Salmon [not live]; Salmon, not live; Salted and fermented seafood (jeotgal); Salted cashews; Salted eggs; Salted fish; Salted jellyfish; Salted meat; Salted meats; Salted nuts; Salted vegetables; Salt-fermented sea urchin roe; Samgyetang [Korean ginseng chicken soup]; Sardines [not live]; Sardines, not live; Sashimi; Satay; Sauerkraut; Sausage casings; Sausage casings, natural or artificial; Sausage meat; Sausage skins and imitations thereof; Sausage skins [synthetic]; Sausages; Sausages in batter; Saveloys; Savory butters; Scotch eggs; Sea basses [not live]; Sea basses, not live; Sea bream, not live; Sea breams [red snappers, not live]; Sea breams [red snappers], not live; Sea cucumbers, not live; Sea salmon roe for food; Sea trout roe for food; Sea urchins [not live]; Sea urchins, not live; Sea-cucumbers, not live; Seafood; Seafood extracts; Seafood jellies; Seafood [not live]; Seafood, not live; Seafood paste; Seafood preserves; Seafood products; Seafood spread; Seafoods boiled down in soy sauce (tsukudani); Seasoned laver (Jaban-gim); Seasoned nuts; Seaweed extracts for food; Seed butters; Seeds, prepared; Seeds (Processed -); Seeds (Processed sunflower -); Seitan [meat substitute]; Seolleongtang [Korean ox bone broth]; Sesame oil; Sesame oil [for food]; Sesame oil for food; Shashliks; Sheep cheese; Sheep milk; Sheets of dried laver (hoshi-nori); Shelled nuts; Shelled prawns; Shellfish, not live; Shepherd's pie; Shish kabobs; Shortening; Short-necked clams [not live]; Short-necked clams, not live; Shredded coconut; Shrimp floss; Shrimp paste; Shrimps, not live; Silkworm chrysalis, for human consumption; Silkworm chrysalis for human consumption; Silver carps, not live; Skimmed milk; Skyr; Sliced and seasoned barbequed beef (bulgogi); Sliced fruit; Sliced meat; Sliced sea whelks; Smetana; Smetana [sour cream]; Smoked cheese; Smoked fish; Smoked fish spread; Smoked meats; Smoked salmon; Smoked sausages; Snack food (Fruit-based -); Snack foods based on legumes; Snack foods based on nuts; Snack foods based on vegetables; Snack mixes consisting of dehydrated fruit and processed nuts; Snack mixes consisting of processed fruits and processed nuts; Snacks of edible seaweed; Snail eggs for consumption; Snails prepared for human consumption; Snakehead fish, not live; Snow crabs, not live; Soft cheese; Soft white cheese; Soft-ripened cheeses; Soft-shelled turtles [not live]; Sole fish, not live; Soup; Soup concentrates; Soup cubes; Soup mixes; Soup pastes; Soup powders; Soup (Preparations for making -); Soup preparations (Vegetable -); Soups; Soups and stocks, meat extracts; Sour cream; Sour cream substitutes; Sour milk; Soured milk; Soy bean oil [for food]; Soy burger patties; Soy chips; Soy milk beverages; Soy milk-based beverages; Soy sauce marinated crab (Ganjang-gejang); Soya bean curd; Soya bean milk; Soya bean oil for food; Soya beans, preserved, for food; Soya chips; Soya milk; Soya milk [milk substitute]; Soya patties; Soya [prepared]; Soya yoghurt; Soya-based beverages used as milk substitutes; Soy-based food bars; Soy-based snack foods; Soybean milk [soy milk]; Soybean oil; Soybean oil for cooking; Soybean oil for culinary purposes; Spanish mackerel, not live; Spiced nuts; Spiced oils; Spicy beef broth (yukgaejang); Spicy pickles; Spinach [prepared]; Spiny lobsters; Spiny lobsters, not live; Split peas; Spreads consisting mainly of eggs; Spreads consisting mainly of fruits; Spreads consisting of hazelnut paste; Squashes [plants, preserved]; Squid ink; Squid, not live; Squid [prepared]; Steaks of fish; Steaks of meat; Steamed cakes of smashed fish and yam (hampen); Steamed egg hotchpotch; Steamed or toasted cakes of fish paste (kamaboko); Stewed apples; Stewed fruit; Stews; Stir-fried chestnuts with sugar; Stock; Stock cubes; Stock in the form of granules; Stock [prepared]; Strained cheese; Strained soft white cheese; Strained soft white cheeses; Strawberries being preserved; Strawberry jam; Stuffed cabbage rolls; Stuffed olives; Stuffed potatoes; Sturgeon eggs; Suet for food; Sultanas; Sunflower oil for food; Sunflower oil [for food]; Sunflower seeds, prepared; Surimi; Sweet corn, processed; Sweet corn-based snack foods; Sweetcorn [preserved]; Sweetfish [not live]; Sweetfish, not live; Swordfish, not live; Tagine [prepared meat, fish or vegetable dish]; Tahini; Tahini [sesame seed paste]; Tajine [prepared meat, fish or vegetable dish]; Tangerines [preserved]; Tapenades; Tea flavored eggs; Tempeh; Teriyaki chicken; Tinned fish; Tinned fruits; Tinned meat; Tinned meats; Tinned olives; Tinned seafood; Tinned tomatoes; Tinned vegetables; Toasted laver; Toasted sheets of laver (yaki-nori); Tofu; Tofu burger patties; Tofu patties; Tofu skin; Tofu skin (Yuba); Tofu-based snacks; Tomato concentrates [puree]; Tomato extracts; Tomato juice for cooking; Tomato paste; Tomato preserves; Tomato purée; Tomatoes [preserved]; Tripe; Trouts, not live; Truffle cheeses; Truffle juice; Truffle paste; Truffle-based oils; Truffle-based spread products (truffle creams); Truffles, preserved; Tube-shaped toasted cakes of fish paste (chikuwa); Tuna fish; Tuna fish [not live]; Tuna fish, not live; Tuna fish [preserved]; Tuna in oil; Tuna, not live; Turkey; Turkey burger patties; Turkey burgers; Turkey meat; Turkey pieces; Turkey products; Tzatziki; Uncongealed tofu (Tofu nao); Uncooked hamburger patties; Uncooked sausages; Veal; Veal stock; Vegetable burgers; Vegetable chips; Vegetable crisps; Vegetable extracts for cooking; Vegetable extracts for culinary purposes; Vegetable extracts for food; Vegetable fats for cooking; Vegetable fats for food; Vegetable jellies; Vegetable juice concentrates for food; Vegetable juices for cooking; Vegetable marrow paste; Vegetable mousses; Vegetable oils for food; Vegetable pastes; Vegetable pate; Vegetable powders; Vegetable preserves; Vegetable puree; Vegetable purees; Vegetable salads; Vegetable soup preparations; Vegetable spreads; Vegetable stock; Vegetable-based chips; Vegetable-based concentrate for cooking; Vegetable-based cream; Vegetable-based entrees; Vegetable-based meat substitutes; Vegetable-based snack foods; Vegetable-based spreads; Vegetables, canned; Vegetables, cooked; Vegetables, dried; Vegetables in vinegar; Vegetables pickled in soy sauce; Vegetables (Prepared -); Vegetables, preserved; Vegetables preserved in oil; Vegetables, processed; Vegetables, tinned; Vegetables, tinned [canned (Am.)]; Vegetarian charcuterie; Vegetarian sausages; Veggie burger patties; Venison; Waffle fries; Walnut kernels; Walnuts, prepared; Weed extracts for food; Whale fat for food; Whale oil for food; Whales [not live]; Whales, not live; Whey; Whipped cream; Whipping cream; White cheese; White of eggs; White pudding; Whiteners [dairy] for beverages; Yakitori; Yellow croakers, not live; Yellow morels, dried; Yellow split peas; Yoghurt; Yoghurt based drinks; Yoghurt beverages; Yoghurt desserts; Yoghurt drinks; Yoghurt made from goats milk; Yoghurt-based beverages; Yoghurts; Yogurt; Yogurt drinks; Yogurt-based beverages; Yolk of eggs; Yuba [tofu skin]; Yuca chips; Yucca chips.Class 30 Acanthopanax tea (Ogapicha); Achar pachranga (fruit pickle); Acid drops [confectionery]; Adlay flour for food; Aerated beverages [with coffee, cocoa or chocolate base]; Aerated chocolate; Aerated drinks [with coffee, cocoa or chocolate base]; Agave syrup for use as a natural sweetener; Agave syrup [natural sweetener]; Aioli; Alfredo sauce; Alimentary pasta; Alimentary paste [dough]; Alimentary seasonings; Allspice; Almond cake; Almond confectionery; Almond cookies; Almond flavorings, other than essential oils; Almond flour; Almond paste; Almond pastries; Almonds covered in chocolate; Angelica; Aniseed; Aniseeds for use as a seasoning; Aperitif biscuits; Apple cider vinegar; Apple flavoured tea [other than for medicinal use]; Apple fritters; Apple pies; Apple sauce [condiment]; Apple tarts; Aromatic preparations for cakes; Aromatic preparations for candies; Aromatic preparations for food; Aromatic preparations for ice-creams; Aromatic preparations for making non-medicated infusions; Aromatic preparations for making non-medicated tisanes; Aromatic preparations for pastries; Aromatic teas [other than for medicinal use]; Artichoke sauce; Artificial coffee; Artificial rice [uncooked]; Artificial tea; Artificial tea [other than for medicinal use]; Asian apricot tea (maesilcha); Asian noodles; Bacon buns; Bagels; Baguettes; Bakery goods; Baking powder; Baking powders; Baking soda; Baking soda [bicarbonate of soda for baking purposes]; Baking soda [bicarbonate of soda for cooking purposes]; Baking spices; Baking-powder; Baklava; Balsamic vinegar; Banana fritters; Baozi; Baozi [stuffed buns]; Baps; Barbecue sauce; Barley (Crushed -); Barley flakes; Barley flour [for food]; Barley flour for food; Barley for use as a coffee substitute; Barley (Husked -); Barley meal; Barley prepared for human consumption; Barley tea; Barley-leaf tea; Barm cakes; Bars based on wheat; Bars of sweet jellied bean paste (Yohkan); Bases for making milk shakes [flavourings]; Basil, dried; Batter for making crepes; Batter for making pancakes; Batter mixes; Batter mixes for okonomiyaki [Japanese savory pancakes]; Batter mixes for okonomiyaki [Japanese savoury pancakes]; Bavarian creams; Bean jam buns; Bean meal; Bean paste; Bean-jam filled wafers (monaka); Bean-starch noodles (harusame, uncooked); Bee glue; Beer vinegar; Beverages based on chocolate; Beverages based on coffee; Beverages based on coffee substitutes; Beverages based on tea; Beverages (Chocolate-based -); Beverages (Cocoa-based -); Beverages (Coffee-based -); Beverages consisting principally of chocolate; Beverages consisting principally of cocoa; Beverages consisting principally of coffee; Beverages containing chocolate; Beverages (Flavorings [flavourings], other than essential oils, for -); Beverages (flavorings [flavourings], other then essential oils, for -); Beverages made from chocolate; Beverages made from cocoa; Beverages made from coffee; Beverages made of coffee; Beverages made of tea; Beverages made with chocolate; Beverages (Tea-based -); Beverages with a chocolate base; Beverages with a cocoa base; Beverages with a coffee base; Beverages with a tea base; Beverages with coffee base; Beverages with tea base; Bibimbap [Korean dish consisting primarily of cooked rice with added vegetables and beef]; Bibimbap [rice mixed with vegetables and beef]; Bicarbonate of soda for cooking purposes; Bicarbonate of soda for cooking purposes [baking soda]; Binding agents for edible ices; Binding agents for ice cream; Binding agents for ice cream [edible ices]; Binding preparations for ice cream [edible ices]; Biological honey for human consumption; Biscotti; Biscotti dough; Biscuit mixes; Biscuit rusk; Biscuits; Biscuits containing chocolate flavoured ingredients; Biscuits containing fruit; Biscuits flavoured with fruit; Biscuits for cheese; Biscuits for human consumption made from cereals; Biscuits for human consumption made from malt; Biscuits having a chocolate coating; Biscuits having a chocolate flavoured coating; Biscuits [sweet or savoury]; Biscuits with an iced topping; Black tea; Black tea [English tea]; Black treacle; Blends of seasonings; Blueberry pies; Boiled confectionery; Boiled sugar; Boiled sugar confectionery; Boiled sugar sweetmeats; Boiled sweets; Bonbons; Bonbons made of sugar; Boxed lunches consisting of rice, with added meat, fish or vegetables; Bran preparations for human consumption; Bread; Bread and buns; Bread biscuits; Bread buns; Bread casings filled with fruit; Bread concentrates; Bread crumbs; Bread doughs; Bread flavored with spices; Bread flavoured with spices; Bread (Ginger -); Bread improvers being cereal based preparations; Bread made with soya beans; Bread mixes; Bread pudding; Bread rolls; Bread sticks; Bread with soy bean; Bread with sweet red bean; Bread-based stuffing mixes; Breadcrumbs; Breads; Breadsticks; Breakfast cake; Breakfast cereals; Breakfast cereals containing a mixture of fruit and fibre; Breakfast cereals containing fibre; Breakfast cereals containing fruit; Breakfast cereals containing honey; Breakfast cereals flavoured with honey; Breakfast cereals made of rice; Breakfast cereals, porridge and grits; Breath mints for use as a breath freshener; Breath-freshening chewing gum; Brine for cooking; Brine for pickling; Brine for use in cocktails; Brioches; Brittle; Brown rice; Brown sauce; Brown sugar; Brownie dough; Brownie mixes; Brownies; Bubble gum; Bubble gum [confectionery]; Buckwheat flour; Buckwheat flour [for food]; Buckwheat flour for food; Buckwheat jelly (Memilmuk); Buckwheat noodles; Buckwheat pasta; Buckwheat, processed; Buckwheat tea; Bulgur; Bun mix; Buns; Burdock root tea (Wooungcha); Burgers contained in bread rolls; Burritos; Butter biscuits; Butterscotch chips; Cacao powder; Cachou [confectionery], other than for pharmaceutical purposes; Caffeine-free coffee; Cake bars; Cake batter; Cake decorations made of candy; Cake dough; Cake doughs; Cake flour; Cake frosting; Cake frosting [icing]; Cake icing; Cake mixes; Cake mixtures; Cake Pops; Cake powder; Cake preparations; Cakes; Cakes (Flavorings [flavourings], other than essential oils, for -); Cakes of sugar-bounded millet or popped rice (okoshi); Cakes (Rice -); Calzones; Canapes; Candied cakes of popped rice; Candies; Candies (Non-medicated -); Candies (Non-medicated -) with alcohol; Candies (Non-medicated -) with honey; Candies (Non-medicated -) with mint; Candies [sweets]; Candy; Candy bars; Candy cake; Candy cake decorations; Candy canes; Candy coated apples; Candy coated confections; Candy coated popcorn; Candy decorations for cakes; Candy mints; Candy (Non-medicated -); Candy, other than for medical purposes; Candy [sugar]; Candy with caramel; Candy with cocoa; Candy-coated apples; Candy-coated popcorn; Canned pasta foods; Canned sauces; Canned spaghetti in tomato sauce; Cannelloni; Capers; Cappuccino; Caramel; Caramel coated popcorn; Caramel coated popcorn with candied nuts; Caramel popcorn; Caramel-coated popcorn; Caramelised sugar; Caramels; Caramels [candies]; Caramels [candy]; Caramels [sweets]; Caraway seeds for use as a seasoning; Carbohydrate preparations for food; Carbonated and non-carbonated tea based beverages; Castor sugar; Catchup; Catsup; Celery salt; Cereal bars; Cereal bars and energy bars; Cereal based energy bars; Cereal based food bars; Cereal based foodstuffs for human consumption; Cereal based prepared snack foods; Cereal based snack foods; Cereal based snacks; Cereal breakfast foods; Cereal cakes for human consumption; Cereal flour; Cereal powders; Cereal preparations; Cereal preparations coated with sugar and honey; Cereal preparations consisting of bran; Cereal preparations consisting of oatbran; Cereal preparations containing oatbran; Cereal products in bar form; Cereal seeds, processed; Cereal snack foods flavoured with cheese; Cereal snacks; Cereal-based bars; Cereal-based meal replacement bars; Cereal-based savoury snacks; Cereal-based snack bars; Cereal-based snack food; Cereals; Cereals for food for consumption by humans; Cereals for use in making pasta; Cereals prepared for consumption by humans; Cereals, processed; Chai tea; Chalupas; Chamomile tea; Chamomile-based beverages; Cheese balls [snacks]; Cheese curls [snacks]; Cheese flavored puffed corn snacks; Cheese puffs; Cheese sauce; Cheeseburgers [sandwiches]; Cheesecake; Cheesecakes; Cheese-flavored biscuits; Chemical seasonings [cooking]; Chewing candy; Chewing gum; Chewing gum for breath freshening; Chewing gum, not for medical purposes; Chewing gums; Chewing sweets (Non-medicated -); Chewing sweets (Non-medicated -) having liquid fruit fillings; Chicken gravy; Chicken pies; Chicken sandwiches; Chicken wraps; Chickpea flour; Chickpea pasta; Chicory and chicory mixtures, all for use as substitutes for coffee; Chicory based coffee substitute; Chicory [coffee substitute]; Chicory extracts for use as substitutes for coffee; Chicory for use as substitutes for coffee; Chicory mixtures, all for use as substitutes for coffee; Chicory mixtures for use as substitutes for coffee; Chili oil for use as a seasoning or condiment; Chili oils being condiments; Chili paste for use as a seasoning; Chili pepper paste being condiment; Chili pepper pastes being condiments; Chili powder; Chili powders; Chili sauce; Chili seasoning; Chili seasonings; Chilled pizzas; Chimichanga; Chimichangas; Chimney cakes; Chinese batter flour; Chinese matrimony vine tea (Gugijacha); Chinese noodles; Chinese noodles [uncooked]; Chinese rice noodles (bifun, uncooked); Chinese steamed dumplings (shumai, cooked); Chinese stuffed dumplings; Chinese stuffed dumplings (gyoza, cooked); Chips [cereal products]; Chocolate; Chocolate bark containing ground coffee beans; Chocolate bars; Chocolate based drinks; Chocolate based fillings; Chocolate based products; Chocolate beverages; Chocolate beverages containing milk; Chocolate beverages with milk; Chocolate biscuits; Chocolate brownies; Chocolate bunnies; Chocolate cake; Chocolate cakes; Chocolate candies; Chocolate candy with fillings; Chocolate caramel wafers; Chocolate chips; Chocolate coated biscuits; Chocolate coated fruits; Chocolate coated macadamia nuts; Chocolate coated marshmallow biscuits containing toffee; Chocolate coated nougat bars; Chocolate coated nuts; Chocolate coating; Chocolate coffee; Chocolate confectionary; Chocolate confectionery; Chocolate confectionery containing pralines; Chocolate confectionery having a praline flavour; Chocolate confectionery products; Chocolate confections; Chocolate covered biscuits; Chocolate covered cakes; Chocolate covered pretzels; Chocolate covered wafer biscuits; Chocolate creams; Chocolate decorations for cakes; Chocolate decorations for christmas trees; Chocolate decorations for confectionery items; Chocolate desserts; Chocolate drink preparations; Chocolate drink preparations flavoured with banana; Chocolate drink preparations flavoured with mint; Chocolate drink preparations flavoured with mocha; Chocolate drink preparations flavoured with nuts; Chocolate drink preparations flavoured with orange; Chocolate drink preparations flavoured with toffee; Chocolate eggs; Chocolate essences for the preparation of beverages; Chocolate extracts; Chocolate extracts for the preparation of beverages; Chocolate fillings for bakery products; Chocolate flavoured beverage making preparations; Chocolate flavoured beverages; Chocolate flavoured coatings; Chocolate flavoured confectionery; Chocolate flavourings; Chocolate fondue; Chocolate food beverages not being dairy-based or vegetable based; Chocolate for confectionery and bread; Chocolate for toppings; Chocolate fudge; Chocolate marzipan; Chocolate mousses; Chocolate pastes; Chocolate pastries; Chocolate powder; Chocolate sauce; Chocolate sauces; Chocolate shells; Chocolate spread; Chocolate spreads; Chocolate spreads containing nuts; Chocolate spreads for use on bread; Chocolate sweets; Chocolate syrup; Chocolate syrups; Chocolate syrups for the preparation of chocolate based beverages; Chocolate topped pretzels; Chocolate topping; Chocolate truffles; Chocolate vermicelli; Chocolate wafers; Chocolate waffles; Chocolate with alcohol; Chocolate with Japanese horseradish; Chocolate-based bars; Chocolate-based beverages; Chocolate-based beverages with milk; Chocolate-based fillings for cakes and pies; Chocolate-based meal replacement bars; Chocolate-based ready-to-eat food bars; Chocolate-based spreads; Chocolate-coated bars; Chocolate-coated nuts; Chocolate-coated rice cakes; Chocolate-coated sugar confectionery; Chocolate-covered nuts; Chocolates; Chocolates in the form of pralines; Chocolates in the form of sea horses; Chocolates in the form of sea shells; Chocolates presented in an advent calendar; Chocolates with mint flavoured centres; Chocolatines; Chow chow [relishes]; Chow mein; Chow mein [noodle-based dishes]; Chow mein noodles; Chow-chow [condiment]; Christmas puddings; Christmas tree decorations [edible]; Christmas trees (Confectionery for decorating -); Chrysanthemum tea (Gukhwacha); Churros; Chutney; Chutneys; Chutneys [condiment]; Chutneys [condiments]; Cilantro, dried; Cinnamon; Cinnamon powder [spice]; Cinnamon rolls; Cinnamon [spice]; Cinnamon sticks; Citron tea; Clear gums [confectionery]; Clove powder [spice]; Cloves; Cloves [spice]; Coated nuts [confectionery]; Cocoa; Cocoa based creams in the form of spreads; Cocoa beverages; Cocoa beverages with milk; Cocoa drinks; Cocoa extracts for human consumption; Cocoa for use in making beverages; Cocoa mixes; Cocoa powder; Cocoa preparations; Cocoa preparations for use in making beverages; Cocoa products; Cocoa [roasted, powdered, granulated, or in drinks]; Cocoa-based beverages; Cocoa-based ingredients for confectionery products; Coconut macaroons; Coconut meal for human consumption; Coffee; Coffee (Artificial -); Coffee bags; Coffee based beverages; Coffee based drinks; Coffee based fillings; Coffee beans; Coffee beverages; Coffee beverages with milk; Coffee capsules; Coffee capsules, filled; Coffee concentrates; Coffee drinks; Coffee essence; Coffee essences; Coffee essences for use as substitutes for coffee; Coffee extracts; Coffee extracts for use as substitutes for coffee; Coffee flavorings; Coffee flavorings [flavourings]; Coffee flavourings; Coffee in brewed form; Coffee in ground form; Coffee in whole-bean form; Coffee mixtures; Coffee oils; Coffee pods; Coffee [roasted, powdered, granulated, or in drinks]; Coffee substitutes; Coffee substitutes [artificial coffee or vegetable preparations for use as coffee]; Coffee substitutes [grain or chicory based]; Coffee substitutes (Vegetal preparations for use as -); Coffee, teas and cocoa and substitutes therefor; Coffee (Unroasted -); Coffee-based beverage containing milk; Coffee-based beverages; Coffee-based beverages containing ice cream (affogato); Coixseed flour; Common salt for cooking; Concentrated sauce; Condiments; Condiments in powder form; Cones for ice cream; Cones for icecream; Confectioners' glaze; Confectionery; Confectionery bars; Confectionery chips for baking; Confectionery chocolate products; Confectionery containing jam; Confectionery containing jelly; Confectionery for decorating Christmas trees; Confectionery having liquid fruit fillings; Confectionery having liquid spirit fillings; Confectionery having wine fillings; Confectionery ices; Confectionery in frozen form; Confectionery in liquid form; Confectionery in the form of tablets; Confectionery items coated with chocolate; Confectionery items formed from chocolate; Confectionery items (Non-medicated -); Confectionery made of sugar; Confectionery (Non-medicated -); Confectionery products (Non-medicated -); Cooked rice; Cooked rice mixed with vegetables and beef (bibimbap); Cookie dough; Cookie mixes; Cookies; Cooking essences; Cooking salt; Cooking sauces; Cooling ice; Coriander, dried; Corn candy; Corn chips; Corn curls; Corn flakes; Corn flour; Corn flour [for food]; Corn kernels being roasted; Corn kernels being toasted; Corn meal; Corn, milled; Corn (Pop -); Corn (Processed -); Corn, roasted; Corn starch derivatives in powder form for making into drinks; Corn starch flour; Corn starch [for food]; Corn syrup; Corn syrup for culinary purposes; Corn-based savoury snacks; Corn-based snack foods; Cornflakes; Cornflour; Cornflour bun bread (almojábana); Cornmeal; Cornstarch for culinary purposes; Cotton candy; Coulis (Fruit -) [sauces]; Couscous; Couscous [semolina]; Covered tarts; Crab boil [seasoning]; Cracked wheat; Crackers; Crackers [edible]; Crackers filled with cheese; Crackers flavoured with cheese; Crackers flavoured with fruit; Crackers flavoured with herbs; Crackers flavoured with meat; Crackers flavoured with spices; Crackers flavoured with vegetables; Crackers made of prepared cereals; Cranberry sauce [condiment]; Cream buns; Cream cakes; Cream crackers; Cream (Ice -); Cream of tartar for cooking purposes; Cream of tartar for culinary purposes; Cream pies; Cream puffs; Creamed rice; Crème brûlée; Crème brûlées; Creme brulees; Crème caramel; Creme caramels; Crepes; Crescent rolls; Crisp breads; Crisp rolls; Crispbread; Crispbread snacks; Crisps made of cereals; Croissants; Croutons; Croûtons; Crumb; Crumble; Crumpets; Crushed barley; Crushed oats; Crusty rolls; Crystal sugar [not confectionery]; Crystal sugar pieces [confectionery]; Crystallized rock sugar; Cube sugar; Culinary herbs; Cumin powder; Cupcakes; Currant bread; Curried food pastes; Curry mixes; Curry paste; Curry pastes; Curry powder; Curry powder [spice]; Curry powders; Curry sauces; Curry [seasoning]; Curry [spice]; Curry spice mixes; Curry spices; Custard; Custard mixes; Custard powder; Custard tarts; Custard-based fillings for cakes and pies; Custards; Custards [baked desserts]; Dairy chocolate; Dairy confectionery; Dairy ice cream; Dairy-free chocolate; Danish bread; Danish bread rolls; Danish butter cookies; Danish pastries; Darjeeling tea; Dashi-tsuyu; Decaffeinated coffee; Decorations [edible] for christmas trees; Deep chocolate cake made with chocolate sponge; Deep frozen pasta; Deep-fried dough sticks (Youtiao); Dental health gum [other than medicated]; Deproteinised flour for use in the production of beer; Dessert mousses [confectionery]; Dessert puddings; Dessert souffles; Dough; Dough flour; Dough for cakes; Dough mix; Doughnut mixes; Doughnuts; Doughs, batters, and mixes therefor; Dragees [non-medicated confectionery]; Dressings for salad; Dried and fresh pastas, noodles and dumplings; Dried basil; Dried chili peppers seasoning; Dried chives; Dried cilantro; Dried cooked-rice; Dried coriander; Dried coriander for use as seasoning; Dried coriander seeds for use as seasoning; Dried cumin seeds; Dried fig-based condiment; Dried herbs; Dried herbs for culinary purposes; Dried mint; Dried noodles; Dried pasta; Dried pasta foods; Dried pieces of wheat gluten (fu, uncooked); Dried sauce in powder form; Dried seaweed rolls [gimbap]; Dried sugared cakes of rice flour (rakugan); Dried tortellini; Dried wheat gluten; Drinking chocolate; Drinking cocoa paste; Drinks based on chocolate; Drinks based on cocoa; Drinks containing chocolate; Drinks containing cocoa; Drinks flavoured with chocolate; Drinks in powder form containing cocoa; Drinks prepared from chocolate; Drinks prepared from cocoa; Drip bag coffee; Dry and liquid ready-to-serve meals, mainly consisting of pasta; Dry and liquid ready-to-serve meals, mainly consisting of rice; Dry condiments; Dry seasoning mixes for stews; Dry seasonings; Dulce de leche; Dumpling skins; Dumplings; Dutch gingerbread (taai taai); Dutch rusk; Earl Grey; Earl Grey tea; Earl grey tea; Easter eggs; Eclairs; Edible essences for foodstuffs [other than etheric substances and essential oils]; Edible flour; Edible fruit ices; Edible ice; Edible ice powder for use in icing machines; Edible ice sculptures; Edible ices; Edible paper; Edible paper wafers; Edible rice paper; Edible salt; Edible spices; Edible turmeric; Edible wafers; Egg noodles; Egg pies; Egg roll cookies; Egg rolls; Egg tarts; Eight-treasure rice pudding; Empanada dough; Empanadas; Enchiladas; English muffins; Enriched farina [meal]; Enriched rice; Enriched rice [uncooked]; Espresso; Essences for cooking [other than essential oils]; Essences for food [other than essential oils]; Essences for foodstuffs, except etheric essences and essential oils; Essences for use in cooking [other than essential oils]; Essences for use in food preparation [other than essential oils]; Extracts of cocoa for use as flavours in beverages; Extracts of cocoa for use as flavours in foodstuffs; Extracts of coffee for use as flavours in beverages; Extracts of coffee for use as flavours in foodstuffs; Extracts used as flavoring [not essential oils]; Extruded corn snacks; Extruded food products made of maize; Extruded food products made of rice; Extruded food products made of wheat; Extruded snacks containing maize; Extruded wheat snacks; Fajitas; Farina; Farina [meal]; Farinaceous food pastes; Farinaceous food pastes for human consumption; Farinaceous foods; Fermented hot pepper paste (gochujang); Fermented tea; Fermenting malted rice (Koji); Ferments for pastes; Fern root starch for food; Filled baguettes; Filled bread rolls; Filled buns; Filled caramels; Filled chocolate; Filled chocolate bars; Filled chocolates; Filled pasta; Filled rolls; Filled sandwiches; Filled sweetmeats; Filled yeast dough with fillings consisting of fruits; Filled yeast dough with fillings consisting of meat; Filled yeast dough with fillings consisting of vegetables; Filo dough; Filo doughs; Filo pastry; Filters in the form of paper bags filled with coffee; Fish dumplings; Fish sandwiches; Fish sauce; Flaked corn; Flaked wheat; Flakes (Corn -); Flakes (Maize -); Flakes (Oat -); Flaky pastry containing ham; Flan base wafers; Flans; Flapjacks; Flapjacks [griddle cakes]; Flat bread; Flavored ices; Flavored vinegar; Flavoring syrup; Flavorings and seasonings; Flavorings [flavourings], other than essential oils, for beverages; Flavorings [flavourings], other than essential oils, for cakes; Flavorings for beverages; Flavorings for beverages, other than essential oils; Flavorings for cakes; Flavorings, other than essential oils, for beverages; Flavorings, other than essential oils, for cakes; Flavour enhancers for food [other than essential oils]; Flavoured coffee; Flavoured popcorn; Flavoured rices; Flavoured sugar confectionery; Flavoured vinegar; Flavouring syrups; Flavourings and seasonings; Flavourings for beverages; Flavourings for butter; Flavourings for cakes; Flavourings for cakes other than essential oils; Flavourings for cheeses; Flavourings for foods; Flavourings for snack foods [other than essential oils]; Flavourings for soups; Flavourings for soups [other than essential oils]; Flavourings in the form of concentrated sauces; Flavourings in the form of dehydrated sauces; Flavourings made from fish; Flavourings made from fruits; Flavourings made from fruits [other than essential oils]; Flavourings made from lobsters; Flavourings made from meat; Flavourings made from pickles; Flavourings made from poultry; Flavourings made from shrimps; Flavourings made from snails; Flavourings made from vegetables [other than essential oils]; Flavourings [not essential oils]; Flavourings of almond; Flavourings of almond for food or beverages; Flavourings of almond, other than essential oils, for food or beverages; Flavourings of lemons; Flavourings of lemons for food or beverages; Flavourings of lemons, other than essential oils, for food or beverages; Flavourings of tea; Flavourings of tea for food or beverages; Flavourings, other than essential oils, for beverages; Flavourings, other than essential oils, for butter; Flavourings, other than essential oils, for cakes; Flavourings, other than essential oils, for cheeses; Flavourings, other than essential oils, for foods; Flavourings, other than essential oils, for soups; Flaxseed for culinary purposes [seasoning]; Floating islands; Flour; Flour based chips; Flour based savory snacks; Flour concentrate for food; Flour confectionery; Flour for baking; Flour for doughnuts; Flour for food; Flour for making dumplings of glutinous rice; Flour mixes; Flour mixtures for use in baking; Flour of barley; Flour of corn; Flour of millet; Flour of oats; Flour of rice; Flour preparations for food; Flour ready for baking; Flour-based dumplings; Flour-based gnocchi; Flowers or leaves for use as tea substitutes; Foamed sugar pastilles; Foamed sugar sweets; Fondants; Fondants [confectionery]; Food condiment consisting primarily of ketchup and salsa; Food dressings [sauces]; Food essences [except etheric essences and essential oils]; Food flavorings [non-essential oils]; Food flavorings, other than essential oils; Food flavourings; Food flavourings, other than essential oils; Food flavourings [other than essential oils]; Food leavening agents; Food mixtures consisting of cereal flakes and dried fruits; Food preparations based on grains; Food seasonings; Foods (Farinaceous -); Foods produced from baked cereals; Foods with a cocoa base; Foodstuffs containing chocolate [as the main constituent]; Foodstuffs containing cocoa [as the main constituent]; Foodstuffs (Essences for -), except etheric essences and essential oils; Foodstuffs made from cereals; Foodstuffs made from dough; Foodstuffs made from maize; Foodstuffs made from oats; Foodstuffs made of a sweetener for making a dessert; Foodstuffs made of a sweetener for sweetening desserts; Foodstuffs made of rice; Foodstuffs made of sugar for making a dessert; Foodstuffs made of sugar for sweetening desserts; Fortune cookies; Frankfurter sandwiches; Frappes; Freeze-dried coffee; Freeze-dried dishes with main ingredient being pasta; Freeze-dried dishes with main ingredient being rice; Freeze-dried dishes with the main ingredient being pasta; Freeze-dried dishes with the main ingredient being rice; French toast; Fresh bread; Fresh pasta; Fresh pasties; Fresh pies; Fresh pizza; Fresh pizzas; Fresh sausage rolls; Fried corn; Fried dough cookies; Fried dough cookies (karintoh); Fried dough twists; Fried noodles; Fried rice; Frosting [icing] (Cake -); Frosting mixes; Frostings; Frozen biscotti dough; Frozen brownie dough; Frozen cakes; Frozen confectionery; Frozen confectionery containing ice cream; Frozen confections; Frozen confections on a stick; Frozen cookie dough; Frozen custards; Frozen dairy confections; Frozen dough; Frozen ices; Frozen lollipops; Frozen meals consisting primarily of pasta; Frozen meals consisting primarily of rice; Frozen pastries; Frozen pastry; Frozen pastry sheets; Frozen pastry stuffed with meat; Frozen pastry stuffed with meat and vegetables; Frozen pastry stuffed with vegetables; Frozen pizza; Frozen pizzas; Frozen prepared rice; Frozen prepared rice with seasonings; Frozen prepared rice with seasonings and vegetables; Frozen yoghurt; Frozen yoghurt [confectionery ices]; Frozen yoghurts; Frozen yogurt; Frozen yogurt cakes; Frozen yogurt [confectionery ices]; Frozen yogurt confections; Frozen yogurt pies; Fructose for food; Fructose syrup for use in the manufacture of foods; Fruit bread; Fruit breads; Fruit cake snacks; Fruit cakes; Fruit confectionery; Fruit coulis [sauces]; Fruit drops [confectionery]; Fruit filled pastry products; Fruit flavorings, other than essential oils; Fruit flavoured tea [other than medicinal]; Fruit flavoured water ices in the form of lollipops; Fruit flavourings, except essences; Fruit flavourings for food or beverages, except essences; Fruit gums [other than for medical use]; Fruit ice; Fruit ice bars; Fruit ice cream; Fruit ice creams; Fruit ices; Fruit infusions; Fruit jellies [confectionery]; Fruit jelly candy; Fruit pastries; Fruit pies; Fruit sauces; Fruit sugar; Fruit tea [other than for medical purposes]; Fruit teas; Fruit vinegar; Fruited malt loaf; Fruited scones; Fudge; Garden herbs, preserved [seasonings]; Garlic bread; Garlic juice; Garlic powder; Garlic puree; Gateaux; Gâteaux; Gelatin-based chewy candies; German ravioli [Maultaschen]; Gimbap [Korean dish consisting of cooked rice wrapped in dried seaweed]; Gimbap [Korean rice dish]; Ginger bread; Ginger paste [seasoning]; Ginger [powdered spice]; Ginger puree [condiment]; Ginger [spice]; Ginger tea; Gingerbread; Gingerbread nuts; Gingersnaps; Ginseng confectionery; Ginseng tea; Ginseng tea [insamcha]; Glazed popcorn; Glucose for culinary purposes; Glucose for food; Glucose powder for food; Glucose preparations for food; Glucose syrup for use as a fermenting aid for food; Glucose syrup for use as a gelling agent for food; Glucose syrup for use as a preservative for food; Glucose syrup for use as a sweetener for food; Glucose syrup for use as a texture improver for food; Glucose syrup for use in the manufacture of foods; Glucose syrups for food; Glutamate for food; Gluten additives for culinary purposes; Gluten prepared as foodstuff; Gluten-free bread; Glutinous pounded rice cake coated with bean powder (injeolmi); Glutinous rice; Glutinous rice flour; Glutinous rice wrapped in bamboo leaves (Zongzi); Glutinous starch syrup (mizu-ame); Gnocchi; Golden syrup; Graham crackers; Grain-based chips; Grain-based snack foods; Granulated sugar; Grape sugar; Gravies; Gravies (Meat -); Gravy; Gravy mixes; Gravy mixes in granular form; Green onion pancake [pajeon]; Green onion pancake (pajeon); Green tea; Grist; Grits; Groats; Groats for human food; Ground barley; Ground coffee; Ground coffee beans; Ground coriander; Ground ginger; Ground pepper; Gruel, with a milk base, for food; Guar gum; Gukhwacha; Gum sweets; Gum sweets (Non-medicated -); Gummy candies; Half covered chocolate biscuits; Half-moon-shaped cake of rice containing sweet or semi-sweet fillings (songpyeon); Half-moon-shaped rice cake [songpyeon]; Halvah; Ham glaze; Hamburger sandwiches; Hamburgers being cooked and contained in a bread roll; Hamburgers contained in bread buns; Hamburgers contained in bread rolls; Hamburgers in buns; Hand made candies; Hard candy; Hard caramels [candies]; Hardtack [biscuits]; Harissa [condiment]; Helichrysum [flavour]; Helichrysum (flavour); Helichrysum honey; Helichrysum [spices]; Helichrysum (spices); Herb sauces; Herb tea [infusions]; Herb teas, other than for medicinal purposes; Herb teas, other than for medicinal use; Herbal flavourings for making beverages; Herbal flavourings, other than essential oils, for making beverages; Herbal honey; Herbal honey lozenges [confectionery]; Herbal infusions; Herbal infusions [other than for medicinal use]; Herbal preparations for making beverages; Herbal tea; Herbal tea [other than for medicinal use]; Herbal teas; Herbal teas [infusions]; Herbal teas, other than for medicinal use; High-protein cereal bars; Hominy; Hominy grits; Honey; Honey [for food]; Honey glazes for ham; Honey substitutes; Honeycomb toffee; Honeys; Hon-mirin-type flavouring sauce; Horseradish [relishes]; Horseradish sauce; Horseradish sauces; Hot breakfast cereals; Hot chili bean paste; Hot chili pepper sauce; Hot chocolate; Hot chocolate mixes; Hot cocoa mix; Hot dog sandwiches; Hot pepper powder [spice]; Hot sauce; Hot sausage and ketchup in cut open bread rolls; Hushpuppies [breads]; Husked barley; Husked oats; Husked rice; Ice; Ice beverages with a chocolate base; Ice beverages with a cocoa base; Ice beverages with a coffee base; Ice blocks; Ice candies; Ice candy; Ice confectionery; Ice confectionery in the form of lollipops; Ice confections; Ice cream; Ice cream bars; Ice cream (Binding agents for -); Ice cream cakes; Ice cream cone mixes; Ice cream cones; Ice cream confectionery; Ice cream confections; Ice cream desserts; Ice cream drinks; Ice cream gateaux; Ice cream infused with alcohol; Ice cream mixes; Ice cream powder; Ice cream powders; Ice cream sandwiches; Ice cream stick bars; Ice cream substitute; Ice cream with fruit; Ice creams; Ice creams containing chocolate; Ice creams flavoured with chocolate; Ice cubes; Ice for refreshment; Ice [frozen water]; Ice, ice creams, frozen yogurts and sorbets; Ice in block form; Ice lollies; Ice lollies being milk flavoured; Ice lollies containing milk; Ice milk bars; Ice milk [ice cream]; Ice, natural or artificial; Ice pops; Ice-cream; Ice-cream cakes; Iced cakes; Iced coffee; Iced confectionery (Non-medicated -); Iced fruit cakes; Iced lollies; Iced sponge cakes; Iced tea; Iced tea mix powders; Iced tea (Non-medicated -); Iced teas; Ices; Ices (Binding agents for edible -); Ices (Edible -); Ices (Powder for edible -); Ices (Powders for edible -); Icing; Icing for cakes; Icing mixes; Icing sugar; Icings; Imitation chocolate; Imitation custard; Imitation ice cream; Imitation mayonnaise; Infusions, not medicinal; Injeolmi [glutinous rice cakes coated with powdered beans]; Instant black tea; Instant chinese noodles; Instant cocoa powder; Instant coffee; Instant cooking noodles; Instant dessert puddings; Instant doughnut mixes; Instant green tea; Instant ice cream mixes; Instant noodles; Instant oatmeal; Instant Oolong tea; Instant pancake mixes; Instant porridge; Instant powder for making tea [other than for medical use]; Instant pudding mixes; Instant rice; Instant soba noodles; Instant tea; Instant tea [other than for medicinal purposes]; Instant udon noodles; Instant white tea; Instant yeast; Invert sugar; Invert sugar cream [artificial honey]; Jam buns; Jam filled brioches; Japanese arrowroot powder for culinary purposes; Japanese arrowroot powder (kudzu-ko, for food); Japanese green tea; Japanese horseradish powder spice (wasabi powder); Japanese noodle-based dish (Ramen); Japanese pepper powder spice (sansho powder); Japanese sponge cakes (kasutera); Japanese style steamed cakes (mushi-gashi); Jasmine tea; Jasmine tea bags, other than for medicinal purposes; Jasmine tea, other than for medicinal purposes; Jellies (Fruit -) [confectionery]; Jelly beans; Jiaozi; Jiaozi [stuffed dumplings]; Kasha [meal]; Kebab sauce; Kelp tea; Ketchup; Ketchup [sauce]; Ketchups; Kettle corn; Kettle corn [popcorn]; Kheer mix (rice pudding); Kimchi pancakes; Kimchi pancakes (kimchijeon); Kimchi pannenkoeken; Kimchijeon [fermented vegetable pancakes]; Kimchijeon [Korean-style pancakes made with fermented vegetables]; Kombucha; Konjac starch for food; Korean soy sauce [ganjang]; Korean traditional pressed sweets (Dasik); Korean traditional rice cake [injeolmi]; Korean traditional sweets and cookies [hankwa]; Korean-style dried seaweed rolls containing cooked rice (gimbap); Korean-style dumplings (mandu); Laksa; Lapsang souchong tea; Lasagna; Lasagne; Leaven; Lemon flavorings, other than essential oils; Lentil flour; Lentil pasta; Licorice; Lily bulb starch for food; Lime blossom tea; Lime tea; Linden tea; Linseed for culinary purposes [seasoning]; Liqueur chocolates; Liquid sugar; Liquorice; Liquorice [confectionery]; Liquorice flavoured confectionery; Lo mein; Lo mein [noodles]; Lollipops; Lollipops [confectionery]; Lomper [potato-based flatbread]; Long-life pastry; Lotus root starch for food; Low-carbohydrate confectionery; Low-salt bread; Lozenges [confectionery]; Lozenges [non-medicated confectionery]; Lyophilised dishes with main ingredient being pasta; Lyophilised dishes with main ingredient being rice; Lyophilised dishes with the main ingredient being pasta; Lyophilised dishes with the main ingredient being rice; Lyophilized dishes with main ingredient being pasta; Lyophilized dishes with main ingredient being rice; Lyophilized dishes with the main ingredient being pasta; Lyophilized dishes with the main ingredient being rice; Macaroni; Macaroni cheese; Macaroni salad; Macaroni [uncooked]; Macaroni with cheese; Macarons; Macaroons [pastry]; Madeleines; Maize based snack products; Maize flakes; Maize flour; Maize meal; Maize, milled; Maize (Processed -) for consumption by humans; Maize, roasted; Mallows [confectionery]; Malt biscuits; Malt bread; Malt cakes; Malt coffee; Malt coffee extracts; Malt dextrin glazings for confectionary; Malt dextrin glazings for foodstuffs; Malt extract for food; Malt extracts for food; Malt extracts used as flavoring; Malt for human consumption; Malt-based food preparations; Malted barley prepared for human consumption; Malted bread mix; Malted wheat; Maltodextrins for nutritional use [other than medical]; Maltose; Maltose for food; Manuka honey; Maple syrup; Marinades; Marinades containing herbs; Marinades containing seasonings; Marinades containing spices; Marshmallow; Marshmallow confectionery; Marshmallow creme; Marshmallow filled chocolates; Marshmallow topping; Marshmallows; Marzipan; Marzipan substitutes; Mate [tea]; Matzo; Mayonnaise; Mayonnaise and ketchup-based spreads; Mayonnaise with pickles; Mayonnaise-based sauces; Mayonnaise-based spreads; Meal; Meals consisting primarily of pasta; Meals consisting primarily of rice; Meat gravies; Meat pies; Meat pies [prepared]; Meat tenderizers, for household purposes; Meat tenderizers for household purposes; Meringue; Meringues; Microwave popcorn; Milk chocolate; Milk chocolate bars; Milk chocolate teacakes; Milk chocolates; Milk tablet candy; Milled rice for human consumption; Mille-feuilles; Millet cakes; Minced garlic; Minced garlic [condiment]; Mincemeat pies; Mineral salts for preserving foodstuffs; Mint based sweets [non-medicated]; Mint, dried; Mint flavoured confectionery (Non-medicated -); Mint flavoured sweets (Non-medicated -); Mint for confectionery; Mint-based sweets; Mints [candies, non-medicated]; Mints for breath freshening; Mirror icing [mirror glaze]; Miso; Miso bean paste; Miso [condiment]; Mixed flour for food; Mixed spice powder; Mixed spices; Mixes for making bakery products; Mixes for making cakes; Mixes for making puddings; Mixes for preparing sauces; Mixes for the preparation of bread; Mixes of sweet adzuki-bean jelly [mizu-yokan-no-moto]; Mixtures for making cakes; Mixtures for making frozen confections; Mixtures for making ice cream; Mixtures for making ice cream confections; Mixtures for making ice cream products; Mixtures for making ice creams; Mixtures for making pastries; Mixtures for making water ices; Mixtures of chicory for use as coffee substitutes; Mixtures of chicory for use as substitutes for coffee; Mixtures of coffee; Mixtures of coffee and chicory; Mixtures of coffee and malt; Mixtures of coffee essences and coffee extracts; Mixtures of malt coffee extracts with coffee; Mixtures of malt coffee with cocoa; Mixtures of malt coffee with coffee; Mizu-yokan-no-moto [Japanese confectionery made from sweet adzuki bean jelly]; Modified corn starch; Modified pregelatinized starches for food [not medical]; Modified starches for food [not medical]; Molasses; Molasses for food; Molasses syrup; Molasses syrup for culinary purposes; Molasses syrup for food; Moon cakes; Mooncakes; Mousse confections; Mousse (sweet); Mousses; Mousses (Chocolate -); Mousses (Dessert -) [confectionery]; Muesli; Muesli bars; Muesli consisting predominantly of cereals; Muesli desserts; Muffin mixes; Muffins; Mugi-cha [roasted barley tea]; Multigrain bread; Multigrain-based snack foods; Mung bean flour; Mung bean pancakes (bindaetteok); Mung bean porridge; Mushroom sauces; Mustard; Mustard for food; Mustard meal; Mustard powder for food; Mustard powder [spice]; Mustard preparations for food; Mustard vinegar; Naan bread; Nachos; Nan bread; Natural flavourings for use in ice cream [other than etheric essences or essential oils]; Natural flavourings for use in ices [other than etheric essences or essential oils]; Natural honey; Natural low calorie sweeteners; Natural rice flakes; Natural rice [processed] for food for human consumption; Natural ripe honey; Natural starches for food; Natural sweetener; Natural sweeteners; Natural sweeteners in the form of fruit concentrates; Natural sweetening substances; Nerikiri [traditional Japanese confectionery consisting of a soft sugared bean-based shell containing sweet bean jam]; Non-dairy ice cream; Non-meat pies; Non-medicated candy; Non-medicated chocolate; Non-medicated chocolate confectionery; Non-medicated confectionery; Non-medicated confectionery candy; Non-medicated confectionery containing chocolate; Non-medicated confectionery containing milk; Non-medicated confectionery for use as part of a calorie controlled diet; Non-medicated confectionery having a milk flavour; Non-medicated confectionery having toffee fillings; Non-medicated confectionery in jelly form; Non-medicated confectionery in the form of lozenges; Non-medicated confectionery in the shape of eggs; Non-medicated confectionery products; Non-medicated flour confectionery; Non-medicated flour confectionery coated with chocolate; Non-medicated flour confectionery coated with imitation chocolate; Non-medicated flour confectionery containing chocolate; Non-medicated flour confectionery containing imitation chocolate; Non-medicated flour confections; Non-medicated infusions; Non-medicated lozenges; Non-medicated mint confectionery; Non-medicated mouth freshening lozenges; Non-medicated mouth freshening tablets; Non-medicated sugar confectionery; Non-medicated sweets; Non-medicinal burdock root tea (Wooungcha); Non-medicinal herbal infusions; Non-medicinal herbal tea; Non-medicinal infusions; Nonpareils; Noodle-based prepared meals; Noodles; Nougat; Nut confectionery; Nut flours; Nutmeg; Nutmegs; Oat bars; Oat biscuits for human consumption; Oat cakes for human consumption; Oat clusters containing dried fruit; Oat flakes; Oat meal; Oat porridge; Oat-based food; Oat-based food for human consumption; Oat-based foods; Oatmeal; Oatmeal for human consumption; Oats (Crushed -); Oats for human consumption; Oats (Husked -); Oilseed flour for food; Okonomiyaki [Japanese savory pancakes]; Okonomiyaki [Japanese savoury pancakes]; Oligosaccharides for culinary purposes; Onigiri; Onigiri [rice balls]; Onigiri (rice balls); Onion biscuits; Onion or cheese biscuits; Oolong tea; Oolong tea [Chinese tea]; Open sandwiches; Orange based confectionery; Orange based pastry; Orange blossom water for culinary purposes; Orange flavoured tea [other than for medicinal use]; Organic binding agents for ice cream; Organic thickening agents for cooking foodstuffs; Ornaments for christmas trees [edible]; Oyster sauce; Packaged tea [other than for medicinal use]; Pad thai (Thai stir-fried noodles); Paella; Pains au chocolat; Pajeon [Korean-style pancakes made with green onions]; Palm sugar; Pancake mixes; Pancake syrup; Pancakes; Pandoro; Panettone; Panettoni; Panned sweets (Non-medicated -); Papads; Papadums; Paprika; Parfaits; Pasta; Pasta containing eggs; Pasta containing fillings; Pasta containing stuffings; Pasta dishes; Pasta for incorporating into pizzas; Pasta for soups; Pasta in the form of sheets; Pasta preserves; Pasta products; Pasta salad; Pasta sauce; Pasta sauces; Pasta shells; Pasta-based prepared meals; Pasta-wrappings for gyoza; Paste (Almond -); Paste (Soya bean -) [condiment]; Pastes (Farinaceous food -); Pasties; Pastila [confectionery]; Pastilles [confectionery]; Pastilles [other than for medical purposes]; Pastries; Pastries, cakes, tarts and biscuits (cookies); Pastries consisting of vegetables and fish; Pastries consisting of vegetables and meat; Pastries consisting of vegetables and poultry; Pastries containing creams; Pastries containing creams and fruit; Pastries containing fruit; Pastries filled with fruit; Pastries with fruit; Pastry; Pastry cases; Pastry dough; Pastry mixes; Pastry shells; Pastry shells for monaka; Pâté [pastries]; Pâtés en croûte; Pavlovas flavoured with hazelnuts; Pavlovas made with hazelnuts; Peanut brittle; Peanut butter confectionery chips; Peanut confectionery; Peanut sauce; Pearl barley; Pearl barley [prepared]; Pearled barley; Pecan logs; Pellet-shaped rice crackers (arare); Pelmeni; Pelmeni [dumplings stuffed with meat]; Pepper; Pepper powder [spice]; Pepper sauces; Pepper spice; Pepper vinegar; Peppercorns; Peppermint bonbons [other than for medicinal use]; Peppermint candy; Peppermint for confectionery; Peppermint pastilles [confectionery], other than for medicinal use; Peppermint sweets; Peppermint sweets [other than for medicinal use]; Peppermint tea; Peppermints [other than for medicinal use]; Peppers [seasonings]; Perilla powder for food; Pesto; Pesto [sauce]; Petit fours; Petit-beurre biscuits; Petits fours; Petits fours [cakes]; Phyllo dough; Picante sauce; Piccalilli; Pickle relish; Pickled ginger [condiment]; Pickling salt for pickling foodstuffs; Pie crusts; Pie shells; Pies; Pies containing fish; Pies containing game; Pies containing meat; Pies containing poultry; Pies containing vegetables; Pies (Meat -); Pies [sweet or savoury]; Pikelets; Pimento used as a condiment; Pineapple fritters; Pita bread; Pita chips; Pitta bread; Pizza; Pizza bases; Pizza crust; Pizza crusts; Pizza dough; Pizza flour; Pizza mixes; Pizza pies; Pizza sauce; Pizza sauces; Pizza spices; Pizzas; Pizzas [prepared]; Plant flavourings [other than essential oils] for beverages; Plum cakes; Plum-cakes; Polenta; Polysaccharides for use as food for human consumption; Pop corn; Popadoms; Popcorn; Popcorn seasoning; Poppadoms; Poppadums; Popped popcorn; Poppy seed pastry; Poppy seeds for use as a seasoning; Pork pies; Porridge; Porridge oats; Pot pies; Potato flour; Potato flour confectionery; Potato flour for food; Potato flour [for food]; Potato starch for food; Potato-based flatbreads; Potpies; Potstickers [dumplings]; Poultry and game meat pies; Poultry pies; Pounded rice cakes (mochi); Pounded wheat; Powder (Cake -); Powder for edible ices; Powder for making cakes; Powder for making edible ices; Powder for making ice cream; Powdered coffee in drip bags; Powdered garlic; Powdered preparations containing cocoa for use in making beverages; Powdered starch syrup [for food]; Powdered sugar; Powdered sugar for preparing isotonic beverages; Powders for ice cream; Powders for ices; Powders for making ice cream; Pralines; Pralines made of chocolate; Pralines with liquid filling; Prawn crackers; Pre-baked bread; Pre-baked pizzas crusts; Pre-mixes ready for baking; Pre-packaged lunches consisting primarily of rice, and also including meat, fish or vegetables; Preparations based on cocoa; Preparations for making bakery products; Preparations for making beverages [chocolate based]; Preparations for making beverages [cocoa based]; Preparations for making beverages [coffee based]; Preparations for making beverages [tea based]; Preparations for making gateaux; Preparations for making gravy; Preparations for making of sugar confectionery; Preparations for making pizza bases; Preparations for making sauces; Preparations for making up into sauces; Preparations for making waffles; Preparations for stiffening whipped cream; Preparations for use as rising agents in food; Preparations made from cereals; Preparations of chicory for use as a substitute for coffee; Prepared baking mixes; Prepared cocoa and cocoa-based beverages; Prepared coffee and coffee-based beverages; Prepared coffee beverages; Prepared desserts [chocolate based]; Prepared desserts [confectionery]; Prepared desserts [pastries]; Prepared foodstuffs in the form of sauces; Prepared horseradish [condiment]; Prepared meals consisting primarily of pasta; Prepared meals consisting primarily of rice; Prepared meals containing [principally] pasta; Prepared meals containing [principally] rice; Prepared meals in the form of pizzas; Prepared oats for human consumption; Prepared pasta; Prepared pie crust mixes; Prepared pizza meals; Prepared rice; Prepared rice dishes; Prepared rice rolled in seaweed; Prepared savory foodstuffs made from potato flour; Prepared wasabi; Preservatives for animal feeds [salt]; Preservatives for food [salt]; Preserved chervil; Preserved garden herbs as seasonings; Preserved ginger; Preserved ginger [condiment]; Preserved herbs; Preserved pizzas; Preserving foodstuffs (Salt for -); Pretzels; Processed cereals; Processed cereals for food for human consumption; Processed corn; Processed garlic for use as seasoning; Processed ginseng used as a herb, spice or flavoring; Processed grains; Processed grains for food for human consumption; Processed grains, starches, and goods made thereof, baking preparations and yeasts; Processed herbs; Processed hops; Processed maize; Processed oats; Processed oats for food for human consumption; Processed popcorn; Processed quinoa; Processed seeds for use as a seasoning; Processed seeds used as a flavoring for foods and beverages; Processed semolina; Processed shallots for use as seasoning; Processed sorghum; Processed teff; Processed unpopped popcorn; Processed wheat; Profiteroles; Propolis; Propolis [bee glue] for human consumption; Propolis for food purposes; Pudding powders; Puddings; Puddings for use as desserts; Puddings in powder form; Puff pastry; Puffed cheese balls [corn snacks]; Puffed corn snacks; Puffed rice; Pulse flour for food; Pumpernickel; Pumpkin pies; Pumpkin porridge (Hobak-juk); Pykelets; Quesadillas; Quiche; Quiche [tart]; Quiches; Quiches [tarts]; Quinoa pasta; Quinoa, processed; Ramen; Ramen [Japanese noodle-based dish]; Ravioli; Ravioli [prepared]; Raw honeycombs; Raw sugar; Ready to eat savory snack foods made from maize meal formed by extrusion; Ready-made baking mixtures; Ready-made sauces; Ready-to-bake dough products; Ready-to-eat cereal-derived food bars; Ready-to-eat cereals; Ready-to-eat puddings; Red bean porridge (patjuk); Red ginseng candy; Red ginseng tea; Red pepper powder (Gochutgaru); Relish [condiment]; Relish [condiments]; Relishes; Relishes [condiments]; Remoulade sauce; Ribbon vermicelli; Rice; Rice based dishes; Rice biscuits; Rice cake snacks; Rice cakes; Rice chips; Rice crackers; Rice crackers [senbei]; Rice crisps; Rice crusts; Rice dumplings; Rice dumplings dressed with sweet bean jam (ankoro); Rice flour; Rice flour porridge; Rice glue balls; Rice mixed with vegetables and beef [bibimbap]; Rice mixes; Rice noodles; Rice pasta; Rice porridge; Rice pudding; Rice puddings; Rice puddings containing sultanas and nutmeg; Rice pulp for culinary purposes; Rice salad; Rice snacks; Rice starch flour; Rice sticks; Rice tapioca; Rice vermicelli; Rice-based prepared meals; Rice-based pudding dessert; Rice-based snack food; Rice-based snack foods; Risotto; Roasted and ground sesame seeds for use as a seasoning; Roasted barley and malt for use as substitute for coffee; Roasted barley tea; Roasted barley tea [mugicha]; Roasted brown rice tea; Roasted coffee beans; Roasted corn; Roasted maize; Rock [confectionery]; Rolled oats; Rolled oats and wheat; Rolled wafers [biscuits]; Rolls [bread]; Rolls (Bread -); Rooibos tea; Rose hip tea; Rosemary tea; Royal jelly; Rusks; Rye bread; Rye flour; Rye full grain grist; Sachima; Saffron; Saffron for use as a seasoning; Saffron salt for seasoning food; Saffron [seasoning]; Sage [seasoning]; Sage tea; Sago; Sago palm starch [for food]; Sal ammoniac liquorice sweets (Non-medicated -); Salad cream; Salad dressing; Salad dressings; Salad dressings containing cream; Salad (Dressings for -); Salad sauces; Saleratus for culinary purposes; Salsa; Salsa sauces; Salsas; Salt; Salt (Cooking -); Salt crackers; Salt for cooking; Salt for flavouring food; Salt for popcorn; Salt for preserving fish; Salt for preserving food; Salt for preserving foodstuffs; Salt pellets for preserving fish; Salt pellets for preserving food; Salt pellets for preserving foodstuffs; Salted biscuits; Salted butter caramel; Salted butter fudge; Salted wafer biscuits; Salts, seasonings, flavourings and condiments; Salty biscuits; Sambal oelek (ground red pepper sauce); Sambal oeleks being condiments; Sambal sauce (ground red pepper sauce); Sambals; Samosas; Sandwich spread made from chocolate and nuts; Sandwich wraps [bread]; Sandwiches; Sandwiches containing chicken; Sandwiches containing fish; Sandwiches containing fish fillet; Sandwiches containing hamburgers; Sandwiches containing meat; Sandwiches containing minced beef; Sandwiches containing salad; Sansho powder [Japanese pepper seasoning]; Satay sauces; Sauce [edible]; Sauce mixes; Sauce powder; Sauce powders; Sauce (Tomato -); Sauces; Sauces [condiments]; Sauces containing nuts; Sauces flavoured with nuts; Sauces for barbecued meat; Sauces for chicken; Sauces for frozen fish; Sauces for ice cream; Sauces for pasta; Sauces for pizzas; Sauces for rice; Sauces for use with pasta; Sausage binding materials; Sausage rolls; Savarins; Savory biscuits; Savory food flavourings for animal foods [other than essential oils]; Savory food flavourings for food [other than essential oils]; Savory pancake mixes; Savory pancakes; Savory pastries; Savory sauces; Savory sauces, chutneys and pastes; Savory sauces used as condiments; Savoury biscuits; Savoury pancake mixes; Savoury pancakes; Savoury sauces; Scones; Sea salt for cooking; Sea salt for preserving foodstuffs; Sea water for cooking; Seasoned bean paste; Seasoned breading mix for deep frying; Seasoned coating for meat, fish, poultry; Seasoned popcorn; Seasoned salt; Seasoned salt for cooking; Seasoned soy sauce (Chiyou); Seasoning marinade; Seasoning mixes; Seasoning mixes for stews; Seasonings; Seasonings for instant-boiled mutton; Seaweed [condiment]; Seaweed flavoured corn chips; Seaweed for use as a condiment; Seitan [dried wheat gluten]; Semi-baked bread; Semolina; Semolina pudding; Senbei [rice crackers]; Senbei (rice crackers); Sesame candy bars; Sesame confectionery; Sesame paste; Sesame seeds [seasonings]; Shao mai; Shaved ice with sweetened red beans; Shaved ices with sweetened red beans; Sherbet [confectionery]; Sherbet mixes; Sherbets [confectionery]; Sherbets [confectionery ices]; Sherbets [ices]; Sherbets [sorbets]; Sherbets [water ices]; Shortbread; Shortbread biscuits; Shortbread part coated with a chocolate flavoured coating; Shortbread part coated with chocolate; Shortbread with a chocolate coating; Shortbread with a chocolate flavoured coating; Shortbreads; Shortcake; Shortcrust pastry; Shrimp chips; Shrimp dumplings; Shrimp noodles; Shrimp sauce; Sichuan pepper powder; Sichuan peppers being condiments; Skin for spring rolls; Skin [pastry] for spring rolls; Sloppy joe seasoning mix; Smoke distillates from wood for flavouring foodstuffs; Snack bars containing a mixture of grains, nuts and dried fruit [confectionery]; Snack food (Cereal-based -); Snack food products consisting of cereal products; Snack food products made from cereal flour; Snack food products made from cereal starch; Snack food products made from cereals; Snack food products made from maize flour; Snack food products made from potato flour; Snack food products made from rice; Snack food products made from rice flour; Snack food products made from rusk flour; Snack food products made from soya flour; Snack food (Rice-based -); Snack foods consisting principally of bread; Snack foods consisting principally of confectionery; Snack foods consisting principally of extruded cereals; Snack foods consisting principally of grain; Snack foods consisting principally of pasta; Snack foods consisting principally of rice; Snack foods made from cereals; Snack foods made from corn; Snack foods made from corn and in the form of puffs; Snack foods made from corn and in the form of rings; Snack foods made from wheat; Snack foods made of wheat; Snack foods made of whole wheat; Snack foods prepared from maize; Snack foods prepared from potato flour; Snack products made of cereals; Snacks made from muesli; Snacks manufactured from cereals; Snacks manufactured from muesli; Soba noodles; Soba noodles [japanese noodles of buckwheat, uncooked]; Soda bread; Sodium chloride for preserving foodstuffs; Soft caramels; Soft ices; Soft pin-rolled cakes of pounded rice (gyuhi); Soft pretzels; Soft rolls [bread]; Somen noodles; Somen noodles [very thin wheat noodle, uncooked]; Songpyeon [half-moon-shaped rice cakes with sweet or semi-sweet fillings]; Sopapilla; Sopapillas [fried bread]; Sopapillas [fried pastries]; Sorbet; Sorbet infused with alcohol; Sorbet mixes [ices]; Sorbets; Sorbets [ices]; Sorbets [water ices]; Sour dough; Soy sauce; Soy sauce [soya sauce]; Soya based ice cream products; Soya bean paste; Soya bean paste [condiment]; Soya flour; Soya flour for food; Soya sauce; Soya sauces; Soya-based ice cream substitutes; Soy-based ice cream substitute; Soybean paste condiment [doenjang]; Spaghetti; Spaghetti and meatballs; Spaghetti sauce; Spaghetti [uncooked]; Spaghetti with meatballs; Spice extracts; Spice mixes; Spice preparations; Spice rubs; Spiced salt; Spices; Spices in the form of powders; Spicy sauces; Sponge cake; Sponge cakes; Sponge fingers [cakes]; Spray crystallized maltose for food; Spring roll skin [pastry]; Spring rolls; Sriracha hot chili sauce; Star aniseed; Starch derivatives for food human consumption; Starch for food; Starch noodles; Starch products for food; Starch syrup for culinary purposes; Starch syrup [for food]; Starch vermicelli; Starch-based candies; Starch-based candies (ame); Steamed bread; Steamed buns stuffed with minced meat (niku-manjuh); Steamed buns stuffed with red bean paste; Steamed buns stuffed with red beans; Steamed rice; Steamed sponge cakes (fagao); Steel cut oats; Stew seasoning mixes; Stick liquorice [confectionery]; Sticky rice cakes (Chapsalttock); Stiffening whipped cream (Preparations for -); Stir fried rice cake [topokki]; Stir-fried noodles with vegetables (Japchae); Stir-fried rice; Strawberry gateaux; Stuffed bread; Stuffed pasta; Stuffing mixes containing bread; Stuffing mixes [foodstuffs]; Substances for binding ice cream; Substances imparting flavour for addition to drink [other than essential oils]; Substances imparting flavour for addition to food [other than essential oils]; Substances imparting savour for addition to drink [other than essential oils]; Substances imparting savour for addition to food [other than essential oils]; Substances imparting smell for addition to drink [other than essential oils]; Substances imparting smell for addition to food [other than essential oils]; Substances imparting taste for addition to drink [other than essential oils]; Substances imparting taste for addition to food [other than essential oils]; Substitutes (Chocolate -); Substitutes (Coffee -); Sugar; Sugar almonds; Sugar candies (Non-medicated -); Sugar candy [for food]; Sugar coated pine nuts; Sugar confectionery; Sugar confectionery (Non-medicated -); Sugar for making conserves of fruit; Sugar for making jams; Sugar for making jellies; Sugar, honey, treacle; Sugar [other than for medical purposes]; Sugar, other than for medical use; Sugar substitutes; Sugar-coated coffee beans; Sugar-coated hard caramels; Sugared almonds; Sugared beans (ama-natto); Sugarfree chewing gum; Sugar-free chewing gum; Sugar-free mint candies; Sugarfree sweets; Sugar-free sweets; Sugarless candies; Sugarless chewing gum; Sugarless sweets; Sugars; Sugars, natural sweeteners, sweet coatings and fillings, bee products; Sugars [other than for medical purposes]; Sumac for use as a seasoning; Sushi; Sweet and sour sauce; Sweet bean jam coated with sugared-bean based soft shell [nerikiri]; Sweet biscuits for human consumption; Sweet dumplings (dango); Sweet glazes and fillings; Sweet pickle [condiment]; Sweet potato starch; Sweet potato starch for food; Sweet pounded rice cakes (mochi-gashi); Sweet rice with nuts and jujubes (yaksik); Sweet spreads [honey]; Sweeteners consisting of fruit concentrates; Sweeteners (Natural -); Sweeteners (Natural -) in granular form; Sweetmeat made of sesame oil; Sweetmeats; Sweetmeats being candies; Sweetmeats [candy]; Sweetmeats [candy] being flavoured with fruit; Sweetmeats [candy] containing fruit; Sweetmeats made of sesame oil; Sweets; Sweets [candy]; Sweets (candy), candy bars and chewing gum; Sweets (Non-medicated -); Sweets (Non-medicated -) being acidulated; Sweets (Non-medicated -) being acidulated caramel sweets; Sweets (Non-medicated -) being alcohol based; Sweets (Non-medicated -) being honey based; Sweets (Non-medicated -) containing herbal flavourings; Sweets (Non-medicated -) in compressed form; Sweets (Non-medicated -) in the nature of caramels; Sweets (Non-medicated -) in the nature of chocolate eclairs; Sweets (Non-medicated -) in the nature of fudge; Sweets (Non-medicated -) in the nature of nougat; Sweets (Non-medicated -) in the nature of sugar confectionery; Sweets (Non-medicated -) in the nature of toffees; Sweets (Peppermint -); Synthetic thickeners for foodstuffs; Syrup for food; Syrup of molasses for food; Syrups and treacles; Tabbouleh; Table salt; Table salt mixed with sesame seeds; Table syrup; Tablet (confectionary); Tablets (Non-medicated -) made of glucose with a caffeine base; Tabouleh; Taco chips; Taco seasoning; Taco seasonings; Taco shells; Tacos; Taffy; Taiyaki (Japanese fish-shaped cakes with various fillings); Tamales; Tamarind [condiment]; Tapioca; Tapioca flour; Tapioca flour for food; Tapioca flour [for food]; Tart shells; Tartar sauce; Tartare sauce; Tarts; Tarts [sweet or savoury]; Tea; Tea bags; Tea bags for making non-medicated tea; Tea bags (Non-medicated -); Tea based beverages (Non-medicated -); Tea beverages; Tea beverages (Non-medicated -); Tea cakes; Tea essence (Non-medicated -); Tea essences; Tea essences (Non-medicated -); Tea extracts; Tea extracts (Non-medicated -); Tea for infusions; Tea (Iced -); Tea leaves; Tea mix powders; Tea mixtures; Tea (Non-medicated -); Tea (Non-medicated -) consisting of cranberry extracts; Tea (Non-medicated -) consisting of cranberry leaves; Tea (Non-medicated -) containing cranberry extracts; Tea (Non-medicated -) containing cranberry leaves; Tea (Non-medicated -) sold loose; Tea of parched powder of barley with husk (mugi-cha); Tea of salty kelp powder (kombu-cha); Tea pods; Tea substitutes; Tea-based beverages; Tea-based beverages with fruit flavoring; Teas; Teas (Non-medicated -); Teas (Non-medicated -) containing lemon; Teas (Non-medicated -) flavoured with lemon; Tempura batter mix; Teriyaki sauce; Theine-free tea; Theine-free tea sweetened with sweeteners; Theine-free tea with added sweeteners; Thick breadsticks; Thickeners for cooking foodstuffs; Thickening agents for cooking foodstuffs; Thickening agents for use in cooking; Thin breadsticks; Tieguanyin tea; Tiramisu; Tisanes made of tea (Non-medicated -); Toast; Toasted bread; Toasted cheese sandwich; Toasted cheese sandwich with ham; Toasted corn kernels; Toasted grain flour; Toasted natural wood chips added to wine to improve its flavour; Toasted sandwiches; Toasts; Toasts [biscuits]; Toffee; Toffees; Tomato based sauces; Tomato ketchup; Tomato sauce; Topping syrup; Topping syrups; Tortellini; Tortes; Tortilla chips; Tortilla shells; Tortilla snacks; Tortillas; Treacle; Treacle cake; Treacle tarts; Treacles; Truffle cream sauces; Truffle flour; Truffle honey; Truffle ices; Truffle pasta; Truffle salt; Truffles [confectionery]; Truffles (rum -) [confectionery]; Turbinado sugar; Turkey sandwiches; Turkish delight; Turkish delight coated in chocolate; Turmeric; Turmeric for food; Turmeric for use as a condiment; Turmeric powders for use as a condiment; Udon (Japanese style noodles); Udon noodles; Udon noodles [uncooked]; Uncooked dried pieces of wheat gluten; Uncooked pizzas; Unfermented bread; Unleavened bread; Unleavened bread in thin sheets; Unroasted coffee; Unsorted wheatflour; Vanilla; Vanilla beans; Vanilla [flavoring] [flavouring]; Vanilla [flavoring] flavouring; Vanilla flavorings; Vanilla flavorings for culinary purposes; Vanilla flavourings for culinary purposes; Vanilla flavourings for food or beverages; Vanillin; Vanillin [vanilla substitute]; Vareniki [stuffed dumplings]; Vegan cakes; Vegan hot chocolate; Vegan ice cream; Vegan mayonnaise; Vegetable based coffee substitutes; Vegetable concentrates used for seasoning; Vegetable flavoured corn chips; Vegetable flour; Vegetable pastes [sauces]; Vegetable pies; Vegetable pulps [sauces - food]; Vegetable purees [sauces]; Vegetable thickeners; Vegetable-based seasonings for pasta; Vegetal preparations for use as coffee substitutes; Vermicelli; Vermicelli [noodles]; Vermicelli (Ribbon -); Viennese pastries; Viennoiserie; Vinegar; Vinegars; Vla [custard]; Vol-au-vent cases; Vol-au-vents; Wafer biscuits; Wafer dough; Wafer doughs; Wafered pralines; Wafers; Wafers [biscuits]; Wafers [food]; Waffles; Waffles with a chocolate coating; Wasabi paste; Wasabi powder; Water chestnut starch for food; Water ice; Water ices; Water (Sea -) for cooking; Weeds [condiment]; Wheat (Flakes of -); Wheat flour; Wheat flour [for food]; Wheat germ; Wheat germ for human consumption; Wheat germ [other than a dietary supplement]; Wheat meal; Wheat starch flour; Wheat-based snack foods; Wheaten flour; Wheatgerm; Whipped cream (Preparations for stiffening -); White lotus tea (Baengnyeoncha); White sugar; White tea; Whole wheat bread; Whole wheat grains being cooked; Whole wheat grains being dried; Whole wheat grains being precooked; Whole wheat grains being preserved; Wholemeal bread; Wholemeal bread mixes; Wholemeal noodles; Wholemeal pasta; Wholemeal rice; Wholewheat crisps; Wild rice [prepared]; Wine vinegar; Won ton wrappers; Won tons; Wonton chips; Wontons; Worcestershire sauce; Wrap sandwiches; Wraps [sandwich]; Xylitol-sweetened sweets; Yacon syrup; Yaksik [Korean dish consisting primarily of sweet rice with added nuts and jujubes]; Yeast; Yeast and leavening agents; Yeast extracts; Yeast extracts for food; Yeast extracts for human consumption; Yeast for use as an ingredient in foods; Yeast powder; Yerba mate; Yoghurt based ice cream [ice cream predominating]; Yoghurt (Frozen -) [confectionery ices]; Yogurt (Frozen -) [confectionery ices]; Yorkshire puddings; Yuja-cha (Korean honey citron tea); Zefir [confectionery]; Zephyr [confectionery]; Ziti; Zwieback.Class 31 Abalones [live]; Abrasive liners for cat litter pans; Active dried yeast for animals; ***Agricultural*** and aquacultural crops, horticulture and forestry products; ***Agricultural*** grains for planting; ***Agricultural*** produce (Unprocessed -); ***Agricultural*** seeds; Algae for animal consumption; Algae for human consumption; Algae for human or animal consumption; Algae powder for animal consumption; Algae, unprocessed, for human or animal consumption; Algarovilla for animal consumption; Almonds [fruits]; Aloe vera, fresh, for food; Aloe vera plants; Anchovy, live; Animal beverages; Animal biscuits; Animal embryos; Animal fattening preparations; Animal feed; Animal feed preparations; Animal feeds; Animal feedstuffs; Animal food; Animal foodstuffs; Animal foodstuffs consisting of soya bean products; Animal foodstuffs containing air-cured hay; Animal foodstuffs containing hay; Animal foodstuffs derived from air-cured hay; Animal foodstuffs derived from hay; Animal foodstuffs derived from vegetable matter; Animal foodstuffs for the weaning of animals; Animal foodstuffs in the form of nuts; Animal foodstuffs in the form of pellets; Animal foodstuffs in the form of pieces; Animal forage (Lime for -); Animal litter; Animal litter for cats; Animal litter made from hydrated calcium silicate; Animals (Edible chews for -); Animals (Live -); Animals (Menagerie -); Apple tree seeds; Apple trees; Apples (Fresh -); Apples (Unprocessed -); Aquarium fish; Ark-shells [live]; Aromatic sand for pets [litter]; Aromatic sand [litter] for pets; Arrangements of dried flowers for decorative purposes; Arrangements of fresh fruit; Arrangements of natural flowers; Artichokes, fresh; Artificial milk prepared for use as a feeding stuff for calves; Asparagus (Fresh -); Asparagus plant material (Fresh -); Asparagus plants; Asparagus (Unprocessed -); Baby corns, fresh; Bagasses of cane [raw material]; Bagasses of cane [raw materials]; Bait (Fishing -), live; Bait [live]; Bait, not artificial; Baled air-cured hay; Bark for mulches; Bark for use as animal litter; Bark for use in mulching; Bark mulches; Bark-based products for use as animal litter; Bark-based products for use in mulching; Barks (Raw -); Barley; Barley for use in brewing beer; Barley (Unprocessed -); Beans, fresh; Beans (Locust -); Bedding and litter for animals; Bedding material for fowl; Bedding materials for animals; Bee pollen being raw material for industrial use; Bee pollen (Raw -); Bee pollen (Unprocessed -); Beef cattle; Beer barley; Bees; Beet; Beet, fresh; Berries, fresh; Berries, fresh fruits; Berries (Raw -); Berries (Unprocessed -); Betel nuts, fresh; Beverages for animals; Beverages for canines; Beverages for cats; Beverages for dogs; Beverages for pets; Biodegradable mulching plates made of wood fibres; Bird food; Bird seed; Biscuits (Dog -); Biscuits for animals; Biscuits for dogs; Biscuits for puppies; Biscuits made from cereals for animals; Biscuits made from malt for animals; Blue mussels [live]; Boars for breeding purposes; Bones for dogs; Bouquets of dried flowers; Bouquets of fresh flowers; Bran; Bran mash for animal consumption; Bred stock; Breeder birds; Brine shrimp for fish food; Buckwheat, unprocessed; Bulbs; Bulbs (Flower -); Bulbs for ***agricultural*** purposes; Bulbs for horticultural purposes; Bulbs for planting; Bulbs (Plant -); Bulbs (Plant -) for ***agricultural*** use; Bulbs (Plant -) for horticultural use; Bumblebees; Bushes; Bushes [shrubs]; By-products of the processing of cereals, for animal consumption; Cake (Oil -); Cake (Peanut -) for animals; Cake (Rape -) for cattle; Calamari, live; Cannabis plants; Cannabis, unprocessed; Canned foods for dogs; Canned foodstuffs consisting of meat for young animals; Canned foodstuffs containing meat for young animals; Canned foodstuffs for cats; Canned foodstuffs for dogs; Canned or preserved foods for animals; Capelin, live; Capsicums; Carp [live]; Carrots (Fresh -); Cat biscuits; Cat food; Cat litter; Cat litter and litter for small animals; Cat litters; Cat treats [edible]; Catnip; Catnip [fresh]; Cats; Cattle cake; Cattle feed; Cattle food; Cellulose for use as animal bedding; Cellulose sheets for use as animal bedding; Cereal based foodstuffs for animals; Cereal cakes for animals; Cereal grains (Unprocessed -); Cereal seeds, unprocessed; Cereals preparations being food for animals; Cereals products for consumption by animals; Cereals (Residual products of -) for animal consumption; Cereals (Unprocessed -); Cheese flavoured foodstuffs for dogs; Cherries (Fresh -); Cherries (Unprocessed -); Chestnuts, fresh; Chewing bones for dogs; Chews for animals (Edible -); Chicks; Chicory, fresh; Chicory roots; Chicory [salad]; Chillies; Chillies (Unprocessed -); Chinese artichoke, fresh vegetable; Chinese roses; Chinese roses, natural; Chinese toon sprout, fresh vegetable; Chopped straw for animal bedding; Christmas trees; Citrus fruit; Citrus fruit, fresh; Climbing plants; Cocoa beans, raw; Cocoa beans (Unprocessed -); Cocoanut shell; Coconut fibre mulches; Coconut shell; Coconut shells; Coconuts; Cocoons for egg production; Cocoons for silkworm breeding; Cola nuts; Cones (Hop -); Cones (Pine -); Conifer trees; Copra; Cork (Rough -); Corms; Corn husks, dried, for decoration; Corn (Unprocessed -); Courgettes (Fresh -); Crabs [live]; Crabs, live; Crayfish, live; Crop seeds; Crustaceans, live; Cucumbers, fresh; Culinary herbs (Fresh -); Cut Christmas trees; Cut flowers; Cuttings (Plant -); Cuttle bone for birds; Cuttle bone [for cage birds]; Cuttlebones for birds; Cuttlefish bones; Decorative woodchip mulch; Digestible chewing bones and bars for domestic animals; Digestible chewing bones for dogs; Distillery waste for animal consumption; Dog biscuits; Dog food; Dog foods; Dog treats [edible]; Dogs; Draff; Dried alfalfa for animals; Dried boutonnieres; Dried cattails for decoration; Dried corn husks for decoration; Dried corsages; Dried flower arrangements; Dried flower wreaths; Dried flowers; Dried flowers for decoration; Dried herbs for decoration; Dried plants; Dried plants for decoration; Durian saplings; Edible aquatic animals [live]; Edible baits; Edible bird treats; Edible bones and sticks for pets; Edible chewing products for domestic animals; Edible chews for animals; Edible chews for dogs; Edible dog treats; Edible flaxseed, unprocessed; Edible flowers, fresh; Edible food for animals for chewing; Edible horse treats; Edible insects, live; Edible linseed, unprocessed; Edible nuts [unprocessed]; Edible pet treats; Edible seeds [unprocessed]; Edible sesame, unprocessed; Edible silvervine powder for pet cats; Edible treats for animals; Egg laying poultry (Preparations for -); Eggplants; Eggs for hatching; Eggs for hatching, fertilised; Eggs for hatching, fertilized; Fattening preparations (Animal -); Feeding preparations for bees; Feeding substances for bees; Feedingstuffs for animals; Ferns; Fertilised eggs for hatching; Fertilized eggs for hatching; Fir trees for grafting purposes; Fir trees for propagation purposes; Fish eggs for hatching; Fish food; Fish, live; Fish meal [animal feed]; Fish meal for animal consumption; Fish spawn; Fishing bait, live; Flax [linseed] plant seeds; Flax [linseed] plants; Flax meal [fodder]; Flaxseed for animal consumption; Flaxseed meal for animal consumption; Floral decorations [dried]; Floral decorations [fresh]; Floral decorations [natural]; Flounders, live; Flower bulbs; Flower corms; Flower seeds; Flowering plants; Flowers; Flowers, dried, for decoration; Flowers [natural]; Flowers, natural; Flowers (Wreaths of natural -); Fodder; Foliage plants; Food for animals; Food for aquarium fish; Food for birds; Food for cats; Food for dogs; Food for fish; Food for goldfish; Food for hamsters; Food for racing dogs; Food for rodents; Food for wild birds; Food (Pet -); Food preparations for cats; Food preparations for dogs; Food products for animals; Foods containing beef for feeding cats; Foods containing beef for feeding dogs; Foods containing chicken for feeding cats; Foods containing chicken for feeding dogs; Foods containing liver for feeding cats; Foods containing liver for feeding dogs; Foods flavoured with beef for feeding cats; Foods flavoured with beef for feeding dogs; Foods flavoured with chicken for feeding cats; Foods flavoured with chicken for feeding dogs; Foods flavoured with liver for feeding cats; Foods flavoured with liver for feeding dogs; Foods in the form of rings for feeding to cats; Foods in the form of rings for feeding to dogs; Foodstuff for animals; Foodstuff for dogs; Foodstuffs and fodder for animals; Foodstuffs (Animal -); Foodstuffs containing phosphate for feeding animals; Foodstuffs for animals; Foodstuffs for animals containing botanical extracts; Foodstuffs for animals on a milk basis; Foodstuffs for birds; Foodstuffs for calves; Foodstuffs for cats; Foodstuffs for cats based on or consisting of fish; Foodstuffs for cattle; Foodstuffs for chickens; Foodstuffs for dairy animals; Foodstuffs for dogs; Foodstuffs for domestic animals; Foodstuffs for ewes; Foodstuffs for farm animals; Foodstuffs for fish; Foodstuffs for horses; Foodstuffs for marine animals; Foodstuffs for pet animals; Foodstuffs for pigs; Foodstuffs for poultry; Foodstuffs for puppies; Foodstuffs for sheep; Forage; Forage for animals; Formula animal feed; Fortified food substances for animals; Freeze-dried fishing bait; Fresh adzuki beans; Fresh almonds; Fresh apple mangos; Fresh apples; Fresh apricots; Fresh artichokes; Fresh arugula; Fresh asparagus; Fresh avocados; Fresh balloon flower root (Doraji); Fresh bamboo fungus; Fresh bamboo shoots; Fresh bananas; Fresh basil; Fresh bean sprouts; Fresh beans; Fresh beetroots; Fresh beets; Fresh bell peppers; Fresh berries; Fresh black raspberry (Bokbunja); Fresh blackberries; Fresh blackcurrants; Fresh blood oranges; Fresh blueberries; Fresh bok choy; Fresh boysenberries; Fresh Brazil nuts; Fresh broad beans; Fresh brussel sprouts; Fresh brussels sprouts; Fresh burdock root; Fresh cabbage; Fresh carambolas; Fresh carrots; Fresh cashew apples; Fresh cashew nuts; Fresh champignons; Fresh chanterelles; Fresh cherries; Fresh cherry tomatoes; Fresh chervil; Fresh chestnuts; Fresh chick peas; Fresh chickpeas; Fresh chilies; Fresh Chinese yams; Fresh chives; Fresh cilantro; Fresh citrus fruit; Fresh citrus fruits; Fresh cloudberries; Fresh coconuts; Fresh cola nuts; Fresh corn; Fresh corni fructus (Sansuyu) in the nature of live plants; Fresh cranberries; Fresh cucumbers; Fresh culinary herbs; Fresh currant; Fresh cut garlands; Fresh cut wreaths; Fresh dates; Fresh dragon fruits; Fresh durians; Fresh edible aloe vera; Fresh edible black fungi; Fresh edible cacti; Fresh edible flowers; Fresh edible mushrooms; Fresh edible rootstocks; Fresh eggplants; Fresh fava beans; Fresh fern (Gosari); Fresh figs; Fresh finger limes; Fresh flavoring leaves of Japanese pepper tree (Sansho); Fresh flower arrangements; Fresh flowers; Fresh fruit; Fresh fruits; Fresh fruits and vegetables; Fresh fruits, nuts, vegetables and herbs; Fresh funghi; Fresh garden herbs; Fresh garlic; Fresh garlic scapes; Fresh ginger; Fresh gingko nuts; Fresh ginkgo nuts; Fresh ginseng; Fresh goji berries; Fresh golden berries; Fresh gooseberries; Fresh grape tomatoes; Fresh grapefruits; Fresh grapes; Fresh green garlic; Fresh green split-peas; Fresh guavas; Fresh hawthorn fruits; Fresh hazelnuts; Fresh herbs; Fresh horseradish root; Fresh ice cream beans; Fresh jackfruit; Fresh Japanese edible horseradishes (wasabi); Fresh Japanese leeks; Fresh Japanese persimmons; Fresh kale; Fresh kelps; Fresh khorasan wheatgrass; Fresh kiwi fruit; Fresh kohlrabi; Fresh kumquats; Fresh leafy Asian vegetables; Fresh leeks; Fresh legumes; Fresh lemons; Fresh lentils; Fresh lettuce; Fresh limes; Fresh loganberries; Fresh long net stinkhorn; Fresh longan; Fresh loquats; Fresh lotus roots; Fresh lychees; Fresh mandarin oranges; Fresh mandarins; Fresh mangos; Fresh mangosteens; Fresh melons; Fresh mint; Fresh mugwort (Yakssuk) in the nature of live plants; Fresh mulberries; Fresh mushrooms; Fresh napa cabbage (Baechu); Fresh naranjillas; Fresh noni fruit; Fresh nuts; Fresh oak mushroom; Fresh oats; Fresh okra; Fresh olives; Fresh onions; Fresh oranges; Fresh oregano; Fresh oriental melon (Cham-oe); Fresh palm fruits; Fresh papayas; Fresh parsley; Fresh parsnips; Fresh passion fruit; Fresh peaches; Fresh peanuts; Fresh peas; Fresh pecans; Fresh peppers; Fresh perilla leaves (Shiso); Fresh pine mushroom; Fresh pine nuts; Fresh pineapple guavas (feijoa); Fresh pineapples; Fresh pistachio nuts; Fresh plantains; Fresh plants; Fresh plum tomatoes; Fresh plums; Fresh pomegranates; Fresh potatoes; Fresh pulses; Fresh pumpkins; Fresh quince; Fresh radicchio; Fresh rambutans; Fresh raspberries; Fresh redcurrants; Fresh rosemary; Fresh sage; Fresh sapodillas; Fresh sapotes; Fresh scallions; Fresh seaweed; Fresh shallots; Fresh shiitake mushrooms; Fresh soursops; Fresh soy beans; Fresh soya beans; Fresh Spanish limes; Fresh spinach; Fresh star fruit; Fresh strawberries; Fresh strawberry guavas; Fresh string beans; Fresh sugar-apples; Fresh sweet potatoes; Fresh tangerines; Fresh thyme; Fresh tiger nuts; Fresh tomatoes; Fresh truffles; Fresh vegetables; Fresh walnuts; Fresh water chestnuts; Fresh wax apples; Fresh waxberries; Fresh wheat; Fresh wheatgrass; Fresh white carrots (arracacha); Fresh wine grapes; Fresh yams; Fresh yellow peaches; Fresh zucchini; Fruit bushes; Fruit, fresh; Fruit plants; Fruit residue [marc]; Fruit seeds; Fruit shrubs; Fruit trees; Fuller's earth for use as animal litter; Funeral wreaths; Fungi; Garden herbs, fresh; Garden salads; Garlands of natural flowers; Garlic [fresh]; Garlic, fresh; Germ grains; Germ (Seed -) for botanical purposes; Gift baskets of fresh fruits; Ginger, fresh; Goldfish; Grains [cereals]; Grains for animal consumption; Grains [seeds]; Grape vine trees; Grapefruits; Grapes, fresh; Grass; Grass seed; Grass seeds; Grasses [plants]; Gravel paper for bird cages; Groats for poultry; Ground bait [live or natural]; Hamster food; Hamsters; Hanging basket liners [moss]; Hay; Hazelnuts; Hazelnuts, fresh; Helichrysum [shrub]; Helichrysum (shrub); Herbs, dried, for decoration; Herbs (Fresh -); Herbs, fresh (Garden -); Herrings, live; Hop cones; Hop pellets; Hop saplings; Hops; Horse feed; Horticultural mulches; Horticultural mulches made from cocoa shell waste; House plants; Hovenia acerba, fresh; Hybrid wheat seeds; Hydroponic plants; Hydroponic seeds; Irish moss, other than for medical purposes; Juniper berries; Kitty litter; Koi carp, live; Kola nuts; Krill, live; Kumquats; Lawn/turf; Leaf mustard, fresh; Leeks, fresh; Leguminous plants; Lemons, fresh; Lentils, fresh; Lettuce, fresh; Lichees, fresh; Lime for animal forage; Linseed for animal consumption; Linseed meal for animal consumption; Litter for animals; Litter for birds; Litter for cats; Litter for dogs; Litter for domestic animals; Litter for small animals; Litter peat; Live abalones; Live anchovies; Live animals; Live animals, organisms for breeding; Live aquarium coral; Live aquatic creatures; Live ark-shells; Live arthropods for the control of pests; Live bait; Live bait for fishing; Live bait for hunting; Live baits; Live bee pupae; Live birds; Live black-bone chickens; Live blue mussels; Live bullfrogs; Live bushes; Live butterflies; Live carp; Live carps; Live cattle; Live Christmas trees; Live Christmas trees [cut]; Live clams; Live codfishes; Live coral; Live corsages; Live cows; Live crabs; Live crayfish; Live crucian carps; Live cuttlefish; Live ducks; Live edible aquatic animals; Live eels; Live fish; Live fish for food purposes; Live fish for human consumption; Live fish [not for food]; Live fish, other than for human consumption; Live fishing bait; Live flower arrangements; Live flower wreaths; Live flowers; Live game; Live goats; Live goldfish; Live hamsters; Live hatching eggs; Live hens; Live horses; Live insects; Live laboratory animals; Live langoustines; Live lobsters; Live mammals; Live octopuses; Live oysters; Live perches; Live pigs; Live plaices; Live plants; Live plants used as aquarium landscapes; Live plants with symbiotic microorganisms; Live poultry; Live prawns; Live rootstocks; Live roses; Live salmon; Live sardines; Live sea basses; Live sea breams [red snappers]; Live seafood; Live sheep; Live shellfish; Live short-necked clams; Live shrimp; Live shrimps; Live silver carps; Live snails; Live topiaries; Live trees; Live trouts; Livestock; Livestock fattening preparations; Livestock feed; Living animals; Living christmas trees [cut]; Living flowers; Living fruit plants; Living natural flowers; Living plants; Living poultry; Living salad; Lobsters, live; Lobsters (Spiny -), live; Locust beans, raw; Loose hemp for use as animal bedding; Maize; Maize cake for cattle; Maize for consumption by animals; Maize (Processed -) for consumption by animals; Maize products for consumption by animals; Maize products (Processed -) for consumption by animals; Malt; Malt albumen for animal consumption [other than for medical use]; Malt albumin for animal consumption [other than for medical use]; Malt extracts for consumption by animals; Malt for animals; Malt for brewing; Malt for brewing and distilling; Malt for distilling; Malt germs; Malt grains [unprocessed]; Malted barley; Malts and unprocessed cereals; Mandarins [fruit, fresh]; Marc; Marrows; Marrows, fresh; Mash for fattening livestock; Meal for animals; Meal for consumption by animals; Melons; Menagerie animals; Milk for use as foodstuffs for animals; Milk for use as foodstuffs for dogs; Milk replacers for animals; Milk substitutes for use as foodstuffs for animals; Milk-based foodstuffs for animals; Milled food products for animals; Milled peat; Mineral salt licking bricks for livestock; Mineral salts for cattle; Mint [fresh]; Mixed animal feed; Mixed fruits [fresh]; Molluscs, live; Mollusks, live; Moss (Irish -), other than for medical purposes; Mulch; Mulch mats made of natural materials for use in suppressing weeds; Mulch (Straw -); Mulch (Straw -) for weed suppression; Mulches of natural materials for use in suppressing weeds in horticultural environments; Mushroom spawn for propagation; Mushrooms, fresh; Mushrooms, fresh, for food; Mussels, live; Mycelium for ***agricultural*** purposes; Natural edible plants [unprocessed]; Natural flowering plants; Natural flowers; Natural greenery for decoration; Natural plants; Natural plants and flowers; Natural plants [live]; Natural rice for use as animal fodder; Natural seeds; Natural turf; Nettles; Non-artificial turf; Non-debarked timber; Nursery plants; ***Nutrients*** [foodstuffs] for fish; Nuts being fresh; Nuts [fruits]; Nuts, unprocessed; Oat biscuits for consumption by animals; Oat cakes for consumption by animals; Oat-based food for animals; Oatmeal for consumption by animals; Oats; Oats for consumption by animals; Oil cake; Oilseed meal for animals; Olives, fresh; Onions; Onions, fresh; Onions, fresh vegetables; Oranges; Oranges, fresh; Organic fresh fruit; Organic fresh herbs; Organic fresh vegetables; Oyster mushrooms, fresh; Oysters, live; Paddy; Palm fronds; Palm tree leaves [unworked or partly worked material]; Palm trees; Palms [leaves of the palm tree]; Paper for use as animal bedding; Peanut cake for animals; Peanut meal for animals; Peanuts, fresh; Peanuts, unprocessed; Pearl barley [in the husk]; Pears, fresh; Peas, fresh; Peat (Litter -); Peat litter for animals; Peat moss; Pennyroyal [plants]; Peppers [plants]; Pet animals; Pet beverages; Pet birds; Pet food; Pet food for birds; Pet food for dogs; Pet foods; Pet foods in the form of chews; Pet foodstuffs; Pet rabbit food; Pet treats in the nature of bully sticks; Pets (Aromatic sand for -) [litter]; Pets (Sanded paper for -) [litter]; Pig feed; Pigs; Pine cones; Pineapples [fresh]; Plant bulbs for horticultural use; Plant residues (raw materials); Plant seeds; Plants; Plants, dried, for decoration; Plants for aquaria [live]; Plants for ponds [live]; Plants (Live -); Pollen [raw material]; Pollen [raw materials]; Pomegranates; Pomelos, fresh; Potatoes, fresh; Potted dwarfed trees (bonsai); Potted fresh herbs; Potted plants; Poultry for breeding; Poultry grit; Poultry, live; Powdered milk for kittens; Powdered milk for puppies; Prawns, live; Prawns [live]; Preparations for egg laying poultry; Prepared oats for consumption by animals; Preserved crops for animal feeds; Preserved flowers; Preserved flowers for decoration; Processed cereals for consumption by animals; Processed grains for consumption by animals; Processed oats for consumption by animals; Propagation material [seeds]; Pulses [foodstuffs for animals]; Purslane, fresh vegetable; Pyrethrum [plants]; Quassia trees; Quebracho trees; Quinoa, unprocessed; Rabbit food; Rape cake for cattle; Rapeseed meal for animal consumption; Raw ***agricultural*** products; Raw and unprocessed ***agricultural*** products; Raw and unprocessed aquacultural products; Raw and unprocessed forestry products; Raw and unprocessed grains; Raw and unprocessed horticultural products; Raw and unprocessed seeds; Raw apples; Raw apricots; Raw aquacultural products; Raw artichokes; Raw asparagus; Raw avocados; Raw bark; Raw barks; Raw beans; Raw beets; Raw blueberries; Raw cabbage; Raw cereals [unprocessed]; Raw cocoa beans; Raw coconuts; Raw corn; Raw dates; Raw forestry products; Raw fruit; Raw fruits; Raw garlic; Raw ginger; Raw grain; Raw herbs; Raw horseradish root; Raw horticultural products; Raw lemons; Raw mushrooms; Raw nut kernels; Raw nuts; Raw oats; Raw olives; Raw onions; Raw oranges; Raw peaches; Raw peppers; Raw potatoes; Raw quince; Raw red beans; Raw seeds; Raw sugar cane bagasses; Raw timber; Raw tomatoes; Raw vegetables; Raw wheat; Raw zucchini; Reinforced turf; Residual products of cereals for animal consumption; Residue in a still after distillation; Residues from malt treatment for use as an animal feed; Rhizomes; Rhubarb; Rhubarb, fresh; Rice bran [animal feed]; Rice meal for forage; Rice, unprocessed; Root vegetables [fresh]; Roots for animal consumption; Roots for food; Rose bushes; Roses; Roses [plants]; Rough cork; Round timber; Rye; Rye seed; Salad crops; Salad vegetables [fresh]; Salmon, live; Salt for cattle; Salt licks; Sanded paper for domestic animals (litter); Sanded paper for pets [litter]; Sanded paper for use in animal cages; Sanded paper for use in bird cages; Sanded paper [litter] for pets; Saplings; Sardines, live; Sardines [live]; Savory biscuits for animals; Sea basses [live]; Sea breams [red snappers, live]; Sea hares, live; Sea whelks, live; Sea-cucumbers, live; Seaweed for human or animal consumption; Seaweed, unprocessed, for human or animal consumption; Seed germ for botanical purposes; Seed (Mats containing -) for laying lawns; Seed potatoes; Seedlings; Seedlings for planting; Seeds; Seeds, bulbs and seedlings for plant breeding; Seeds coated with a fertilizer; Seeds coated with an anti-parasitic preparation; Seeds for ***agricultural*** purposes; Seeds for ***agricultural*** use; Seeds for flowers; Seeds for fruit; Seeds for growing herbs; Seeds for growing plants; Seeds for horticultural purposes; Seeds for horticultural use; Seeds for planting; Seeds for sowing; Seeds for vegetables; Seeds in pellet form; Seeds of urushi; Seeds (Plant -); Seeds prepared for consumption by animals; Seeds pre-sown in a propagation media for grassing between plants; Seeds pre-sown in a propagation media for grassing between trees; Seeds pre-sown in a propagation media for grassing drainage channels; Seeds pre-sown in fibrous propagation media for grassing banks; Seeds pre-sown in matted fibrous propagation media for grassing banks; Seeds pre-sown in matted fibrous propagation media for grassing fields; Seeds pre-sown in matted fibrous propagation media for grassing golf courses; Seeds pre-sown in matted fibrous propagation media for grassing lawns; Seeds pre-sown in matted fibrous propagation media for grassing paths; Seeds pre-sown in matted fibrous propagation media for grassing sports fields; Seeds pre-sown in matted fibrous propagation media for grassing tracks; Sheep; Shell (Cocoanut -); Shellfish, live; Short-necked clams [live]; Shrimp, live; Shrimps, [live]; Shrimps, live; Shrubs; Shrubs (Live -); Silkworm eggs; Silkworms; Small animal bedding made of recycled paper; Small animal litter; Smolt [live]; Snails [live]; Snakehead fish, live; Snow crabs, live; Sod; Soft-shelled turtles [live]; Soft-shelled turtles, live; Sole fish, live; Sowing seeds; Soy bean meal [animal feed]; Soy sauce cakes [animal feed]; Soya beans, fresh; Spanish mackerel, live; Spawn (Fish -); Spawn for ***agricultural*** purposes; Spinach, fresh; Spiny lobsters, live; Spores and spawn [for ***agricultural*** purposes]; Spores for ***agricultural*** purposes; Squashes; Squashes, fresh; Squid [live]; Squid, live; Stall food for animals; Starch pulp [animal feed]; Straw; Straw [forage]; Straw litter; Straw mulch; Strawberries [fresh]; Strengthening animal forage; Sugar cane; Sugarcane; Sunflower seeds; Sweet biscuits for consumption by animals; Sweet potato leaves, fresh; Sweetcorn [fresh]; Synthetic animal feed; Tangerines [fresh]; Timber (Undressed -); Timber (Unsawn -); Tomatoes [fresh]; Tree trunks; Trees; Trees and forestry products; Trees (Trunks of -); Tropical fruits [fresh]; Truffles, fresh; Trunks of trees; Tubers for plant propagation; Tuna, live; Turf [natural]; Turf, natural; Turkey hens [live]; Turkey [live]; Turkeys [live]; Undaria pinnatifida, fresh; Undressed timber; Unprocessed agar (Tengusa seaweed); Unprocessed ***agricultural*** products; Unprocessed algae for human consumption; Unprocessed apples; Unprocessed apricots; Unprocessed aquacultural products; Unprocessed artichokes; Unprocessed asparagus; Unprocessed avocados; Unprocessed barley; Unprocessed beans; Unprocessed beets; Unprocessed blueberries; Unprocessed brown algae (Hijiki seaweed); Unprocessed buckwheat; Unprocessed cabbage; Unprocessed cereal seeds; Unprocessed cereals; Unprocessed chia seeds; Unprocessed coconuts; Unprocessed corn; Unprocessed dates; Unprocessed edible laver; Unprocessed edible seaweeds; Unprocessed flax seeds; Unprocessed forestry products; Unprocessed foxtail millet; Unprocessed fruits; Unprocessed garlic; Unprocessed ginger; Unprocessed ginseng; Unprocessed grain; Unprocessed grains for eating; Unprocessed herbs; Unprocessed hops; Unprocessed horticultural products; Unprocessed Japanese barnyard millet; Unprocessed kelp (Kombu seaweed); Unprocessed laver; Unprocessed lemons; Unprocessed lychee fruit; Unprocessed mushrooms; Unprocessed nuts; Unprocessed oats; Unprocessed oil seeds; Unprocessed olives; Unprocessed onions; Unprocessed oranges; Unprocessed peaches; Unprocessed peppers; Unprocessed potatoes; Unprocessed proso millet; Unprocessed quince; Unprocessed quinoa; Unprocessed rice; Unprocessed sea lettuce (Aosa seaweed); Unprocessed seaweed (Wakame); Unprocessed seeds; Unprocessed seeds for ***agricultural*** use; Unprocessed shallots; Unprocessed sorghum; Unprocessed spirulina; Unprocessed sugar beets; Unprocessed sugar crops; Unprocessed sweet corn ears [husked or unhusked]; Unprocessed tea leaves; Unprocessed teff; Unprocessed tomatoes; Unprocessed vegetables; Unprocessed wheat; Unprocessed zucchini; Unsawn timber; Unseasoned timber; Urushi tree seeds; Vegetable marrows, fresh; Vegetable seeds; Vegetables, fresh; Vine plants; Waste (Distillery -) for animal consumption; Water chestnuts, fresh; Watermelon, fresh; Weeds for human or animal consumption; Wheat; Wheat bran; Wheat germ for animal consumption; Wheat proteins for animal food; Wheat seed; Wild blueberries, fresh; Wildlife seed mixtures; Wood chips for the manufacture of wood pulp; Wood chips for use as ground cover; Wood shavings for use as animal bedding; Wood shavings for use as animal litter; Woodshavings for use as animal bedding; Woodshavings for use as animal litter; Wreaths of dried herbs for decoration; Wreaths of natural flowers; Yeast extracts for consumption by animals; Yeast for animal consumption; Yeast for animal fodder; Yeast for consumption by animals; Yeast tablets for consumption by animals; Yellow croakers, live; Young fresh soybeans in the pod (eda-mame).Class 32 Aerated fruit juices; Aerated juices; Aerated mineral waters; Aerated water; Aerated water (Preparations for making -); Aerated water [soda water]; Aerated waters; Alcohol free aperitifs; Alcohol free beverages; Alcohol free cider; Alcohol free wine; Alcohol-free beers; Ale; Ales; Aloe juice beverages; Aloe vera drinks, non-alcoholic; Aloe vera juices; Aperitifs, non-alcoholic; Apple juice beverages; Apple juice drinks; Barley wine [Beer]; Barley wine [beer]; Beer; Beer and brewery products; Beer wort; Beer-based beverages; Beer-based cocktails; Beers; Beers enriched with minerals; Beverages consisting of a blend of fruit and vegetable juices; Beverages consisting principally of fruit juices; Beverages containing vitamins; Beverages (Non-alcoholic -); Beverages (Preparations for making -); Beverages (Whey -); Birch water; Bitter lemon; Black beer; Black beer [toasted-malt beer]; Blackcurrant cordial; Blackcurrant juice; Bock beer; Bottled drinking water; Bottled water; Brown rice beverages other than milk substitutes; Carbohydrate drinks; Carbonated mineral water; Carbonated non-alcoholic drinks; Carbonated soft drinks; Carbonated water; Carbonated waters; Cider, non-alcoholic; Cocktails, non-alcoholic; Coconut juice; Coconut water; Coconut water as a beverage; Coconut water as beverage; Coconut-based beverages; Coffee-flavored ale; Coffee-flavored beer; Coffee-flavored soft drinks; Cola; Cola drinks; Colas [soft drinks]; Concentrated fruit juice; Concentrated fruit juices; Concentrates for making fruit drinks; Concentrates for making fruit juices; Concentrates for use in the preparation of soft drinks; Concentrates used in the preparation of soft drinks; Condensed smoked plum juice; Cordials; Cordials [non-alcoholic]; Cordials (non-alcoholic beverages); Craft beer; Craft beers; Cranberry juice; Cream soda; De-alcoholised beer; De-alcoholised drinks; De-alcoholised wines; De-alcoholized beer; De-alcoholized drinks; De-alcoholized wines; Dilutable preparations for making beverages; Distilled drinking water; Douzhi (fermented bean drink); Drinking mineral water; Drinking spring water; Drinking water; Drinking water with vitamins; Drinking waters; Dry ginger ale; Effervescing beverages (Pastilles for -); Effervescing beverages (Powders for -); Energy drinks; Energy drinks containing caffeine; Energy drinks [not for medical purposes]; Essences for making beverages; Essences for making flavoured mineral water [not in the nature of essential oils]; Essences for making non-alcoholic beverages; Essences for making non-alcoholic beverages [not in the nature of essential oils]; Essences for making non-alcoholic drinks, not in the nature of essential oils; Extracts for making beverages; Extracts for making non-alcoholic beverages; Extracts of hops for making beer; Extracts of unfermented must; Flavor enhanced water; Flavored beer; Flavored beers; Flavored mineral water; Flavored waters; Flavoured beers; Flavoured carbonated beverages; Flavoured mineral water; Flavoured waters; Frozen carbonated beverages; Frozen fruit beverages; Frozen fruit drinks; Frozen fruit-based beverages; Frozen fruit-based drinks; Fruit beverages; Fruit beverages and fruit juices; Fruit beverages (non-alcoholic); Fruit drinks; Fruit extracts (Non-alcoholic -); Fruit flavored drinks; Fruit flavored soft drinks; Fruit flavoured carbonated drinks; Fruit flavoured drinks; Fruit flavoured waters; Fruit juice; Fruit juice bases; Fruit juice beverages; Fruit juice beverages (Non-alcoholic -); Fruit juice concentrates; Fruit juice drinks; Fruit juice for use as beverages; Fruit juices; Fruit nectars; Fruit nectars, nonalcoholic; Fruit nectars, non-alcoholic; Fruit smoothies; Fruit squashes; Fruit-based beverages; Fruit-based soft drinks flavored with tea; Fruit-flavored beverages; Fruit-flavored soft drinks; Fruit-flavoured beverages; Functional water-based beverages; Ginger ale; Ginger beer; Ginger juice beverages; Glacial water; Grape juice; Grape juice beverages; Grape must, unfermented; Grapefruit juice; Green vegetable juice beverages; Guarana drinks; Guava juice; Honey-based beverages (Non-alcoholic -); Hop extracts for manufacturing beer; Hop extracts for use in the preparation of beverages; Hops (Extracts of -) for making beer; Iced fruit beverages; Imitation beer; India pale ales (IPAs); IPA (Indian Pale Ale); Isotonic beverages; Isotonic beverages [not for medical purposes]; Isotonic drinks; Isotonic non-alcoholic drinks; Juice drinks; Juice (Fruit -); Juices; Kvass; Kvass [non-alcoholic beverage]; Kvass [non-alcoholic beverages]; Lager; Lagers; Lemon barley water; Lemon juice for use in the preparation of beverages; Lemon squash; Lemonade; Lemonades; Lime juice cordial; Lime juice for use in the preparation of beverages; Liqueurs (Preparations for making -); Lithia water; Low alcohol beer; Low calorie soft drinks; Low-alcohol beer; Low-calorie soft drinks; Malt beer; Malt syrup for beverages; Malt wort; Mango juice; Maple water; Melon juice; Mineral and aerated waters; Mineral enriched water [beverages]; Mineral water; Mineral water [beverages]; Mineral water (Non-medicated -); Mineral waters; Mineral waters [beverages]; Mixed fruit juice; Mixed fruit juices; Mixes for making sorbet beverages; Mung bean beverages; Must; Nectars (Fruit -), non-alcoholic; Non alcoholic aperitifs; Non-alcoholic beer; Non-alcoholic beer flavored beverages; Non-alcoholic beers; Non-alcoholic beverages; Non-alcoholic beverages containing fruit juices; Non-alcoholic beverages containing vegetable juices; Non-alcoholic beverages flavored with coffee; Non-alcoholic beverages flavored with tea; Non-alcoholic beverages flavoured with coffee; Non-alcoholic beverages flavoured with tea; Non-alcoholic beverages with tea flavor; Non-alcoholic carbonated beverages; Non-alcoholic cinnamon punch with dried persimmon (sujeonggwa); Non-alcoholic cocktail bases; Non-alcoholic cocktail mixes; Non-alcoholic cocktails; Non-alcoholic cordials; Non-alcoholic dried fruit beverages; Non-alcoholic drinks; Non-alcoholic drinks enriched with vitamins and mineral salts; Non-alcoholic essences for making beverages; Non-alcoholic flavored carbonated beverages; Non-alcoholic fruit cocktails; Non-alcoholic fruit drinks; Non-alcoholic fruit extracts; Non-alcoholic fruit extracts used in the preparation of beverages; Non-alcoholic fruit juice beverages; Non-alcoholic fruit punch; Non-alcoholic grape juice beverages; Non-alcoholic honey-based beverages; Non-alcoholic malt beverages; Non-alcoholic malt drinks; Non-alcoholic malt free beverages [other than for medical use]; Non-alcoholic preparations for making beverages; Non-alcoholic punch; Non-alcoholic punches; Non-alcoholic rice punch (sikhye); Non-alcoholic soda beverages flavoured with tea; Non-alcoholic sparkling fruit juice drinks; Non-alcoholic syrups for making beverages; Non-alcoholic vegetable juice drinks; Non-alcoholic wine; Non-alcoholic wines; Non-carbonated soft drinks; Nut and soy based beverages; Nutritionally fortified beverages; Nutritionally fortified water; Oat-based beverages [not being milk substitutes]; Orange barley water; Orange juice; Orange juice beverages; Orange juice drinks; Orange squash; Organic fruit juice; Orgeat; Pale ale; Part frozen slush drinks; Pastilles for effervescing beverages; Pineapple juice beverages; Pomegranate juice; Porter; Powders for effervescing beverages; Powders for the preparation of beverages; Powders used in the preparation of coconut water drinks; Powders used in the preparation of fruit-based beverages; Powders used in the preparation of fruit-based drinks; Powders used in the preparation of soft drinks; Preparation for making non-alcoholic beverages; Preparations for making aerated water; Preparations for making beverages; Preparations for making carbonated water; Preparations for making liqueurs; Protein drinks; Protein-enriched sports beverages; Purified drinking water; Quinine water; Ramune (Japanese soda pops); Red ginseng juice beverages; Rice-based beverages, other than milk substitutes; Root beer; Root beers; Root beers, non-alcoholic beverages; Saison beer; Sarsaparilla [non-alcoholic beverage]; Seltzer water; Shandy; Sherbet beverages; Sherbets [beverages]; Slush drinks; Smoked plum beverages; Smoked plum juice beverages; Smoothies; Smoothies containing grains and oats; Smoothies [fruit beverages, fruit predominating]; Smoothies [non-alcoholic fruit beverages]; Soda pops; Soda water; Soft drinks; Soft drinks flavored with tea; Soft drinks for energy supply; Sorbets [beverages]; Sorbets in the nature of beverages; Soy beverage; Soya-based beverages, other than milk substitutes; Soy-based beverages, not being milk substitutes; Sparkling water; Sports drinks; Sports drinks containing electrolytes; Spring water; Spring waters; Squashes [non-alcoholic beverages]; Still water; Still waters; Stout; Stouts; Syrup for making beverages; Syrup for making lemonade; Syrups and other non-alcoholic preparations for making beverages; Syrups for beverages; Syrups for lemonade; Syrups for making beverages; Syrups for making flavoured mineral waters; Syrups for making fruit-flavored drinks; Syrups for making non-alcoholic beverages; Syrups for making soft drinks; Syrups for making whey-based beverages; Syrups used in the preparation of soft drinks; Table water; Table waters; Tomato juice [beverage]; Tomato juice beverages; Tonic water; Tonic water [non-medicated beverages]; Unfermented preserved must; Vegetable drinks; Vegetable juice; Vegetable juices [beverage]; Vegetable juices [beverages]; Vegetable smoothies; Vegetable-based beverages; Vitamin enriched sparkling water [beverages]; Vitamin fortified non-alcoholic beverages; Water; Water enhanced with minerals; Water (Lithia -); Water (Seltzer -); Water-based beverages containing tea extracts; Watermelon juice; Waters; Waters [beverages]; Waters (Table -); Wheat beer; Whey beverages.Class 33 Absinthe; Acanthopanax wine (Ogapiju); Aguardiente [sugarcane spirits]; Akvavit; Alcohol (Rice -); Alcoholic aperitif bitters; Alcoholic aperitifs; Alcoholic beverages containing fruit; Alcoholic beverages, except beer; Alcoholic beverages (except beer); Alcoholic beverages except beers; Alcoholic beverages (except beers); Alcoholic beverages [except beers]; Alcoholic beverages of fruit; Alcoholic bitters; Alcoholic carbonated beverages, except beer; Alcoholic cocktail mixes; Alcoholic cocktails; Alcoholic cocktails containing milk; Alcoholic cocktails in the form of chilled gelatins; Alcoholic coffee-based beverage; Alcoholic cordials; Alcoholic egg nog; Alcoholic energy drinks; Alcoholic essences; Alcoholic extracts; Alcoholic fruit beverages; Alcoholic fruit cocktail drinks; Alcoholic fruit extracts; Alcoholic jellies; Alcoholic preparations for making beverages; Alcoholic punches; Alcoholic tea-based beverage; Alcoholic wines; Alcopops; Amontillado; Anise [liqueur]; Anisette; Anisette [liqueur]; Aperitif wines; Aperitifs; Aperitifs with a distilled alcoholic liquor base; Aquavit; Arak; Arak [arrack]; Arrack; Arrack [arak]; Baijiu [Chinese distilled alcoholic beverage]; Beverages (Alcoholic -), except beer; Beverages containing wine [spritzers]; Beverages (Distilled -); Bitters; Black raspberry wine (Bokbunjaju); Blackberry wine; Blackcurrant liqueur; Blended whisky; Bourbon whiskey; Brandy; Cachaca; Calvados; Canadian whisky; Cherry brandy; Chinese brewed liquor (laojiou); Chinese mixed liquor (wujiapie-jiou); Chinese spirit of sorghum (gaolian-jiou); Chinese white liquor (baiganr); Chinese white liquor [baiganr]; Cider; Ciders; Cocktails; Coffee-based liqueurs; Cooking brandy; Cooking wine; Cordials [alcoholic beverages]; Cream liqueurs; Curacao; Dessert wines; Digesters [liqueurs and spirits]; Distilled beverages; Distilled rice spirits [awamori]; Distilled spirits; Distilled spirits of rice (awamori); Dry cider; Extracts of spiritous liquors; Fermented spirit; Flavored tonic liquors; Fortified wines; Fruit (Alcoholic beverages containing -); Fruit extracts, alcoholic; Fruit wine; Gaolian-jiou [sorghum-based Chinese spirits]; Gin; Ginseng liquor; Grain-based distilled alcoholic beverages; Grape wine; Grappa; Herb liqueurs; Hulless barley liquor; Hydromel [mead]; Japanese liquor containing herb extracts; Japanese liquor containing mamushi-snake extracts; Japanese liquor flavored with Japanese plum extracts; Japanese liquor flavored with pine needle extracts; Japanese regenerated liquors (naoshi); Japanese sweet grape wine containing extracts of ginseng and cinchona bark; Japanese sweet rice-based mixed liquor (shiro-zake); Japanese sweet rice-based mixed liquor [shiro-zake]; Japanese white liquor (shochu); Japanese white liquor [shochu]; Kirsch; Korean distilled spirits (soju); Korean traditional rice wine (makgeoli); Liqueurs; Liqueurs containing cream; Liquor-based aperitifs; Low alcoholic drinks; Low-alcoholic wine; Malt whisky; Mead [hydromel]; Mulled wine; Mulled wines; Natural sparkling wines; Naturally sparkling wines; Nira [sugarcane-based alcoholic beverage]; Peppermint liqueurs; Perry; Piquette; Potable spirits; Pre-mixed alcoholic beverages; Pre-mixed alcoholic beverages, other than beer-based; Preparations for making alcoholic beverages; Prepared alcoholic cocktails; Prepared wine cocktails; Red ginseng liquor; Red wine; Red wines; Rice alcohol; Rose wines; Rum; Rum [alcoholic beverage]; Rum infused with vitamins; Rum punch; Rum-based beverages; Sake; Sake substitutes; Sangria; Schnapps; Scotch whisky; Scotch whisky based liqueurs; Sherry; Shochu (spirits); Sorghum-based Chinese spirits; Sparkling fruit wine; Sparkling grape wine; Sparkling red wines; Sparkling white wines; Sparkling wine; Sparkling wines; Spirits; Spirits [beverages]; Still wine; Strawberry wine; Sugar cane juice rum; Sugarcane-based alcoholic beverages; Sweet cider; Sweet wine; Sweet wines; Table wines; Tonic liquor containing herb extracts (homeishu); Tonic liquor containing mamushi-snake extracts (mamushi-zake); Tonic liquor flavored with japanese plum extracts (umeshu); Tonic liquor flavored with pine needle extracts (matsuba-zake); Vermouth; Vodka; Whiskey; Whiskey [whisky]; Whisky; White wine; White wines; Wine; Wine coolers [drinks]; Wine punch; Wine-based aperitifs; Wine-based drinks; Wines; Wines of protected appellation of origin; Wines of protected geographical indication; Yellow rice wine.Class 35 Account auditing; Accountancy; Accountancy advice relating to tax preparation; Accountancy advice relating to taxation; Accountancy advice relating to the preparation of tax returns; Accountancy, book keeping and auditing; Accountancy services; Accountancy services relating to accounts receivable; Accounting; Accounting advisory services; Accounting consultancy relating to taxation; Accounting for third parties; Accounting, in particular book-keeping; Accounting services; Accounting services for mergers and acquisitions; Accounting services for pension funds; Accounting services relating to costs for farming enterprises; Accounting services relating to tax planning; Accounts (Drawing up of statements of -); Accounts (Preparation of -); Acquisition (Business -) searches; Acquisition of business information relating to company activities; Acquisition of business information relating to company status; Acquisition of commercial information; Acquisitions (Advice relating to -); Acquisitions (Business -) consulting services; Addressing envelopes; Addressing of envelopes; Administering medication reimbursement programs and services; Administering of professional competency testing; Administering of professional [vocational] certifications; Administering pharmacy reimbursement programs and services; Administration, billing and reconciliation of accounts on behalf of others; Administration (Business -) relating to statistical methods; Administration (Commercial -) of the licensing of the goods and services of others; Administration of a discount program for enabling participants to obtain discounts on goods and services through use of a discount membership card; Administration of business affairs; Administration of business payroll for others; Administration of businesses; Administration of competitions for advertising purposes; Administration of consumer loyalty programs; Administration of contests for advertising purpose; Administration of cultural and educational exchange programs; Administration of customer loyalty and incentive schemes; Administration of employee benefit plans; Administration of employee pension plans; Administration of employee welfare benefit plans; Administration of foreign business affairs; Administration of frequent flyer programmes that allow members to redeem miles for points or awards offered by other loyalty programmes; Administration of frequent flyer programs; Administration of frequent flyer programs that allow members to redeem miles for points or awards offered by other loyalty programs; Administration of incentive award programs to promote the sale of the goods and services of others; Administration of loyalty and incentive schemes; Administration of loyalty programs involving discounts or incentives; Administration of loyalty rewards programmes; Administration of loyalty rewards programs; Administration of loyalty rewards programs featuring trading stamps; Administration of membership schemes; Administration of newspaper subscription [for others]; Administration of patient reimbursement programs; Administration of preferred provider plans; Administration of prepaid health care plans; Administration of sales and promotional incentive schemes; Administration of sales promotion incentive programs; Administration of the business affairs of franchises; Administration of the business affairs of retail stores; Administration relating to business appraisal; Administration relating to business planning; Administration relating to marketing; Administration relating to sales methods; Administrative accounting; Administrative assistance in responding to calls for tenders; Administrative assistance in responding to requests for proposals [RFPs]; Administrative ***data*** processing; Administrative hotel management; Administrative loyalty card services; Administrative management of health care clinics; Administrative management of hospitals; Administrative order processing; Administrative processing and organising of mail order services; Administrative processing of computerized purchase orders; Administrative processing of orders; Administrative processing of purchase orders; Administrative processing of purchase orders placed by telephone or computer; Administrative processing of purchase orders within the framework of services provided by mail-order companies; Administrative processing of warranty claims; Administrative services for medical referrals; Administrative services for the relocation of businesses; Administrative services relating to credit card registration; Administrative services relating to customs clearance; Administrative services relating to dental health insurance; Administrative services relating to employee stock plans; Administrative services relating to hospital referrals; Administrative services relating to referrals for general building contractors; Administrative services relating to referrals for insurance agents; Administrative services relating to the management of legal dockets; Administrative services relating to the referral of clients to lawyers; Administrative services relating to the referral of patients; Administrative services relating to the relocation of personnel; Administrative services relating to warranty claims processing; Administrative support and ***data*** processing services; Advertisement and publicity services by television, radio, mail; Advertisement billboards (Rental of -); Advertisement for others on the Internet; Advertisement hoarding rental; Advertisement hoardings (Rental of -); Advertisement via mobile phone networks; Advertisements (Placing of -); Advertisements (Preparing of -); Advertising; Advertising agencies; Advertising agency services; Advertising analysis; Advertising and advertisement services; Advertising and marketing; Advertising and marketing consultancy; Advertising and marketing services; Advertising and marketing services provided by means of blogging; Advertising and marketing services provided by means of social media; Advertising and marketing services provided via communications channels; Advertising and promotion services; Advertising and promotion services and related consulting; Advertising and promotional services; Advertising and publicity; Advertising and publicity services; Advertising automobiles for sale by means of the Internet; Advertising business especially in the field of telematic and telephone networks; Advertising by mail order; Advertising by transmission of on-line publicity for third parties through electronic communications networks; Advertising consultation; Advertising copywriting; Advertising flyer distribution; Advertising flyer distribution for others; Advertising for motion picture films; Advertising for others; Advertising in periodicals, brochures and newspapers; Advertising in the field of tourism and travel; Advertising in the popular and professional press; Advertising, including on-line advertising on a computer network; Advertising, including promotion of products and services of third parties through sponsoring arrangements and licence agreements relating to international sports' events; Advertising, marketing and promotion services; Advertising, marketing and promotional consultancy, advisory and assistance services; Advertising, marketing and promotional services; Advertising material (Dissemination of -); Advertising material (Updating of -); Advertising matter (Dissemination of -); Advertising matter (Production of -); Advertising of business web sites; Advertising of cinemas; Advertising of commercial or residential real estate; Advertising of the goods of other vendors, enabling customers to conveniently view and compare the goods of those vendors; Advertising of the services of other vendors, enabling customers to conveniently view and compare the services of those vendors; Advertising on the Internet for others; Advertising particularly services for the promotion of goods; Advertising planning; Advertising, promotional and marketing services; Advertising, promotional and public relations services; Advertising relating to pharmaceutical products and in-vivo imaging products; Advertising relating to transport and delivery; Advertising research; Advertising research services; Advertising services; Advertising services by means of balloon displays; Advertising services by means of sandwich board; Advertising services by means of television screen based text; Advertising services for architects; Advertising services for promoting the brokerage of stocks and other securities; Advertising services for the literary industry; Advertising services for the promotion of beverages; Advertising services for the promotion of e-commerce; Advertising services of a radio and television advertising agency; Advertising services provided by a radio and television advertising agency; Advertising services provided by television; Advertising services provided for florists; Advertising services provided for others; Advertising services provided over the internet; Advertising services provided via a ***data*** base; Advertising services provided via the internet; Advertising services relating to books; Advertising services relating to clothing; Advertising services relating to cosmetics; Advertising services relating to ***data*** bases; Advertising services relating to esports events; Advertising services relating to financial investment; Advertising services relating to financial services; Advertising services relating to hotels; Advertising services relating to in vivo imaging apparatus; Advertising services relating to in vivo imaging products; Advertising services relating to jewelry; Advertising services relating to motor cars; Advertising services relating to newspapers; Advertising services relating to perfumery; Advertising services relating to pharmaceutical products; Advertising services relating to pharmaceuticals; Advertising services relating to pharmaceuticals for the treatment of diabetes; Advertising services relating to public works; Advertising services relating to real property; Advertising services relating to the commercialization of new products; Advertising services relating to the marine and maritime industry; Advertising services relating to the motor vehicle industry; Advertising services relating to the provision of business; Advertising services relating to the recruitment of personnel; Advertising services relating to the sale of goods; Advertising services relating to the sale of motor vehicles; Advertising services relating to the sale of personal property; Advertising services relating to the transport industries; Advertising services relating to the travel industries; Advertising services to create corporate and brand identity; Advertising services to promote public awareness in the field of social welfare; Advertising services to promote public awareness of environmental issues and initiatives; Advertising services to promote public awareness of environmental matters; Advertising services to promote public awareness of medical conditions; Advertising services to promote public awareness of medical issues; Advertising services to promote public awareness of nephrotic syndrome and focal segmental glomerulosclerosis [FSGS]; Advertising services to promote public awareness of social issues; Advertising services to promote public awareness of the benefits of shopping locally; Advertising services to promote the sale of beverages; Advertising space (Rental of -); Advertising space (Rental of -) on the internet; Advertising text publication services; Advertising the goods and services of online vendors via a searchable online guide; Advertising through all public communication means; Advertising via electronic media and specifically the internet; Advertising via the Internet; Advice and information concerning commercial business management; Advice concerning chemical product marketing; Advice for consumers (Commercial information and -) [consumer advice shop]; Advice in the field of business management and marketing; Advice in the running of establishments as franchises; Advice on tax preparation; Advice on the analysis of consumer buying habits and needs provided with the help of sensory, quality and quantity-related ***data***; Advice relating to barter trade; Advice relating to business management; Advice relating to business organisation; Advice relating to business organization; Advice relating to marketing management; Advice relating to personnel management; Advice relating to the acquisition of businesses; Advice relating to the business management of fitness clubs; Advice relating to the business management of health clubs; Advice relating to the business operation of fitness clubs; Advice relating to the business operation of health clubs; Advice relating to the organisation and management of business; Advice relating to the sale of businesses; Advising commercial enterprises in the conduct of their business; Advising industrial enterprises in the conduct of their business; Advisory and consultancy services relating to import-export agencies; Advisory and consultancy services relating to the procurement of goods for others; Advisory services and information in business organization and management; Advisory services (Business -) relating to the establishment of franchises; Advisory services (Business -) relating to the exploitation of inventions; Advisory services (Business -) relating to the management of businesses; Advisory services (Business -) relating to the management of public sector businesses; Advisory services (Business -) relating to the operation of franchises; Advisory services for business management; Advisory services for preparing and carrying out commercial transactions; Advisory services relating to advertising; Advisory services relating to business acquisitions; Advisory services relating to business administration; Advisory services relating to business analysis; Advisory services relating to business management; Advisory services relating to business management and business operations; Advisory services relating to business organisation; Advisory services relating to business organisation and management; Advisory services relating to business organization; Advisory services relating to business planning; Advisory services relating to business risk management; Advisory services relating to commercial planning; Advisory services relating to commercial transactions; Advisory services relating to corporate identity; Advisory services relating to ***data*** processing; Advisory services relating to electronic ***data*** processing; Advisory services relating to market research; Advisory services relating to marketing; Advisory services relating to personnel placement; Advisory services relating to personnel recruitment; Advisory services relating to promotional activities; Advisory services relating to public relations; Advisory services relating to publicity for franchisees; Advisory services relating to sales promotion; Advisory services relating to tax preparation; Advisory services relating to the corporate structure of businesses; Advisory services relating to the corporate structure of companies; Advisory services relating to the operation of franchises; Advisory services relating to the ordering of stationery; Advisory services relating to the purchase of goods on behalf of business; Advisory services relating to the purchase of goods on behalf of others; Affiliate marketing; Agency services for arranging business introductions; Agency services for promoting sports personalities; Airport administration services; Alcoholic beverage procurement services for others [purchasing goods for other businesses]; Analysis (Cost price -); Analysis of advertising response; Analysis of advertising response and market research; Analysis of business ***data***; Analysis of business information; Analysis of business management systems; Analysis of business ***statistics***; Analysis of business trends; Analysis of company attitudes; Analysis of company behaviour; Analysis of market research ***data***; Analysis of market research ***data*** and ***statistics***; Analysis of market research ***statistics***; Analysis of marketing trends; Analysis of markets; Analysis of the public awareness of advertising; Analysis relating to marketing; Announcement services for advertising purposes; Answering (Telephone -) for unavailable subscribers; Appointment reminder services [office functions]; Appointment scheduling services [office functions]; Appraisal of business opportunities; Appraisals (Business -); Arrangement of advertising; Arranging advertising and promotional contracts for others; Arranging advertising contracts for others; Arranging and concluding commercial transactions for others; Arranging and conducting auctions; Arranging and conducting business fairs; Arranging and conducting commercial trade shows; Arranging and conducting marketing promotional events for others; Arranging and conducting of advertising events; Arranging and conducting of art exhibitions for commercial or advertising purposes; Arranging and conducting of auctions and reverse auctions via computer and telecommunication networks; Arranging and conducting of auctions and reverse auctions via mobile telephones; Arranging and conducting of business meetings; Arranging and conducting of commercial exhibitions; Arranging and conducting of commercial exhibitions and shows; Arranging and conducting of demonstrations for advertising purposes; Arranging and conducting of displays for advertising purposes; Arranging and conducting of exhibitions for business purposes; Arranging and conducting of fairs and exhibitions for advertising purposes; Arranging and conducting of fairs and exhibitions for business and advertising purposes; Arranging and conducting of fairs and exhibitions for business purposes; Arranging and conducting of flea markets; Arranging and conducting of Internet auctions; Arranging and conducting of marketing events; Arranging and conducting of promotional events; Arranging and conducting of real estate auctions; Arranging and conducting of telephone auctions; Arranging and conducting of television auctions; Arranging and conducting recruitment fairs; Arranging and conducting sales events for cattle; Arranging and conducting sales events for livestock; Arranging and conducting sales events for others of livestock and registered and commercial cattle; Arranging and conducting trade fairs; Arranging and conducting trade show exhibitions; Arranging and conducting trade shows; Arranging and conducting trade shows relating to publishing; Arranging and conduction of auction sales; Arranging and placing of advertisements; Arranging business introductions; Arranging business introductions relating to the buying and selling of products; Arranging commercial transactions, for others, via online shops; Arranging for the provision of advertising space in newspapers; Arranging newspaper subscriptions; Arranging newspaper subscriptions for others; Arranging of advertising in cinemas; Arranging of auction sales; Arranging of auctions; Arranging of business introductions; Arranging of buying and selling contracts for third parties; Arranging of ***collective*** buying; Arranging of commercial and business contacts; Arranging of competitions for advertising purposes; Arranging of contracts for others for the buying and selling of goods; Arranging of contracts, for others, for the providing of services; Arranging of contracts for the purchase and sale of goods and services, for others; Arranging of contractual [trade]services with third parties; Arranging of demonstrations for advertising purposes; Arranging of demonstrations for business purposes; Arranging of demonstrations for commercial purposes; Arranging of demonstrations for trade purposes; Arranging of displays for advertising purposes; Arranging of displays for business purposes; Arranging of displays for commercial purposes; Arranging of displays for trade purposes; Arranging of exhibitions for advertising purposes; Arranging of exhibitions for business purposes; Arranging of exhibitions for commercial purposes; Arranging of exhibitions for trade purposes; Arranging of newspaper subscriptions for others; Arranging of presentations for advertising purposes; Arranging of presentations for business purposes; Arranging of presentations for commercial purposes; Arranging of presentations for trade purposes; Arranging of product launches; Arranging of subscriptions for the publications of others; Arranging of trade fairs; Arranging of trade shows; Arranging of trading transactions and commercial contracts; Arranging promotion of charitable fundraising events; Arranging subscriptions of the online publications of others; Arranging subscriptions to a television channel; Arranging subscriptions to electronic journals; Arranging subscriptions to information media; Arranging subscriptions to information packages; Arranging subscriptions to Internet services; Arranging subscriptions to media packages; Arranging subscriptions to publications for others; Arranging subscriptions to telecommunication services for others; Arranging subscriptions to telecommunication services [for others]; Arranging subscriptions to telephone services; Arranging the buying of goods for others; Arranging the distribution of advertising literature in response to telephone enquiries; Arranging the distribution of advertising samples; Arranging the distribution of advertising samples in response to telephone enquiries; Artists (Business management of performing -); Assessment analysis relating to business management; Assistance, advisory services and consultancy with regard to business analysis; Assistance, advisory services and consultancy with regard to business management; Assistance, advisory services and consultancy with regard to business organization; Assistance, advisory services and consultancy with regard to business planning; Assistance and advice regarding business management; Assistance and advice regarding business organisation and management; Assistance and advice regarding business organization; Assistance and advice regarding business organization and management; Assistance and consultancy relating to business management and organisation; Assistance and consultancy services in the field of business management of companies in the energy sector; Assistance (Business management -); Assistance in business management within the framework of a franchise contract; Assistance in franchised commercial business management; Assistance in management of business activities; Assistance in product commercialization, within the framework of a franchise contract; Assistance relating to business organisation; Assistance relating to recruitment and placement of staff; Assistance to commercial enterprises in the management of their business; Assistance to industrial enterprises in the conduct of their business; Assistance to industrial or commercial enterprises in the running of their business; Assistance to management in commercial enterprises in respect of advertising; Assistance to management in commercial enterprises in respect of public relations; Assistance with business management; Assistance with business planning; Auction and reverse auction services; Auction sales (Arranging of -); Auction services; Auctioneering; Auctioneering of property; Auctioneering provided on the internet; Auctioneering services; Auctioneering services provided via telecommunication networks; Auctioneering services relating to ***agriculture***; Auctioning of vehicles; Auctioning via telecommunication networks; Audience rating determination for radio and television broadcasts; Audio-visual displays for advertising purposes (Preparation or presentation of -); Auditing of accounts; Auditing of financial statements; Auditing utility rates for others; Auditioning of performing artists [selection of personnel]; Automated ***data*** processing; Automatic re-ordering service for business; Automobile registration services; Balance sheet accounting; Banner advertising; Benchmarking (evaluation of business organisation practices); Benchmarking services; Bidding quotation; Bill presentment services; Bill sticking; Billing; Billing services; Billing services in the field of energy; Billing services in the field of healthcare; Bill-posting; Blogger outreach services; Book club services retailing books to its members; Booking agent services for models; Bookkeeping; Book-keeping; Book-keeping and accounting; Book-keeping and accounting services; Bookkeeping for electronic funds transfer; Brand creation services; Brand creation services (advertising and promotion); Brand evaluation services; Brand positioning; Brand positioning services; Brand strategy services; Brand testing; Brokerage of name and address based lists; Business accounting advisory services; Business accounts management; Business acquisitions; Business acquisitions (Advice relating to -); Business acquisitions consultation; Business administration; Business administration and management; Business administration assistance; Business administration consultancy; Business administration for others; Business administration in the field of transport and delivery; Business administration of employee share schemes; Business administration services; Business administration services for processing sales made on the internet; Business administration services for the processing of sales made on a global computer network; Business administration services for the processing of sales made on the Internet; Business administration services in the field of healthcare; Business administration services in the field of transportation; Business advertising services relating to franchising; Business advice; Business advice and consultancy relating to franchising; Business advice, inquiries or information; Business advice relating to accounting; Business advice relating to acquisitions; Business advice relating to advertising; Business advice relating to disposals; Business advice relating to financial re-organisation; Business advice relating to franchising; Business advice relating to growth financing; Business advice relating to marketing; Business advice relating to marketing management consultations; Business advice relating to mergers; Business advice relating to restaurant franchising; Business advice relating to strategic marketing; Business advisory and consultancy services; Business advisory services; Business advisory services provided to determine pay and grading structures; Business advisory services relating to business liquidations; Business advisory services relating to company performance; Business advisory services relating to franchising; Business advisory services relating to franchising of a motor dealership; Business advisory services relating to product development; Business advisory services relating to product manufacturing; Business advisory services relating to the establishment and operation of franchises; Business advisory services relating to the establishment of motor dealership; Business advisory services relating to the running of restaurants; Business advisory services relating to the running of sandwich bars; Business advisory services relating to the selection of computers; Business advisory services relating to the setting up of restaurants; Business advisory services relating to the setting up of sandwich bars; Business advisory services relating to the use of computers; Business advisory services to determine pay and grading structures by job evaluation; Business analysis; Business analysis and information services, and market research; Business analysis of markets; Business analysis services; Business and commercial information services; Business and market research; Business appraisal; Business appraisal consultancy; Business appraisal services; Business appraisals; Business appraisals and evaluations in business matters; Business assistance; Business assistance, management and administrative services; Business assistance relating to business image; Business assistance relating to corporate identity; Business assistance relating to franchising; Business assistance relating to starting and running a franchise; Business assistance relating to the establishment of franchises; Business assistance relating to the formation of commercial undertakings; Business auditing; Business brokerage services; Business consultancy; Business consultancy and advisory services; Business consultancy, in the field of transport and delivery; Business consultancy (Professional -); Business consultancy relating to the administration of information technology; Business consultancy services; Business consultancy services relating to ***data*** processing; Business consultancy services relating to disaster planning and recovery; Business consultancy services relating to insolvency; Business consultancy services relating to management of fund raising campaigns; Business consultancy services relating to manufacturing; Business consultancy services relating to product development; Business consultancy services relating to the marketing of fund raising campaigns; Business consultancy services relating to the promotion of fund raising campaigns; Business consultancy services relating to the supply of quality management systems; Business consultancy to firms; Business consultancy to individuals; Business consultation; Business consultation relating to advertising; Business consultation services; Business consulting; Business consulting for enterprises; Business consulting services; Business consulting services in the ***agriculture*** field; Business ***data*** analysis; Business ***data*** analysis services; Business efficiency advice; Business efficiency expert services; Business efficiency studies; Business Enquiries; Business enquiries and investigations; Business enquiry services; Business examinations services; Business expertise; Business expertise services; Business feasibility studies; Business file management; Business information; Business information agency services; Business information and inquiries; Business information and research services; Business information (Compilation of -); Business information for enterprises; Business information for enterprises (Provision of -); Business information (Provision of -); Business information services; Business information services provided online from a computer database or the internet; Business information services provided on-line from a computer database or the internet; Business information services provided online from a global computer network or the internet; Business inquiries; Business intelligence services; Business intermediary and advisory services in the field of selling products and rendering services; Business intermediary services relating to the matching of potential private investors with entrepreneurs needing funding; Business introduction services; Business introductions (Arranging -); Business investigation; Business investigations; Business invoicing services; Business management; Business management advice; Business management advice and assistance; Business management advice relating to manufacturing business; Business management advisory services; Business management advisory services relating to commercial enterprises; Business management advisory services relating to franchising; Business management advisory services relating to industrial enterprises; Business management analysis; Business management and administration; Business management and consultancy; Business management and consultancy services; Business management and consultation; Business management and consultation services; Business management and consulting; Business management and consulting services; Business management and enterprise organization consultancy; Business management and organisation consultancy; Business management and organisation consultancy services; Business management and organization consultancy; Business management and organization consultancy services; Business management assistance; Business management assistance for industrial or commercial companies; Business management assistance in the establishment and operation of restaurants; Business management assistance in the field of franchising; Business management assistance in the operation of restaurants; Business management consultancy; Business management consultancy, also via the Internet; Business management consultancy and advisory services; Business management consultancy in the field of executive and leadership development; Business management consultancy in the field of transport and delivery; Business management consultancy services; Business management consultancy services provided via the Internet; Business management consultancy via the Internet; Business management consultation; Business management consulting; Business management consulting services; Business management consulting services in the field of information technology; Business management for a trade company and for a service company; Business management for freelance service providers; Business management for shops; Business management in the field of transport and delivery; Business management of actors; Business management of airports; Business management of an airline company; Business management of authors and writers; Business management of car parking facilities; Business management of conference centers; Business management of entertainers; Business management of entertainment venues; Business management of hospitals; Business management of hotels; Business management of hotels for others; Business management of insurance agencies and brokers on an outsourcing basis; Business management of models; Business management of musical performers; Business management of musicians; Business management of performing artists; Business management of petrol stations [for others]; Business management of professional athletes; Business management of reimbursement programmes for others; Business management of reimbursement programs for others; Business management of resort hotels; Business management of restaurants; Business management of retail outlets; Business management of sporting clubs; Business management of sporting facilities [for others]; Business management of sporting venues [for others]; Business management of sports people; Business management of sports personalities; Business management of swimming pool complexes; Business management of theaters; Business management of visitor attractions; Business management of wholesale and retail outlets; Business management of wholesale outlets; Business management organisation; Business management organisation consultancy; Business management planning; Business management services; Business management services for footballers; Business management services provided by theatrical agencies; Business management services relating to electronic commerce; Business management services relating to the acquisition of businesses; Business management services relating to the development of businesses; Business management supervision; Business marketing consultancy; Business marketing consultation services; Business marketing consulting services; Business marketing services; Business meeting planning; Business merchandising display services; Business merger consultation; Business merger services; Business mergers (Advice relating to -); Business networking; Business networking services; Business operation of shopping centers for others; Business operation of shopping malls; Business organisation; Business organisation advice; Business organisation and management consultancy; Business organisation and management consultancy in the field of personnel management; Business organisation and management consulting; Business organisation and management consulting services; Business organisation consultancy; Business organisation consulting; Business organization advice; Business organization and management consultancy including personnel management; Business organization and management consulting; Business organization and operation consultancy; Business organization consultancy; Business organization consulting; Business organizational consultation; Business planning; Business planning and business continuity consulting; Business planning consultancy; Business planning services; Business planning services for enterprises; Business process management; Business process management and consulting; Business process management consultancy; Business process re-engineering; Business profit analysis; Business project management; Business project management services; Business project management services for construction projects; Business promotion; Business promotion services; Business promotion services provided by audio/visual means; Business promotion services provided by telephone; Business promotion services provided by telex; Business record keeping services; Business records keeping; Business records management; Business recruitment consultancy; Business relocation consulting; Business relocation services; Business reports (Preparation of -); Business reports (Writing of -); Business representative services; Business research; Business research and advisory services; Business research and information services; Business research and survey services; Business research and surveys; Business research consulting; Business research for new businesses; Business research services; Business risk assessment services; Business risk management services; Business secretarial services; Business services relating to the arrangement of joint ventures; Business services relating to the establishment of businesses; Business statistical analysis; Business statistical information services; Business statistical studies; Business ***statistics*** information; Business strategic planning; Business strategic planning services; Business strategy and planning services; Business strategy development services; Business strategy services; Business studies; Business succession planning; Business supervision; Business supervision [on behalf of others]; Business surveys; Businesses (Relocation services for -); Businesses (supervision of -) [on behalf of others]; Career advisory services (other than education and training advice); Career information and advisory services (other than educational and training advice); Career networking services; Career placement; Career placement consulting services; Career planning consultancy; Carrying out auction sales; Casting [recruitment] of performing artists; Chamber of commerce services for the promotion of businesses; Chamber of commerce services for the promotion of commerce; Chamber of commerce services for the promotion of trade; Chartered accountancy business services; Cinema advertising; Cinematographic film advertising; Classified advertising; Classified advertising services; Clerical employment agency services; Clerical services for making appointments; Clerical services for the handling of enquiries; Clerical services for the taking of sales orders; Collating of ***data*** in computer databases; ***Collecting*** business information; ***Collecting*** business ***statistics***; ***Collecting*** information for business; ***Collection*** and systematisation of information into computer databases; ***Collection*** of commercial information; ***Collection*** of ***data***; ***Collection*** of information relating to advertising; ***Collection*** of information relating to market analysis; ***Collection*** of information relating to market research; ***Collection*** of information relating to market studies; ***Collection*** of market research information; ***Collection*** of personnel information; ***Collection*** of ***statistics*** for business; Commercial administration of the licensing of the goods and services of others; Commercial and industrial management assistance; Commercial assistance in business management; Commercial business management; Commercial consultancy; Commercial consultancy services; Commercial information; Commercial information agencies; Commercial information agencies [provides business information, e.g , marketing or demographic ***data***]; Commercial information agency services; Commercial information and advice for consumers [consumer advice shop]; Commercial information and advice for consumers in the choice of products and services; Commercial information and advice services for consumers in the field of beauty products; Commercial information and advice services for consumers in the field of cosmetic products; Commercial information and advice services for consumers in the field of make-up products; Commercial information (Compilation of -); Commercial information provided by means of a computer database; Commercial information (Provision of -); Commercial information research studies; Commercial information services; Commercial information services provided by access to a computer database; Commercial information services relating to wine; Commercial information services, via the internet; Commercial intermediation for business purposes; Commercial intermediation services; Commercial lobbying services; Commercial management; Commercial management assistance; Commercial or industrial management assistance; Communication media (Presentation of goods on -), for retail purposes; Company information (Searches relating to -); Company management [for others]; Company management, including consultancy in demographic matters; Company office secretarial services; Company record keeping [for others]; Company record-keeping; Comparison services (Price -); Comparison shopping services; Competitive intelligence services; Compilation and input of information into computer databases; Compilation and provision of trade and business price and statistical information; Compilation and systematisation of information in databanks; Compilation and systemisation of information into computer databases; Compilation and systemization of information into computer databases; Compilation and systemization of information used in electronic transmissions; Compilation and systemization of written communications and ***data***; Compilation of advertisements; Compilation of advertisements for use as web pages; Compilation of advertisements for use as web pages on the Internet; Compilation of advertisements for use on internet web pages; Compilation of advertisements for use on the internet; Compilation of business ***data***; Compilation of business directories; Compilation of business directories for publishing on the Internet; Compilation of business information; Compilation of business ***statistics***; Compilation of business ***statistics*** and commercial information; Compilation of commercial registers; Compilation of company information; Compilation of computer ***data*** bases; Compilation of computer databases; Compilation of ***data***; Compilation of ***data*** in computer databases; Compilation of direct mailing lists; Compilation of directories for publication on the internet; Compilation of directories for publishing on global computer networks or the internet; Compilation of directories for publishing on the internet; Compilation of indexed addresses; Compilation of information into computer databases; Compilation of information into computerised registers; Compilation of information onto computer databases; Compilation of lists of prospective customers; Compilation of mailing lists; Compilation of mathematical ***data***; Compilation of online business directories; Compilation of political ***statistics***; Compilation of registers relating to exporters; Compilation of registers relating to importers; Compilation of statistical ***data*** for use in scientific research; Compilation of statistical ***data*** relating to business; Compilation of statistical ***data*** relating to medical research; Compilation of statistical information; Compilation of statistical models for the provision of market dynamics information; Compilation of ***statistics***; Compilation of ***statistics*** [for business or commercial purposes]; Compilation of ***statistics*** for business or commercial purposes; Compilation of ***statistics*** relating to advertising; Compilation of ***statistics*** relating to health care utilization; Compilation, production and dissemination of advertising matter; Compiling indexes of information for commercial or advertising purposes; Compiling of information into computer databases; Compiling of ***statistics***; Composing advertisements for use as web pages; Composing advertisements for use as webpages; Computer assisted business information; Computer ***data*** processing; Computer database management; Computer database management services; Computer databases (Compilation of information into -); Computer databases (Systemization of information into -); Computer file management; Computerised accounting; Computerised accounting (Maintenance of -); Computerised accounting (Preparation of -); Computerised auditing; Computerised book-keeping; Computerised business information processing services; Computerised business information retrieval; Computerised business information services; Computerised business management [for others]; Computerised business promotion; Computerised business records keeping; Computerised business research; Computerised compilation of customer indexes; Computerised compilation of order lists; Computerised compilation of stock control records; Computerised ***data*** management; Computerised ***data*** processing; Computerised ***data*** verification; Computerised ***data***-base management; Computerised database management services; Computerised file management; Computerised information services to business opportunities appraisals; Computerised inventory control; Computerised inventory preparation; Computerised market research; Computerised office management; Computerised payroll preparation; Computerised point-of-sale ***data*** ***collection*** services for retailers; Computerised register management; Computerised stock management; Computerised stock ordering; Computerised tax assessments (preparation of -) [accounting]; Computerized accounting services; Computerized database management; Computerized database management services; Computerized file management; Computerized market research services; Computerized on-line ordering services; Computerized word processing; Condominium management; Conducting, arranging and organizing trade shows and trade fairs for commercial and advertising purposes; Conducting business and market research surveys; Conducting employee incentive award programs; Conducting interactive virtual auctions; Conducting market surveys; Conducting marketing studies; Conducting of auction sales; Conducting of business appraisals; Conducting of business feasibility studies; Conducting of business research; Conducting of internal business communication surveys; Conducting of market research; Conducting of market studies involving opinion polling; Conducting of marketing studies; Conducting of trade shows; Conducting online business management research surveys; Conducting public opinion polls; Conducting studies in the field of public relations; Conducting trade shows in the field of automobiles; Conducting virtual trade show exhibitions online; Conference call transcription services; Confirming scheduled appointments for others; Consultancy and advisory services for business management; Consultancy and advisory services in the field of business strategy; Consultancy and advisory services relating to business management; Consultancy and advisory services relating to personnel management; Consultancy and advisory services relating to personnel placement; Consultancy and advisory services relating to personnel recruitment; Consultancy and information services relating to accounting; Consultancy of personnel recruitment; Consultancy (Professional business -); Consultancy regarding advertising communication strategies; Consultancy regarding advertising communications strategy; Consultancy regarding business organisation and business economics; Consultancy regarding public relations communication strategies; Consultancy regarding public relations communications strategy; Consultancy regarding the organization or managing of a trade company; Consultancy relating to advertising; Consultancy relating to advertising and promotion services; Consultancy relating to auditing; Consultancy relating to business acquisition; Consultancy relating to business advertising; Consultancy relating to business analysis; Consultancy relating to business document management; Consultancy relating to business efficiency; Consultancy relating to business management; Consultancy relating to business management and organisation; Consultancy relating to business organisation; Consultancy relating to business planning; Consultancy relating to costing of sales orders; Consultancy relating to ***data*** processing; Consultancy relating to demographics for marketing purposes; Consultancy relating to management selection; Consultancy relating to marketing; Consultancy relating to personnel management; Consultancy relating to personnel recruitment; Consultancy relating to public relations; Consultancy relating to sales promotions; Consultancy relating to search engine optimisation; Consultancy relating to tax accounting; Consultancy relating to the establishment and running of businesses; Consultancy relating to the management of personnel; Consultancy relating to the organisation of promotional campaigns for business; Consultancy relating to the preparation of business ***statistics***; Consultancy relating to the selection of personnel; Consultancy services in the field of affiliate marketing; Consultancy services regarding business strategies; Consultancy services relating to advertising, publicity and marketing; Consultancy services relating to the administration and management of hotels; Consultancy services relating to the management of telephone call centers; Consultancy services relating to the management of telephone call centres; Consultancy services relating to the procurement of goods and services; Consultation in the field of business acquisitions; Consultations relating to advertising; Consultations relating to business acquisitions; Consultations relating to business advertising; Consultations relating to business disposals; Consultations relating to business mergers; Consultations relating to business promotion; Consulting and information concerning accounting; Consulting in sales techniques and sales programmes; Consulting services in business organization and management; Consulting services in the field of Internet marketing; Consulting services relating to marketing; Consulting services relating to publicity; Consumer market information services; Consumer profiling for commercial or marketing purposes; Consumer research; Consumer response analysis; Consumers (Commercial information and advice for -) [consumer advice shop]; Copying of documents; Copying of documents for others; Copying services; Copywriting; Copywriting for advertising and promotional purposes; Corporate communications services; Corporate identity services; Corporate image development consultation; Corporate image studies; Corporate management assistance; Corporate management consultancy; Corporate management consultancy services; Corporate planning; Cost accounting; Cost analyses; Cost analysis; Cost assessment services; Cost benefit analysis; Cost management accounting; Cost price analysis; Cost price analysis regarding waste disposal, removal, handling and recycling; Counselling on business matters; Coupon procurement services for others; Creating advertising material; Credit card registration services; Customer club services, for commercial, promotional and/or advertising purposes; Customer loyalty services for commercial, promotional and/or advertising purposes; Customer relationship management; ***Data*** ***collection*** [for others]; ***Data*** ***collection*** services; ***Data*** compilation for others; ***Data*** entry and ***data*** processing; ***Data*** file administration; ***Data*** inputting services; ***Data*** management; ***Data*** management services; ***Data*** processing; ***Data*** processing for businesses; ***Data*** processing for the ***collection*** of ***data*** for business purposes; ***Data*** processing management; ***Data*** processing services; ***Data*** processing services in the field of healthcare; ***Data*** processing services in the field of payroll; ***Data*** processing services in the field of transportation; ***Data*** processing, systematisation and management; ***Data*** processing verification; ***Data*** retrieval services; ***Data*** search in computer files for others; ***Data*** searches in computerised files for others; ***Data*** transcription; Database management; ***Data***-base management (Computerised -); Database management services; Database marketing; ***Data***-based stock control; ***Data***-based stock location services; Demonstration [for promotional/advertising purposes]; Demonstration of goods; Demonstration of goods and services by electronic means, also for the benefit of the so-called teleshopping and homeshopping services; Demonstration of goods for advertising purposes; Demonstration of goods for promotional purposes; Demonstration of photographic equipment [for advertising purposes]; Demonstration of products; Design of advertising brochures; Design of advertising flyers; Design of advertising logos; Design of advertising materials; Design of marketing surveys; Design of public opinion surveys; Developing promotional campaigns for business; Developing promotional campaigns for businesses; Development and implementation of marketing strategies for others; Development of advertising concepts; Development of concepts for business economy; Development of hospital management systems; Development of marketing strategies and concepts; Development of promotional campaigns; Digital advertising services; Digital marketing; Direct mail advertising; Direct mail advertising services; Direct mail advertising services provided by lettershops; Direct mail advertising to attract new customers and to maintain the existing customer base; Direct market advertising; Direct marketing; Direct marketing consulting; Direct marketing services; Directories (Compilation of business -); Display services for merchandise; Displaying advertisements for others; Dissemination of advertisements; Dissemination of advertisements and of advertising material [flyers, brochures, leaflets and samples]; Dissemination of advertisements via the Internet; Dissemination of advertising and promotional materials; Dissemination of advertising for others; Dissemination of advertising for others via an on-line communications network on the internet; Dissemination of advertising for others via the Internet; Dissemination of advertising, marketing and publicity materials; Dissemination of advertising material; Dissemination of advertising material [leaflets, brochure and printed matter]; Dissemination of advertising material [leaflets, brochures and printed matter]; Dissemination of advertising materials; Dissemination of advertising matter; Dissemination of advertising matter by mail; Dissemination of advertising matter online; Dissemination of advertising via online communications networks; Dissemination of business information; Dissemination of commercial information; Dissemination of ***data*** relating to advertising; Dissemination of ***data*** relating to business; Dissemination of information relating to the recruitment of graduates; Dissemination services of advertisement matter; Distribution and dissemination of advertising materials [leaflets, prospectuses, printed material, samples]; Distribution of advertisements and commercial announcements; Distribution of advertising announcements; Distribution of advertising brochures; Distribution of advertising leaflets; Distribution of advertising mail and of advertising supplements attached to regular editions; Distribution of advertising, marketing and promotional material; Distribution of advertising material; Distribution of advertising material by post; Distribution of advertising materials; Distribution of advertising matter; Distribution of advertising samples; Distribution of flyers, brochures, printed matter and samples for advertising purposes; Distribution of printed advertising matter; Distribution of printed promotional material by post; Distribution of products for advertising purposes; Distribution of promotional leaflets; Distribution of promotional material; Distribution of promotional matter; Distribution of prospectuses and samples; Distribution of prospectuses and samples for advertising purposes; Distribution of prospectuses for advertising purposes; Distribution of publicity leaflets; Distribution of publicity materials (flyers, prospectuses, brochures, samples, particularly for catalogue long distance sales) whether cross border or not; Distribution of publicity materials, namely, flyers, prospectuses, brochures, samples, particularly for catalogue long distance sales [whether crossborder or not]; Distribution of publicity texts; Distribution of samples; Distribution of samples for advertising purposes; Distribution of samples for publicity purposes; Document preparation; Document reproduction; Document reproduction [photocopying services]; Drafting of publicity material; Drawing up of business statistical information; Drawing up of statements of accounts; Drawing up statements of account; Duplication of documents; Economic analysis for business purposes; Economic forecasting; Economic forecasting analysis for business purposes; Economic forecasting and analysis; Economic forecasting for business purposes; Economic forecasting services; Economic information services for business purposes; Economic studies for business purposes; Editing of publicity texts; Efficiency (Business -) expert services; Efficiency expert services; Efficiency experts; Electricity meter reading for billing purposes; Electronic billboard advertising; Electronic ***data*** processing; Electronic order processing; Electronic publication of printed matter for advertising purposes; Electronic stock management services; Employee leasing; Employee record services; Employee relocation services; Employment agencies; Employment agency services; Employment agency services for people skilled in the use of computers; Employment agency services for personnel in general office positions; Employment agency services for temporary work assignments; Employment agency services provided for nannies; Employment agency services relating to au pairs; Employment agency services relating to bilingual staff; Employment agency services relating to nurses; Employment agency services relating to placement of medical and nursing personnel; Employment agency services the provision of staff for the manning of show houses; Employment booking services for film television technicians; Employment booking services for performing artists; Employment bureau services; Employment consultancy; Employment consultancy services; Employment consultancy services relating to ***data*** processing personnel; Employment counselling; Employment counselling and consultancy services; Employment counselling services; Employment management services for film television technicians; Employment outplacement services; Employment placement services for butlers; Employment placement services for housekeepers; Employment placement services for personal assistants; Employment recruiting consultancy; Employment recruiting services; Employment recruitment; Energy price comparison services; Estimations for marketing purposes; Evaluating the impact of advertising on audiences; Evaluation of business opportunities; Evaluation of personnel requirements; Evaluations relating to business management in commercial enterprises; Evaluations relating to business management in industrial enterprises; Evaluations relating to business management in professional enterprises; Evaluations relating to commercial matters; Event marketing; Execution of stenographic work to order; Executive placement services; Executive recruiting services; Executive recruitment services; Executive search and placement services; Executive search and selection services; Executive search services; Executive selection services; Exhibitions (Arranging -) for advertising purposes; Exhibitions (Arranging -) for business purposes; Exhibitions (Arranging -) for commercial purposes; Exhibitions (Arranging -) for trade purposes; Exhibitions (Conducting -) for advertising purposes; Exhibitions (Conducting -) for business purposes; Exhibitions (Conducting -) for commercial purposes; Exhibitions (Conducting -) for trade purposes; Exhibitions for commercial or advertising purposes; Expert evaluations and reports relating to business matters; Export agency services; Export and import agencies; Export promotion services; Export-import agency services; Fashion show exhibitions for commercial purposes; Fashion shows for promotional purposes (Organization of -); File management (Computerized -); Filing documents or magnetic-tapes [office functions]; Financial auditing; Financial marketing; Financial records management; Financial statement preparation and analysis for businesses; Forecasting (Economic -); Forecasting (Economic -) for business purposes; Foreign trade consultancy services; Foreign trade information and consultation; Foreign trade information (Provision of -); Foreign trade information (Services for the provision of -); Forensic accounting services; Franchising (Business advice relating to -); Franchising (Business advisory services relating to -); Franchising services providing business assistance; Franchising services providing marketing assistance; Gas meter reading for billing purposes; Gift registry services; Goods import-export agencies; Goods or services price quotations; Grain market analysis; Graphic advertising services; Handbill distribution; Headhunting services; Health care cost management; Health care cost review; Help in the management of business affairs or commercial functions of an industrial or commercial enterprise; Hire of advertising aids; Hire of advertising billboards; Hire of advertising equipment; Hire of advertising hoardings; Hire of office equipment; Hire of office machinery; Hiring of advertising materials; Hiring of machines or apparatus for offices; Hiring of office equipment; Hiring of publicity materials; Hiring of typewriters; Hospital management; Hotel management for others; Hotel management service [for others]; Hotels (Business management of -); Human resources consultancy; Human resources consultation; Human resources management; Human resources management and recruitment services; Import agency services; Import and export agencies; Import and export agencies services; Import and export agency services; Import and export services; Import-export agencies; Import-export agencies in the field of energy; Import-export agency services; Income tax returns (Preparation of -); Industrial management assistance (Commercial or -); Industrial management consultation including cost/yield analyses; Information about sales methods; Information agencies (Commercial -); Information and ***data*** compiling and analyzing relating to business management; Information and expert opinions relating to companies and business; Information (Business -); Information in business matters; Information or enquiries on business and marketing; Information services relating to advertising; Information services relating to business matters; Information services relating to businesses; Information services relating to ***data*** processing; Information services relating to jobs and career opportunities; Initiating telephone calls for others; Inquiries (Business -); Inserting printed matter into envelopes; Interim business management; Intermediary services relating to advertising; Intermediary services relating to the rental of advertising time and space; Internet marketing; Internship placement services; Interpretation of market research ***data***; Interviewing for market research purposes; Interviewing for qualitative market research; Interviewing services [for personnel recruitment]; Inventories (Preparation of -); Inventory control; Inventory management; Inventory management of parts and components for manufacturers and suppliers; Inventory management services; Inventorying merchandise; Investigations (Business -); Investigations of marketing strategy; Invoicing; Invoicing services; Issuing and updating of advertising texts; Issuing of publicity leaflets; Job agency services; Job agency services for medical personnel; Job agency services for para-medical personnel; Job and personnel placement; Job matching services; Job placement; Job placement consultancy; Key return registration; Keypunching [office functions]; Labor exchanges; Labour exchange services; Layout services for advertising purposes; Leasing of advertising billboards; Leasing of advertising hoardings; Leasing of advertising space on pamphlets; Leasing of advertising space on railway properties; Leasing of advertising space on trains; Leasing of billboards; Leasing of office machines; Leasing of typewriters; Licensing of the goods and services of others (Commercial administration of the -); Lifecycle costing for business purposes; Literary agency services consisting of the negotiation of contracts; Loyalty, incentive and bonus program services; Loyalty scheme services; Magazine advertising; Mail order retail services connected with clothing accessories; Mail order retail services for clothing; Mail order retail services for clothing accessories; Mail order retail services for cosmetics; Mail order retail services related to alcoholic beverages (except beer); Mail order retail services related to beer; Mail order retail services related to foodstuffs; Mail order retail services related to non-alcoholic beverages; Mail sorting, handling and receiving; Mail sorting, handling and receiving [office functions]; Mailing list preparation services; Mailing lists (Compilation of -); Mail-order advertising; Maintaining a registry of animal breeds; Maintaining a registry of certified aerospace technicians; Maintaining a registry of certified medical technical professionals; Maintaining a registry of dog breeds; Maintaining a registry of information; Maintaining a registry of professional vocational evaluators; Maintaining files and records concerning the medical condition of individuals; Maintaining personal medical history records and files; Maintenance of asset registers [for others]; Maintenance of personnel records [for others]; Maintenance of registers [for others]; Management accounting; Management administration of commercial undertakings; Management advice; Management advice relating to the placing of staff; Management advice relating to the recruitment of staff; Management (Advisory services for business -); Management advisory services related to franchising; Management and compilation of computerised databases; Management and operation assistance to commercial businesses; Management assistance; Management assistance (Commercial or industrial -); Management assistance for industrial organisations; Management assistance for promoting business; Management assistance in business affairs; Management assistance in the establishment of commercial undertakings; Management assistance services; Management assistance to commercial companies; Management assistance to commercial firms; Management (Computerized file -); Management consultancy (Personnel -); Management consultancy services; Management consulting; Management of a retail enterprise for others; Management of an airline company; Management of business [for others]; Management of business offices for others; Management of business projects [for others]; Management of computer databases; Management of computer files; Management of computerised files; Management of customer loyalty, incentive or promotional schemes; Management of health care clinics for others; Management of hotel incentive programs of others; Management of performing artists; Management of professional athletes; Management of telephone call centers for other; Management of telephone call centers for others; Management on behalf of industrial and commercial enterprises in terms of supplying them with office requisites; Market analysis; Market analysis and research; Market analysis and research services; Market analysis reports; Market analysis services; Market analysis services relating to the availability of antiques; Market analysis services relating to the availability of goods; Market analysis services relating to the sale of antiques; Market analysis services relating to the sale of goods; Market analysis studies; Market assessment consultancy; Market assessment services; Market campaigns; Market canvassing; Market forecasting; Market information services relating to index levels; Market information services relating to market ***statistics***; Market information services relating to trade reports; Market intelligence services; Market investigation via the telephone; Market opinion polling studies; Market prospecting; Market reporting consultancy; Market reporting services; Market reports and studies; Market research; Market research and analysis; Market research and analysis services; Market research and business analyses; Market research and market analysis; Market research and marketing studies; Market research by means of a computer ***data*** base; Market research by means of a computer database; Market research consultancy; Market research ***data*** analysis; Market research ***data*** ***collection*** services; Market research ***data*** retrieval services; Market research for advertising; Market research for compiling information on readers of publications; Market research for compiling information on viewers of television; Market research services; Market research services for publishers; Market research services regarding customer loyalty; Market research services regarding Internet usage habits; Market research services relating to broadcast media; Market research studies; Market segmentation consultation; Market studies; Market study and analysis of market studies; Market study services; Market survey analysis; Market surveys; Market surveys conducted by telephone; Marketing; Marketing, advertising and promotion services; Marketing, advertising, and promotional services; Marketing advice; Marketing advisory services; Marketing agency services; Marketing analysis; Marketing analysis services; Marketing assistance; Marketing (Business advice relating to -); Marketing by telephone; Marketing consultancy; Marketing consultation services; Marketing consulting; Marketing forecasting; Marketing in the framework of software publishing; Marketing information; Marketing management advice; Marketing research; Marketing research and analysis; Marketing research in the fields of cosmetics, perfumery and beauty products; Marketing research or analysis; Marketing research services; Marketing services; Marketing services in the field of dentistry; Marketing services in the field of restaurants; Marketing services in the field of travel; Marketing services provided by means of digital networks; Marketing services relating to esports events; Marketing studies; Marketing the goods and services of others; Marketing the goods and services of others by distributing coupons; Matching skilled volunteers with non-profit organisations; Media buying services; Media relations services; Mediation and conclusion of commercial transactions for others; Mediation of advertising; Mediation of agreements regarding the sale and purchase of goods; Mediation of contracts for purchase and sale of products; Mediation of trade business for third parties; Medical billing; Medical billing services for doctors; Medical billing services for hospitals; Medical cost management; Medical transcription services; Merchandising; Merchandizing; Message transcription; Model recruitment agencies; Modeling agency services; Modeling for advertising or sales promotion; Modeling services for advertising or sales promotion; Modelling agency services for advertising purposes; Modelling agency services for sales promotion purposes; Modelling agency services relating to advertising; Modelling agency services relating to sales promotions; Modelling and models for advertising or sales promotion; Modelling for advertising or sales promotion; Nanny placement services; Negotiating and concluding commercial transactions for others; Negotiation and conclusion of commercial transactions for third parties; Negotiation and conclusion of commercial transactions for third parties via telecommunication systems; Negotiation and settlement of commercial transactions for third parties; Negotiation of advertising contracts; Negotiation of business contracts for others; Negotiation of commercial transactions for performing artists; Negotiation of commercial transactions for third parties; Negotiation of contracts relating to the purchase and sale of goods; Negotiation of contracts with health care payors; News and current affairs clipping services; News clipping services; Newspaper advertising; Newspaper subscription services; Newspaper subscription services for others; Newspaper subscriptions; Newspaper subscriptions (Arranging -) for others; Obtaining business ***statistics*** [for others]; Office administration services [for others]; Office equipment rental services; Office functions; Office functions services; Office machine rental services; Office machines and equipment rental; Office machines (Rental of -); Office management services [for others]; Office services for electronically collating ***data***; Office services for electronically ***collecting*** ***data***; Office services for electronically manipulating ***data***; Office support staff recruitment services; Online advertisements; Online advertising; On-line advertising; On-line advertising and marketing services; Online advertising network matching services for connecting advertisers to websites; Online advertising on a computer network; On-line advertising on a computer network; On-line advertising on computer communication networks; Online advertising on computer networks; On-line advertising on computer networks; Online advertising services; Online advertising via a computer communications network; On-line advertising via a computer communications network; On-line auction bidding for others; On-line auctioneering; On-line auctioneering services via the Internet; Online business networking services; Online community management services; Online ***data*** processing services; On-line ***data*** processing services; Online marketing; Online ordering services; On-line ordering services in the field of restaurant take-out and delivery; On-line promotion of computer networks and websites; Online retail services for downloadable and pre-recorded music and movies; Online retail services for downloadable digital music; Online retail services for downloadable ring tones; Online retail services relating to clothing; Online retail services relating to cosmetics; Online retail services relating to handbags; Online retail services relating to jewelry; Online retail services relating to luggage; Online retail services relating to toys; Online retail store services in relation to clothing; Online retail store services relating to clothing; Online retail store services relating to cosmetic and beauty products; On-line trading services in which seller posts products to be auctioned and bidding is done via the Internet; Operation of a telephone switchboard for others; Operation of businesses [for others]; Operation of commercial businesses [for others]; Operational business assistance to enterprises; Opinion polling; Ordering services [for others]; Ordering services for third parties; Organisation and conducting of product presentations; Organisation and holding of fairs for commercial or advertising purposes; Organisation and management of business incentive and loyalty schemes; Organisation and management of customer loyalty programs; Organisation for a third party of telephone welcoming services and of telephone receptionist services; Organisation of customer loyalty programs for commercial, promotional or advertising purposes; Organisation of events for commercial and advertising purposes; Organisation of exhibitions and events for commercial or advertising purposes; Organisation of exhibitions and trade fairs for business and promotional purposes; Organisation of exhibitions and trade fairs for commercial and advertising purposes; Organisation of exhibitions and trade fairs for commercial or advertising purposes; Organisation of exhibitions for business or commerce; Organisation of exhibitions for commercial and advertising purposes; Organisation of exhibitions for commercial or advertising purposes; Organisation of exhibitions of flowers and plants for commercial or advertising purposes; Organisation of exhibitions or trade fairs for commercial or advertising purposes; Organisation of fashion shows for commercial purposes; Organisation of internet auctions; Organisation of prize draws for advertising purposes; Organisation of promotions using audiovisual media; Organisation of promotions using audio-visual media; Organisation of trade fairs; Organisation of trade fairs and exhibitions for commercial or advertising purposes; Organisation of trade fairs for advertising purposes; Organisation of trade fairs for commercial or advertising purposes; Organisation, operation and supervision of an incentive scheme; Organisation, operation and supervision of customer loyalty schemes; Organisation, operation and supervision of loyalty and incentive schemes; Organisation, operation and supervision of loyalty schemes and incentive schemes; Organisation, operation and supervision of sales and promotional incentive schemes; Organisational consultancy regarding customer loyalty programmes; Organising and conducting job fairs; Organising exhibitions for commercial or advertising purposes; Organization of art exhibitions for commercial or advertising purposes; Organization of events, exhibitions, fairs and shows for commercial, promotional and advertising purposes; Organization of exhibitions and trade fairs for commercial or advertising purposes; Organization of exhibitions for commercial or advertising purposes; Organization of fairs and exhibitions for commercial and advertising purposes; Organization of fairs for commercial and advertising purposes; Organization of fashion shows for promotional purposes; Organization of trade fairs; Organization of trade fairs for commercial or advertising purposes; Organization, operation and supervision of loyalty and incentive schemes; Organization, operation and supervision of sales and promotional incentive schemes; Organizing exhibitions for commercial or advertising purposes; Organizing of trade shows; Outdoor advertising; Outsource service provider in the field of customer relationship management; Outsourced administrative management for companies; Outsourcing services [business assistance]; Outsourcing services in the field of business analytics; Outsourcing services in the field of business operations; Outsourcing services in the field of customer relationship management; Outsourcing services in the nature of arranging procurement of goods for others; Outsourcing services in the nature of arranging service contracts for others; Pay per click advertising; Payroll advisory services; Payroll assistance; Payroll preparation; Payroll processing services [for others]; Permanent staff recruitment; Personal management consultancy services; Personality testing for recruitment purposes; Personality testing for the selection of personnel; Personnel agency services relating to the electronics industry; Personnel consultancy; Personnel management; Personnel management advice; Personnel management and employment consultancy; Personnel management assistance; Personnel management assistance services; Personnel management consultancy; Personnel management consultancy services; Personnel management consultation; Personnel management consulting; Personnel management for advertising purposes; Personnel management of marketing personnel; Personnel management of sales personnel; Personnel management services; Personnel placement; Personnel placement and recruitment; Personnel placement consultancy; Personnel placement services; Personnel recruitment; Personnel recruitment advertising; Personnel recruitment agency services; Personnel recruitment consultancy; Personnel recruitment services; Personnel recruitment services and employment agencies; Personnel relocation; Personnel resources management; Personnel selection [for others]; Personnel selection using psychological testing; Personnel services; Photocopying; Photocopying services; Placement of design staff; Placement of permanent personnel; Placement of staff; Placement of temporary personnel; Placing advertisements for others; Planning and conducting of trade fairs, exhibitions and presentations for commercial or advertising purposes; Planning and conducting of trade fairs, exhibitions and presentations for economic or advertising purposes; Planning concerning business management, namely, searching for partners for amalgamations and business take-overs as well as for business establishments; Planning of marketing strategies; Planning services for advertising; Planning services for marketing studies; Political advertising services; Political opinion polling; Polling (Opinion -); Preparation and compilation of business and commercial reports and information; Preparation and completion of income tax returns; Preparation and presentation of audio visual displays for advertising purposes; Preparation and realization of media and advertising plans and concepts; Preparation of accounts; Preparation of advertisements; Preparation of advertising campaigns; Preparation of advertising material; Preparation of advertising matter; Preparation of annual returns for business undertakings; Preparation of audio and/or visual displays for businesses; Preparation of business balances; Preparation of business reports; Preparation of business statistical ***data***; Preparation of business ***statistics***; Preparation of business surveys; Preparation of commercial reports; Preparation of custom advertisements for others; Preparation of documents relating to business; Preparation of documents relating to taxation; Preparation of economic reports; Preparation of expert evaluations and reports relating to business matters; Preparation of income tax returns; Preparation of inventories; Preparation of invoices; Preparation of mailing lists; Preparation of mailing lists for direct mail advertising services [other than selling]; Preparation of market analysis reports; Preparation of market reports and studies; Preparation of marketing plans; Preparation of marketing surveys; Preparation of pay packets; Preparation of payrolls [for others]; Preparation of project studies relating to business matters; Preparation of public opinion surveys; Preparation of publicity columns; Preparation of publicity documents; Preparation of publicity leaflets; Preparation of publicity material; Preparation of publicity publications; Preparation of reports for marketing; Preparation of résumés for others; Preparation of statements of accounts; Preparation of ***statistics*** [business]; Preparation of tax declarations; Preparation of tax returns; Preparation of trade publicity texts; Preparation of wage slips; Preparing advertisements for others; Preparing and placing advertisements for others; Preparing and placing of advertisements; Preparing and placing outdoor advertisements for others; Preparing audiovisual presentations for use in advertising; Preparing audio-visual presentations for use in advertising; Preparing business reports; Preparing promotional and merchandising material for others; Presentation of companies and their goods and services on the Internet; Presentation of companies on the Internet and other media; Presentation of financial products on communication media, for retail purposes; Presentation of goods and services; Presentation of goods on communication media, for retail purposes; Presentation of goods on communications media, for retail purposes; Press advertising consultancy; Press advertising services; Price analysis services; Price comparing services; Price comparison rating of accommodations; Price comparison services; Pricing analysis; Pricing surveys; Prize draws (Organising of -) for advertising purposes; Prize draws (Organising of -) for promotional purposes; Processing (Administrative -) of purchase orders; Processing of business survey results; Processing telephone inquiries regarding advertised goods and services; Processing warranty registration documents for others; Processing (Word -); Procurement of contracts concerning energy supply; Procurement of contracts [for others]; Procurement of contracts for others relating to the sale of goods; Procurement of contracts for the purchase and sale of goods and services; Procurement of contracts for the purchase and sale of goods and services for others; Procurement of goods on behalf of other businesses; Procurement services; Procurement services for others [purchasing goods and services for other businesses]; Procurement services for others relating to office requisites; Procuring of contracts for the purchase and sale of goods; Producing promotional videotapes, video discs, and audio visual recordings; Product demonstration services in shop windows by live models; Product demonstrations and product display services; Product launch services; Product launches; Product marketing; Product merchandising; Product merchandising for others; Product sales information; Product sales rankings information; Product sampling; Production and distribution of radio and television commercials; Production of advertising films; Production of advertising material; Production of advertising materials; Production of advertising matter; Production of advertising matter and commercials; Production of cinema commercials; Production of commercials; Production of infomercials; Production of radio advertisements; Production of radio commercials; Production of sound recordings for advertising purposes; Production of sound recordings for marketing purposes; Production of sound recordings for publicity purposes; Production of teleshopping programmes; Production of teleshopping programs; Production of television and radio advertisements; Production of television commercials; Production of video recordings for advertising purposes; Production of video recordings for marketing purposes; Production of video recordings for publicity purposes; Production of visual advertising matter; Professional business consultancy; Professional business consultancy services; Professional business consultation relating to the operation of businesses; Professional business consultation relating to the setting up of businesses; Professional business consultations; Professional business consulting; Professional consultancy relating to business management; Professional consultancy relating to marketing; Professional consultancy relating to personnel management; Professional recruitment services; Profit surveys; Prognosis on economical affairs; Project studies for businesses; Project studies relating to business matters (Preparation of -); Promoting a series of films for others; Promoting and conducting trade shows; Promoting services for baseball game; Promoting the artwork of others by means of providing online portfolios via a website; Promoting the designs of others by means of providing online portfolios via a website; Promoting the goods and services of others; Promoting the goods and services of others by arranging for sponsors to affiliate their goods and services with awards programs; Promoting the goods and services of others by arranging for sponsors to affiliate their goods and services with sporting activities; Promoting the goods and services of others by arranging for sponsors to affiliate their goods and services with sports competitions; Promoting the goods and services of others by distributing coupons; Promoting the goods and services of others by means of a loyalty rewards card scheme; Promoting the goods and services of others by means of a preferred customer program; Promoting the goods and services of others over the Internet; Promoting the goods and services of others through advertisements on Internet websites; Promoting the goods and services of others through discount card programs; Promoting the goods and services of others through infomercials; Promoting the goods and services of others through the administration of sales and promotional incentive schemes involving trading stamps; Promoting the goods and services of others through the distribution of discount cards; Promoting the goods and services of others via a global computer network; Promoting the goods and services of others via computer and communication networks; Promoting the music of others by means of providing online portfolios via a website; Promoting the sale of fashion goods through promotional articles in magazines; Promoting the sale of goods and services of others by awarding purchase points for credit card use; Promoting the sale of goods and services of others through promotional events; Promoting the sale of goods and services of others through the distribution of printed material and promotional contests; Promoting the sale of the services [on behalf of others] by arranging advertisements; Promotion, advertising and marketing of on-line websites; Promotion [advertising] of business; Promotion [advertising] of concerts; Promotion [advertising] of travel; Promotion of fairs for trade purposes; Promotion of financial and insurance services, on behalf of third parties; Promotion of goods and services for others; Promotion of goods and services through sponsorship; Promotion of goods and services through sponsorship of international sports events; Promotion of goods and services through sponsorship of sports events; Promotion of insurance services, on behalf of third parties; Promotion of musical concerts; Promotion of special events; Promotion of sports competitions and events; Promotion services; Promotion services relating to esports events; Promotional advertising carried out via the telephone; Promotional advertising for exploration projects; Promotional advertising relating to philosophical instruction; Promotional advertising relating to philosophical training; Promotional advertising services; Promotional and advertising services; Promotional management for sports personalities; Promotional management of celebrities; Promotional marketing; Promotional marketing services using audiovisual media; Promotional services; Promotional services provided by telephone; Providing a directory of third party web sites to facilitate business transactions; Providing a searchable online advertising guide featuring the goods and services of online vendors; Providing a searchable online advertising guide featuring the goods and services of other on-line vendors on the internet; Providing academic course administration services for academic institutions; Providing academic course administration services relating to online course registration; Providing academic course administration services relating to on-line course registration; Providing administrative assistance to pharmacies for managing drug inventories; Providing advertising services; Providing advertising space; Providing advertising space in periodicals, newspapers and magazines; Providing advice and information relating to commercial business management; Providing advice in the field of business management and marketing; Providing advice relating to sales methods and techniques; Providing advice relating to the analysis of consumer buying habits; Providing advice relating to the marketing of chemical products; Providing advice relating to the organisation and management of businesses; Providing an on-line commercial information directory on the internet; Providing and rental of advertising space; Providing and rental of advertising space on the internet; Providing assistance in the field of business management; Providing assistance in the field of business management and planning; Providing assistance in the field of business management within the framework of a franchise contract; Providing assistance in the field of business organisation; Providing assistance in the field of business promotion; Providing assistance in the field of product commercialization; Providing assistance in the field of product commercialization within the framework of a franchise contract; Providing assistance in the management of business activities; Providing assistance in the management of franchised businesses; Providing assistance in the management of industrial or commercial enterprises; Providing business directory information via a global computer network; Providing business efficiency advice; Providing business information; Providing business information, also via internet, the cable network or other forms of ***data*** transfer; Providing business information by way of computer terminals; Providing business information directory services, via a global computer network; Providing business information in the field of social media; Providing business information via a web site; Providing business information via a website; Providing business intelligence services; Providing business management and operational assistance to commercial businesses; Providing business management start-up support for other businesses; Providing business marketing information; Providing commercial and business contact information; Providing commercial directory information via the Internet; Providing commercial information and advice for consumers in the choice of products and services; Providing commercial information relating to companies; Providing commercial information to consumers; Providing consumer information relating to goods and services; Providing consumer product advice; Providing consumer product advice relating to cosmetics; Providing consumer product advice relating to laptops; Providing consumer product advice relating to software; Providing consumer product information; Providing consumer product information relating to cosmetics; Providing consumer product information relating to food or drink products; Providing consumer product information relating to laptops; Providing consumer product information relating to software; Providing consumer product information via the Internet; Providing employment counseling services; Providing employment information; Providing employment information via a global computer network; Providing hotel rate comparison information; Providing information about commercial business and commercial information via the global computer network; Providing information concerning commercial sales; Providing information in the field of marketing; Providing information in the field of time management; Providing information relating to employee relocation services; Providing information relating to employment recruitment; Providing information relating to personnel recruitment; Providing information via the Internet relating to the sale of automobiles; Providing market information in relation to consumer products; Providing market intelligence services; Providing market research ***statistics***; Providing marketing consulting in the field of social media; Providing marketing information via websites; Providing office functions; Providing on-line auction services; Providing online commercial directory information services; Providing online marketplaces for sellers of goods and or services; Providing recruitment information via a global computer network; Providing searchable online advertising guides; Providing temporary office support staff; Providing trade information; Providing transportation documentation for others [administrative services]; Providing user rankings for commercial or advertising purposes; Providing user ratings for commercial or advertising purposes; Providing user reviews for commercial or advertising purposes; Provision and rental of advertising space; Provision and rental of advertising space, time and media; Provision of administrative staff; Provision of advertising information; Provision of advertising space; Provision of advertising space by electronic means and global information networks; Provision of advertising space on a global computer network; Provision of advertising space on electronic media; Provision of advertising space, time and media; Provision of advice relating to marketing; Provision of advice relating to the recruitment of graduates; Provision of an online marketplace for buyers and sellers of goods and services; Provision of an on-line marketplace for buyers and sellers of goods and services; Provision of assistance [business] in the establishment of franchises; Provision of assistance [business] in the operation of franchises; Provision of business advice relating to franchising; Provision of business and commercial contact information via the Internet; Provision of business and commercial information; Provision of business assistance; Provision of business ***data***; Provision of business ***data*** in the form of mailing lists; Provision of business information; Provision of business information relating to franchising; Provision of business information relating to joint ventures; Provision of business information relating to the ***agricultural*** industry; Provision of business information via global computer networks; Provision of business management assistance; Provision of business management information; Provision of business statistical information; Provision of business statistical information relating to medical matters; Provision of clerical and secretarial services; Provision of commercial and business contact information; Provision of commercial business information by means of a computer database; Provision of commercial information; Provision of commercial information [business]; Provision of commercial information from online databases; Provision of commercial information via the Internet; Provision of commission sales staff; Provision of computerised advertising services; Provision of computerised business information; Provision of computerised business information ***data***; Provision of computerised business management information; Provision of computerised business ***statistics***; Provision of computerised ***data*** relating to business; Provision of computerised information relating to business records; Provision of contract sales forces; Provision of foreign trade information; Provision of information and advice to consumers regarding the selection of products and items to be purchased; Provision of information and advisory services relating to e-commerce; Provision of information concerning commercial sales; Provision of information relating to accounts [accountancy]; Provision of information relating to advertising; Provision of information relating to business; Provision of information relating to commerce; Provision of information relating to ***data*** processing; Provision of information relating to marketing; Provision of information relating to recruitment; Provision of initial company secretarial services on company formation; Provision of market research information; Provision of marketing advisory services for manufacturers; Provision of marketing information; Provision of marketing reports; Provision of models for advertising; Provision of models for promotional purposes; Provision of nominee company directors; Provision of on-line business and commercial information; Provision of online financial services comparisons; Provision of online price comparison services; Provision of reports relating to accounting information; Provision of sales analyses; Provision of sales staff; Provision of secretarial services; Provision of space on websites for advertising goods and services; Provision of space on web-sites for advertising goods and services; Provision of statements of accounts; Provision of statistical information relating to business; Provision of trade information; Psychological testing for the selection of personnel; Psychometric testing for the selection of personnel; Public opinion polling; Public opinion polling services; Public opinion polls (Conducting of -); Public opinion polls (Operating of -); Public opinion surveys; Public relations; Public relations agency; Public relations consultancy; Public relations services; Public relations studies; Publication of advertising literature; Publication of advertising matter; Publication of advertising texts; Publication of printed matter for advertising purposes; Publication of printed matter for advertising purposes in electronic form; Publication of publicity material; Publication of publicity materials; Publication of publicity materials and texts; Publication of publicity materials on-line; Publication of publicity texts; Publicity; Publicity (Advisory services relating to -); Publicity agencies; Publicity agency services; Publicity agents; Publicity and advertising; Publicity and promotional services; Publicity and sales promotion; Publicity and sales promotion services; Publicity brochure distribution; Publicity bureau services; Publicity column preparation; Publicity columns preparation; Publicity leaflets (Issuing of -); Publicity material (Preparation of -); Publicity material rental; Publicity material (Rental of -); Publicity personnel management services; Publicity publication services; Publicity services; Publicity texts (Publication of -); Publicity texts (Writing of -); Purchase orders (Administrative processing of -); Purchasing agency services; Purchasing of goods and services for other businesses; Purchasing services; Radio advertising; Radio advertising and commercials; Radio and television advertising; Real estate marketing; Real estate marketing analysis; Records management services, namely, document indexing for others; Recruiting of office support staff; Recruitment advertising; Recruitment and personnel management services; Recruitment and placement services; Recruitment [casting] of actors; Recruitment consultancy for lawyers; Recruitment consultancy for legal secretaries; Recruitment consultancy services; Recruitment consultants in the financial services field; Recruitment of airline personnel; Recruitment of airport ground staff; Recruitment of computer staff; Recruitment of executive staff; Recruitment of flight personnel; Recruitment of high-level management personnel; Recruitment of personnel; Recruitment of political operatives; Recruitment of political volunteers; Recruitment of temporary personnel; Recruitment of temporary technical personnel; Recruitment (Personnel -); Recruitment services; Recruitment services for sales and marketing personnel; Referral marketing; Registration and transcription of written communications; Registration of written communications and ***data***; Relocation services (Employee -); Relocation services for business; Relocation services for businesses; Rental of advertisement billboards; Rental of advertisement hoardings; Rental of advertisement space; Rental of advertisement space and advertising material; Rental of advertising material; Rental of advertising matter; Rental of advertising space; Rental of advertising space on the internet; Rental of advertising space on the Internet for employment advertising; Rental of advertising space on web sites; Rental of advertising space on-line; Rental of advertising space, time and materials; Rental of advertising time in cinemas; Rental of advertising time on communication media; Rental of all publicity and marketing presentation materials; Rental of billboards; Rental of billboards [advertising boards]; Rental of card-operated vending machines; Rental of coin-operated vending machines; Rental of copying apparatus; Rental of digital billboards; Rental of electronic point of sale (EPOS) equipment; Rental of office equipment; Rental of office equipment in co-working facilities; Rental of office machinery and equipment; Rental of office machines; Rental of office machines and equipment; Rental of photocopiers; Rental of photocopying machines; Rental of publicity equipment; Rental of publicity material; Rental of publicity matter; Rental of sales stands; Rental of signs for advertising purposes; Rental of typewriters; Rental of typewriters and copying machines; Rental of vending machines; Rental [Office machines and equipment -]; Rental (Publicity material -); Renting of advertising spaces; Reproduction (Document -); Reproduction of advertising material; Reproduction of drawings; Reproduction of files [paper]; Reproduction of records [paper]; Reproduction services (Document -); Reprographic services; Research and analysis in the field of market manipulation; Research (Business -); Research for business purposes; Research (Market -); Research of business information; Research services relating to advertising; Research services relating to advertising and marketing; Research services relating to business; Response advertising; Restaurant management for others; Retail of third-party pre-paid cards for the purchase of clothing; Retail of third-party pre-paid cards for the purchase of entertainment services; Retail of third-party pre-paid cards for the purchase of multimedia content; Retail of third-party pre-paid cards for the purchase of telecommunication services; Retail or wholesale services for pharmaceutical, veterinary and sanitary preparations and medical supplies; Retail purposes (Presentation of goods on communication media, for -); Retail services connected with stationery; Retail services connected with the sale of clothing and clothing accessories; Retail services connected with the sale of furniture; Retail services connected with the sale of subscription boxes containing beers; Retail services connected with the sale of subscription boxes containing chocolates; Retail services connected with the sale of subscription boxes containing cosmetics; Retail services connected with the sale of subscription boxes containing food; Retail services for computer software; Retail services for pharmaceutical, veterinary and sanitary preparations and medical supplies; Retail services for works of art provided by art galleries; Retail services in relation to ***agricultural*** equipment; Retail services in relation to alcoholic beverages (except beer); Retail services in relation to animal grooming preparations; Retail services in relation to art materials; Retail services in relation to articles for use with tobacco; Retail services in relation to audio-visual equipment; Retail services in relation to bags; Retail services in relation to baked goods; Retail services in relation to bakery products; Retail services in relation to beauty implements for animals; Retail services in relation to beauty implements for humans; Retail services in relation to bedding for animals; Retail services in relation to beer; Retail services in relation to bicycle accessories; Retail services in relation to bicycles; Retail services in relation to building materials; Retail services in relation to car accessories; Retail services in relation to chemicals for use in ***agriculture***; Retail services in relation to chemicals for use in forestry; Retail services in relation to chemicals for use in horticulture; Retail services in relation to chocolate; Retail services in relation to cleaning articles; Retail services in relation to cleaning preparations; Retail services in relation to clothing; Retail services in relation to clothing accessories; Retail services in relation to cocoa; Retail services in relation to coffee; Retail services in relation to computer hardware; Retail services in relation to computer software; Retail services in relation to confectionery; Retail services in relation to construction equipment; Retail services in relation to cookware; Retail services in relation to cooling equipment; Retail services in relation to cups and drinking glasses; Retail services in relation to cups and glasses; Retail services in relation to cutlery; Retail services in relation to dairy products; Retail services in relation to desserts; Retail services in relation to dietary supplements; Retail services in relation to dietetic preparations; Retail services in relation to disposable paper products; Retail services in relation to diving equipment; Retail services in relation to domestic electrical equipment; Retail services in relation to domestic electronic equipment; Retail services in relation to downloadable electronic publications; Retail services in relation to downloadable music files; Retail services in relation to earthmoving equipment; Retail services in relation to educational supplies; Retail services in relation to fabrics; Retail services in relation to fashion accessories; Retail services in relation to festive decorations; Retail services in relation to floor coverings; Retail services in relation to fodder for animals; Retail services in relation to food cooking equipment; Retail services in relation to food preparation implements; Retail services in relation to foodstuffs; Retail services in relation to footwear; Retail services in relation to fragrancing preparations; Retail services in relation to freezing equipment; Retail services in relation to frozen yogurts; Retail services in relation to fuels; Retail services in relation to furnishings; Retail services in relation to furniture; Retail services in relation to games; Retail services in relation to gardening articles; Retail services in relation to gardening products; Retail services in relation to hair products; Retail services in relation to hand-operated implements for construction; Retail services in relation to hand-operated tools for construction; Retail services in relation to headgear; Retail services in relation to hearing protection devices; Retail services in relation to heaters; Retail services in relation to heating equipment; Retail services in relation to horticulture equipment; Retail services in relation to horticulture products; Retail services in relation to hygienic implements for animals; Retail services in relation to hygienic implements for humans; Retail services in relation to ice creams; Retail services in relation to information technology equipment; Retail services in relation to jewellery; Retail services in relation to kitchen appliances; Retail services in relation to kitchen knives; Retail services in relation to lighting; Retail services in relation to litter for animals; Retail services in relation to lubricants; Retail services in relation to luggage; Retail services in relation to meats; Retail services in relation to medical apparatus; Retail services in relation to medical instruments; Retail services in relation to metal hardware; Retail services in relation to mobile phones; Retail services in relation to musical instruments; Retail services in relation to navigation devices; Retail services in relation to non-alcoholic beverages; Retail services in relation to paints; Retail services in relation to pet products; Retail services in relation to pharmaceutical preparations; Retail services in relation to physical therapy equipment; Retail services in relation to preparations for making alcoholic beverages; Retail services in relation to preparations for making beverages; Retail services in relation to printed matter; Retail services in relation to pushchairs; Retail services in relation to recorded content; Retail services in relation to refrigerating equipment; Retail services in relation to saddlery; Retail services in relation to safes; Retail services in relation to sanitary installations; Retail services in relation to sanitation equipment; Retail services in relation to seafood; Retail services in relation to sewing articles; Retail services in relation to sex aids; Retail services in relation to smartphones; Retail services in relation to smartwatches; Retail services in relation to sorbets; Retail services in relation to sporting articles; Retail services in relation to sporting equipment; Retail services in relation to stationery supplies; Retail services in relation to sun tanning appliances; Retail services in relation to tableware; Retail services in relation to teas; Retail services in relation to threads; Retail services in relation to time instruments; Retail services in relation to tobacco; Retail services in relation to toiletries; Retail services in relation to toys; Retail services in relation to umbrellas; Retail services in relation to vehicles; Retail services in relation to veterinary apparatus; Retail services in relation to veterinary articles; Retail services in relation to veterinary instruments; Retail services in relation to veterinary preparations; Retail services in relation to wall coverings; Retail services in relation to water supply equipment; Retail services in relation to weapons; Retail services in relation to wearable computers; Retail services in relation to works of art; Retail services in relation to yarns; Retail services relating to accumulators; Retail services relating to alcoholic beverages; Retail services relating to audiovisual equipment; Retail services relating to automobile accessories; Retail services relating to automobile parts; Retail services relating to bakery products; Retail services relating to batteries; Retail services relating to candy; Retail services relating to clothing; Retail services relating to delicatessen products; Retail services relating to fake furs; Retail services relating to flowers; Retail services relating to food; Retail services relating to food preparation implements; Retail services relating to fragrancing preparations; Retail services relating to fruit; Retail services relating to furniture; Retail services relating to furs; Retail services relating to home textiles; Retail services relating to horticultural equipment; Retail services relating to horticultural products; Retail services relating to jewelry; Retail services relating to kitchen knives; Retail services relating to live animals; Retail services relating to sporting goods; Retail services via catalogues related to alcoholic beverages (except beer); Retail services via catalogues related to beer; Retail services via catalogues related to foodstuffs; Retail services via catalogues related to non-alcoholic drinks; Retail services via global computer networks related to alcoholic beverages (except beer); Retail services via global computer networks related to beer; Retail services via global computer networks related to foodstuffs; Retail services via global computer networks related to non-alcoholic beverages; Retail shop window display arrangement services; Retail store services in the field of clothing; Risk management consultancy [business]; Sales account management; Sales administration; Sales demonstration [for others]; Sales management services; Sales promotion; Sales promotion for others; Sales promotion for others by means of privileged user cards; Sales promotion for others provided through the distribution and the administration of privileged user cards; Sales promotion for others through trading stamp schemes; Sales promotion for third parties; Sales promotion services; Sales promotion services for third parties; Sales promotion through customer loyalty programs; Sales promotion using audiovisual media; Sales promotions at point of purchase or sale, for others; Sales volume tracking for others; Sample distribution; Samples (Distribution of -); School fee accounting services; School fee cost accounting services; Scriptwriting for advertising purposes; Search engine marketing services; Search engine optimisation; Search engine optimisation for sales promotion; Search engine optimisation services; Search engine optimization; Search engine optimization for sales promotion; Secretarial and clerical services; Secretarial employment agency services; Secretarial employment services; Secretarial services; Secretarial services provided by hotels; Secretariat services; Selection of executive personnel; Selection of personnel; Selection of staff; Services comprising the composition of statistical ***data***; Services comprising the recording of statistical ***data***; Services comprising the transcription of statistical ***data***; Services for provision of foreign trade information; Services of advertising agencies; Services rendered by a franchisor, namely, assistance in the running or management of industrial or commercial enterprises; Services with regard to product presentation to the public; Serving as a human resources department for others; Shareholder record keeping services; Shop retail services connected with carpets; Shop window display arrangement services; Shop window dressing; Shop window dressings; Shorthand; Shorthand secretarial services; Shorthand services; Shorthand typing; Shows (Arranging trade -); Shows (Conducting business -); Shows (Conducting trade -); Sponsorship search; Sponsorship search consultancy services; Staff placement services; Staff recruitment; Staff recruitment consultancy services; Staff recruitment services; Staff utilisation planning; Statements of account (Drawing up of -); Statements of accounts (Drawing up of -); Statistical analysis and reporting; Statistical analysis and reporting services for business purposes; Statistical evaluations of marketing ***data***; Statistical information (Provision of business -); Statistical studies (Business -); ***Statistics*** (Compilation of -); ***Statistics*** (Preparation of business -); Stenographic transcription; Stenography; Stenotyping; Stock control services; Stock management services; Stocktaking; Strategic business analysis; Strategic business consultancy; Strategic business planning; Street dissemination of advertising materials; Subscription to a television channel; Subscription to an information media package; Subscriptions (arranging -) to a telematics, telephone or computer service [internet]; Subscriptions (Arranging -) to telecommunication services for others; Subscriptions (Arranging newspaper -) for others; Subscriptions (arranging of) to books, reviews, newspapers or comic books; Subscriptions for newspapers (Arranging of for others -); Subscriptions to electronic journals; Subscriptions to telecommunications database services; Supervision of businesses on behalf of others; Supply chain management services; Support for employees with regard to business matters; Surveys (Business -); Surveys for business purposes; Surveys (Market -); Systematization of ***data*** in computer databases; Systemisation of information into computer databases; Systemization of information into computer databases; Talent agency services [business management of performing artists]; Targeted marketing; Tariff information and advisory services; Tax advice [accountancy]; Tax assessment [accounts] preparation; Tax assessment preparation; Tax consultancy [accountancy]; Tax consultations [accountancy]; Tax declaration procedure services; Tax filing services; Tax planning [accountancy]; Tax preparation; Tax preparation and consulting services; Tax return advisory [accountancy] services; Tax return preparation; Tax returns (Preparation of -); Taxation [accountancy] advice; Taxation [accountancy] consultancy; Taxation [accountancy] consultation; Telecommunication services (Arranging subscriptions to -) for others; Telemarketing; Telemarketing services; Telephone and television auctions; Telephone answering and message handling services; Telephone answering [for others]; Telephone answering for unavailable subscribers; Telephone answering service; Telephone billing; Telephone marketing services [not selling]; Telephone order-taking services for others; Telephone switchboard services; Telephone welcoming services for third parties; Television advertising; Temporary assignment of employees; Temporary assignment of personnel; Temporary employment agencies; Temporary personnel employment services; Temporary personnel placement services; Temporary personnel services; Temporary placement of employees (Services for the -); Testing (Psychological -) for the selection of personnel; Testing to determine employment skills; Testing to determine job competency; Testing to determine professional competency; Texts (Publication of publicity -); Texts (Writing of publicity -); The bringing together, for the benefit of others, of a variety of insurance services, enabling consumers to conveniently compare and purchase those services; The bringing together, for the benefit of others, of a variety of telecommunications services, enabling consumers to conveniently compare and purchase those services; Theatrical casting agency; Tracking and monitoring energy consumption for others for account auditing purposes; Tracking and monitoring fluctuation in gasoline prices for others for account auditing purposes; Trade fair (Organization of -) for commercial or advertising purposes; Trade fairs (Organization of -) for commercial or advertising purposes; Trade information; Trade information (Provision of -); Trade marketing [other than selling]; Trade promotional services; Trade show and commercial exhibition services; Trade show and exhibition services; Trade show management services; Trade shows (Arranging of -); Trade shows (Conducting of -); Transcription; Transcription of communications; Transcription of communications [office functions]; Transcription of ***data***; Transcription of messages; Transcription of recorded communications; Transcription services; Transportation fleet (business management of -) [for others]; Typewriters (Rental of -); Typewriting; Typewriting agency services; Typing; Typing agency services; Typing services; Unmanned retail store services relating to drink; Unmanned retail store services relating to food; Updating advertising material; Updating and maintenance of ***data*** in computer databases; Updating and maintenance of information in registries; Updating of advertising information on a computer ***data*** base; Updating of advertising material; Updating of business information on a computer ***data*** base; Utility meter reading for billing purposes; Vehicle fleet (business management of a -) [for others]; Vehicular registration and title transfer; Vending machine rental services; Vending machines (Rental of -); Veterinary practice business management; Video recordings for advertising purposes (Production of -); Video recordings for marketing purposes (Production of -); Video recordings for publicity purposes (Production of -); Wage payroll preparation; Wage-packets (Preparation of -); Water meter reading for billing purposes; Web indexing for commercial or advertising purposes; Web site traffic optimisation; Web site traffic optimization; Website traffic optimization; Wholesale ordering services; Wholesale services for pharmaceutical, veterinary and sanitary preparations and medical supplies; Wholesale services in relation to ***agricultural*** equipment; Wholesale services in relation to alcoholic beverages (except beer); Wholesale services in relation to animal grooming preparations; Wholesale services in relation to art materials; Wholesale services in relation to articles for use with tobacco; Wholesale services in relation to audio-visual equipment; Wholesale services in relation to bags; Wholesale services in relation to baked goods; Wholesale services in relation to beauty implements for animals; Wholesale services in relation to beauty implements for humans; Wholesale services in relation to bedding for animals; Wholesale services in relation to beer; Wholesale services in relation to chemicals for use in ***agriculture***; Wholesale services in relation to chemicals for use in forestry; Wholesale services in relation to chemicals for use in horticulture; Wholesale services in relation to chocolate; Wholesale services in relation to cleaning articles; Wholesale services in relation to cleaning preparations; Wholesale services in relation to clothing; Wholesale services in relation to cocoa; Wholesale services in relation to coffee; Wholesale services in relation to computer hardware; Wholesale services in relation to computer software; Wholesale services in relation to confectionery; Wholesale services in relation to construction equipment; Wholesale services in relation to cookware; Wholesale services in relation to cooling equipment; Wholesale services in relation to cutlery; Wholesale services in relation to dairy products; Wholesale services in relation to desserts; Wholesale services in relation to dietary supplements; Wholesale services in relation to dietetic preparations; Wholesale services in relation to earthmoving equipment; Wholesale services in relation to educational supplies; Wholesale services in relation to fabrics; Wholesale services in relation to festive decorations; Wholesale services in relation to floor coverings; Wholesale services in relation to fodder for animals; Wholesale services in relation to food cooking equipment; Wholesale services in relation to food preparation implements; Wholesale services in relation to foodstuffs; Wholesale services in relation to footwear; Wholesale services in relation to fragrancing preparations; Wholesale services in relation to freezing equipment; Wholesale services in relation to frozen yogurts; Wholesale services in relation to fuels; Wholesale services in relation to furnishings; Wholesale services in relation to furniture; Wholesale services in relation to games; Wholesale services in relation to hand-operated implements for construction; Wholesale services in relation to hand-operated tools for construction; Wholesale services in relation to headgear; Wholesale services in relation to heaters; Wholesale services in relation to heating equipment; Wholesale services in relation to horticulture equipment; Wholesale services in relation to horticulture products; Wholesale services in relation to hygienic implements for animals; Wholesale services in relation to hygienic implements for humans; Wholesale services in relation to ice creams; Wholesale services in relation to information technology equipment; Wholesale services in relation to jewellery; Wholesale services in relation to kitchen knives; Wholesale services in relation to lighting; Wholesale services in relation to litter for animals; Wholesale services in relation to lubricants; Wholesale services in relation to luggage; Wholesale services in relation to meats; Wholesale services in relation to medical apparatus; Wholesale services in relation to medical instruments; Wholesale services in relation to metal hardware; Wholesale services in relation to navigation devices; Wholesale services in relation to non-alcoholic beverages; Wholesale services in relation to pharmaceutical preparations; Wholesale services in relation to preparations for making alcoholic beverages; Wholesale services in relation to preparations for making beverages; Wholesale services in relation to printed matter; Wholesale services in relation to refrigerating equipment; Wholesale services in relation to saddlery; Wholesale services in relation to sanitary installations; Wholesale services in relation to sanitation equipment; Wholesale services in relation to seafood; Wholesale services in relation to sewing articles; Wholesale services in relation to sorbets; Wholesale services in relation to sporting articles; Wholesale services in relation to sporting equipment; Wholesale services in relation to stationery supplies; Wholesale services in relation to tableware; Wholesale services in relation to teas; Wholesale services in relation to threads; Wholesale services in relation to tobacco; Wholesale services in relation to toiletries; Wholesale services in relation to toys; Wholesale services in relation to umbrellas; Wholesale services in relation to vehicles; Wholesale services in relation to veterinary apparatus; Wholesale services in relation to veterinary articles; Wholesale services in relation to veterinary instruments; Wholesale services in relation to veterinary preparations; Wholesale services in relation to veterinary preparations and articles; Wholesale services in relation to wall coverings; Wholesale services in relation to water supply equipment; Wholesale services in relation to weapons; Wholesale services in relation to works of art; Wholesale services in relation to yarns; Wholesale services relating to automobile accessories; Wholesale services relating to automobile parts; Wholesale services relating to candy; Wholesale services relating to clothing; Wholesale services relating to fake furs; Wholesale services relating to flowers; Wholesale services relating to furniture; Wholesale services relating to furs; Wholesale services relating to jewelry; Wholesale services relating to sporting goods; Window display arrangement services; Window dressing; Window dressing and display arrangement services; Window dressing services for advertising purposes; Word processing; Word processing and typing services; Word processing services; Work analysis to determine worker skill sets and other worker requirements; Writing of business project reports; Writing of business project studies; Writing of business reports; Writing of curriculum vitae for others; Writing of publicity texts; Writing of résumés for others; Xerography.Class 39 Accompaniment of travellers; Accompanying of travellers; Advisory services related to removals; Advisory services relating to road transportation; Advisory services relating to the distribution of goods; Advisory services relating to the handling of goods; Advisory services relating to the packing of goods; Advisory services relating to the repacking of goods; Advisory services relating to the storage of goods; Advisory services relating to the tracking of goods in transit; Advisory services relating to the transportation of goods; Advisory services relating to transport; Aeroplane rental; Agency services for arranging cruises; Agency services for arranging the transportation of goods; Agency services for arranging the transportation of persons; Agency services for arranging the transportation of travellers; Agency services for arranging the transportation of travellers' luggage; Agency services for arranging tours; Agency services for arranging travel; Agents for arranging travel; Air ambulance services; Air cargo transport; Air cargo transport services; Air charter brokerage services; Air charter services; Air courier services; Air freight shipping services; Air freight transportation; Air line services; Air navigation services; Air passenger transport services; Air ticket booking services; Air traffic control services; Air transport; Air transport of passengers; Air transport of valuables; Air transport services; Air transportation; Air transportation of freight; Air transportation of passengers; Air transportation services; Air transportation services featuring a frequent flyer bonus program; Air transportation services for cargo; Air transportation services for freight; Air transportation services for passengers; Air travel services; Aircraft charter brokerage; Aircraft chartering; Aircraft chartering services; Aircraft handling; Aircraft parking; Aircraft parking services; Aircraft rental; Aircraft (Rental of -); Airline and shipping services; Airline bookings; Airline check-in services; Airline services; Airline services for the transportation of cargo; Airline services for the transportation of goods; Airline services for the transportation of passengers; Airline ticket reservation services; Airline ticket services; Airline transport; Airline transportation services; Airplane chartering; Airplane rental; Airport baggage check-in services [not including security inspection]; Airport baggage handling; Airport check-in services; Airport parking services; Airport passenger check-in services; Airport passenger shuttle services between the airport parking facilities and the airport; Airport services; Airport transfer services; Ambulance services; Ambulance transport; Animal rescue services [transport]; Armored car transport; Armored-car transport; Armoured car transport; Armoured vehicle transport; Armoured-car transport; Arrangement for the delivery of parcels by sea and by air; Arrangement for the transportation of passengers by air; Arrangement for the transportation of passengers by sea; Arrangement for the transportation of works of art; Arrangement of excursions; Arrangement of passenger transport; Arrangement of sightseeing tours; Arrangement of taxi transport; Arrangement of the distribution of fuels; Arrangement of the distribution of hydrocarbons; Arrangement of the storage of fuels; Arrangement of the storage of hydrocarbons; Arrangement of the transportation of fuels; Arrangement of the transportation of hydrocarbons; Arrangement of tours; Arrangement of transport; Arrangement of transportation; Arrangement of transportation of passengers by aircraft; Arrangement of transportation of passengers by cars; Arrangement of transportation of passengers by helicopters; Arrangement of transportation of passengers by ships; Arrangement of transportation of passengers by trains; Arrangement of transportation of people; Arrangement of transportation of travellers; Arrangement of travel; Arrangement of travel to and from hotels; Arrangement of vehicle recovery; Arrangement of vehicle rental; Arrangements for transportation by land, sea and air; Arranging airline tickets, cruise tickets and train tickets; Arranging and booking of city sightseeing tours; Arranging and booking of cruises; Arranging and booking of day trips; Arranging and booking of excursions; Arranging and booking of excursions and sightseeing tours; Arranging and booking of sightseeing tours; Arranging and booking of tours; Arranging and booking of travel; Arranging and booking of travel for package holidays; Arranging and conducting canoe expeditions; Arranging and conducting horseback expeditions; Arranging and conducting jungle and safari expeditions; Arranging and conducting of mail order delivery services; Arranging and conducting of tours and sightseeing; Arranging and providing transport by land, sea and air; Arranging car hire as part of package holidays; Arranging cruises; Arranging escorts for travellers; Arranging excursions; Arranging excursions for tourists; Arranging ferry transportation; Arranging for the shipping of cargo; Arranging for the transport of air freight; Arranging for the transport of goods by sea; Arranging for the transportation of passengers; Arranging for travel visas and travel documents for persons travelling abroad; Arranging for travel visas, passports and travel documents for persons traveling abroad; Arranging holiday travel; Arranging of air transport; Arranging of air travel; Arranging of baggage transfer; Arranging of business travel; Arranging of car hire; Arranging of city sight-seeing tours; Arranging of coach tours; Arranging of coach travel; Arranging of cruises; Arranging of day trips; Arranging of excursions; Arranging of excursions as part of package holidays; Arranging of excursions, day trips and sightseeing tours; Arranging of expeditions; Arranging of flights; Arranging of holiday transport; Arranging of overseas travel for cultural purposes; Arranging of passenger transport; Arranging of passenger transportation services for others via an online application; Arranging of sightseeing tours; Arranging of sightseeing tours and excursions; Arranging of sightseeing tours as part of package holidays; Arranging of tours; Arranging of tours and cruises; Arranging of tours by bus; Arranging of tours by coach; Arranging of transport; Arranging of transport and travel; Arranging of transportation for travel tours; Arranging of travel; Arranging of travel by bus; Arranging of travel by coach; Arranging of travel tours; Arranging of vehicle hire; Arranging of vehicle rental; Arranging the ***collection*** of goods; Arranging the ***collection*** of packages; Arranging the ***collection*** of packets; Arranging the ***collection*** of parcels; Arranging the delivery of gifts; Arranging the delivery of goods; Arranging the delivery of goods by post; Arranging the emergency replacement of airline tickets; Arranging the escorting of travellers; Arranging the hire of all means of transport; Arranging the shipping of goods; Arranging the storage of goods; Arranging the storage of luggage; Arranging the transportation of cargo; Arranging the transportation of goods; Arranging the transportation of parcels; Arranging the transportation of parcels by air; Arranging the transportation of parcels by land; Arranging the transportation of parcels by sea; Arranging the transportation of passengers; Arranging the transportation of passengers by air; Arranging the transportation of passengers by sea; Arranging the unloading of cargo; Arranging tours; Arranging transport for business users; Arranging transport for travelers; Arranging transport of passengers by air, rail and sea; Arranging transport of passengers by rail; Arranging transport services by land, sea and air; Arranging transportation by land, sea, and air; Arranging transportation of goods; Arranging transportation of passengers; Arranging transportation of passengers by road, rail, air and sea; Arranging travel tours; Arranging travel tours as a bonus program for credit cards customers; Arranging vehicle breakdown recovery; Arranging vehicle hire; Arranging vehicle rental; Arranging vehicle towing; Automobile rental reservation services; Automobile rental services; Automobile salvage; Automobile salvage agency services; Automobile salvage services; Automobile towing services; Automobile vehicle leasing services; Automobile vehicle renting services; Baggage check-in services; Baggage handling; Baggage handling services; Barge transport; Bicycle rental; Bicycle sharing services; Boat chartering; Boat chartering services; Boat cruises; Boat hire; Boat rental; Boat storage; Boat transport; Boat transportation; Boat transportation services; Boathouse services; Bonded storage; Bonded storage of goods; Bonded storage of wines; Bonded warehousing; Booking agency services for airline travel; Booking agency services for car hire; Booking agency services for sightseeing tours; Booking agency services for travel; Booking agency services relating to travel; Booking and arranging of access to airport lounges; Booking and reservation services for tours; Booking of air tickets; Booking of airport parking; Booking of hire cars; Booking of holiday travel and tours; Booking of rail tickets; Booking of sea passages; Booking of seats for air travel; Booking of seats for coach travel; Booking of seats for rail travel; Booking of seats for transportation by air; Booking of seats for transportation by motor vehicles; Booking of seats for transportation by rail; Booking of seats for transportation by water; Booking of seats for travel; Booking of seats (travel); Booking of sightseeing tours through agencies; Booking of tickets for air travel; Booking of tickets for train travel; Booking of tickets for travel; Booking of transport; Booking of transport via global computer networks; Booking of transportation via a website; Booking of travel through tourist offices; Bottling services; Bridge operation; Bridges (Operation of -); Brokerage (Freight -); Brokerage services relating to storage; Brokerage services relating to transport; Brokerage (Ship -); Brokerage (Transport -); Bulk storage; Bus chartering; Bus ferry services; Bus transport; Bus transport services; Bus transportation services; Cable-car transport; Canal lock gate operation; Canal lock gates (Operation of -); Canal locks (Operating -); Car hire; Car hire services; Car park services; Car parking; Car parking facilities (Provision of -); Car parking services; Car parking [valet] services; Car pooling services; Car rental; Car rental services; Car sharing services; Car transport; Car transport services; Car transporters (Rental of -); Cargo container rental services; Cargo delivery services; Cargo forwarding services; Cargo handling; Cargo handling and freight services; Cargo handling services; Cargo loading services; Cargo services; Cargo ship transport; Cargo tracking services; Cargo transportation; Cargo unloading; Cargo unloading services; Carpooling services; Carriage of persons by urban rapid transit rail systems; Cars (Rental of -); Carting; Carting of furniture; Carting of goods; Carting services; Cash replenishment of automated teller machines; Charitable services in the nature of providing transport for the elderly or disabled persons; Charitable services, namely distribution of blankets; Charitable services, namely distribution of clothing; Charitable services, namely providing transportation; Charitable services, namely, providing transportation to the elderly or handicapped persons; Charter of aircraft; Charter of boats; Charter of helicopters; Charter of motor vehicles; Charter of sea vessels; Charter of ships; Chartering of aircraft; Chartering of boats; Chartering of buses; Chartering of marine vessels; Chartering of shipping; Chartering of ships; Chartering of transport; Chartering of vehicles; Chartering of vehicles for transportation; Chartering of vehicles for travelling; Chartering of watercraft; Chartering of watercraft, yachts, ships, boats and water vehicles; Chartering of yachts; Chauffeur driven car hire services; Chauffeur services; Clearance [removal and transportation] of liquid waste; Clearance [removal and transportation] of waste; Coach hire; Coach (Motor -) rental; Coach (Railway -) rental; Coach transport; Coach transport services; Coach transportation services; Coat check services; Coin wrapping services; Cold store keeping services; ***Collection*** and transport of electronic scrap; ***Collection*** of cash from vending machines; ***Collection*** of commercial waste; ***Collection*** of containers for waste materials; ***Collection*** of documents; ***Collection*** of domestic waste; ***Collection*** of freight; ***Collection*** of goods; ***Collection*** of industrial waste; ***Collection*** of letters; ***Collection*** of liquid waste; ***Collection*** of luggage; ***Collection*** of merchandise; ***Collection*** of packages; ***Collection*** of packages by air; ***Collection*** of packages by road; ***Collection*** of packages by sea; ***Collection*** of recyclable goods [transport]; ***Collection*** of refuse; ***Collection*** of sewage through public sewers; ***Collection*** of waste skips; ***Collection***, transport and delivery of goods; ***Collection***, transport and delivery of goods, documents, parcels and letters; ***Collection***, transport and delivery of palletised goods; Commercial furniture removals; Commercial removal services; Commercial vehicle breakdown recovery; Commercial vehicle towing services; Computerised distribution advisory services relating to transport; Computerised distribution planning relating to transportation; Computerised information services relating to the carriage of passengers; Computerised information services relating to transport; Computerised information services relating to travel; Computerised information services relating to travel reservations; Computerised reservation services for travel; Computerised reservation services relating to the carriage of passengers; Computerised transport information services; Conducting of sightseeing tours; Conducting sightseeing tours; Conducting sightseeing tours for others; Consultancy for travel planning of routes; Consultancy in the field of air transport; Consultancy in the field of business travel provided by telephone call centers and hotlines; Consultancy in the field of storage services provided by telephone call centers and hotlines; Consultancy in the field of transport services provided by telephone call centers and hotlines; Consultancy in the field of transport services provided by telephone call centres and hotlines; Consultancy in the field of travel provided by telephone call centers and hotlines; Consultancy services relating to storage; Consultancy services relating to the distribution of electricity; Consultancy services relating to transportation; Consultancy services relating to warehousing; Container handling; Container hire services; Container leasing; Container leasing for the shipping industry; Container rental; Container storage; Container stuffing of ships cargo; Container transport services; Containers (Rental of -); Contract filling of aerosols; Contract hire of motor vehicles; Contract hire of transport vehicles; Contract rental of vehicles; Coolers renting (refrigerators); Coordinating travel arrangements for individuals and for groups; Correspondence delivery by post and/or messenger; Correspondence (Delivery of -); Courier services; Courier services for cargo; Courier services for goods; Courier services for merchandise; Courier services for messages; Courier services for the delivery of goods; Courier services for the delivery of parcels; Courier services for the delivery packages; Courier services for the transportation of cargo; Courier services [merchandise]; Courier services [messages or merchandise]; Courier services (Travel -); Cranage services; Crate hire services; Crating of goods; Crating services; Cruise arrangement; Cruise arranging; Cruise reservation services; Cruise ship services; Cruise ship services [for travel]; Cruise ship transport services; Cruises (Arranging of -); Cryogenic storage; Cryogenic storage of biological tissue intended for subsequent implantation; Delivery and forwarding of letters and parcels; Delivery and forwarding of mail; Delivery and storage of goods; Delivery by road; Delivery, despatching and distribution of newspapers and magazines; Delivery [distribution] of goods; Delivery (Flower -); Delivery (Message -); Delivery of bottled water to homes and offices; Delivery of cargo by air; Delivery of cargo by land; Delivery of correspondence; Delivery of disposable napkins; Delivery of domestic appliance parts; Delivery of food; Delivery of food and drink prepared for consumption; Delivery of food by restaurants; Delivery of fuel; Delivery of fuel to barges; Delivery of furniture; Delivery of gas cookers; Delivery of gift baskets with selected items regarding a particular occasion or theme; Delivery of goods; Delivery of goods by mail order; Delivery of goods by messenger; Delivery of goods by rail; Delivery of groceries; Delivery of hampers containing food and drink; Delivery of letters; Delivery of magazines; Delivery of mail by courier; Delivery of messages; Delivery of messages by courier; Delivery of messages [courier]; Delivery of newspapers; Delivery of packets; Delivery of parcels; Delivery of parcels by air; Delivery of parcels by courier; Delivery of parcels by land; Delivery of parcels by road; Delivery of parts to grounded aircraft via airplane; Delivery of spirits; Delivery of valuables; Delivery of vehicles; Delivery of water; Delivery of wines; Delivery services; Depository storage; Depot services for the storage of vehicles; Despatch of goods; Disposal [transport] of waste; Distribution and supply of water; Distribution and transmission of electricity; Distribution by pipeline and cable; Distribution of electricity; Distribution of electricity to households; Distribution of energy; Distribution of energy for heating and cooling buildings; Distribution of gas; Distribution of heat; Distribution of renewable energy; Distribution of water; Distribution services; Distribution services relating to beverages, such as alcoholic beverages; Distribution [transport] of frozen semen; Distribution [transport] of goods by air; Distribution [transport] of goods by road; Distribution [transport] of goods by sea; Distribution [transport] of retail goods; Diving bells (Rental of -); Diving services (Salvage -); Diving suits (Rental of -); Document delivery; Document delivery by non-electronic means; Document delivery [hand carried]; Drayage services; Driving services; Dumping [transportation] of sewage waste; Dumping [transportation] of waste; Electricity distribution; Electricity distribution and supply; Electricity distribution services; Electricity distribution via cables; Electricity distribution via wires; Electricity storage; Electricity supply and distribution; Electricity supply services; Embarking services; Emergency auto or truck towing; Emergency automobile towing; Emergency truck towing; Emptying [removal] of the contents cesspits; Emptying [removal] of the contents septic tanks; Emptying [removal] of the contents sumps; Energy distribution; Energy (Distribution of -); Escorting [accompanying] of travellers; Escorting of passengers; Escorting of patients during transportation; Escorting of travelers; Escorting of travellers; Escorting travellers; Excursion arrangement; Excursions (Arranging of -); Expeditions (Arranging of -); Express delivery of freight; Express delivery of goods; Express delivery of letters; Fares (Provision of information relating to -); Ferry boat services; Ferry transport services; Ferryboat operating; Ferryboat transport; Ferry-boat transport; Filling of containers; Filling of machines and containers; Filling of vehicles with freight; Filling of vending machines; Filling of vessels with freight; Flight planning services; Flower delivery; Food delivery; Food delivery services; Food storage services; Food transportation services; Forwarding agency services; Forwarding of freight; Forwarding of goods; Forwarding of letters; Forwarding of parcels; Franking of mail; Freezers (Rental of -); Freight and cargo services; Freight and cargo transportation and removal services; Freight and transport brokerage; Freight and transport brokerage services; Freight brokerage; Freight brokerage [forwarding (Am.)]; Freight brokerage services; Freight forwarding; Freight forwarding agency services; Freight forwarding between seaports; Freight forwarding by air; Freight forwarding by land; Freight forwarding by sea; Freight forwarding services; Freight loading services; Freight services; Freight ship transport; Freight shipping; Freight [shipping of goods]; Freight train transport; Freight transportation; Freight transportation brokerage; Freight transportation by air; Freight transportation services; Freight warehousing; Freight warehousing services; Freight-forwarding services; Freighting; Freighting services; Frozen food storage services; Frozen storage facilities (Provision of -); Frozen-food locker rental; Fuel bunkering services [storage]; Fuel delivery services; Fuel distribution services; Fur storage; Furniture moving; Furniture removals; Furniture storage; Furniture transportation; Furniture (Transporting -); Garage rental; Garages (Rental of -); Garaging; Garbage ***collection***; Garbage ***collection*** [trash pickup only]; Gas distribution services; Gas storage services; Gas supplying [distribution]; Gift delivery; Gift wrapping; Gift-wrapping; Global Positioning System navigation services; Goods (Delivery of -); Goods (Storage of -); Goods warehousing; GPS navigation services; Ground support freight handling services provided at airports; Ground support passenger handling services; Ground traffic control services for aircraft; Ground transportation relating to the aviation industry; Guarded transport; Guarded transport of goods; Guarded transport of money and valuables; Guarded transport of valuables; Guarded transportation; Guarded transportation of valuables; Guarded transportation of valuables and money by lorry; Guarded truck transport; Guide services (Travel -); Handling of baggage; Handling of passengers luggage; Handling [transport] of rubbish; Harboring services for ships and boats; Harbour crane unloading; Haulage services; Haulage services (Road -); Haulier (Services of a -); Hauling; Hauling services; Hazardous materials warehousing; Hazardous waste transport services; Heat supplying [distribution]; Helicopter transport; Hire of aircraft; Hire of boats; Hire of buses; Hire of cars; Hire of fork lift trucks; Hire of garages; Hire of motor vehicles; Hire of pallet cages; Hire of pallet collars; Hire of pallet racks; Hire of pallets; Hire of rail transport; Hire of road transport; Hire of transport vehicles; Hire of vehicles; Hire of warehouse storage space; Hire of waste handling containers; Hire of waste storage containers; Hired car transport; Hiring of cars; Hiring of fork lift trucks; Hiring of horses for transport; Hiring of motor vehicles; Hiring of storage sites; Hiring of transport vehicles; Hiring of vehicles; Holiday travel reservation services; Horse boxes (Rental of -); Horse rental; Horses (Rental of -) for transportation purposes; Household removal services; Household removals; Ice breaking for the shipping industry; Ice-breaking; Import and export cargo handling services; Industrial removal services [transportation]; Information and advisory services in relation to the distribution of energy; Information on transport; Information relating to airline services; Information relating to journeys (Services for the provision of -); Information relating to transport services; Information relating to transport (Services for the provision of -); Information relating to travel (Services for the provision of -); Information relating to travelling (Services for the provision of -); Information services relating to guarded transport; Information services relating to methods of transport; Information services relating to refrigerated storage; Information services relating to road conditions; Information services relating to storage; Information services relating to the location of goods; Information services relating to the movement of cargo; Information services relating to the transportation of bitumen; Information services relating to the transportation of crude oil; Information services relating to the transportation of goods; Information services relating to the transportation of petroleum; Information services relating to traffic; Information services relating to traffic congestion; Information services relating to traffic speed; Information services relating to transport timetables; Information services relating to transportation; Information services relating to travel; Information (Transportation -); Inland waterway transport; Inspection of goods for transportation; International air freight shipping services; International ocean freight shipping services; Issuing of tickets for travel; Itinerary planning services; Itinerary travel advice services; Labelling services; Land freight services; Launch and placement in prescribed orbit of satellites of others; Launching of satellites; Launching of satellites for others; Launching of spacecraft; Leasing of aircraft; Leasing of cargo container chassis; Leasing of cargo containers; Leasing of lorries; Leasing of motor vehicles; Leasing of pallets for industrial and commercial use; Leasing of pallets for the transport or storage of goods; Leasing of railroad flatcars; Leasing of road trailers; Leasing of ships; Leasing of storage units; Leasing of trailers; Leasing of trucks; Leasing of vehicles; Leasing of warehouse units; Leasing the use of power lines to third parties for the transmission of electricity; Letters (***Collection*** of -); Letters (Delivery of -); Lighterage services; Limousine services; Loading and unloading of airplanes; Loading and unloading of goods; Loading and unloading of vehicles; Loading of air freight; Loading of cargo; Loading of coal; Loading of coke; Loading of freight; Loading of freight containers onto rail vehicles; Loading of freight containers onto ships; Loading of freight containers onto trucks; Loading of ore; Loading of scrap; Loading of ships; Loading of slag; Loading of trains; Loading of trucks; Loan of vehicles; Loaning and rental of aeroplanes; Lorries (Rental of -); Luggage storage; Luggage storage services; Luggage trolley service; Mail box rental; Mail delivery; Mail delivery and courier services; Mail forwarding; Mail-boxes (Rental of -); Making travel bookings (Services for -); Making travel reservations (Services for -); Management of vehicular traffic flow through advanced communications network and technology; Marina services; Marina services [berthing, mooring, storage]; Marina services [docking services]; Marine freighting; Marine salvage; Marine towage; Marine towing; Marine transport; Marine transport of liquefied natural gas; Marine transport services; Maritime towing; Maritime towing services; Mass transit services for the general public; Merchandise (Packing of -); Message delivery; Messenger courier services; Messenger (Delivery of goods by -); Messenger services for letters; Messenger services for messages; Minibus transport services; Monorail transport; Mooring facility services; Motor car rental; Motor car transport services; Motor coach rental; Motor land vehicle hire services; Motor land vehicle leasing services; Motor land vehicle renting; Motor vehicle hire services; Motor vehicle recovery services; Motor vehicle rental; Motor vehicle transport services; Motorcycle rental; Moving van services; Moving van transport; Nappy delivery services; Naval tugging services; Navigation (positioning, and route and course plotting); Navigation services; Navigational advisory services; Newspaper delivery; Ocean salvage services; Ocean shipping; Ocean towing services; Oil bunkering services [storage]; Oil distribution services; Omnibus transport services; Operating canal locks; Operating cruises; Operating of road and motorway tolls; Operating of tours; Operating toll roads; Operating tours; Operation of canal lock gates; Operation of ferryboats; Operation of locks and bridges used for transport purposes; Operation of stations used for transport purposes; Operation of transporter bridges; Organisation of city sightseeing; Organisation of cruises; Organisation of excursions; Organisation of holiday travel; Organisation of sightseeing tours; Organisation of tours; Organisation of travel; Organisation of travel tours; Organisation of trips; Organising of excursions; Organising of foreign travel; Organising of travel; Organising the transportation of people; Organising tours; Organization of cruises; Organization of excursions; Organization of sightseeing tours; Organization of tours; Organization of travel; Organization of travel and boat trips; Organization of travel tours; Organization of trips; Organizing and arranging travel; Organizing of travel; Organizing transport for travelers; Overnight storage of letters in depots; Overnight transportation of letters by air; Overnight transportation of letters by road; Overseas removal services; Package delivery; Package holiday services for arranging travel; Packaging and storage of goods; Packaging and storage services; Packaging articles for transportation; Packaging articles to the order and specification of others; Packaging clothing articles for transportation; Packaging of food; Packaging of goods; Packaging of goods in transit; Packaging of products; Packaging services; Packing; Packing and packaging services; Packing articles for transportation; Packing of aerosols to order and specification; Packing of cargo; Packing of food; Packing of food products; Packing of freight; Packing of goods for removal; Packing of goods in containers; Packing of liquids to order and specification; Packing of merchandise; Packing services; Pallet packaging services; Palletised freight distribution services; Paper and cardboard ***collection*** for recycling; Parcel ***collection*** services; Parcel delivery; Parcel delivery services; Parcel distribution; Parcel receipt services; Parcel shipping services; Parcel storage services; Parking and vehicle storage, mooring; Parking garages services; Parking lot services; Parking of boats; Parking of cars; Parking place rental; Parking services; Parking services for vehicles; Parking space rental; Passenger cargo services; Passenger coach services; Passenger escort services; Passenger road transport services; Passenger ship transport; Passenger train transport; Passenger transport; Passenger transport services; Passenger transportation services; Passenger transportation services by air; Passenger transportation services by land; Passenger transportation services by rail; Passenger transportation services by sea; Passenger vehicle hire; Passengers (Transportation of -); Personal tour guide services; Pet rescue services; Physical storage of electronically stored computer games; Physical storage of electronically stored ***data***, documents, digital photographs, music, images, video, and computer games; Physical storage of electronically stored ***data*** or documents; Physical storage of electronically stored digital ***data***, photographs, audio and image files; Physical storage of electronically stored digital images; Physical storage of electronically stored digital music; Physical storage of electronically stored digital photographs; Physical storage of electronically stored digital video files; Physical storage of electronically stored files and documents; Physical storage of electronically-stored ***data*** or documents; Pick-up and delivery of letters; Pickup and delivery of parcels and goods; Pick-up and delivery of textile goods; Piloting; Piloting of civilian drones; Piloting of ships; Pipeline (Transport by -); Pipeline transport of gases; Pipeline transport of liquids; Pipeline (Transport of oil by -); Pizza delivery; Plane chartering; Planning and arranging of sightseeing tours and day trips; Planning and booking of airline travel, via electronic means; Planning and booking of travel and transport, via electronic means; Planning, arranging and booking of travel; Planning, arranging and booking of travel by electronic means; Planning of journeys; Pleasure boat cruises; Pleasure boat transport; Pleasure boat transport services; Port services [docking services]; Porter services; Porter services [transportation]; Porterage; Porterage services; Post restante services; Postal services; Power supply and distribution; Preferential passenger check-in services; Pre-transit storage of cargo; Priority air line check-in services; Priority boarding, check-in, seating and reservation services for frequent air travelers; Professional consultancy relating to transport; Propeller airplane transport; Providing advice relating to freight forwarding services; Providing cruise ships for travel; Providing customized driving directions; Providing driving directions for travel purposes; Providing flight arrival and departure information; Providing information about automobiles for lease by mean of the internet; Providing information about booking business travel, via the Internet; Providing information about temporary storage services; Providing information about travel, via the Internet; Providing information relating to air transport; Providing information relating to aircraft rental services; Providing information relating to airline travel, via electronic means; Providing information relating to bicycle rental services; Providing information relating to car rental services; Providing information relating to car transport; Providing information relating to cargo unloading services; Providing information relating to freight brokerage; Providing information relating to marine transport services; Providing information relating to removal services; Providing information relating to shipbrokerage; Providing information relating to storage services; Providing information relating to the delivery of documents, letters and parcels; Providing information relating to the distribution of electricity; Providing information relating to the planning and booking of airline travel, via electronic means; Providing information relating to the planning and booking of travel and transport, via electronic means; Providing information relating to the rental of freezers; Providing information relating to the rental of mechanical parking systems; Providing information relating to the rental of packing or wrapping machines and apparatus; Providing information relating to the rental of refrigerators; Providing information relating to the rental of vessels; Providing information relating to the rental of warehouse space; Providing information relating to the rental of wheelchairs; Providing information relating to the temporary storage of personal belongings; Providing information relating to travel and transport, via electronic means; Providing information relating to vehicle driving services; Providing information relating to vehicle parking services; Providing information relating to warehousing services; Providing information relating to water supplying services; Providing information to tourists relating to excursions and sightseeing; Providing online information relating to travel; Providing road and traffic information; Providing self-storage facilities for others; Providing taxi booking services via mobile applications; Providing tourist travel information; Providing tourist travel information, via the Internet; Providing traffic information; Providing transport and travel information; Providing transport and travel information via mobile telecommunications apparatus and devices; Providing transportation information; Providing transportation to the elderly or handicapped persons [charitable services]; Providing travel information via global computer networks; Providing vehicles for tours and excursions; Providing vessel mooring facilities; Provision of airport facilities for aviation; Provision of airport information services relating to aviation; Provision of berthing facilities; Provision of car parking facilities; Provision of car parks and car parking services; Provision of cold store facilities; Provision of computerised travel information; Provision of cruises in yachts; Provision of ***data*** relating to methods of transport; Provision of ***data*** relating to the transportation of passengers; Provision of ***data*** relating to timetables; Provision of dry dock facilities; Provision of flight information; Provision of flight plans; Provision of frozen storage facilities; Provision of hired vehicles; Provision of hired vehicles for the transport of passengers; Provision of information on matters relating to travel; Provision of information relating to airline arrivals; Provision of information relating to airline departures; Provision of information relating to airline scheduling; Provision of information relating to anchorages; Provision of information relating to harbours; Provision of information relating to marinas; Provision of information relating to moorings; Provision of information relating to motoring routes; Provision of information relating to ports; Provision of information relating to postal codes; Provision of information relating to road conditions; Provision of information relating to road traffic conditions; Provision of information relating to road transport; Provision of information relating to the transport of freight; Provision of information relating to the transportation of passengers; Provision of information relating to transport; Provision of information relating to travel; Provision of information relating to travel routes; Provision of moorings; Provision of navigational information relating to the aviation; Provision of parking facilities; Provision of refrigerated storage facilities; Provision of shipborne storage services; Provision of sightseeing tours [transport]; Provision of tourist travel information; Provision of tours; Provision of transport for passengers by air; Provision of transport for passengers by land; Provision of transport for passengers by water; Provision of transport for the elderly by road; Provision of transportation tariff information; Provision of travel information; Provision of travel information by computer; Provision of vehicle parking facilities; Provision of warehousing services and facilities; Public utilities in the nature of supplying water; Public utility services in the nature of electricity distribution; Public utility services in the nature of natural gas distribution; Public utility services in the nature of supplying water; Public utility services in the nature of water distribution; Push-chair rental; Rail freight distribution services; Rail freight services; Rail transport services; Railway coach rental; Railway passenger transport; Railway transport; Railway transport services; Railway truck rental; Recovery of commercial motor land vehicles; Recovery of vehicles; Recovery services for vehicles; Recovery (Vehicle -); Recovery winching of vehicles; Re-filling of containers; Refilling of vending machines; Refloating of ships; Re-floating of ships; Refrigerated storage; Refrigerated storage of goods; Refrigerated storage of seafood; Refrigerated storage services; Refrigerated transport of cold goods; Refrigerated transport of food; Refrigerated transport of frozen goods; Refrigerated warehousing; Refrigeration storage; Refrigerator rental; Refuse ***collection*** services; Removal of commercial furniture; Removal of domestic furniture; Removal of domestic goods; Removal of household goods; Removal of office equipment; Removal of personal effects; Removal of waste; Removal services; Removal services [moving services]; Removals; Removals (Household -); Rental and hire of aircraft; Rental and hire of vehicles; Rental car reservation; Rental of aero engines; Rental of aeroplanes; Rental of aircraft; Rental of aircraft engines; Rental of aircraft parts; Rental of airplanes; Rental of automobile trailers; Rental of automobiles; Rental of barges; Rental of barrows; Rental of berths for boats; Rental of bicycles; Rental of boats; Rental of buses; Rental of canoes; Rental of car parking spaces; Rental of car transporters; Rental of cars; Rental of chauffeur driven cars; Rental of coaches; Rental of commercial vehicles; Rental of containers; Rental of containers for freight; Rental of containers for warehousing and storage; Rental of crates; Rental of cycles; Rental of deep water diving suits; Rental of diving bells; Rental of diving bells and diving suits; Rental of diving helmets; Rental of diving suits; Rental of dolly tracks; Rental of electric cars; Rental of electric wine cellars; Rental of fork-lift trucks; Rental of freezers; Rental of freezers for commercial use; Rental of freezers for household purposes; Rental of freezing machines and apparatus; Rental of frozen food lockers; Rental of garage parking places; Rental of garage space; Rental of garages; Rental of garages and parking places; Rental of goods vehicles; Rental of GPS equipment for navigational purposes; Rental of GPS-equipped vehicles; Rental of horse-boxes; Rental of horses; Rental of horses for transport; Rental of hydrogen cars; Rental of loading-unloading machines and apparatus; Rental of lorries; Rental of machines which issue tickets for travel; Rental of mail boxes; Rental of means of transportation; Rental of mechanical parking systems; Rental of moorings for boats; Rental of motor cars; Rental of motor homes; Rental of motor land vehicles; Rental of motor racing cars; Rental of motor road vehicles; Rental of motor vehicles; Rental of motorboats; Rental of moving vans; Rental of navigational systems; Rental of packing machines; Rental of packing or wrapping machines and apparatus; Rental of pallets; Rental of pallets and containers for storage of goods; Rental of pallets and containers for transport of goods; Rental of parking places; Rental of parking places and garages for vehicles; Rental of parking spaces; Rental of portable roadways; Rental of portable storage containers; Rental of railway vehicles; Rental of railway vehicles for use in the measurement of rail profiles; Rental of railway vehicles for use in the reprofiling of rail profiles; Rental of railways; Rental of recreational vehicles; Rental of recycling containers; Rental of refrigerated storage; Rental of refrigerator-freezers for household purposes; Rental of refrigerators; Rental of road vehicles; Rental of roof racks; Rental of rowing boats; Rental of sailboats; Rental of scooters for transportation purposes; Rental of self-propelled lifting platforms for transportation purposes; Rental of ships; Rental of space, structures, units and containers, for storage and transportation; Rental of storage cartons; Rental of storage containers; Rental of storage crates; Rental of storage facilities; Rental of storage space; Rental of storage units; Rental of strongrooms; Rental of tankers; Rental of traction vehicle and trailers; Rental of tractors; Rental of trains; Rental of trams; Rental of transport vehicles; Rental of transportation vehicles; Rental of trolleys; Rental of trucks; Rental of vehicle parking spaces; Rental of vehicle parts; Rental of vehicle roof racks; Rental of vehicles; Rental of vehicles and apparatus for locomotion by air; Rental of vehicles equipped with lifting platforms; Rental of vehicles equipped with nacelles; Rental of vehicles for transport; Rental of vehicles for transportation; Rental of vehicles, in particular automobiles and lorries; Rental of vessels; Rental of wagons; Rental of warehouse space; Rental of warehouses; Rental of warehousing; Rental of water craft; Rental of wheelbarrows; Rental of wheelchairs; Rental services related to transportation and storage; Repatriation services for patients; Replenishment of vending machines; Rescue of ships in distress; Rescue operations [transport]; Rescue, recovery, towing and salvage; Rescue, recovery, towing and salvage services; Rescue services [transportation]; Rescue [transport] of persons; Rescue [transport] of vehicles in the air; Rescue [transport] of vehicles in the water; Rescue [transport] of vehicles on the land; Rescue [transport] services; Reservation and booking of seats for travel; Reservation and booking services for transportation; Reservation of air transport; Reservation of air transportation; Reservation of berths for travel; Reservation of coach transport; Reservation of ferry transport; Reservation of parking spaces; Reservation of rail transport; Reservation of seats for travel; Reservation services for air travel; Reservation services for airline travel; Reservation services for booking seats [travel]; Reservation services for bus transportation; Reservation services for tours; Reservation services for transportation; Reservation services for transportation by air; Reservation services for transportation by boat; Reservation services for transportation by land; Reservation services for transportation by sea; Reservation services for travel; Reservation services for travel by air; Reservation services for travel by land; Reservation services for travel by sea; Reservation services for vehicle rental; Reservation (Transport -); Reservation (Travel -); River transport; River transport by boat; River transport services; Road delivery of parcels; Road freight services; Road haulage services; Road haulage services for containers; Road rescue [transport] services; Road trailer leasing services; Road transport services; Road transport services for passengers; Road transport services for persons; Roadways (Portable, rental of -); Roof racks (Rental of vehicle -); Route planning [navigation services]; Route planning services; Sailboat transportation services; Salvage diving apparatus (Rental of -); Salvage diving services; Salvage of motor vehicles; Salvage of ships; Salvage of ships cargo; Salvage of wrecks; Salvage of yachts; Salvage services; Salvage (Underwater -); Salvaging; Salvaging services; Scheduled passenger airline services; Sea freight forwarding services; Sea freight services; Sea towage services; Seat reservation services for travel; Seat reservation services for travellers; Seat reservations for various forms of transport; Security storage services [transport]; Services for arranging the transportation of travellers; Services for arranging tours; Services for arranging transportation by air; Services for arranging transportation by rail; Services for arranging transportation by road; Services for arranging transportation by water; Services for chartering railway transport; Services for freight-forwarding by air; Services for freight-forwarding by land; Services for freight-forwarding by sea; Services for the arranging of excursions for tourists; Services for the arranging of tours; Services for the arranging of transportation; Services for the booking of seats for travel; Services for the booking of travel; Services for the escorting of travellers; Services for the garaging of vehicles; Services for the operation of tugs; Services for the provision of information relating to motor transport; Services for the provision of information relating to rail transport; Services for the provision of information relating to travel routes; Services for the storage of freight; Services for the supply of water by pipeline; Services for the transportation of baggage; Services for the transportation of freight; Services for the transportation of passengers; Services for the transportation of travellers; Services for transportation; Services of a freight broker; Sewage disposal [transport] services; Sewage transportation; Ship brokerage; Ship bunkering services [storage]; Ship chartering; Ship chartering services; Ship loading services; Ship piloting; Ship refloating; Ship rescue services; Ship transport; Ship transport services; Ship unloading; Shipbrokerage; Shipping; Shipping agency; Shipping agency services; Shipping agency services for arranging the transportation of goods; Shipping of cargo; Shipping of documents; Shipping of goods; Shipping services; Ships in distress (Rescue of -); Ships (Refloating of -); Ships (Rental of -); Sightseeing services; Sightseeing, tour guide and excursion services; Sightseeing [tourism]; Sightseeing tours (Arranging of -); Sightseeing tours (Conducting -); Skip hire service; Slipping of boats; Slipping of yachts; Stevedore services; Stevedoring; Stevedoring services; Storage; Storage and delivery of goods; Storage (Boat -); Storage containers (Rental of -); Storage information; Storage of ***agricultural*** foodstuffs; Storage of aviation fuel; Storage of baggage; Storage of beverages; Storage of boats; Storage of brochures; Storage of cargo; Storage of cargo after transportation; Storage of cargo before transportation; Storage of clothes; Storage of clothing; Storage of commercial goods; Storage of containers; Storage of containers and cargo; Storage of contaminated waste; Storage of cosmetics; Storage of cranage; Storage of documentary records; Storage of documents; Storage of domestic appliances; Storage of electrical plant; Storage of electricity; Storage of energy and fuels; Storage of farm products; Storage of farm products in warehouses; Storage of fluids; Storage of food; Storage of freight; Storage of frozen food in warehouses; Storage of fuel oil; Storage of furniture; Storage of gas; Storage of gaseous fuels; Storage of goods; Storage of goods for transportation; Storage of goods in refrigerated conditions; Storage of goods in transit; Storage of goods in warehouses; Storage of human cells; Storage of liquefied natural gas on ships; Storage of liquids; Storage of luggage; Storage of oil; Storage of packages; Storage of parcels; Storage of parts for motor vehicles; Storage of passengers baggage; Storage of passengers luggage; Storage of pharmaceuticals; Storage of radioactive waste; Storage of ships; Storage of surgical instruments and equipment; Storage of vehicle parts; Storage of vehicles; Storage of waste; Storage of waste oil; Storage of water in reservoirs; Storage of water in tanks; Storage of watercraft, yachts, boats and water vehicles; Storage of weapons; Storage of yachts; Storage (Physical -) of electronically-stored ***data*** or documents; Storage services; Storage services for aircraft; Storage services for freight; Storage services for goods; Storage units (Rental of -); Storehouse rental; Storing, safekeeping of clothes; Streetcar transport; Subdividing and repackaging of goods; Supply of electricity; Supply of waste heat; Supply of water; Supply of water by pipeline; Supply [transport] of water for ***agricultural*** use; Supply [transport] of water for domestic use; Supply [transport] of water for industrial use; Supply [transport] of water through pipes; Supplying tickets to enable holders to travel; Tanker transport; Taxi services; Taxi transport; Taxi transport for people in wheelchairs; Temperature- and humidity-controlled storage of wines; Temperatures controlled storage of chemicals; Temporary safekeeping of personal belongings; Temporary storage of deliveries; Temporary storage of personal belongings; Ticket booking services for travel; Ticket reservation services for travel; Ticket reservation services (Travel -); Ticketing services for travel; Timetable enquiry services relating to travel; Tour arranging; Tour conducting; Tour guide services; Tour operating; Tour operating and organising; Tour operating and organizing; Tour operator services for the booking of travel; Tour organising; Tour organizing; Tour reservation services; Tourist guide services; Tourist travel reservation services; Tours (Arranging of -); Tours (Arranging of travel -); Towage of ships; Towing; Towing and transport of cars as part of vehicle breakdown services; Towing by motor vehicles; Towing of aeroplanes; Towing of motor vehicles; Towing of road vehicles; Towing of vehicles; Towing of vehicles in connection with breakdown services; Towing of vessels; Tracking and tracing of shipments; Tracking and tracing services for letters and parcels; Tracking of passenger or freight vehicles by computer or via GPS; Tracking of passenger vehicles by computer or via GPS; Traffic information; Traffic information services; Tram services; Tram transport; Transit services; Transmission of oil or gas through pipelines; Transport; Transport and delivery of goods; Transport and distribution of natural gas and liquefied gas; Transport and freight brokerage; Transport and freight brokerage services; Transport and storage; Transport and storage of goods; Transport and storage of trash; Transport and storage of waste; Transport brokerage; Transport by air; Transport by barge; Transport by boat; Transport by coach; Transport by ferry; Transport by heavy goods vehicles; Transport by inland water; Transport by land; Transport by man-powered vehicles; Transport by pipeline; Transport by rail; Transport by road; Transport by sea; Transport by ship; Transport by two-wheeled motor vehicles; Transport by water; Transport information, advice and reservation services; Transport information service; Transport of building materials; Transport of cargo by air; Transport of contaminated soil; Transport of contaminated waste; Transport of cranage; Transport of farm products; Transport of food; Transport of freight by air; Transport of freight by rail; Transport of freight containers by lorry; Transport of freight containers by rail; Transport of freight containers by ship; Transport of fuels by pipeline; Transport of furniture; Transport of gas by pipelines; Transport of goods; Transport of goods by inland water; Transport of goods by rail; Transport of goods by ship; Transport of liquefied natural gas by sea; Transport of money; Transport of money and valuables; Transport of motor vehicles; Transport of natural gas; Transport of oil; Transport of packages; Transport of parcels; Transport of passengers; Transport of passengers by air; Transport of passengers by boat; Transport of passengers by bus; Transport of passengers by car; Transport of passengers by coach; Transport of passengers by cruise ship; Transport of passengers by funicular railway; Transport of passengers by inland water; Transport of passengers by rail; Transport of passengers by road; Transport of passengers by train; Transport of people by land; Transport of persons; Transport of persons and goods by land, air and water; Transport of persons by land; Transport of pets; Transport of textiles by road; Transport of travelers; Transport of travellers; Transport of travellers by air; Transport of travellers by bus; Transport of travellers by car; Transport of travellers by land; Transport of travellers by road; Transport of travellers by taxi; Transport of travellers by train; Transport of travellers by tram; Transport of valuables; Transport of valuables in security vehicles; Transport of water by pipeline; Transport rescue operations; Transport reservation; Transport services; Transport services and trips for disabled persons; Transport services for sightseeing tours; Transport services for the disabled; Transportation; Transportation and delivery of goods; Transportation and delivery services by air, road, rail and sea; Transportation and storage; Transportation and storage of goods; Transportation (Arranging of -); Transportation by air; Transportation by air of baggage; Transportation by air of freight; Transportation by air of passengers; Transportation by ambulance; Transportation by bus; Transportation by courier; Transportation by land; Transportation by marine container ship; Transportation by rail; Transportation by road; Transportation check-in services; Transportation information; Transportation logistics; Transportation of animals; Transportation of baggage; Transportation of bitumen; Transportation of books; Transportation of cargo; Transportation of cargo by air; Transportation of cargo by land vehicle; Transportation of clothing; Transportation of containers; Transportation of cosmetics; Transportation of crude oil; Transportation of dry gas; Transportation of flowers; Transportation of fluids by pipeline; Transportation of food; Transportation of freight; Transportation of freight by air; Transportation of freight by land; Transportation of freight by road; Transportation of freight by water; Transportation of fruit; Transportation of furniture; Transportation of furniture of others by trucks; Transportation of goods; Transportation of goods by air; Transportation of goods by rail; Transportation of goods by road; Transportation of goods by sea; Transportation of goods in refrigerated conditions; Transportation of heavy fuel-oil; Transportation of household effects; Transportation of luggage; Transportation of mechanics to grounded aircraft via airplane; Transportation of medical waste and special waste; Transportation of money; Transportation of oil by pipeline; Transportation of parcels; Transportation of parcels by air; Transportation of parcels by road; Transportation of parcels by sea; Transportation of parcels overnight; Transportation of passengers; Transportation of passengers and passengers' luggage; Transportation of passengers' baggage; Transportation of passengers by air; Transportation of passengers by airship; Transportation of passengers by boat; Transportation of passengers by bus; Transportation of passengers by coach; Transportation of passengers by cruise ship; Transportation of passengers by ferryboat; Transportation of passengers by land; Transportation of passengers by minibus; Transportation of passengers by omnibus; Transportation of passengers by rail; Transportation of passengers by road; Transportation of passengers by train; Transportation of passengers in chauffeur driven vehicles; Transportation of passengers' luggage; Transportation of patients by ambulance; Transportation of patients by car; Transportation of patients by minibus; Transportation of people; Transportation of persons; Transportation of pet animals; Transportation of petroleum; Transportation of pharmaceuticals by road; Transportation of plants; Transportation of travellers; Transportation of travellers' baggage; Transportation of valuables; Transportation of vehicles; Transportation of waste; Transportation of waste to disposal sites; Transportation of works of art; Transportation reservation services; Transportation services; Transportation services by boat; Transportation services for medical staff; Transportation services for nursing staff; Transportation services for the injured; Transportation services for the sick; Transporting furniture; Transshipment services; Travel agency services for arranging holiday travel; Travel agency services for arranging travel; Travel agency services for business travel; Travel agency services, namely arranging transportation for travelers; Travel agency services, namely, making reservations and bookings for transportation; Travel agency services relating to travel by omnibus; Travel agents services for arranging travel; Travel and passenger transportation; Travel and tour ticket reservation service; Travel and transport reservation services; Travel arrangement; Travel arrangement and reservation services; Travel arrangement services; Travel arrangements; Travel booking agencies; Travel consultancy; Travel consultancy and information services; Travel courier; Travel courier services; Travel guide and travel information services; Travel guide services; Travel information; Travel information about disruptions due to adverse weather conditions; Travel information services; Travel organisation; Travel organization; Travel reservation; Travel reservation and booking services; Travel reservation services; Travel reservations; Travel route planning; Travel services; Travel ticket reservation services; Travellers (Escorting of -); Travellers (Transport of -); Travelling trunks rental; Trip planning services; Trolley services for others; Trolleys (Rental of -); Truck and trailer rental; Truck and vehicle rental; Truck hauling; Truck leasing; Truck (Railway -) rental; Truck rental; Truck transport; Tunnels (Operation of -); Turbojet airplane transport; Underwater recovery services; Underwater salvage; Underwater salvage services; Unloading and repackaging services; Unloading cargo; Unloading cargo and luggage; Unloading of cargo; Unloading of cargo (Services for the -); Unloading of goods (Services for the -); Unloading services; Valet parking; Valuables (Guarded transport of -); Vehicle breakdown assistance [towing]; Vehicle breakdown recovery services; Vehicle breakdown towing services; Vehicle contract hire; Vehicle hire; Vehicle hire services; Vehicle leasing services; Vehicle location services; Vehicle parking; Vehicle parking and storage; Vehicle parking services; Vehicle recovery; Vehicle rental; Vehicle rental services; Vehicle rescue [recovery]; Vehicle rescue services; Vehicle routing by computer on ***data*** networks; Vehicle salvage services; Vehicle storage; Vehicle towing services; Vehicle transport services; Vehicle-driving services; Vehicles (Recovery of -); Vehicles (Rental of -); Vessel rental; Vessel salvage; Vessel salvage services; Vessel towing services; Vessel transport; Warehouse storage; Warehouse storage services; Warehouses (Rental of -); Warehousing; Warehousing and cellarage services; Warehousing information; Warehousing of baggage; Warehousing of components; Warehousing of finished goods; Warehousing of freight; Warehousing of goods; Warehousing of parts; Warehousing services; Waste ***collection***; Waste disposal [transporation]; Waste removal; Waste removal [transport]; Waste storage; Waste transport; Water distribution; Water distribution and supply; Water distribution services; Water supply; Water supply and distribution services; Water supply services; Water supplying; Water supplying [distribution]; Water transport services; Weighbridge services; Wharfage services; Wheelbarrows (Rental of -); Winching of vehicles; Wrapping and packaging of goods; Wrapping and packaging services; Wrapping of goods; Wrapping of merchandise; Wrapping services for baggage protection during travel; Yacht and boat charter services; Yacht chartering; Yacht chartering services.Class 40 3 D reproduction services; 3D printing; 3D printing services; Abrasion; Abrasive polishing; Abrasive polishing of metal surfaces; Acrylic finishing of vehicles; Advisory services relating to dyeing; Agglomerating of solid material (Services for the -); Air and water conditioning and purification; Air brushing services; Air conditioning apparatus (Rental of -); Air deodorising; Air deodorizing; Air freshening; Air purification; Air purification apparatus (Rental of -); Air regeneration; Air treatment; Alteration (Clothing -); Alteration of clothing [custom manufacture]; Animals (Slaughtering of -); Annealing; Annealing of surfaces of machine parts (Services for the -); Annealing (Services for -); Anodising services; Anti-microbial treatment of carpets; Anti-mildew treatment; Anti-moth treatment; Anti-moth treatment of furs; Anti-moth treatment of textiles; Anti-mould treatment; Application of appliques to clothing; Application of appliques to textiles; Application of backing to carpet to the order of others; Application of coatings using chemical vapor deposition techniques; Application of coatings using physical vapor deposition techniques; Application of coatings using thermal plasma spraying techniques; Application of coatings using vacuum deposition techniques; Application of finishes to textiles; Application of motifs to clothing; Application of motifs to textiles; Application of protective coatings to leather; Application of protective surface coatings to machines and tools; Application of relief patterns to board surfaces; Application of relief patterns to card surfaces; Application of relief patterns to paper surfaces; Application of wear resistant coatings by autocatalytic processes; Application of wear resistant coatings by electrolytic processes; Application of wear resistant coatings to engineering components; Application of wear-resistant coatings on metals and plastics; Applying backing to the underside of carpets; Applying finish to stainless steel sheets and coils; Applying finishes to cloth; Applying finishes to clothing; Applying finishes to fabric; Applying finishes to textiles; Assembling of materials (Custom -) for others; Assembly of products for others; Beer brewing for others; Bevelling of glass; Binding of books or documents; Bioremediation services; Blacksmithing; Blast treatment; Blast treatment of a surface (Services for the -); Bleaching (Fabric -); Bleaching of cloth; Bleaching of clothing; Bleaching of fabric; Bleaching of fabrics; Bleaching of textiles; Blending of crude oil and synthetic oils; Blueprinting; Boilermaking; Bookbinding; Brazing; Brewing of beer; Brewing services; Brushing of textiles; Building dehumidification; Buildings (Damp-proofing to existing -); Buildings (Fire-proofing to existing -); Buildings (Waterproofing of existing -); Burning of refuse and waste; Burnishing by abrasion; Burnishing services; Butchering; Butchery; Cabinet making; Cabinet-making (custom manufacture); Cadmium plating; Calcination services; Carpet deodorizing; Carpet dyeing; Casting; Catalytic conversion of chemical compounds; Ceramic glazing; Ceramic processing; Chemical decontamination of nuclear plant; Chemical recycling of waste products; Chemical treatment of boiler pipework; Chemical treatment of boilers; Chemical treatment of exhaust gases from fossil fuel combustion; Chemical treatment of textile; Chemical treatment of waste products; Chemical vapour deposition; Chromium plating; Chromium plating of metal articles; Chromium plating of metallic objects; Cider-making for others; Cinematographic film processing; Cinematographic films (Processing of -); Cloth cutting; Cloth dyeing; Cloth edging; Cloth (Edging of -); Cloth fireproofing; Cloth (Moth-proofing of -); Cloth (Permanent press treatment of -); Cloth pre-shrinking; Cloth (Pre-shrinking of -); Cloth treating; Cloth waterproofing; Clothing alteration; Clothing alterations; Clothing alterations [custom manufacture]; Clothing (hot-pressing of -) [forming of clothing]; Clothing (Shrinking of -); Coating by plasma nitriding; Coating of cylinders with chromium plate; Coating of optical lenses; Cobbler's services [custom manufacture]; Coffee roasting and processing; Coffee-grinding; Cold forming of metal; Collation [binding] of copied material; Collation [binding] of printed material; Collation [binding] of typewritten material; Color enhancement of black and white film; Color enhancement of black and white video film; Color separation services; Colour separation services; Colouring glass sheets by surface treatment; Conditioning of fur; Consultancy in the field of wine making; Consultancy relating to the clearance of chemical pollution; Consultancy relating to the clearance of oil pollution; Consultancy relating to the destruction of waste and trash; Consultancy relating to the incineration of waste and trash; Consultancy relating to the recycling of waste and trash; Consultancy relating to the treatment of chemical pollution; Consultancy relating to the treatment of oil pollution; Consultancy services relating to the generation of electrical power; Contact lens tinting; Contract moulding services; Conversion of nuclear fuels; Conversion of targeted substrates into targeted chemical preparations by treatment with enzyme systems; Cooked foods (Processing of -); Cooked foods (Treatment of -); Cooking oil and vegetable oil recycling services; Coppering; Coppersmithing; Cotton spinning; Covering of books; Crease resistant treatment of cloth; Crease resistant treatment of clothing; Crease resistant treatment of textiles; Crease-resistant treatment for clothing; Crease-resistant treatment of cloth; Crease-resistant treatment of fabric; Crease-retaining treatment; Cryogenic preservation; Cryopreservation services; Curtain-making; Custom 3D printing for others; Custom assembling of automobile bodies and chassis for others; Custom assembling of electronic components for communication devices; Custom assembling of electronic components for medical devices; Custom assembling of electronic components for mobile telephones; Custom assembling of electronic components for PDAs; Custom assembling of leather materials for others; Custom assembling of materials for others; Custom blending of essential oils for aromatherapy use; Custom clothing alteration; Custom color compounding of paint; Custom construction of machines; Custom fabrication of steel construction elements; Custom fashioning of fur; Custom imprinting of clothing with decorative designs; Custom manufacture and fitting of wigs; Custom manufacture by direct metal laser sintering; Custom manufacture of biopharmaceuticals; Custom manufacture of boats; Custom manufacture of communication devices for others; Custom manufacture of computers for others; Custom manufacture of dental prostheses; Custom manufacture of dental prosthesis and dentures; Custom manufacture of dental prosthetics; Custom manufacture of drapery; Custom manufacture of elastomeric components; Custom manufacture of furniture; Custom manufacture of ice sculptures; Custom manufacture of medical devices for others; Custom manufacture of metal hardware; Custom manufacture of molded components; Custom manufacture of molds for use in industry; Custom manufacture of ophthalmic lenses for eyeglasses; Custom manufacture of pharmaceuticals; Custom manufacture of prefabricated buildings; Custom manufacture of prefabricated construction elements; Custom manufacture of sculptures; Custom manufacture of semiconductor components, devices and circuits; Custom manufacture of sintered parts; Custom manufacture of steel construction elements; Custom manufacture of thermoplastic components; Custom manufacture of tools for others; Custom manufacture of wigs; Custom manufacture of yachts; Custom manufacturing of bread; Custom quilting; Custom tailoring; Custom tailoring or dressmaking; Custom tailoring services; Customisation of motor vehicles; Customized printing of company names and logos for promotional and advertising purposes on the goods of others; Customized production of cosmetics for others; Cutting (Cloth -); Cutting of cloth; Cutting of cloths; Cutting of curtains; Cutting of diamonds; Cutting of fabric; Cutting of fabrics; Cutting of gemstones; Cutting of leather; Cutting of metal; Cutting of precious stones; Cutting of replacement keys; Cutting of sheet glass; Cutting of textiles; Cutting-out of cloth; Cutting-out of fabrics; Damp-proofing to existing buildings; De-acidification of paper; Decontamination of hazardous materials; Decontamination of nuclear waste; Decontamination of subsurface soil sites; Degaussing; Demagnetization; Demineralisation of water; Dental laboratories; Dental prosthesis (Custom manufacture of -); Dental scrap refining; Dental technician services; Dental technician (Services of a -); Deodorising of the air; Deoxidizing of printed circuits; Desalination; Desalination of water; Design printing for others; Destruction of confidential material; Destruction of trash; Destruction of waste; Destruction of waste and trash; Detoxification of hazardous materials; Developing of photographic film; Development of photographic films; Development (Photographic film -); Die casting; Die-casting of metals; Digital enhancement of photographs; Digital on-demand printing services of books and other documents; Digital printing; Digital printing services; Digital restoration of photographs; Discharge printing; Disposal of solid residues; Disposal of waste water from industrial processes; Distilling of spirits for others; Document binding; Document destruction; Document shredding services; Drapery deodorizing; Dressing of animal skins; Dressmaking; Drilling of metals; Drink preservation; Dry mounting services; Dry-rot treatment of timber; Duplicating of audio-tapes; Duplicating of cinematographic films; Duplicating of cinematographic films for television; Duplicating of films; Duplicating of photographic film; Duplicating of photographic transparencies; Duplicating of tape recordings; Duplicating of transparencies; Duplicating of video-tapes; Duplication of audio and video recordings; Duplication of audio cassettes; Duplication of sound discs; Duplication of sound tapes; Duplication of video cassettes; Duplication of video discs; Duplication of video tapes; Dyeing; Dyeing (Cloth -); Dyeing [for textile or furs]; Dyeing (Fur -); Dyeing of cloth; Dyeing of cloth or clothing; Dyeing of clothing; Dyeing of fabrics; Dyeing of fur; Dyeing of furs; Dyeing of non-woven textiles; Dyeing of textiles; Dyeing of woven textiles; Dyeing services; Dyeing (Textile -); Dyeline services for document copying; Edging (Cloth -); Edging of cloth; Edging of fabric; Edging of textiles; Electricity generating; Electricity generation; Electricity generators (Rental of -); Electrochemical treatment; Electrolytic colouring services; Electro-phoretic coating; Electroplating; Electro-plating; Embossing of leather; Embroidering; Embroidery [embroidering]; Embroidery services; Enamelling; Enamelling of metals; Energy production; Energy (Production of -); Engraving; Engraving of dies; Engraving of molds; Engraving of sealing stamps; Engraving services for nameplates; Engraving services for rubber stamps; Engraving services for seals; Enlarging of photographic prints; Enlarging of pictorial work; Etching; Etching of a sequence of traceable identification numbers on automobile windows so as to identify a particular automobile recovered after theft; Etching of glass; Exterior and interior plating of pipes and tubes made of metal; Extraction of elements contained in waste residues; Extraction of minerals contained in waste residues; Extruding of metal alloys; Extruding of plastics; Fabric bleaching; Fabric dyeing; Fabric fireproofing; Fabric waterproofing; Fabrics (Edging of -); Fabrics (Fireproofing of -); Fabrics (Moth-proofing of -); Fabrics (Permanent press treatment of -); Fabrics (Pre-shrinking of -); Fabrics (Waterproofing of -); Film developing; Film developing and processing; Film developing (Photographic -); Film development and reproduction of photographs; Film printing (Photographic -); Film processing and photofinishing; Filtration of gases; Filtration of liquids; Filtration services for the parapetroleum industry; Filtration services for the petroleum industry; Filtration services utilising gravel; Finishing and coating of textiles; Finishing of surfaces by peen forming; Finishing of surfaces by shot peening; Fireproofing (Cloth -); Fireproofing [for textile or furs]; Fireproofing of cloth; Fireproofing of clothing; Fireproofing of existing structures; Fireproofing of fabric; Fireproofing of furs; Fireproofing of textiles; Firing of ceramics; Firing of pottery; Firing pottery; Fish processing; Fish smoking; Flame proofing; Flame proofing of bedding; Flame proofing of furniture; Flame proofing of padding materials; Flame proofing of stuffing materials; Flour milling; Food and beverage treatment; Food and drink preservation; Food canning; Food grinding; Food milling; Food preservation; Food preservation services; Food processing; Food smoking; Foods (Freezing of -); Forage processing; Forging; Forging of metal goods to the order and specification of others; Forging of metals; Formation of silage; Framing of pictures; Framing of works of art; Freezing; Freezing of foods; Freezing services for others; French polishing; Fruit crushing; Fuel processing; Fuel refining; Fuel treatment services; Fulling of cloth; Fur conditioning; Fur (Custom fashioning of -); Fur cutting; Fur dyeing; Fur (Edging of -); Fur (Fireproofing of -); Fur glossing; Fur mothproofing; Fur moth-proofing; Fur (Permanent press treatment of -); Fur (Pre-shrinking of -); Fur satining; Fur (Waterproofing of -); Fur working; Galvanisation; Galvanising; Galvanising of metal; Galvanization; Galvanization services; Galvanizing; Gas compression services; Gas processing services; Gas production services; Generating of electricity; Generation of electrical power using carbon sequestration; Generation of electricity; Generation of electricity from geothermal energy; Generation of electricity from solar energy; Generation of electricity from wave energy; Generation of electricity from wind energy; Generation of energy; Generation of gas and electricity; Generation of power; Generators (Electricity -) rental of ; Gilding; Glass etching; Glass polishing; Glass resurfacing; Glass tempering; Glass tinting; Glass-blowing; Glossing (Fur -); Gold plating; Gold-leafing; Gold-plating; Grinding; Grinding and polishing glass for eyeglasses; Grinding of coffee; Grinding of lenses; Grinding of optical glass; Grinding (Optical glass -); Grit blasting services; Halal slaughtering services [Dhabihah]; Hard chromium plating and hard nickel plating of metal surfaces; Hard chromium plating of metal surfaces; Hard drive shredding services; Hard nickel plating of metal surfaces; Hardening of metals; Hazardous substances (Treatment of -); Hazardous waste management; Hazardous waste treatment services; Heat treatment and coating of steel; Heat treatment of metal surfaces; Heat treatment of metals; Heat treatment of ores; Heat treatment of pipes and tubes made of metal; Heating apparatus (Rental of space -); Hire of electrical generators; Hot dipping; Hot-pressing [forming] of clothing; Imprinting messages on tee-shirts; Incineration and destruction of waste; Incineration of gases; Incineration of spent air; Incineration of trash; Incineration of waste; Incineration of waste and trash; Industrial toxic waste disposal; Industrial treatment of effluents; Information, advice and consultancy services relating to the recycling of waste and trash; Information and advisory services relating to the generation of electricity from wave energy; Information (Material treatment -); Information services relating to the printing of photographic film; Information services relating to the processing of photographic film; Intaglio printing; Irradiation of food; Jewelry casting; Joinery [custom manufacture]; Joining of components using adhesives; Joining of components using ultrasonic welding techniques; Key cutting; Key duplicating; Kiln drying of timber; Kiln drying of wood; Knitting machine rental; Kosher slaughtering services [Shechita]; Laminating; Laminating of board; Laminating of card; Laminating of fabrics; Laminating of glass sheets; Laminating of metal plates; Laminating of paper; Laminating of plastic; Laminating of plastic sheets; Laminating of textiles; Laminating of wood; Laminating of wood substitutes; Land decontamination; Laser engraving; Laser scribing; Laser scribing services; Lead working; Leasing of energy generating equipment; Leasing of sewing machines; Leasing of water purification equipment; Leather staining; Leather working; Lenses (Grinding of -); Letterpress printing; Lithographic printing; Machining parts for others; Magnetic encoding services; Magnetic striping of cine-film; Magnetisation; Magnetization; Making of rubber stamps; Manufacture of furniture to order and specification of others; Material treatment information; Material treatment (Information relating to -); Metal brazing; Metal casting; Metal coating; Metal coating [not painting]; Metal colouring [not painting]; Metal cutting; Metal fabrication and finishing services; Metal finishing; Metal forging; Metal hardening; Metal laminating; Metal melting services; Metal moulding; Metal plating; Metal plating and laminating; Metal polishing; Metal pressing; Metal stamping; Metal tempering; Metal treating; Metal treatment; Metal treatment services; Metallising; Metallizing; Metallurgical processing; Metallurgical smelting; Metalworking; Microencapsulating services provided for others; Mildew-prevention treatment of food; Mildew-proofing; Milk processing; Mill working; Milling; Milling (Flour -); Milling of flour; Millworking; Mixing lubricants for third parties; Mold prevention treatment; Mold prevention treatment of cloth; Mold prevention treatment of fabric; Mold prevention treatment of furs; Mold prevention treatment of textiles; Molding of plastic materials; Monogramming of clothes; Monogramming of clothing; Mothproofing [for textile or furs]; Mothproofing (Fur -); Mothproofing of clothing; Mothproofing of furs; Mothproofing of materials; Mothproofing of textiles; Mothproofing services; Mothproofing (Textile -); Moulding of concrete; Moulding of furniture; Moulding of implant models for the human body; Moulding of implants for the human body; Moulding of synthetic products; Moulding of textiles; Mould-inhibiting treatment; Mounting of prints or transparencies; Mounting of works of art as part of the framing process; Must making services; Natural gas liquefaction services; Needlework and dressmaking; Needlework [custom manufacture]; Nickel plating; Nickelling; Nuclear fuel recycling; Nuclear fuel reprocessing; Nuclear waste treatment; Odour counteracting services; Odour removal services; Offset printing; Offset printing services; Oil (Processing of -); Oil refinery services; Oil refining; Oil well fracturing; Oils (Processing of -); Oil-spill treatment; On-site water purification services; Optical glass grinding; Optical grinding; Optical lens grinding; Paint mixing services; Painting mounting services; Paper bleaching; Paper finishing; Paper treating; Paper treating and working; Paper treatment; Pasteurising of food and beverages; Pasteurization services for food and beverages; Pasteurizing of food and beverages; Pattern cutting; Pattern printing; Pattern printing of carpet tiles; Pattern printing of carpets; Pattern printing of floor coverings; Pattern printing of wall coverings; Pattern printing on fabric; Pattern printing on textiles; Permanent press treatment of cloth; Permanent press treatment of clothing; Permanent press treatment of fabric; Permanent press treatment of items of clothing; Permanent press treatment of textiles; Permanent-press treatment of clothes; Permanent-press treatment of fabrics; Petrochemical refining services; Petroleum gas liquefaction; Photo finishing; Photocomposing services; Photocomposition services; Photofinishing; Photographic developing; Photographic duplicating; Photographic enlarging; Photographic etching; Photographic etching of articles of clothing; Photographic etching of fabrics; Photographic etching of household articles; Photographic etching of paper; Photographic etching of printed matter; Photographic etching of textiles; Photographic film developing; Photographic film development; Photographic image processing; Photographic laboratory services; Photographic preservation; Photographic preservation and conservation; Photographic printing; Photographic printing apparatus (Rental of -); Photographic processing; Photographic processing apparatus (Rental of -); Photographic reproduction; Photographic restoration; Photographic restoration services; Photographic retouching; Photographic slide and print processing; Photogravure; Photogravure printing; Photo-printing; Picture-framing; Planing of materials; Planing of timber; Planing [saw mill]; Plating; Plating (Metal -); Pneumatic abrasion of surfaces; Polishing; Polishing of diamonds; Polishing of diamonds and other precious stones; Polishing of gems; Polishing of gemstones; Polishing of metals; Polishing of stainless steel; Polymerization; Portrait printing; Pottery firing; Powder coating; Preparation and treatment of fabric; Preparation by solution deposition; Preparation of electronic circuitry by solution deposition; Preparation of electronic circuitry by surface energy patterning; Preservation of drink; Preservation of food; Preservative treatment of wood [other than painting]; Pre-shrinking (Cloth -); Pre-shrinking of cloth; Pre-shrinking of clothing; Pre-shrinking of fabric; Pre-shrinking of items of clothing; Pre-shrinking of textiles; Pressing of compact disc masters; Pressing of record masters; Pressure-treatment of timber for preservation purposes; Print finishing [binding] services; Print finishing [cutting] services; Print finishing [folding] services; Print finishing services; Printing; Printing, and photographic and cinematographic development; Printing (Lithographic -); Printing of advertising matter; Printing of books; Printing of cinematographic film; Printing of decorative patterns on gift wrap; Printing of digitally stored pictures and photographs; Printing of documents from digital media; Printing of images on objects; Printing of patterns on textiles; Printing of photographic film; Printing of photographic images from digital media; Printing of photographic transparencies; Printing of photos; Printing of stamps; Printing (Offset -); Printing (Pattern -); Printing (Photographic -); Printing services; Processing and cutting of diamonds and other precious stones; Processing of bamboo; Processing of biopharmaceutical materials for others; Processing of chemicals; Processing of chemicals and petrochemicals; Processing of cinematographic films; Processing of coal; Processing of dry gas; Processing of foodstuffs for use in manufacture; Processing of fuel materials; Processing of gas; Processing of gas and oil; Processing of hydrocarbon derivatives; Processing of hydrocarbons; Processing of iron oxides; Processing of metal surfaces by abrasive polishing; Processing of metal surfaces by precision grinding and abrasive polishing; Processing of metal surfaces using precision grinding techniques; Processing of natural gas; Processing of nuclear fuels; Processing of oil; Processing of optical lenses to meet individual requirements; Processing of organic chemical liquids; Processing of photographic and cinematographic films; Processing of photographic film; Processing of plastics; Processing of rattan; Processing of rubber; Processing of semiconductor wafers; Processing of tree barks; Processing of used exhaust catalysts for recovery of noble metals; Processing of waste oil; Processing (Photographic -); Production of electrical power from renewable sources; Production of energy; Production of energy by nuclear power plants; Production of energy by power plants; Production of hydroelectric power; Production of wine for others; Providing information relating to bookbinding services; Providing information relating to ceramic processing; Providing information relating to dressmaking; Providing information relating to embroidery services; Providing information relating to material treatment; Providing information relating to nuclear fuel reprocessing; Providing information relating to paper finishing services; Providing information relating to paper treating services; Providing information relating to photographic enlarging services; Providing information relating to photographic film development; Providing information relating to photographic printing services; Providing information relating to photogravure services; Providing information relating to printing services; Providing information relating to tailoring; Providing information relating to taxidermy; Providing information relating to the engraving of sealing stamps; Providing information relating to the processing of cinematographic films; Providing information relating to the processing of plastics; Providing information relating to the processing of rubber; Providing information relating to the recycling of waste; Providing information relating to the rental of air conditioning apparatus; Providing information relating to the rental of bookbinding machines; Providing information relating to the rental of chemical processing machines and apparatus; Providing information relating to the rental of glassware manufacturing machines and apparatus; Providing information relating to the rental of knitting machines; Providing information relating to the rental of machines for making shoes; Providing information relating to the rental of printing machines and apparatus; Providing information relating to the rental of sewing machines; Providing information relating to the rental of space cooling apparatus for household purposes; Providing information relating to the rental of space cooling apparatus for industrial purposes; Providing information relating to the rental of tobacco processing machines; Providing information relating to the rental of waste compacting machines and apparatus; Providing information relating to the rental of waste crushing machines and apparatus; Providing information relating to the rental of water purifying apparatus; Providing information relating to the treatment of materials; Providing information relating to water treatment; Providing information relating to woodworking; Providing material treatment information; Provision of information relating to chemical processing; Provision of information relating to the treatment of materials; Provision of material treatment information; Purification of air; Purification of gases; Purification of industrial waste water; Purification of minerals by chemical methods; Purification of minerals by magnetic methods; Purification of refrigerant fluids; Quilting; Radiation area decontamination services; Reclamation of material from waste; Reclamation of solids from aqueous media by chemical precipitation; Reclamation of solvents; Recovery of hydrocarbons from gas; Recovery of precious metals; Recycling; Recycling and waste treatment; Recycling catalytic converters; Recycling of aerosol propellants; Recycling of beverage bottles; Recycling of chemicals; Recycling of chlorofluorocarbon (CFC) containing gases; Recycling of chlorofluorocarbon (CFC) containing liquids; Recycling of clothing; Recycling of clothing to obtain materials for making synthetic fibers; Recycling of foam blowing agents; Recycling of insulating gases from air conditioning plant; Recycling of insulating gases from freezers; Recycling of insulating gases from refrigerators; Recycling of metals; Recycling of minerals; Recycling of organic solvents; Recycling of paper; Recycling of plastics; Recycling of refrigerant fluids; Recycling of refuse and waste; Recycling of scrap; Recycling of solvents; Recycling of toner; Recycling of valuable materials; Recycling of waste; Recycling of waste and rubbish; Recycling of waste and trash; Recycling of waste materials; Recycling of waste products; Recycling services; Refinement of fuel materials; Refining; Refining of crude oil; Refining of gas; Refining of metals; Refining of oil; Refining of petroleum products; Refining services; Refinishing of acrylic fixtures; Refinishing of fibreglass; Refinishing of porcelain; Refrigerant reclamation services; Regeneration of air; Regeneration of spent catalysts; Regeneration of water; Remastering of films from one format to another; Removal of specified chemicals from chemical process fluids; Rental of 3D printers; Rental of air conditioning apparatus; Rental of air purification apparatus; Rental of air-conditioning apparatus; Rental of assembly machine equipment; Rental of batteries; Rental of boilers; Rental of bookbinding equipment; Rental of bookbinding machines; Rental of chemical processing machines; Rental of chemical processing machines and apparatus; Rental of chemical processing machines and apparatus and providing information relating thereto; Rental of cooling apparatus and installations; Rental of cutting equipment; Rental of electric fans for cooling; Rental of electric power generators; Rental of electric welding apparatus; Rental of electric welding machines; Rental of electrical transformers; Rental of electricity generators; Rental of equipment for the treatment and transformation of materials, for energy production and for custom manufacturing; Rental of gas-operated welding apparatus; Rental of generators; Rental of generators (Electric -); Rental of glassware manufacturing machines; Rental of glassware manufacturing machines and apparatus; Rental of heating apparatus; Rental of heating boilers; Rental of heating installations; Rental of knitting machines; Rental of laser engraving machines; Rental of machines and apparatus for film development; Rental of machines and apparatus for fireproofing textiles; Rental of machines and apparatus for lumbering; Rental of machines and apparatus for mothproofing textiles; Rental of machines and apparatus for papermaking; Rental of machines and apparatus for paper-working; Rental of machines and apparatus for photograph enlargement; Rental of machines and apparatus for photograph finishing; Rental of machines and apparatus for photograph printing; Rental of machines and apparatus for plywood making; Rental of machines and apparatus for processing beverages; Rental of machines and apparatus for processing foods; Rental of machines and apparatus for pulp-making; Rental of machines and apparatus for treating textiles; Rental of machines and apparatus for veneering; Rental of machines and apparatus for wood-working; Rental of machines for the manufacture of corrugated board; Rental of machines for the manufacture of corrugated cardboard; Rental of misting systems for outdoor cooling; Rental of photographic enlargers; Rental of photographic lenses for developing; Rental of photographic printing apparatus; Rental of photographic processing apparatus; Rental of photographic processing equipment; Rental of power-generating equipment; Rental of printing machines and apparatus; Rental of refrigerating apparatus; Rental of sewing machines; Rental of shoe making machines; Rental of space cooling apparatus for household purposes; Rental of space cooling apparatus for household use; Rental of space cooling apparatus for industrial use; Rental of space heating apparatus; Rental of textile dyeing machines and apparatus; Rental of textile treating machines and apparatus; Rental of tobacco processing machines; Rental of typographic presses; Rental of waste compacting machines; Rental of waste compacting machines and apparatus; Rental of waste crushing machines; Rental of waste crushing machines and apparatus; Rental of water and air purification equipment; Rental of water filters; Rental of water filtration units for commercial use; Rental of water purifying apparatus; Rental of water treatment equipment; Rental of welding apparatus; Reprocessing lubrication oils; Reprocessing of nuclear fuels; Reproduction of cinematographic film; Reproduction of museum artwork; Reproduction of photographic prints; Reproduction of photographic transparencies; Rolling; Rot prevention treatment of buildings; Rotogravure; Saddlery working; Sand blasting; Sandblasting services; Satining (Fur -); Sawing of materials; Sawing of timber; Sawing [saw mill]; Sawmill planing; Sawmill services; Sawmills, planing [sawmill]; Scrapping of vehicles; Screen printing; Scribing (Laser -); Services for burnishing by abrasion; Services for the custom manufacturing of curtains; Services for the custom manufacturing of loose covers; Services for the custom manufacturing of roller blinds; Services for the dyeing of fabrics; Services for the enrichment of uranium isotope 235; Services for the transfer of photographic prints onto video tapes; Services for the treatment of sewage; Services of a dental technician; Sewage treatment services; Sewing; Sewing (custom manufacture); Sewing of curtains; Sewing services; Shaping of metal components; Shearing of carpets; Sheet material encapsulating services; Sheet material encapsulating services for documents; Sheet material encapsulating services for maps; Sheet material encapsulating services for photographs; Sheet material encapsulating services for pictures; Shoe staining; Shoe staining and dyeing; Shoemaking; Shot blasting; Shrinking of cloth; Shrinking of clothing; Shrinking of fabric; Shrinking of items of clothing; Shrinking of textiles; Shrink-proofing [for textile or furs]; Sign lettering; Silk screen painting; Silk screen printing; Silkscreen printing; Silver plating; Silversmithing; Sizing of cardboard; Sizing of paper; Skin dressing; Skins (Dressing of -); Slaughtering; Slaughtering of animals; Slaughtering of livestock; Slaughtering of poultry; Slide-duplicating (Photographic -); Smithing; Smoke house services for smoking food; Smoking of cheese; Smoking of fish; Smoking of foodstuffs; Smoking of meat; Soil treatment services; Soil, waste or water treatment services [environmental remediation services]; Soldering; Solvent purification; Sorting of waste and recyclable material; Sorting of waste and recyclable material [transformation]; Spirits distillery services; Staining; Staining of leather; Stainless steel brushing services; Stainless steel polishing services; Stamping [pressing]; Stationery printing services; Steel cutting; Stone carving; Stone crushing; Stone grinding; Stripping finishes; Stripping of furniture; Stripping of wooden objects; Surface energy patterning; Surface finishing of metal articles; Surface grinding; Surface plating; Surface polishing; Surfacing of textiles; Swaging services in respect of automobile parts; Tailoring [custom manufacture]; Tailoring or dressmaking; Tailoring services; Tanning; Tanning of leather; Tapestry weaving for others; Tapestry-weaving; Taxidermy; Tea-leaf processing; Tee-shirt embroidering services; Tempering (Metal -); Tempering of metals; Textile and fabric treating; Textile cutting; Textile dyeing; Textile finishing; Textile fireproofing; Textile, leather and fur treatment; Textile mothproofing; Textile printing; Textile treating; Textile treating against moths; Textile treatment in the nature of waterproofing; Textile warping; Textile weaving; Textiles (Applying finishes to -); Textiles (Edging of -); Textiles (Fireproofing of -); Textiles (Moth-proofing of -); Textiles (Permanent press treatment of -); Textiles (Pre-shrinking of -); Textiles (Waterproofing of -); Thin film coating of optical components; Three-dimensional printing [3DP]; Three-dimensional printing [3DP] services; Timber felling and processing; Timber preservation; Timber processing; Tin plating; Tin smithing; Tinning; Tin-plating; Tinting of car windows; Tinting of lenses; Titanium nitride coating; Tombstone engraving; Transfer of cine films on to video tape; Transfer of cine-films on to videotape; Transfer of cinematographic film onto video tape; Transfer of photographic films on to video tape; Transfer of photographic films on to videotape; Transfer of photographic prints; Transfer of photographic transparencies; Transfer of photographs on to compact disc; Transparency duplicating (Photographic -); Trash incineration; Trash (Incineration of -); Trash (Recycling of -); Treating [embossing] of metal; Treating [enamelling] of metal; Treating [forging] of metal; Treating [forming] of metal; Treating materials with ultrasonic waves to modify their properties; Treating of cloth; Treating of textile against mites; Treating of textiles; Treating [shaping] of metal; Treating [stamping] of metal; Treating [tempering] of metal; Treatment and coating of metal surfaces; Treatment and processing of clothing for recycling purposes; Treatment and processing of ores and ore concentrates; Treatment and processing of plastics; Treatment and recycling of packaging; Treatment of aerial or satellite photographs; Treatment of carpets to impart antistatic properties; Treatment of carpets to impart stain repellent properties; Treatment of chemical waste; Treatment of cloth; Treatment of contaminated soil; Treatment of crude mineral oil; Treatment of effluent; Treatment of fabrics to impart antistatic properties; Treatment of fabrics to impart stain repellent properties; Treatment of finished products by means of electrolysis; Treatment of fur; Treatment of glass to alter the optical properties; Treatment of hazardous gases; Treatment of hazardous liquids; Treatment of hazardous materials; Treatment of hazardous substances; Treatment of hazardous waste; Treatment of hazardous waste by encapsulation; Treatment of industrial waste; Treatment of industrial waste to sequester carbon; Treatment of lenses to alter the optical properties; Treatment of materials by laser beam; Treatment of materials for the manufacture of ceramic goods; Treatment of materials using chemicals; Treatment of metal; Treatment of metal parts to prevent corrosion; Treatment of metal parts to prevent corrosion using hot-dip galvanizing and powder coating processes; Treatment of metals; Treatment of natural gas; Treatment of oils by the removal of polychlorinated biphenols; Treatment of optical components to alter the optical properties; Treatment of plastic materials to produce plastic mouldings; Treatment of semi-manufactured products by means of electrolysis; Treatment of slag arising from metal casting; Treatment of stereoscopic images; Treatment of synthetic polymers against bacteriological infections; Treatment of synthetic polymers against fungal attacks; Treatment of timber with preservatives; Treatment of toxic material; Treatment of toxic sludges; Treatment of toxic waste; Treatment of waste; Treatment of waste materials; Treatment of waste materials in the field of environmental pollution control; Treatment of waste water; Treatment of waste water from generating operations; Treatment of waste water from industrial processes; Treatment of water; Treatment of wet rot; Treatment of wool; Treatment [purification] of water; Treatment [reclamation] of industrial waste; Treatment [reclamation] of material from hazardous products; Treatment [reclamation] of material from waste; Treatment [recycling] of chemicals; Treatment [recycling] of hazardous liquids; Treatment [recycling] of hazardous products; Treatment [recycling] of radioactive waste; Treatment [recycling] of toxic liquids; Treatment [recycling] of waste; Treatment [transformation] of waste; Treatment [washing] of coal; T-shirt embroidering services; T-shirt printing; Typesetting; Typesetting services; Typography; Upcycling [waste recycling]; Upholstery deodorizing; Vapour depositing on metal surfaces; Video cassette duplicating; Video tapes (Transfer of cine-films on to -); Video tapes (Transfer of photographic film on to -); Video transfer for the conversion of cine-film to video tape; Vinyl wrapping of vehicles; Vulcanisation (material treatment); Vulcanization [material treatment]; Vulcanization [not repair]; Vulcanizing [material treatment]; Warping [looms]; Waste and/or water treatment services; Waste and trash (Destruction of -); Waste and trash (Incineration of -); Waste and trash (Recycling of -); Waste destruction; Waste disposal [treatment of waste]; Waste incineration; Waste management services [recycling]; Waste processing; Waste processing [transformation]; Waste recycling services; Waste treatment; Waste treatment by electrolysis; Waste (Treatment of toxic -); Waste treatment [transformation]; Waste water reprocessing; Waste water treatment; Water demineralization; Water pollution control; Water purification; Water treating; Water treatment; Water treatment and purification; Water treatment [demineralising] services; Water treatment services; Waterproofing (Cloth -); Waterproofing [for textile or furs]; Waterproofing of cloth; Waterproofing of clothing; Waterproofing of fabric; Waterproofing of fabrics; Waterproofing of textiles; Waterproofing textiles; Weaving; Welding; Welding services; Whitening [bleaching] of fabrics; Whitening of cloth; Whitening of clothing; Whitening of fabric; Whitening of laundry; Whitening of textiles; Window tinting treatment, being surface coating; Wine making for others; Wine-making for others; Wood-carving; Woodturning services; Woodworking; Wood-working; Wool cutting; Wool dyeing; Wool (Edging of -); Wool (Fireproofing of -); Wool (Moth-proofing of -); Wool (Permanent press treatment of -); Wool (Pre-shrinking of -); Wool printing; Wool treating; Wool treatment and finishing; Wool (Waterproofing of -); Working of leather; Working of leather and furs; Works of art (Framing of -); Zinc plating.Class 43 Accommodation booking agency services [time share]; Accommodation bureau services; Accommodation bureau services [hotels, boarding houses]; Accommodation bureaux [hotels, boarding houses]; Accommodation bureaux services; Accommodation exchange services [time share]; Accommodation letting agency services [time share]; Accommodation (Rental of temporary -); Accommodation reservation services; Accommodation reservation services [time share]; Accommodation reservations; Accommodation reservations (Temporary -); Accommodation services; Accommodation services for functions; Accommodation services for meetings; Advice concerning cooking recipes; Agency services for booking hotel accommodation; Agency services for reservation of restaurants; Agency services for the reservation of temporary accommodation; Animal boarding; Animals (Boarding for -); Appraisal of hotel accommodation; Arranging and providing temporary accommodation; Arranging holiday accommodation; Arranging hotel accommodation; Arranging of accommodation for holiday makers; Arranging of accommodation for tourists; Arranging of banquets; Arranging of holiday accommodation; Arranging of hotel accommodation; Arranging of meals in hotels; Arranging of temporary accommodation; Arranging of wedding receptions [food and drink]; Arranging of wedding receptions [venues]; Arranging temporary housing accommodations; Banqueting services; Bar and restaurant services; Bar information services; Bar services; Bars; Beer bar services; Beer garden services; Bistro services; Boarding for animals; Boarding for horses; Boarding for pets; Boarding house bookings; Boarding house services; Boarding houses; Boarding kennel services; Booking agency services for holiday accommodation; Booking agency services for hotel accommodation; Booking of accommodation for travellers; Booking of campground accommodation; Booking of hotel accommodation; Booking of hotel rooms for travellers; Booking of restaurant seats; Booking of temporary accommodation; Booking of temporary accommodation via the Internet; Booking services for accommodation; Booking services for holiday accommodation; Booking services for hotels; Brasserie services; Buildings [Rental of transportable -]; Business catering services; Café services; Cafe services; Cafés; Cafeteria services; Cafeterias; Cake decorating; Camp services (Holiday -) [lodging]; Campground facilities (Providing -); Canteen services; Canteens; Caravan park facilities (Provision of -); Carry-out restaurants; Carvery restaurant services; Catering; Catering (Food and drink -); Catering for the provision of food and beverages; Catering for the provision of food and drink; Catering in fast-food cafeterias; Catering of food and drink; Catering of food and drinks; Catering services; Catering services for company cafeterias; Catering services for conference centers; Catering services for educational establishments; Catering services for hospitality suites; Catering services for hospitals; Catering services for nursing homes; Catering services for providing European-style cuisine; Catering services for providing Japanese cuisine; Catering services for providing Spanish cuisine; Catering services for retirement homes; Catering services for schools; Catering services for the provision of food; Catering services for the provision of food and drink; Catering services specialised in cutting ham by hand, for fairs, tastings and public events; Catering services specialised in cutting ham by hand, for weddings and private events; Catering services specialising in cutting ham for fairs, tastings and public events; Catering services specialising in cutting ham for weddings and private events; Cattery services; Charitable services, namely providing food and drink catering; Charitable services, namely, providing food to needy persons; Charitable services, namely providing temporary accommodation; Child care centers; Child care services; Child minding services; Children's creches; Children's residential home services; Club services for the provision of food and drink; Cocktail lounge buffets; Cocktail lounge services; Cocktail lounges; Coffee bar services; Coffee shop services; Coffee shops; Coffee supply services for offices [provision of beverages]; Consultancy provided by telephone call centers and hotlines in the field of temporary accommodation; Consultancy services in the field of food and drink catering; Consultancy services relating to baking techniques; Consultancy services relating to food; Consultancy services relating to food preparation; Consultancy services relating to hotel facilities; Consulting services in the field of culinary arts; Contract food services; Cookery advice; Cooking apparatus (Rental of -); Corporate hospitality (provision of food and drink); Creche services; Creche services provided in shopping locations; Day care centers; Day nursery services; Day-care center services; Day-nurseries; Day-nurseries [crèches]; Day-nursery [crèche] services; Decorating of food; Delicatessens [restaurants]; Dog day care services; Drink dispensing machines (rental of); Electronic information services relating to hotels; Emergency shelter services [providing temporary housing]; Event facilities and temporary office and meeting facilities; Fast food restaurants; Fast-food restaurant services; Food and drink catering; Food and drink catering for banquets; Food and drink catering for cocktail parties; Food and drink catering for institutions; Food and drink preparation services; Food preparation; Food preparation for others on an outsourcing basis; Food preparation services; Food sculpting; Food service apparatus (Rental of -); Grill restaurants; Guest house services; Guest houses; Guesthouse; Guesthouses; Hire of bed linen; Hire of interior chairs; Hire of interior lighting; Hire of interior matting; Hire of interior tables; Hire of marquees; Hire of pavilions; Hire of temporary office space; Hiring of furniture; Hiring of furniture for conferences; Hiring of furniture for exhibitions; Hiring of furniture for presentations; Hiring of mats; Hiring of rooms for social functions; Holiday accommodation services; Holiday camp services [lodging]; Holiday lodgings; Holiday planning services [accommodation]; Homes for the elderly [retirement]; Homes (Retirement -); Homes (Tourist -); Hookah bar services; Hookah lounge services; Hospitality services [accommodation]; Hospitality services [food and drink]; Hostels; Hotel accommodation reservation services; Hotel accommodation services; Hotel catering services; Hotel information; Hotel reservation services; Hotel reservation services provided via the Internet; Hotel reservations; Hotel restaurant services; Hotel room booking services; Hotel services; Hotel services for preferred customers; Hotels; Hotels and motels; Hotels, hostels and boarding houses, holiday and tourist accommodation; Houses (Boarding -); Ice cream parlors; Ice cream parlour services; Information, advice and reservation services for the provision of food and drink; Information and advice in relation to the preparation of meals; Information relating to hotels; Japanese restaurant services; Juice bar services; Juice bars; Leasing of furniture; Leasing of metal and non-metal transportable buildings; Letting of holiday accommodation; Linen hire; Lounge services (Cocktail -); Making hotel reservations for others; Making reservations and bookings for restaurants and meals; Marquee hire; Marquees (Rental of -); Mobile catering; Mobile catering services; Mobile creches; Mobile restaurant services; Motel services; Motels; Night club services [provision of food]; Nurseries and day care centers; Nurseries, day-care and elderly care facilities; Office catering services for the provision of coffee; Old people's home services; Operating membership accommodation; Organisation of catering for birthday parties; Outside catering; Outside catering services; Personal chef services; Pet boarding services; Pet day care services; Pet hotel services; Pizza parlors; Preparation and provision of food and drink for immediate consumption; Preparation of food and beverages; Preparation of food and drink; Preparation of Japanese food for immediate consumption; Preparation of meals; Preparation of Spanish food for immediate consumption; Preschooler and infant care at daycare centers; Private members dining club services; Private members drinking club services; Providing accommodation for functions; Providing accommodation for meetings; Providing accommodation in hotels and motels; Providing assisted living facilities [temporary accommodation]; Providing banquet and social function facilities for special occasions; Providing campground facilities; Providing child care centers; Providing community centers for social gatherings and meetings; Providing conference rooms; Providing convention facilities; Providing drink services; Providing emergency shelter services in the nature of temporary housing; Providing exhibition facilities in hotels; Providing facilities for exhibitions; Providing facilities for fairs and exhibitions; Providing food and beverages; Providing food and drink; Providing food and drink catering services for convention facilities; Providing food and drink catering services for exhibition facilities; Providing food and drink catering services for fair and exhibition facilities; Providing food and drink for guests; Providing food and drink for guests in restaurants; Providing food and drink in bistros; Providing food and drink in doughnut shops; Providing food and drink in Internet cafes; Providing food and drink in restaurants and bars; Providing food to needy persons [charitable services]; Providing guesthouse services; Providing hotel accommodation; Providing hotel and motel services; Providing information about bar services; Providing information about bartending; Providing information about creche services; Providing information about restaurant services; Providing information about temporary accommodation services; Providing information about temporary accommodation via the Internet; Providing information in the nature of recipes for drinks; Providing lodging information via the Internet; Providing of food and drink; Providing of food and drink via a mobile truck; Providing on-line information relating to holiday accommodation reservations; Providing online information relating to hotel reservations; Providing restaurant services; Providing reviews of restaurants; Providing reviews of restaurants and bars; Providing room reservation and hotel reservation services; Providing temporary accommodation; Providing temporary accommodation as part of hospitality packages; Providing temporary accommodation in boarding houses; Providing temporary accommodation in holiday flats; Providing temporary accommodation in holiday homes; Providing temporary housing accommodations; Providing temporary lodging at holiday camps; Providing temporary lodging for guests; Providing temporary rest areas for passengers; Providing temporary trailer park facilities; Providing travel lodging information services and travel lodging booking agency services for travelers; Provision of after-school care; Provision of before-school care; Provision of camp ground facilities; Provision of caravan park facilities; Provision of conference, exhibition and meeting facilities; Provision of conference facilities; Provision of day nurseries [other than schools]; Provision of event facilities and temporary office and meeting facilities; Provision of exhibition facilities; Provision of facilities for board meetings; Provision of facilities for conventions; Provision of facilities for exhibitions; Provision of food and beverages; Provision of food and drink; Provision of food and drink in restaurants; Provision of holiday accommodation; Provision of hotel accommodation; Provision of information relating to bars; Provision of information relating to hotels; Provision of information relating to restaurants; Provision of information relating to the booking of accommodation; Provision of information relating to the preparation of food and drink; Provision of temporary accommodation; Provision of temporary furnished accommodation; Provision of temporary lodgings; Provision of temporary work accommodation; Provision of trade show facilities [accommodation]; Public house services; Pubs; Ramen restaurant services; Rating holiday accommodation; Reception services for temporary accommodation [management of arrivals and departures]; Rental of accommodation [temporary]; Rental of bar equipment; Rental of beds; Rental of beverage fountains; Rental of blankets; Rental of carpet; Rental of carpets; Rental of catering equipment; Rental of chafing dishes; Rental of chairs and tables; Rental of chairs, tables, table linen, glassware; Rental of chocolate fountains; Rental of conference rooms; Rental of cooking apparatus; Rental of cooking equipment for industrial purposes; Rental of cooking utensils; Rental of cotton candy making machines; Rental of crockery; Rental of curtains for hotels; Rental of cutlery; Rental of dishes; Rental of drink dispensing machines; Rental of drinking water dispensers; Rental of electric hot plates for household purposes; Rental of electric toasters for household purposes; Rental of floor coverings; Rental of floor coverings for hotels; Rental of food service apparatus; Rental of food service equipment; Rental of furnishings; Rental of furniture; Rental of furniture for hotels; Rental of furniture, linens and table settings; Rental of furniture, linens, table settings, and equipment for the provision of food and drink; Rental of futon; Rental of glassware; Rental of holiday accommodation; Rental of holiday cabins; Rental of holiday homes; Rental of internal furnishings; Rental of kitchen sinks; Rental of kitchen sinks for commercial use; Rental of kitchen sinks for household purposes; Rental of kitchen worktops; Rental of kitchen worktops for preparing food for immediate consumption; Rental of lighting apparatus; Rental of lighting apparatus (Domestic -); Rental of linen; Rental of meeting rooms; Rental of microwave ovens for household purposes; Rental of non-electric cooking heaters; Rental of pillows; Rental of popcorn poppers; Rental of portable buildings; Rental of quilts; Rental of rooms; Rental of rooms as temporary living accommodations; Rental of rooms for social functions; Rental of rugs; Rental of tableware; Rental of temporary accommodation; Rental of temporary accommodation in holiday homes and flats; Rental of tents; Rental of towels for hotels; Rental of transportable buildings; Rental of wall hangings for hotels; Rental of water dispensers; Reservation and booking services for restaurants and meals; Reservation of accommodation in hotels; Reservation of hotel accommodation; Reservation of restaurants; Reservation of rooms for travellers; Reservation of temporary accommodation; Reservation of temporary accommodation in the nature of holiday homes; Reservation of tourist accommodation; Reservation services for accommodation; Reservation services for booking meals; Reservation services for the booking of accommodation; Reservations (Temporary accommodation -); Resort hotel services; Resort hotels; Resort lodging services; Respite care services in the nature of adult day care; Restaurant and bar services; Restaurant information services; Restaurant reservation services; Restaurant services; Restaurant services for the provision of fast food; Restaurant services incorporating licensed bar facilities; Restaurant services provided by hotels; Restaurants; Restaurants (Self-service -); Retirement home services; Retirement homes; Room booking; Room hire services; Room rental for exhibitions; Room reservation services; Salad bars; Salad bars [restaurant services]; Self-service cafeteria services; Self-service restaurant services; Self-service restaurants; Services for providing drink; Services for providing food; Services for providing food and drink; Services for reserving holiday accommodation; Services for the housing of pet birds; Services for the housing of pet fish; Services for the preparation of food and drink; Services for the provision of food and drink; Serving beverages in brewpubs; Serving beverages in microbreweries; Serving food and drink for guests; Serving food and drink for guests in restaurants; Serving food and drink in doughnut shops; Serving food and drink in Internet cafes; Serving food and drink in restaurants and bars; Serving food and drinks; Serving of alcoholic beverages; Shisha bars; Snack bar services; Snack-bar services; Snackbars; Snack-bars; Sommelier services; Spanish restaurant services; Supplying meals to the homeless or underprivileged; Supplying of meals for immediate consumption; Sushi restaurant services; Take away food and drink services; Take away food services; Take-away fast food services; Takeaway food and drink services; Take-away food and drink services; Takeaway food services; Take-away food services; Takeaway services; Take-out restaurant services; Tapas bars; Tea room services; Tea rooms; Teahouse services; Temporary accommodation; Temporary accommodation information, advice and reservation services; Temporary accommodation provided by dude ranches; Temporary accommodation reservation services; Temporary accommodation reservations; Temporary accommodation services; Temporary accommodation services provided by holiday camps; Temporary room hire; Tempura restaurant services; Tour operator services for the booking of temporary accommodation; Tourist agency services for booking accommodation; Tourist camp services [accommodation]; Tourist home services; Tourist homes; Tourist hostels; Tourist inns; Tourist restaurants; Travel agencies for arranging accommodation; Travel agency services for booking accommodation; Travel agency services for booking restaurants; Travel agency services for booking temporary accommodation; Travel agency services for making hotel reservations; Travel agency services for reserving hotel accommodation; Udon and soba restaurant services; Washoku restaurant services; Wine bar services; Wine bars; Wine tasting services (provision of beverages); Youth hostel services.

Filing Date:15 April 2020

Date of registration: 15 May 2020

Representative name: N/A

**Load-Date:** May 18, 2020

**End of Document**



[***HUMAN RIGHTS COUNCIL HOLDS DIALOGUE ON THE RIGHTS OF PERSONS WITH ALBINISM AND BEGINS DIALOGUE ON THE RIGHT TO FOOD***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YC5-6D61-F0YC-N4BY-00000-00&context=1516831)

Impact News Service

March 5, 2020 Thursday

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**Length:** 6405 words

**Body**

Genève, Switzerland: United Nations Office at Geneva has issued the following press release:

The Human Rights Council this afternoon held an interactive dialogue with the Independent Expert on the enjoyment of human rights by persons with albinism, Ikponwosa Ero, and began an interactive dialogue with the Special Rapporteur on the right to food, Hilal Elver.

Presenting her thematic report on women and children impacted by albinism, Ms. Ero noted that the weight of global suffering around albinism was disproportionately borne by women and girls who suffered multiple and intersecting discrimination aggravated by their gender, being impacted by albinism and age, among other factors. Due to the gross misunderstanding and mystification of albinism, mothers of children with albinism were stigmatized right from birth and throughout life. States had to consider developing human rights-centered policies on rare conditions and strategizing to reach women who had been historically left behind, such as through targeted grants or funds, and entrepreneurship for women impacted by albinism and their children.

In the ensuing discussion, speakers recognized that women and girls impacted by albinism faced multiple and intersecting forms of discrimination, which could manifest themselves as some of the most egregious human rights violations, including sexual violence and falling victim to ritual killings, social exclusion and poverty. Efforts to combat such violence must be comprehensive and multidisciplinary and States must seek to address the root causes of violence, which could stem from gender inequality, discriminatory social norms and harmful stereotypes, speakers underlined. Accordingly, speakers called on Member States to prevent and address those violations and ensure that children and women with albinism could exercise their rights on an equal footing with others. States also needed to invest in and adopt policies enabling access of persons with albinism to adequate health services, including eye health, sexual and reproductive health, and prevention of skin cancer.

Speaking in the dialogue on the human rights of persons with albinism were : European Union, Burkina Faso (on behalf of the African Group), UN Women, United Nations Children’s Fund, Brazil, Djibouti, Togo, Burkina Faso, Japan, Lesotho, Malaysia, Namibia, Portugal, Egypt, Venezuela, Cameroon, China, Nigeria, Tanzania and Somalia.

Also taking the floor were the following non-governmental organizations : Standing Voice, Rencontre Africaine pour la Défense des Droits de l'Homme, Amnesty International, World Barua Organization, Chinese Association for International Understanding, Association pour l'Intégration et le Développement Durable au Burundi, China Society for Human Rights Studies, and World Jewish Congress.

The Council also began an interactive dialogue with the Special Rapporteur on the right to food, Hilal Elver.

Presenting her reports, Ms. Elver said that the realisation of the right to food remained a distant, if not an impossible reality for too many. Her report offered a critical perspective on trends and the reality and a review of new developments that had the potential to change the status quo. The globalization and commodification of food systems and the current industrial-***agricultural*** model had serious disadvantages. Put simply, the human rights of food system actors, including ***agricultural*** workers, smallholder farmers and consumers, were often ignored or violated. Power within the food system was concentrated in the hands of a few corporate actors. Positive developments included the 2018 adoption by the General Assembly of the United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas. Ms. Elver also presented her country reports on Azerbaijan, Italy and Zimbabwe.

Azerbaijan, Italy and Zimbabwe spoke as concerned countries, while the Human Rights Commission of Zimbabwe also took the floor.

In the discussion on the right to food, speakers noted that the progress achieved so far was insufficient to achieve the enjoyment of the right to food, and the Sustainable Development Goal target of zero hunger and malnutrition by 2030. Hunger as a result of conflict continued to rise and speakers strongly condemned the unlawful denial of humanitarian access to civilians and the use of starvation as a method of warfare. The adverse effects of climate change posed increased threats to food security and more attention should be paid to rural families as strategic players in ***agricultural*** activities. Additionally, development assistance had to include ***agricultural*** components. Full implementation of the right to food required adequate public and private investment to enable small-scale farmers to increase productivity and to ensure a more equitable distribution of resources.

Speaking on the right to food were : European Union, Organization of Islamic Cooperation, Cuba, State of Palestine, Holy See, Algeria, Burkina Faso, Djibouti, Iraq, Philippines, India, Pakistan, Malaysia, Ecuador, El Salvador, Sudan, Egypt, Myanmar, Turkey, Venezuela, Food and ***Agriculture*** Organization of the United Nations, Libya, Indonesia, Cameroon, United Nations Children’s Fund, and China.

At the beginning of the meeting, the Council concluded its interactive dialogue with Maud De Boer-Buquicchio, the Special Rapporteur on the sale and sexual exploitation of children. The first part of the dialogue, which took part in the previous meeting, can be read here.

In the discussion on the sale and sexual exploitation of children, speakers expressed concern that the sale and sexual exploitation of children had been made even more prevalent due to technological advancements, conflicts, migration and displacement. Combatting that phenomenon required ***collective*** action at the national, regional and international levels in order to hold perpetrators and facilitators accountable. There was a need to adopt a political and cultural approach rejecting the idea that children were commodities that could be bought, sold and sexually exploited. The same approach had to be applied towards the practice of commercial maternal surrogacy that amounted to the sale of children. Finally, speakers recommended that the Special Rapporteur focus on transnational aspects of those types of crimes and on standardization of different ways of working with national police forces.

Speaking in the interactive dialogue with the Special Rapporteur on the sale and sexual exploitation of children were Guyana and Chad.

Also taking the floor were the following non-governmental organizations : Caritas Internationalis, Congregation of Our Lady of Charity of the Good Shepherd, Edmund Rice International, Defence for Children International (in a joint statement with Plan International, Inc.and Terre Des Hommes Federation Internationale), Associazione Comunità Papa Giovanni XXIII, Beijing Children’s Aid and Research Center, Association Ma’onah for Human Rights and Immigration, World Organisation against Torture, International Organization for the Elimination of All Forms of Racial Discrimination, Global Welfare Association.

China, Armenia and Zimbabwe spoke in right of reply.

The meetings of the forty-third regular session of the Human Rights Council can be followed on the webcast of UN Web TV

The Council will meet again on Wednesday, 4 March, at 10 a.m to conclude its interactive dialogue with the Special Rapporteur on the right to food, and to hold separate interactive dialogues with the Special Rapporteur in the field of cultural rights and the Special Rapporteur on human rights defenders.

Interactive Dialogue with the Special Rapporteur on the Sale and Sexual Exploitation of Children

The beginning of the interactive dialogue with Maud De Boer-Buquicchio, Special Rapporteur on the sale and sexual exploitation of children, started in the previous meeting and a summary can be seen here.

Discussion with the Special Rapporteur on the Sale and Sexual Exploitation of Children

Speakers said it was worrying that the sale and sexual exploitation of children had been made even more prevalent due to technological advancements, conflicts, migration and displacement. Combatting this required ***collective*** action at national, regional and international levels to hold perpetrators and facilitators accountable. Governments had to set up efforts to address root causes of violations. There was a need to better ***collect*** ***data*** and children themselves had to be included in decision making. In education, the special needs of children who had been victims had to be accounted for. Many States still allowed the criminalization of children who were exploited in prostitution or begging. There was a need to regulate training in psychology and social work in accordance with international standards. Prevention, support and trauma healing could best be achieved through the expertise of qualified social workers. Speakers suggested adopting terminology online like child sexual exploitation and child sexual abuse material to replace child pornography. This re-branding better stated the severity and criminality of images, videos and actions taking place.

As recognized by the General Assembly resolution on the “girl child”, girls were most affected by the sale and sexual exploitation of children. To better protect girls and boys from significant risks they faced, all countries had to invest in strategies that challenged discriminatory attitudes and harmful social norms. Comprehensive, rights-based prevention strategies were needed to combat the sale and sexual exploitation of children. Anti-trafficking laws had to consider measures to discourage, reduce and eliminate the demand in order to be adequate and effective, following the example of some European countries that had implemented the so-called Nordic Model. There was also a need to adopt a political and cultural approach rejecting the idea that children were commodities that could be bought, sold and sexually exploited. The same approach had to be applied towards the practice of commercial maternal surrogacy that amounted to sale of children. The Special Rapporteur should focus on transnational aspects of these types of crimes, standardization of different ways of working with national police forces and coordination among all national bodies that dealt with identification, and support and integration of victims of sexual exploitation.

Concluding Remarks by the Special Rapporteur on the Sale and Sexual Exploitation of Children

MAUD DE BOER-BUQUICCHIO, Special Rapporteur on the sale and sexual exploitation of children, thanked all those who had made comments on the report and mandate. The 2030 Agenda for Sustainable Development represented an ambitious agenda to leave no behind. It was imbued with human rights and living up to the expectations of international human rights law. It was too slow because it did not reach everyone, the Special Rapporteur noted. The 2030 Agenda provided wonderful tools for national and fully inclusive development plans. It was important to generate ***data*** and show progress. There was progress and some countries had done great work with respect to early marriage, Ms. Boer-Buquicchio underlined. But in the area of sexual exploitation, the lack of ***statistics*** indeed hampered progress. Were they really reaching out to all children, or were they only protecting their own children, the Special Rapporteur asked? Were services available to them, and was the best interest of the child indeed taken into account? Were they really interested in solving that serious problem? Those were the questions the international community needed to tackle, the Special Rapporteur emphasized. The question of accountability was essential. Each and every person carried responsibility and should not turn a blind eye to child abuse. The Special Rapporteur therefore called on States to fully support her successor.

Interactive Dialogue with the Independent Expert on the Enjoyment of Human Rights by Persons with Albinism

Documentation

The Council has before it the Report of the Independent Expert on the enjoyment of human rights by persons with albinism on women and children impacted by albinism (A/HRC/43/42).

The Council has before it an addendum to the Report of the Independent Expert on the enjoyment of human rights by persons with albinism – Visit to South Africa (A/HRC/43/42/Add.1).

Presentation of Reports by the Independent Expert on the Enjoyment of Human Rights by Persons with Albinism

IKPONWOSA ERO, Independent Expert on the enjoyment of human rights by persons with albinism, said that she had recently heard about a 92-year-old woman with albinism whose toes were cut off, and were later found in the hands of alleged witch doctors. Ms. Ero presented her thematic report on women and children impacted by albinism. Although both groups deserved a separate report, an introductory report like this one was better suited given how interlinked the issues were in this context. Her main finding in this report was that the weight of global suffering around albinism was disproportionately borne by women, in particular women with albinism and mothers of children with albinism, who suffered multiple and intersecting discrimination by being impacted by albinism, and aggravated by their gender and age, among other factors. Some particular violations they faced included : blame and abandonment; reprisal in cases where their partners or spouses had participated in ritual attacks against their children with albinism; vulnerability to generalized violence including accusations of witchcraft and ritual attacks; sexual violence on various grounds; and poverty. Due to gross misunderstanding and mystification of albinism, mothers of children with the condition were stigmatized right from birth and throughout life. States had to consider developing human rights centred policies on rare conditions and strategizing to reach women who had been historically left behind, such as through targeted grants or funds and entrepreneurship for women impacted by albinism and their children.

Turning to her country visit, Ms. Ero said she had visited South Africa during September – the month of albinism in South Africa. Many positive initiatives had been undertaken by the Government. They had adopted a comprehensive legislative framework and the Ekurhuleni Declaration on the Rights of Persons with Albinism in 2013. Although South Africa had cases of attacks against persons with albinism, including trafficking, killing and grave robberies, the State had been exemplary compared to its counterparts in the region, because cases had generally been prosecuted in a timely manner. There remained work to be done in several areas : to work on ***data*** and ***statistics***, as currently there was no official ***data*** on this population; to do situation analysis on attacks and security; on discrimination – it was imperative that national languages ceased to refer to people with albinism with dehumanizing terms such as monkey or ape; and in terms of health, particularly as skin cancer remained a scourge. Moreover reasonable accommodation and security had to be improved and the Government had to address harmful practices emanating from accusations of witchcraft and ritual attacks.

Statement by the Concerned Country

South Africa, speaking as the concerned country, considered the country report by the Independent Expert to be a fair and balanced reflection of both positive developments that had taken place in the country since 1994, as well as of the efforts that still needed to be made to enforce the enjoyment of human rights by persons living with albinism. The authorities noted with particular concern issues related to the stigmatization of and discrimination against persons living with albinism, the lack of ***statistics*** and ***data***, the right to life and security, and health and education issues. Furthermore, the Government acknowledged the intersectionality between race, disability and colour that the Independent Expert had highlighted in her report. In that regard, the Government had already met with the task team appointed to develop the National Action Plan on Albinism and would continue to work with the sector to finalize the five-year plan. In addition, the South African Human Rights Commission had undertaken a study tour to the European Union to consider the most appropriate forms of an independent monitoring mechanism for the country, as recommended by the Committee on the Rights of Persons with Disabilities. In conclusion, South Africa welcomed various initiatives taken regionally and internationally to address the rights of persons with albinism.Discussion with the Independent Expert on the Enjoyment of Human Rights by Persons with Albinism

Speakers recognized that women and girls impacted by albinism faced multiple and intersecting forms of discrimination, which could manifest themselves as some of the most egregious human rights violations, including sexual violence and falling victim to ritual killings, social exclusion and poverty. Efforts to combat such violence must be comprehensive and multidisciplinary and they must seek to address the root causes of violence, which could stem from gender inequality, discriminatory social norms, and harmful stereotypes, speakers underlined. Accordingly, they called on Member States to prevent and address those violations and ensure that children and women with albinism could exercise their rights on an equal footing with others. Education and training at all levels should be the priority in order to tackle the root causes of violence against persons with albinism. While that work was ongoing, States also needed to ensure that all services and support were available to avoid further violations and abuses, and that impunity was combatted through the enactment of legislation that criminalized violence and discrimination against persons with albinism. It was important to integrate the issue of women and girls impacted by albinism in national action plans for gender equality and gender violence prevention and response. Access to education, health and justice were the three key elements for a better protection of all persons with albinism, especially women and children.

Speakers asked the Independent Expert to share some of the lessons learned from her efforts to eradicate discrimination against persons with albinism, and they asked for her recommendations to raise awareness and stimulate public support for that issue. Speakers reminded that the lack of education for children with albinism resulted in their unemployment, which led to poverty and low income. Appropriate education support, including teachers with knowledge of albinism, was therefore important for enhancing the development, growth and self-esteem of children with albinism. In addition, to eliminate the scourge of discrimination and violence against persons with albinism, States needed to invest in and adopt policies enabling access of persons with albinism to adequate health services, including eye health, sexual and reproductive health, and prevention of skin cancer. Social security schemes should be in place to ensure adequate protection and prevent further exposure to risk factors.

Interim Remarks by the Independent Expert on the Enjoyment of Human Rights by Persons with Albinism

IKPONWOSA ERO, Independent Expert on the enjoyment of human rights by persons with albinism, asked States to support initiatives coming from the African Group on combatting harmful practices. The Council recognized forced marriages as harmful practices, but harmful practices were also ritual attacks against persons with albinism. Work was being carried out on developing guidelines by the Pan-African Parliament on accusations of witchcraft and ritual attacks. Tanzania, Namibia, Kenya and Sierra Leona had ***collected*** ***data*** on persons with albinism. At their core, the Sustainable Development Goals included everyone, but without ***data***, they could not include everyone. Action plans with concrete measures were needed, including governments and private sectors.

Discussion with the Independent Expert on the Enjoyment of Human Rights by Persons with Albinism

Speakers called on all members of the global community to focus more attention to alleviating the plight of persons with albinism who continued to suffer in silence. Such attention was necessary to achieve the laudable aspirations of the Sustainable Development Goals. Speakers asked the Independent Expert about the role of religious leaders in preventing attacks on persons with albinism based on erroneous belief and myth. They welcomed the Independent Expert’s recommendations on developing forums and the use of media and technology in order to raise awareness about the issue, as well as her appeals to adopt among other measures the implementation of reasonable accommodation to improve access to employment, education and adequate health protection. Speakers encouraged Governments to take measures to prevent the high school dropout rate of children with albinism before exhausting compulsory education level due to the lack of assistive devices, proper support materials, negative attitudes towards learners with albinism, and lack of understanding of albinism and learner needs by both parents and teachers. Policy-makers from all over the world should pay attention to the recommendations outlined by the Independent Expert, noting that they should include albinism in their laws and regulations. Persons with albinism should be treated with dignity and live a life free from fear. Their right to life should be prioritized, speakers stressed.

Concluding Remarks by the Independent Expert on the Enjoyment of Human Rights by Persons with Albinism

IKPONWOSA ERO, Independent Expert on the enjoyment of all human rights by persons with albinism, responding to questions about the role of religious leaders in combatting violence and discrimination against persons with albinism, noted that most of the hatred was coming from not listening to each other. Everyone should be truly inclusive regardless of how difficult it may be. The Independent Expert urged all stakeholders to become inducted in the process of her recommendations. As for the African regional action plan on albinism, she explained that it was available online, addressing particular issues on the continent. Fighting poverty among persons with albinism was fundamental, but that question went beyond the scope of her mandate, the Independent Expert said. One stakeholder could not do everything in that respect. As for research and development on rare conditions, the Independent Expert called on countries and the private sector to increase work on and attention to that question. Recalling the attacks on persons with albinism, she warned that a small-scale genocide could be taking place in front of all eyes without knowing it. Albinism was a phenomenon that combined colourism and racism to an extent that no other condition had.

Interactive Dialogue with the Special Rapporteur on the Right to Food

Documentation

The Council has before it the Critical perspective on food systems, food crises and the future of the right to food - Report of the Special Rapporteur on the right to food (A/HRC/43/44).

The Council has before it an addendum to the Report of the Special Rapporteur on the right to food – Visit to Azerbaijan (A/HRC/43/44/Add.1).

The Council has before it an addendum to the Report of the Special Rapporteur on the right to food - Visit to Zimbabwe (A/HRC/43/44/Add.2).

The Council has before it an addendum to the Report of the Special Rapporteur on the right to food – Comments by Azerbaijan (A/HRC/43/44/Add.3).

The Council has before it an addendum to the Report of the Special Rapporteur on the right to food - Comments by Zimbabwe (A/HRC/43/44/Add.4).

Presentation of Reports by the Special Rapporteur on the Right to Food

HILAL ELVER, Special Rapporteur on the right to food, presented her seventh and final thematic report, along with three other reports about official country visits to Azerbaijan, Zimbabwe and Italy. Over the past six years, Ms. Elver said she had concluded that the realisation of the right to food remained a distant, if not an impossible reality for too many. Her report offered a critical perspective on trends and the reality and a review of new developments that had the potential to change the status quo. The globalization and commodification of food systems and the current industrial-***agricultural*** model had serious disadvantages. Put simply, the human rights of food system actors, including ***agricultural*** workers, small-holder farmers and consumers, were often ignored or violated. Power within the food system was concentrated in the hands of a few corporate actors. Farm subsidies and other protectionist measures mostly benefitted large multinational corporations and big land owners, over the interests of local producers. Positive developments included the 2018 adoption by the General Assembly of the United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas. There was also an emergence of concerning trends. Food system workers continued to rank among the world’s most food insecure, facing a lack of social protection and exposure to toxic pesticides.

The worst food crises had occurred in areas of active conflict threatening over 113 million people. She reiterated her call for a global convention that gave States and the international community clear legal mandates to prevent famine and protect the right to adequate food before situations reached a critical point. Conflict was not the only driver of food insecurity. Climate crises also posed an existential threat and failure to act could push over 3 billion people into extreme poverty and hunger.

Turning to her country visits, the Special Rapporteur said that Azerbaijan was focusing its efforts on developing the country’s ***agricultural*** potential. It had established new institutions such as the State Agency for Food Safety and had introduced new laws, policies and programmes. The challenge now was to maintain implementation of the goals through the allocation of adequate budgets. Despite positive achievements, this growth had not been sufficiently inclusive and had not yet benefitted the whole of the society, and inequality was one of the stumbling blocks in the struggle to eliminate poverty, hunger and malnutrition.

In Zimbabwe, despite the constitutional protection of the right to food, starvation was slowly making its way into the country, with over 60 per cent of the population considered to be food-insecure due to extreme poverty, high inflation and poor ***agricultural*** productivity. There were serious allegations of the distribution of lands and food being manipulated for political ends over the last two decades. As food insecurity and land mismanagement increased the risk of civil unrest, the Government was urged to adopt necessary measures to deliver its zero hunger commitment without discrimination.

In Italy, the right to food was implicitly embedded in its Constitution. Italy had also demonstrated its commitment and active role in engaging with international human rights mechanisms and active participation in the global food policy platforms. Italy faced a number of challenges to fully realize the right to food for all. Italy was still recovering from the 2008 economic crisis and many families had gone from middle-income to low-income. In 2019, the Government introduced the guaranteed minimum income law, a social welfare programme. The Italian ***agricultural*** landscape presented on one side large land holdings and intensive production systems, mostly in the north, and a large group of smallholder farmers. Several reforms to protect smallholder farmers had been enacted. Smallholder producers were struggling with low prices paid by large distributors that led to farmer suicide and bankruptcy.

Statements by Concerned Countries

Azerbaijan, speaking as a concerned country, reminded that a number of United Nations Special Procedure mandate holders had visited Azerbaijan. The visit by the Special Rapporteur on the right to food was viewed as an important contribution to the country’s policies and Azerbaijan thanked her for her valuable recommendations. The Government was focusing on building a non-energy, multi-sector economy, where the ***agricultural*** sector was a major contributor. Small- and medium-sized enterprises and the empowerment of women in ***agriculture*** was a priority for the Government in order to ensure sustainable economic development. In addition, the authorities had to accommodate the needs of one million refugees and internally displaced persons as the result of the occupation by Armenia of southwestern Azerbaijan. Finally, the delegation of Azerbaijan called the Council’s attention to the methodology of Special Rapporteurs when preparing their reports, noting that a sound balance was necessary between the ***statistics*** and information provided by Government officials, and the information gathered from sometimes dubious resources. It was important to avoid political editorializing in those reports.

Italy, speaking as a concerned country, reaffirmed its commitment to Special Procedure mandate holders in general. When it came to the country report by the Special Rapporteur on the right to food, Italy expressed its disappointment since it did not seem to provide an appropriate picture of its endeavours in the field of the right to food. Several negative assessments on the whole agro-alimentary Italian system appeared to be unjustified and very generic, without specific and relevant ***data***. The report did not adequately underline what Italy did to help people in situations of poverty or emergency, nor that the Italian Development Cooperation fostered the right to food through targeted and diversified programmes. Italian legislation provided an excellent framework for permanent solutions in the field of recovery facilitation, like tax incentives for donations of food, which was a form of prevention of food waste. As for the “infiltrations” of organized crime in the Italian food system, the delegation reaffirmed that the Italian authorities were fully engaged in combatting illegal situations.

Zimbabwe, speaking as a concerned country, responded to the Special Rapporteur’s alleged partisan food aid distribution, non-remission of proceeds from the sale of minerals to the treasury, and the claim that there was a man-made food crisis in the country. Indeed, the Special Rapporteur had correctly observed that the country faced the continued imposition of illegal economic sanctions. That situation was compounded by successive droughts and the devastating tropical cyclone Idai. Those factors had negatively impacted the food security of Zimbabwe’s citizens, particularly vulnerable groups. However, the Special Rapporteur’s assessment that the majority of the population was suffering from food insecurity was grossly exaggerated. Her conclusion that Zimbabwe faced a man-made food crisis was a misinterpretation of the situation, which was a direct result of the sanctions and the effects of climate change. The Special Rapporteur had not taken into account the interventions, safety nets and measures implemented to ensure the right to food.

Human Rights Commission of Zimbabwe congratulated the Government of Zimbabwe for having facilitated a transparent, inclusive and participatory assessment of the food security situation in the country by the Special Rapporteur. It was commendable for national processes and programmes to be subjected to such higher level of scrutiny as that demonstrated commitment to good governance, transparency and accountability. The major findings of the report fairly reflected the situation on the ground. It realistically reflected the worsening food security situation in the country due to natural disasters, recurrent droughts, unemployment, high inflation, erosion of incomes, fuel and energy crisis, and economic sanctions. The Commission was ready to work with the Government to ensure the effective implementation of rights-based programmes in order to achieve the national goals of guaranteeing food availability, accessibility and nutritional adequacy in a sustainable manner.

Discussion with the Special Rapporteur on the Right to Food

Speakers expressed gratitude to the Special Rapporteur who amplified the voices of the world’s hungry and food-insecure. The report comprehensively outlined the challenges, good practices and trends related to addressing the realization of the right to food. The progress achieved was insufficient to achieve the enjoyment of the right to food as well as the Sustainable Development Goal target of zero hunger and malnutrition by 2030. Hunger as a result of conflict continued to rise and unlawful denial of humanitarian access to civilians and use of starvation as a method of warfare were condemned in the strongest terms as grave violations of international law. The adverse effects of climate change posed increased threats to food insecurity. The Rapporteur was thanked for reminding the international community about the difficult conditions that Palestinian people and Rohingya were facing. ***Agriculture*** was important in addressing the challenges of food insecurity. More attention had to be given to rural families that were strategic players in ***agricultural*** activities. Additionally, development assistance had to include ***agricultural*** components. The full implementation of the right to food required adequate public and private investment to enable small-scale farmers to increase productivity and a more equitable distribution of resources. A sustainable food system was instrumental to advance the human right to adequate food and the realization of that right had to include a multifaceted approach.

Speakers affirmed that the right to food was not unattainable, only unrealized. Therefore coordinated, well-resourced and prioritized efforts by States, international institutions, civil society and the private sector were essential. More importantly, a human rights based approach was necessary to strengthen legal, policy and institutional environments and tackle the root causes of hunger and malnutrition. The Special Rapporteur was asked about the role that the Human Rights Council could play in order to address challenges related to the right to food? She was also asked to share her views on the impact of food loss and waste in the implementation of right to food. States outlined their institutional set up for ensuring food security, promoting sustainable ***agriculture***, and government policies and national action plans aimed at the realization of the right to food. States also outlined their efforts towards the elimination of hunger and malnutrition. Nonetheless, the rise of malnutrition was still prevalent and it was still the main source of child mortality. An increasing number of countries were facing several challenges against the right to food due to ongoing conflicts, humanitarian crises, climate change, disasters and current ***agricultural*** and industrial models. Good practices which had been already applied by many States were commended.

Interim Remarks by the Special Rapporteur on the Right to Food

HILAL ELVER, Special Rapporteur on the right to food, responding to the comments made by the delegations whose countries she had visited, noted that Special Procedure mandate holders received background reports from the people that could not reach United Nations human rights mechanisms easily. She reminded that the main purpose of country visits was to listen to the most vulnerable people whose voice was never present in the Human Rights Council. It did not mean that the mandate holders were generalizing. Many of the points raised by Governments were also present in her report, which unfortunately was constrained by a word limit. The comprehensive understanding of the right to food exceeded those limitations. Turning to Zimbabwe, the Special Rapporteur underlined that she had used many of the reports on malnutrition and the food security situation there so no other assessment was possible in her report. She expressed hope that her report on Zimbabwe would bring more international attention to the situation there. The Council should be more active in the food agenda and should be reaching New York and Rome, the seat of the United Nations Food and ***Agriculture*** Organization, Ms. Elver said.

Discussion with the Special Rapporteur on the Right to Food

Speakers voiced their concerns over difficult conditions facing small farmers and the collapse of small markets due to globalization. The steady increase in the number of food-insecure people over the last few years, from 815 million in 2016 to 821 million presently, demonstrated that much remained to be done. Conflict zones continued to be the epicentre for the majority of those suffering from hunger, and their livelihoods were made worse in many cases by the impacts of climate change. Recent times had shown how sensitive the relationship was between conflicts and economic, social and cultural rights in a number of countries. Deliberate starvation was a crime against humanity. It was reiterated that smallholder farmers and peasants had to be given particular attention. Any international instrument that would establish a stronger global framework concerning the welfare of smallholder farmers was welcomed, mainly through the United Nations Decade of Family Farming and the Declaration on the Rights of Peasants and Other People Working in Rural Areas. The Rapporteur was asked how good practices of certain countries could be universalized more effectively.

Globally, at least one in two children under the age of five suffered from hidden hunger due to deficiencies in vitamins and other essential ***nutrients***. As the Rapporteur noted, children’s nutrition rights were not fulfilled, so an agenda was proposed by the United Nations Children’s Fund to put children’s nutrition rights first by recommitting to the right of all children to food and nutrition. The agenda included empowerment of families and young people to demand nutritious food, building of healthy food environments for all children, and mobilizing health, water, sanitation and social protection systems to deliver interventions.

**Load-Date:** March 6, 2020

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[***Federal Register: Establishment of a Domestic Hemp Production Program Pages 5596 - 5691 [FR DOC #2021-00967]***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61TB-W411-F0YC-N3D2-00000-00&context=1516831)

Impact News Service

January 19, 2021 Tuesday

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**Length:** 106466 words

**Body**

Washington: Office of the Federal Register has issued the following notice:Department of ***Agriculture***-----------------------------------------------------------------------***Agricultural*** Marketing Service-----------------------------------------------------------------------7 CFR Part 990Establishment of a Domestic Hemp Production Program; Final RuleFederal Register / Vol. 86 , No. 11 / Tuesday, January 19, 2021 / Rules and Regulations[[Page 5596]]-----------------------------------------------------------------------DEPARTMENT OF AGRICULTUREAgricultural Marketing Service7 CFR Part 990[Doc. No. AMS-SC-19-0042; SC19-990-2 FR]Establishment of a Domestic Hemp Production ProgramAGENCY: ***Agricultural*** Marketing Service, Department of ***Agriculture*** (USDA).ACTION: Final rule.-----------------------------------------------------------------------SUMMARY: This final rule supersedes the interim final rule that established the Domestic Hemp Production Program, as mandated by the ***Agriculture*** Improvement Act of 2018 (2018 Farm Bill). This rule includes regulations used by the Department of ***Agriculture*** (USDA) to approve plans submitted by States and Indian Tribes for the domestic production of hemp. This rule also includes regulations on the Federal hemp production plan for producers in States or territories of Indian Tribes that do not have their own USDA-approved plans. The program provides requirements for maintaining records about the land where hemp is produced, testing the levels of total delta-9 tetrahydrocannabinol, disposing of non-compliant plants, licensing hemp producers, and ensuring compliance under the new program.DATES: This rule is effective March 22, 2021.FOR FURTHER INFORMATION CONTACT: Bill Richmond, Branch Chief, U.S Domestic Hemp Production Program, Specialty Crops Program, AMS, USDA; 1400 Independence Ave. SW, Stop 0237, Washington, DC, 20250-0237; Telephone: (202) 720-2491, Fax: (202) 720-8938, or Email: [*William.Richmond@usda.gov.SUPPLEMENTARY*](mailto:William.Richmond@usda.gov.SUPPLEMENTARY) INFORMATION: This rule is issued under the authority of section 10113 of the 2018 Farm Bill (Pub. L. 115-334; December 20, 2018), which amended the ***Agricultural*** Marketing Act of 1946, as previously amended (7 U.S.C 1621 et seq.) (AMA), by adding Subtitle G (sections 297A through 297E). Section 297B of the AMA requires the Secretary of ***Agriculture*** (Secretary) to evaluate and approve or disapprove State or Tribal plans regulating the production of hemp. Section 297C of the AMA requires the Secretary to establish a Federal plan for producers in States and territories of Indian Tribes not covered by plans approved under section 297B. Section 297D of the AMA requires the Secretary to promulgate regulations and guidelines relating to the production of hemp under sections 297B and 297C in consultation with the U.S Attorney General. AMS issued an interim final rule (IFR) on October 31, 2019 (84 FR 58522), and began its initial implementation of the program. To date, USDA has approved approximately 45 State and Tribal hemp plans. However, not all of the States and Tribes have implemented their plans for various reasons, including the need to take additional steps to complete State legislative or rulemaking processes or to establish the regulatory scheme as well as the extension of the 2014 Farm Bill Program. Thus, as of November 2020, twenty States and nine Tribes have submitted reports on their respective programs. Based on the reports submitted by States and Tribes in 2020, producers have planted 6,166 acres under the 2018 Farm Bill hemp plans, of which approximately 730 acres were subject to disposal. As of the effective date of this final rule, the interim final rule is superseded. This final rule replaces the IFR at 7 CFR part 990, effective March 22, 2021. The ***Agricultural*** Marketing Service (AMS), which has been delegated authority to administer the U.S Domestic Hemp Production Program, provided multiple opportunities for public comment. AMS accepted comments during an initial comment period from October 31, 2019, through December 31, 2019. This initial comment period was extended for an additional 30 days on December 18, 2019 (84 FR 69295), ending January 29, 2020. AMS reopened the comment period for 30 additional days on September 8, 2020 (85 FR 55363), ending October 8, 2020. A total of approximately 5,900 comments were received during all comment periods from States; Indian Tribes; industry and ***agricultural*** organizations; private citizens; members of Congress, the scientific community; agencies; and individuals involved in the growing, processing, transporting and marketing of hemp. A summary of the public comments received and AMS's responses appear under ``Comment Analysis'' in section IX of this document.I. Introduction Hemp is a commodity with numerous industrial and horticultural uses including fabric, paper, construction materials, food products, cosmetics, production of cannabinoids (such as cannabidiol or CBD), and other products.\1\ While hemp was produced previously in the United States (U.S ) for hundreds of years, its use diminished in favor of alternatives. Hemp fiber, for instance, which had been used to make rope and clothing, was replaced by less expensive jute and abaca imported from Asia. Rope made from these materials was lighter, more buoyant, and more resistant to saltwater than hemp rope, which required tarring. Improvements in technology further contributed to the decline in hemp use. The cotton gin, for example, simplified the processing of cotton, which replaced hemp in the manufacture of textiles.--------------------------------------------------------------------------- \1\ Section 297D(c) of the AMA explicitly preserved the authority of the U.S Food and Drug Administration (FDA) to promulgate regulations and guidance related to the production of hemp under the Federal Food, Drug, and Cosmetic Act (21 U.S.C 301 et seq.) (FD&C Act) and section 351 of the Public Health Service Act (42 U.S.C 262) (PHS Act). See section 297D(c)(1) (``Nothing in this subchapter shall affect or modify . . . the Federal Food, Drug, and Cosmetic Act (21 U.S.C 301 et seq.); section 351 of the Public Health Service Act (42 U.S.C 262); or the authority of the Commissioner of Food and Drugs and the Secretary of Health and Human Services . . . '' under those Acts).--------------------------------------------------------------------------- The hemp industry continued in the U.S until the Marihuana Tax Act of 1938. This Act ended the legal production of hemp in the United States, and hemp was added to Schedule I of the Controlled Substances Act (CSA), 21 U.S.C 801 et seq. Prior to the 2018 Farm Bill, all Cannabis sativa L., regardless of delta-9 tetrahydrocannabinol (THC) concentration level, fell within the CSA definition of ``marihuana'' unless the product fell under a narrow range of exceptions (e.g , the ``mature stalks'' of the plant).\2\ As a result, many aspects of domestic production of what is now defined as hemp was limited to persons registered under the CSA to do so.--------------------------------------------------------------------------- \2\ Although the statutory spelling is ``marihuana'' in the Controlled Substances Act, this rule uses the more commonly used spelling of marijuana.--------------------------------------------------------------------------- Under the ***Agricultural*** Act of 2014 (2014 Farm Bill), Public Law 113-79, State departments of ***agriculture*** and institutions of higher education were permitted to produce hemp as part of a pilot program for research purposes. The authority for hemp production provided in the 2014 Farm Bill was extended until January 1, 2022, by the Continuing Appropriations Act, 2021, and Other Extensions Act (Pub. L. 116-260) (2021 Continuing Appropriations Act). Hemp production in the U.S has seen a resurgence in the last several years. Since importation of seed is covered under USDA's Animal and Plant Health Inspection Service (APHIS) regulations, this final rule does not regulate hemp[[Page 5597]]seed imports. APHIS regulates the importation of all seeds for planting to ensure safe ***agricultural*** trade. Hemp seeds can be imported into the U.S from Canada if accompanied by either: (1) A phytosanitary certification from Canada's national plant protection organization to verify the origin of the seed and confirm that no plant pests are detected; or (2) a Federal Seed Analysis Certificate (SAC, PPQ Form 925) for hemp seeds grown in Canada. Hemp seeds imported into the U.S from countries other than Canada may be accompanied by a phytosanitary certificate from the exporting country's national plant protection organization to verify the origin of the seed and confirm that no plant pests are detected. This final rule does not address the exportation of hemp. Should there be sufficient public interest in exporting hemp in the future, USDA will work with industry and other Federal agencies to help facilitate this process. The 2018 Farm Bill requires USDA to promulgate regulations and guidelines to establish and administer a program for the production of hemp in the United States. Under this new authority, a State or Indian Tribe that wants to have primary regulatory authority over the production of hemp in that State or territory of that Indian Tribe may submit, for the approval of the Secretary, a plan concerning the monitoring and regulation of such hemp production. For States or Indian Tribes without an approved plan, the Secretary is directed to establish a Departmental plan to monitor and regulate hemp production in those areas. The 2018 Farm Bill specifies requirements that all hemp producers must meet. These include licensing requirements; recordkeeping requirements for maintaining information about the land where hemp is produced; procedures for testing the THC concentration levels for hemp; procedures for disposing of non-compliant plants; compliance provisions; and procedures for handling violations. For the purposes of 7 CFR part 990, and as defined in the 2018 Farm Bill, the term ``hemp'' means the plant species Cannabis sativa L. and any part of that plant, including the seeds thereof and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis. Delta-9 tetrahydrocannabinol, or THC, is the primary intoxicating component of cannabis. Cannabis with a THC level exceeding 0.3 percent is considered marijuana, which remains classified as a Schedule I controlled substance regulated by the Drug Enforcement Administration (DEA) under the CSA. The term ``State'' means any of one of the fifty States of the United States of America, the District of Columbia, the Commonwealth of Puerto Rico, and any other territory or possession of the United States. The term ``Indian Tribe'' or ``Tribe'' has the same definition as in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C 5304). This final rule also includes the definition of ``territory of an Indian Tribe'' to provide clarity to the term because the AMA does not define it. The final rule defines ``territory of the Indian Tribe'' as (a) all land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, including rights-of-way running through the reservation; (b) all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a state; (c) all Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same; and (d) any lands title to which is either held in trust by the United States for the benefit of any Indian Tribe or individual or held by any Indian Tribe or individual subject to restriction by the United States against alienation and over which an Indian Tribe exercises jurisdiction. Under an approved Tribal plan, the Indian Tribe will have regulatory authority over hemp production within its Territory.\3\ A full list of terms and definitions relating to part 990 can be found under ``Definitions'' in section IV.--------------------------------------------------------------------------- \3\ We note that if an Alaskan Native Corporation wants to produce hemp on land it owns in fee simple, it would need to have a State or USDA license, whichever is applicable, because that land does not qualify as Indian Country and the Corporation does not have jurisdiction over that land.--------------------------------------------------------------------------- This rule is divided into several sections. The first section provides a general introduction to the rule. This section does not go into a detailed description of all parts of the rule or about the provisions of the rule that are discussed later on in other sections. Sections for State and Tribal plans as well as the USDA plan contain general information on land use, tribal jurisdiction authority, sampling, testing, disposal and remediation, compliance provisions, information sharing, certification of resources, and State and Tribal plan approvals. The USDA section also includes USDA hemp license provisions and suspension. These two sections provide general provisions that are discussed in more detail in the comment analysis section. Sections containing definitions, severability and the regulatory analysis are included before the regulatory language. The reader may be best served by reading the comment section to determine the changes made to this rule.II. State and Tribal Plans Section 297B (7 U.S.C 1639p) of the AMA requires that States or Indian Tribes seeking primary regulatory authority over the production of hemp in that State or territory of that Indian Tribe, submit, for the approval of the Secretary, a plan concerning the monitoring and regulation of such hemp production. State or Tribal plans must be submitted to USDA and approved prior to their implementation. Nothing preempts or limits any law of a State or Tribe that regulates the production of hemp and is more stringent than the provisions in Subtitle G of the AMA. AMS received extensive public input on the regulatory requirements for State and Tribal hemp plans. Incorporating the input received, the following sections explain the changes to the regulatory requirements for State and Tribal hemp plans.A. Land Used for Production The 2018 Farm Bill and the IFR required that plans include a process by which relevant information regarding the land used for hemp production in their jurisdiction is ***collected*** and maintained. Certain information on mailing addresses and hemp production sites must be ***collected*** for each licensee covered by the State or Tribal plan. The information required to be ***collected*** includes a legal description of the land and geospatial location for each field, greenhouse, or other site where hemp is produced. Geospatial location is necessary because many rural locations do not have specific addresses, and these coordinates will assist with the proper identification of hemp production locations. In addition to the land information required to be ***collected*** by the appropriate State or Indian Tribe, AMS chose to require licensed producers, including those under the USDA plan, to report their hemp crop acreage to the Farm Service Agency (FSA). Although many commenters opposed this requirement based on costs around the time and travel expense necessary to physically visit the appropriate FSA County Office, AMS has determined that maintaining the FSA reporting[[Page 5598]]requirement is essential for several reasons. AMS recognizes that in some cases producers may travel to FSA offices miles away incurring additional time and cost. These costs are incorporated in the expected burden of this program. First, USDA is statutorily required to provide law enforcement with certain ``real-time'' information about who is growing hemp, whether their license is in good standing with the regulatory body issuing the license, and the location(s) where hemp is being grown. Having FSA ***collect*** the necessary information enables USDA to provide the most accurate and ``real-time'' information to law enforcement, as required by Subtitle G of the AMA. Second, FSA offices serve as useful resources to all farmers and, in collaboration with other USDA agencies, can provide a wide range of insurance, risk management, and conservation program guidance and information. These offices currently serve the ***agricultural*** industry within their communities, where producers can establish farm and producer records, record their licensing information, and report crop acreage. The producer may also, with supporting documentation, update their FSA farm records for leases, sub-leases, or land ownership. Requiring farmers to visit the FSA office ensures that they receive information on the availability of these helpful tools and programs. This is particularly important for new farmers, who may not be aware of the wide range of programs and services offered by USDA. Further, FSA maintains the technology necessary for ***data*** ***collection*** and geographical land identification. These tools will provide easy access to information needed for law enforcement and for other ***agricultural*** programs. AMS has determined, for these reasons, to continue to require the reporting of hemp crop acreage to FSA. Based on input from commenters, USDA is also clarifying the distinction between the term ``lot'' as defined in the IFR, and the term ``subfield'' as it relates to FSA reporting. Although this final rule uses the term ``lot'' to discuss the land where hemp is grown, when a producer visits the FSA office to report hemp crop acreage, FSA staff will help producers determine the applicable FSA-specific term for designating the location(s) where hemp is being grown. The terminology used by FSA to denote land areas include terms like ``farm,'' ``tract,'' ``field,'' and ``subfield,'' which are equivalent to AMS's term ``lot.'' FSA staff will not provide a ``lot number'' to producers as described in the IFR. FSA will use designations that they currently use such as track, field, or subfield, depending on the specific area. This designation does not change the requirements or the information submitted for law enforcement. AMS will amend the form to reflect these terms. When reporting to FSA, producers must provide their State or Tribe-issued license or authorization number. A link to FSA information on how to report hemp crop acreage to FSA is available at [*https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2019/crop-acreage-reporting-19.pdf*](https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2019/crop-acreage-reporting-19.pdf) and is available on the USDA hemp production program website. As described in the IFR, certain State hemp pilot programs operating under the 2014 Farm Bill authority developed ``seed certification'' programs to help producers identify hemp strains with potentially lower THC concentrations. The term ``certification'' in this context means tested or verified, but it does not necessarily mean certified for varietal purity. USDA acknowledges that this remains a significant hurdle to the hemp industry and is committed to assisting with the research and development of compliant hemp varietals. Although AMS encourages States and Tribes to develop seed-certification programs if sufficient ***data*** is available, AMS has determined, at this time, that requiring the use of certain ``compliant'' varietals or establishing National rules for State-level certification programs is inappropriate. AMS will look at best practices from States and Tribes to evaluate if a program would be applicable to a USDA plan. If applicable, USDA may develop a performance-based sampling program. Such a program will require USDA to conduct rulemaking and comment procedures. The term ``seed certification,'' as found in the Federal Seed Act and its Regulations, refers to a third-party verification process that assures seed customers that they are receiving pure varieties and high-quality seed for planting purposes. The Federal Seed Act grants authority to seed certifying agencies in each State to administer varietal seed certification standards for all major ***agricultural*** crops, including hemp. Recognized seed certifying agencies are members of the Association of Official Seed Certifying Agencies (AOSCA), and they administer uniform AOSCA standards and inspect crops being grown for seed throughout the production process to maintain varietal purity. These activities protect seed customers in both domestic and export markets. Seed produced under these types of certification programs ensure a distinct, recognized variety that is properly tested and legally labeled. Seed certification under the Federal Seed Act is concerned with many varietal characteristics, not solely THC concentration. This enables farmers to confidently purchase seed of a suitable variety, by purchasing seed certified as to variety. Using certified seed, as described in the Federal Seed Act regulations and AOSCA standards, is an option for states and tribes if they have the ***data*** to support that the seed would work in their environment. While varietal certification does not absolutely ensure a specific THC content, the fact is that THC content (or at least a range) is a reliable varietal characteristic. Therefore, if the farmer is able to confidently purchase seed of a suitable variety by purchasing seed certified to variety, they at least know what to expect from the variety in their area. For this reason, AMS recommends the use of hemp seed from varieties that have undergone varietal certification, following the process outlined in the Federal Seed Act Regulations, and produced following AOSCA standards. This recommendation will assist hemp farmers to purchase recognized hemp varieties that have been tested for purity and are properly labeled. Additionally, AMS administers the Plant Variety Protection Office (PVPO) that is actively accepting applications of seed-propagated hemp for plant variety protection. The PVPO provides intellectual property protection to breeders of new varieties of seeds, tubers, and asexually reproduced plants. Under the U.S Plant Variety Protection Act, PVPO examines new applications and grants certificates that protect varieties for 20 years (25 years for vines and trees). Certificate owners have rights to exclude others from marketing and selling their varieties, manage the use of their varieties by other breeders, and enjoy legal protection of their work. This work, however, does not certify seeds for THC content.B. Tribal Jurisdictional Authority The final rule clarifies the extent of a Tribe's regulatory authority over hemp production within its Territory. Several commenters stated that language in the IFR raised uncertainty as to whether Indian Tribes could regulate hemp production by non-Indians operating on fee lands within a Tribe's Territory. To address this uncertainty, Sec. 990.4(b)(4) of the final rule now provides that ``[u]pon USDA approval of a Tribal plan, a Tribe may exercise jurisdiction and therefore primary regulatory authority over all production of hemp in its Territory regardless of the extent of its inherent[[Page 5599]]regulatory authority.'' Thus, as long as the land at issue qualifies as land within the territory of an Indian Tribe under Sec. 990.1 of the final rule, an Indian Tribe with a USDA-approved plan may regulate all hemp production on that land. USDA determined that this additional language is consistent with Congressional intent in the 2018 Farm Bill and best ensures that hemp production is managed consistently throughout the Territory of an Indian Tribe. If an Indian Tribe desires to have primary regulatory authority over the production of hemp in its Territory, under the 2018 Farm Bill, the Tribe may submit a plan to USDA. Section 297C of the AMA provides that ``In the case of a State or Indian Tribe for which a State or Tribal plan is not approved under section 297B, the production of hemp in that State or the territory of that Indian Tribe shall be subject to a plan established by the Secretary to monitor and regulate that production.'' Hence if a Tribe does not regulate hemp production within its Tribal Territory, USDA, not a State with an approved plan, will regulate hemp production program within that Territory. Sections 297B and C plainly show that Congress chose to take a territorial approach to the Tribal regulation of hemp production under the AMA. If Congress only wanted Indian Tribes to assume primary regulatory authority over hemp production in areas within their inherent jurisdictional authority it could have stated this. Instead, Congress opted for a land-based approach and delegated to Tribes the authority to assume hemp production regulatory authority throughout their territories. In consideration of the statutory language and the overall statutory scheme of the 2018 Farm Bill, USDA has determined that an Indian Tribe with an approved plan may regulate hemp production throughout its territory without regard to the Indian Tribe's ability to demonstrate inherent regulatory authority under the factors set forth in Montana v. United States, 450 U.S 544 (1981). Because Congress did not define Territory of the Indian Tribe in the AMA and did not include discussion in the legislative history of the meaning of this term, USDA is exercising its authority to issue regulations to implement the provisions in the 2018 Farm Bill to define this term in this manner. USDA's decision is in-line with agency determinations where the agency determined that Congress delegated a Tribe with authority to exercise regulatory authority over non-Tribal fee land within reservations. EPA Interpretive Rule: Revised Interpretation of Clean Water Act Tribal Provision, 81 FR 30183 (May 16, 2016); EPA Final Rule: Indian Tribes--Air Quality Planning and Management, 63 FR 7254 (Feb. 12, 1998); Arizona Public Serv. Co. v. EPA, 211 F.3d 1280 (D.C Cir. 2000). Moreover, USDA's decision is practicable and prevents piecemeal licensing by Tribes and USDA within a single Tribal Territory. If a Tribe was only able to exercise primary regulatory authority over hemp production within its Territory when it could demonstrate the inherent authority to do so, USDA could be required to regulate some hemp production within the Territory--for example, it could foreseeably be required to regulate hemp production by non-Indians operating on fee lands in certain cases. Such a system would be confusing for producers and regulators alike. For the foregoing reasons, the final rule now clearly explains that upon USDA approval of a Tribal plan, a Tribe may exercise primary regulatory authority over all production of hemp in its Territory regardless of the extent of its inherent regulatory authority, as reflected in Sec. Sec. 990.2 and 990.4 of the final rule.C. Sampling for Total THC AMS is changing certain aspects of the sampling requirements. This section addresses performance-based sampling, how to sample hemp plants, sampling agents, and the harvest window after sampling takes place.Sampling Requirements AMS received significant input from commenters on how hemp sampling procedures and requirements should be changed. When referring to ``sampling,'' we mean the process of ***collecting*** cuttings from hemp plants for purposes of compliance testing.Performance Based Sampling The IFR required State and Tribal hemp programs to ***collect*** samples from the flower material of the cannabis plant. The IFR also required State and Tribal hemp programs to ***collect*** enough samples to ensure at a confidence level of 95 percent that no more than one percent (1%) of the plants in the lot would exceed the acceptable hemp THC level. Guidance issued concurrently with the IFR explained these requirements in greater detail. The sampling requirements in the IFR did not consider geography, environmental factors, State or Tribal level seed certification programs, or other factors faced by States and Tribes when developing sampling requirements for their hemp programs. AMS is modifying the sampling provisions as presented in the IFR to allow States and Tribes to develop performance-based sampling requirements. Performance-based sampling achieves defined objectives and focuses on results. It differs significantly from a prescriptive action in which licensees are provided detailed direction on how those results are to be obtained. A performance-based approach would simply set a performance objective (e.g , reliability of 95 percent) and allow the States and Tribes considerable freedom in how to achieve that reliability objective with their sampling methodology. Some State hemp regulators have successfully developed sampling requirements that ensure adherence to State and Federal regulations, while allowing for flexibilities due to limited State resources and State and Tribal differences. States expressed extensive concerns about the requirements in the IFR that all lots must be sampled and tested, due to significant logistical and fiscal impacts. They explained that, since most hemp in a given region is harvested at the same time, sampling must be completed within a very short time frame by only a few individuals. Several States also explained how sampling occurs under established State programs and described the different ways that perceived risk determines State requirements. Some States utilize different sampling requirements for broad end-use categories like ``fiber/grain'' hemp versus ``cannabinoid'' hemp, while others base their requirements on historical THC concentrations of certain varietals or on the characteristics and growing history of a certain farm or producer. While these States' plans have not been approved under the 2018 Farm Bill regulations, we believe that providing States and Tribes the flexibility to develop sampling plans based on ***data*** they gather during an extended period of time may be an effective method at ensuring the overall acceptable hemp THC level of hemp grown in the State or Tribe. AMS agrees that sampling requirements should allow States and Indian Tribes more flexibility in the management of their hemp regulatory programs. AMS agrees that requiring sampling from every lot may be burdensome and expensive for State and Tribal regulatory entities and producers. AMS also finds compelling the arguments presented by States' regulatory agencies and other commenters that there are different risk factors for hemp used for fiber and grain versus hemp used for cannabinoids. ***Data*** submitted with[[Page 5600]]comments show that the THC levels of hemp used for cannabinoids are frequently higher than those of hemp for fiber and grain. The FDA authorizes the marketing of few types of cannabinoid products. This final rule does not cover cannabinoid products. AMS also acknowledges that research institutions face special circumstances when conducting hemp research. Accordingly, this rule provides sampling and testing flexibility to these institutions and producers working with them to conduct hemp research. Producers that produce hemp for research, along with the research institution itself, must obtain a license from a State, Tribal Government, or USDA. However, the hemp that is produced for research is not subject to the same sampling requirements provided that the producer adopts and carries out an alternative sampling method that has the potential to ensure, at a confidence level of 95 percent, that the cannabis plant species Cannabis sativa L. that will be subject to this alternative method will not test above the acceptable hemp THC level. Research institutions and producers growing hemp for research purposes shall ensure the disposal of all non-compliant plants. Research institutions and producers growing hemp for research purposes shall also comply with the reporting requirements including reporting disposal of non-compliant plants. Research institutions that handle ``hot'' hemp must follow CSA requirements for handling marijuana. States and Indian Tribes are allowed to develop performance-based requirements for these institutions. However, the alternative method must have the potential to ensure, at a confidence level of 95 percent, that the cannabis plant species Cannabis sativa L. that will be subject to the alternative method will not test above the acceptable hemp THC level. AMS views this flexibility as necessary to help support research and development as it relates to hemp production. This decision allows these types of research facilities and institutions to confidently oversee the study of hemp through trialing and genetics research, which AMS believes to be critical to the growth of industry, particularly in its infancy. Over time, the flexibility provided by this final rule will help to stabilize industry by providing greater understanding of hemp genetics and how certain varietals respond differently to growing conditions in various geographic locations. All producers are expected to benefit from such knowledge as they will be made aware of the more stable and consistently reliable hemp varietals. Any non-compliant plants produced by research institutions as a result of research and development will still need to be disposed and verified through documentation. Research and development facilities are still required to be licensed by States and Tribes. Research institutions must follow licensing and reporting requirements. In performance-based approaches, measurable or calculable parameters are available to determine whether the performance standard is met. These performance parameters are identified to provide measures of performance and the opportunity to take corrective action if performance is lacking. In the case of hemp, the performance parameter is the 0.3 percent THC level and other measures are included in this final rule if the parameter is not achieved such as disposal and remediation. USDA finds that in order to increase regulatory effectiveness, it makes sense to allow States and Indian Tribes to consider performance-based alternatives when developing sampling plans. If the objective or intended result can be achieved by setting a readily measurable standard that is enforceable, the proposed requirement should merely specify the objective or result to be obtained rather than prescribe to the licensee how the objective or result is to be attained. In other words, requirements should be performance-based, and highly prescriptive rules and requirements should be avoided absent good cause to the contrary. The sampling requirements for State and Tribal plans allow for States and Indian Tribes to develop unique sampling protocols for hemp growing facilities under their jurisdiction. Sampling protocols must be sufficient at a confidence level of 95 percent that no more than one percent of the plants in each lot would exceed the acceptable hemp THC level and ensure that a representative sample is ***collected*** that represents a homogeneous composition of the lot. Alternatively, the final rule allows States and Indian Tribes to adopt a performance-based sampling protocol. A performance-based protocol must have the potential to ensure, at a confidence level of 95 percent, that the cannabis plants will not test above the acceptable hemp THC level. USDA encourages the alternative protocol to consider seed certification processes or process that identifies varieties that have consistently demonstrated to result in compliant hemp plants in that State or territory of the Indian Tribe, whether the producer is conducting research on hemp at an institution of higher learning, whether a producer has consistently produced compliant hemp plants over an extended period of time, and other similar factors. AMS believes this will provide needed flexibility to States and Indian Tribes to develop logical and enforceable sampling requirements that take into consideration their unique circumstances. AMS will still require States and Indian Tribes to submit their individual sampling requirements for review as a component of the plan approval process. Sampling protocols submitted by States and Indian Tribes must comply with the thresholds established by the 2018 Farm Bill and this final rule. If performance-based sampling requirements are not included in a State or Tribal plan, the method used for sampling must be sufficient at a confidence level of 95 percent that no more than one percent of the plants in each lot would exceed the acceptable hemp THC level and ensure that a representative sample is ***collected*** from every lot, and thereby every producer must be sampled and tested. When evaluating sampling protocols submitted by States and Indian Tribes, USDA will evaluate the risk of producing non-compliant material to determine approval or disapproval. In evaluating the risk, USDA will take into consideration whether the performance-based factors the State or Indian Tribe used have the potential to assure compliance at a 95 percent confidence level. Since USDA cannot develop performance metrics that would be applicable independently from where the producer is located, producers licensed under the USDA plan are subject to the sampling requirements in the rule. USDA guidelines provided on the USDA website at [*https://www.ams.usda.gov/rules-regulations/hemp/information-sampling*](https://www.ams.usda.gov/rules-regulations/hemp/information-sampling) describe best practices for complying with those requirements. USDA recognizes that several States and Tribes may include performance-based sampling in their plans and that their experience could demonstrate that their sampling procedures may be adaptable to the USDA plan. If USDA finds this to be the case, USDA will explore a performance-based sampling scheme for producers under the USDA plan in the future through notice and comment rulemaking.Where To Take Samples on the Hemp Plant AMS will retain the requirement that pre-harvest samples be taken from the flower material of hemp plants. However, this rule clarifies the number[[Page 5601]]of inches of plant material needed for the sample and provides greater detail as to where exactly on the plant to make a cutting. The IFR required that samples be taken from the ``flower material'' of hemp plants. Further, in guidance material issued concurrently with the IFR, AMS explained in greater detail where exactly on the plant to make a cutting by recommending samples be taken from the top third of the plant, ``just underneath a flowering material.'' Many commenters argued that samples should be taken from the ``whole plant'' or that a ``homogenized'' sample should be taken to include the stem, stalk, leaves, and seeds along with flower material. Alternatively, some commenters proposed that samples be taken post-harvest from shredded whole plant material, otherwise known as ``biomass.'' Advocates of these positions asserted that THC levels of the whole hemp plant are better represented by samples ***collected*** from the entire plant, and not just from floral material. Other commenters advocated for sampling of a certain size or length of cutting. Such commenters advocated adoption of the sampling methods they or others had used under pilot programs. Many State ***agriculture*** departments suggested AMS continue to require samples taken from flower material. Even though many commenters felt that whole plant sampling should be allowed, AMS is of the opinion that since THC is concentrated in the flower material of the plant, the flower material is more appropriate to test than the entire plant. AMS will modify the sampling requirement to state that the sample shall be approximately five to eight inches from the ``main stem'' (that includes the leaves and flowers), ``terminal bud'' (that occurs at the end of a stem), or ``central cola'' (cut stem that could develop into a bud) of the flowering top of the plant. This change is consistent with the sampling practices in several States that established hemp programs pursuant to the 2014 Farm Bill authority. AMS determined that this standard strikes an appropriate balance between the need to ***collect*** a sufficiently large portion of the plant's flower (where THC and other cannabinoids are at their most concentrated), and the need to avoid cutting a portion that is so large that it would be logistically difficult to transport, dry, and prepare for lab testing. Based on the information discussed above and the experience and expertise of States and other commenters already engaged in hemp production pursuant to the 2014 Farm Bill authority, AMS is including new requirements herein. AMS is publishing updated sampling guidance concurrently with this final rule. This guidance describes how to comply with this requirement regarding where to take the sample from the plant as well as other sampling requirements in the final rule. While the sampling guidance provides best practices for meeting the requirements, States, Indian Tribes, and USDA licensees may adopt sampling procedures that differ from the guidance so long as those procedures meet the standards in this final rule.Sampling Agents The IFR required a Federal, State, local, or Tribal law enforcement agency or other Federal, State, or Tribal designated person to ***collect*** hemp samples for the purposes of testing THC levels in hemp. Comments in response to the IFR presented several concepts concerning how sampling agents should be designated and/or trained. Comments mostly suggested the need for enhanced training requirements for sampling agents to promote consistency in the ways that samples are ***collected*** nationwide. Based on comments received regarding sampling agents, AMS will provide additional training resources for sampling agents. These training documents will explain how sampling agents can meet the sampling requirements of this regulation. States and Indian Tribes with an approved plan may require the sampling agents used in their jurisdiction to take the USDA training, or they may develop their own custom training incorporating USDA requirements with additional State or Tribal requirements. States and Tribes must maintain information, available to producers, about trained sampling agents. Other comments on the topic of sampling agents spoke to the strain on State and Tribal resources of requiring agents to take samples instead of producers. Commenters presented two proposals to alleviate this strain--allowing producers to ***collect*** their own samples and reducing the volume of farms and plants from which samples are ***collected***. AMS is retaining the requirement that only designated agents can ***collect*** samples. This ensures that there is consistency in sampling throughout the industry. The flexibilities provided to States and Indian Tribes with primary regulatory authority over hemp in their jurisdiction will likely reduce the number of samples required to be ***collected*** and thus reduce the burden on designated sampling agents.Harvest Window The IFR required harvest within 15 days of sampling. AMS received comments regarding the challenges presented by the 15-day harvest requirement, including the logistical challenges to State and Tribal agencies charged with overseeing the ***collection*** of samples in this short timeframe, the logistical challenges to producers in harvesting hemp crops in this short timeframe, and testing challenges faced by laboratories in having to conduct compliance analyses in this short timeframe. Commenters suggested lengthening the 15-day harvest requirement to a longer period of time--with some asking for up to 60 days. AMS agrees with the arguments presented by commenters and recognizes the challenges imposed on the industry by the 15-day harvest requirement. AMS must also balance the logistical challenges of a harvest window requirement with the fact that THC concentration in hemp generally increases the longer the plant is in the ground. AMS now understands from ***data*** provided in comments that THC concentration does not increase linearly and is impacted by a myriad of environmental factors including moisture, wind, temperature, disease, sunlight, and soil, as discussed in the Comment Analysis section of this rule. The regulatory objective is to ensure, as best as possible, harmonization of the THC levels in the pre-harvest sample and that of the harvested material. Requiring that samples be taken prior to harvest is the best way to judge the THC concentration of the plant and the lot the sample represents. AMS recognizes that the most accurate measurement would be at time of harvest, but also understands the logistical practicalities discussed above and therefore has determined the most balanced approach is 30 days. For these reasons, AMS is expanding the window within hemp must be harvested after sampling to 30 days. Under this final rule, no more than 30 days prior to the anticipated harvest of cannabis plants, a ``sampling agent'' must ***collect*** samples for compliance testing. If producers do not harvest within 30 days of sampling, the plant will likely have a higher THC level at harvest than the sample that is being tested. This requirement balances the need for accuracy with the logistical realities faced in the sampling and testing processes and will yield the most accurate measurement of the THC level at the point of harvest. Increasing the window within hemp must be harvested after sampling from 15 to 30 days will[[Page 5602]]better allow for variables such as testing, weather, ***agricultural*** practices, and equipment delays.D. Testing Laboratories The IFR introduced regulatory requirements for laboratories testing hemp for compliance purposes. AMS also issued guidance with the IFR to explain best practices for hemp testing laboratories ([*www.ams.usda.gov/rules-regulations/hemp*](http://www.ams.usda.gov/rules-regulations/hemp)). Based on comments to the IFR, AMS is changing certain parts of these regulations and updating the accompanying testing guideline. While the testing guidance provides best practices for meeting the regulatory requirements, States, Indian Tribes, and USDA licensees may use test procedures that differ from the guidance so long as those procedures meet the standards in the final rule.Registration With DEA The IFR required all hemp testing laboratories to be registered with the DEA in accordance with the CSA (21 U.S.C 823(f)). On February 27, 2020, AMS announced a delay in enforcement of this requirement until October 31, 2020, or the publication of a final rule, whichever came first (USDA, DEA Provide Options for Labs, Disposal of Non-Compliant Hemp Plants. Thursday, Feb. 27, 2020) \4\ AMS announced this enforcement delay to allow additional time to increase DEA registered analytical lab capacity and avoid potential delays to producers in receiving test results. Although AMS received comments in opposition to this requirement, AMS is retaining the requirement in this final rule that any laboratory testing hemp for purposes of regulatory compliance must be registered with DEA to conduct chemical analysis of controlled substances in accordance with 21 CFR 1301.13 This requirement also applies to any laboratory testing hemp throughout the growing season to informally monitor THC concentration. Registration is necessary because laboratories could potentially handle cannabis that tests above 0.3 percent THC on a dry weight basis, which is, by definition, marijuana and a Schedule 1 controlled substance. Instructions for laboratories to obtain DEA registration, along with a list of approved laboratories, are available on the USDA Domestic Hemp Production Program website. AMS is aware that there are still not enough DEA-registered hemp testing facilities in some States or territories of Indian Tribes. However, since the IFR was published, numerous laboratories have applied for registration and DEA is working diligently to process these requests. Given the limited number of DEA-registered labs available to hemp producers, delay in enforcement of this requirement is continued until December 31, 2022. AMS anticipates this delay will provide adequate time for testing facilities to obtain DEA registration.--------------------------------------------------------------------------- \4\ [*www.ams.usda.gov/press-release/usda-dea-provide-options-labs-disposal-non-compliant-hemp-plants.---------------------------------------------------------------------------Laboratory*](http://www.ams.usda.gov/press-release/usda-dea-provide-options-labs-disposal-non-compliant-hemp-plants.---------------------------------------------------------------------------Laboratory) Testing Requirements Section 297B(a)(2)(A)(ii) of the AMA requires that State and Tribal plans for primary regulatory jurisdiction include a ``procedure for testing, using post-decarboxylation or other similarly reliable methods, delta-9 tetrahydrocannabinol concentration levels of hemp produced in the State or territory of the Indian Tribe.'' Since not all testing methods include decarboxylation, AMS is requiring that the total THC, which includes the potential conversion of tetrahydrocannabinolic acid (THCA) into THC, be reported and used for purposes of determining the THC content of a hemp sample. The IFR included requirements on how laboratories conduct hemp testing for the purposes of regulatory compliance to assure that total THC levels were measured. Commenters provided extensive input on testing requirements, particularly the requirement to test for ``total'' THC instead of only ``delta-9'' THC. AMS is retaining this requirement. AMS looked at current testing methodologies that would meet the decarboxylation requirement set in the 2018 Farm Bill. In gas chromatography (GC) testing, heat is applied to the sample, which decarboxylates THCA, producing delta-9 THC, so that the final delta-9 THC result is actually a total THC result. GC is the more traditional technique used for THC testing and was the technique used by Dr. Small \5\ in his research that derived the 0.3 percent threshold that was used as a basis for the 2018 Farm Bill requirement and is used by law enforcement as the threshold to differentiate hemp from marijuana. In his research papers, the 0.3 percent threshold is based on total available delta-9 THC, which is the sum of THCA and delta-9 THC in the plant material.--------------------------------------------------------------------------- \5\ Small, E.; Beckstead, H.D ; Chan, A. The Evolution of Cannabinoid Phenotypes in Cannabis. Economic Botany, 29, 219-232, 1975.--------------------------------------------------------------------------- Liquid chromatography (LC) testing does not involve the use of significant heat, so that the THCA in a sample does not generally decarboxylate. Results can be reported for THCA and delta-9 THC separately. When LC is used, the total THC needs to be calculated post-testing in order to report results as a ``post-decarboxylation'' delta-9 THC value. The requirement to report the total THC value as the THC content regardless of testing methodology used ensures testing consistency across the program. Samples must be tested using post-decarboxylation or other similarly reliable analytical methods by which the total THC concentration level reported accounts for the conversion of THCA into THC. Acceptable testing methodologies currently include gas or liquid chromatography with detection. The total THC, derived from the sum of the THC and THCA content, shall be determined and reported on a dry weight basis. In order to provide flexibility to States and Tribes in administering their own hemp production programs, alternative testing protocols will be considered if they are comparable to and similarly reliable as the baseline mandated by section 297B(a)(2)(A)(ii) of the AMA and established under USDA regulations and procedures. Updated USDA procedures for sampling and testing will be issued concurrently with this rule and will be provided on the USDA website. Reporting requirements for laboratories are discussed later in Section X (Regulatory Analysis) of this final rule. To clarify these requirements, laboratories conducting testing for purposes of monitoring THC concentration throughout the growing season are not subject to these reporting requirements. These tests are for the producer to monitor his or her production as it grows and not to comply with pre-harvest testing requirements in this rule. Only laboratories conducting the ``final'' test that will be used to determine whether a sample is compliant are subject to reporting requirements.Measurement of Uncertainty This final rule requires that laboratories calculate and include the Measurement of Uncertainty (MU) when they report THC test results. ``Measurement of uncertainty'' is defined as ``the parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the particular quantity subject to measurement.'' This definition is based on the definition of ``uncertainty (of measurement)'' in section 2.2.3 of the Joint Committee for[[Page 5603]]Guides in Metrology \6\ 100:800, Evaluation of measurement ***data***--``Guide to the Expression of Uncertainty in Measurement'' (JCGM Guide). The National Institute of Standards and Technology (NIST) Technical Note 1297, ``Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results'' (TN 1297), is based on the JCGM Guide. AMS also relied on the Eurachem/Co-Operation on International Traceability in Analytical Chemistry's ``Guide on Use of Uncertainty Information in Compliance Assessment, First Edition 2007''. Colloquially, the measurement of uncertainty is similar to a margin of error. When the measurement of uncertainty, normally expressed as a +/- with a number (e.g +/- 0.05), is combined with the reported measurement, it produces a range, and the actual measurement has a known probability of falling within that range (typically 95%). Laboratories should meet the AOAC International \7\ standard method performance requirements for selecting an appropriate method to determine the MU.--------------------------------------------------------------------------- \6\ The Joint Committee for Guides in Metrology is composed of international organizations working in the field of metrology. Its membership includes the Bureau International des Poids et Mesures, the Organisation Internationale de M[eacute]trologie L[eacute]gale, the International Organization for Standardization, the International Electrotechnical Commission, the International Union of Pure and Applied Chemistry, the International Union of Pure and Applied Physics, the International Federation of Clinical Chemistry and Laboratory Medicine, and the International Laboratory Accreditation Cooperation. \7\ USDA established the Association of Official ***Agricultural*** Chemists in 1884. In 1965, it changed its name to the Association of Official Analytical Chemists and became an independent organization in 1979. In 1991, it adopted its current, legal name as AOAC International.--------------------------------------------------------------------------- This final rule requires that laboratories report the MU as part of any hemp test results. The rule also includes a definition of ``acceptable hemp THC level'' to account for the uncertainty in the test results. The reported THC concentration of a sample may not be the actual concentration level in the sample. However, the actual THC concentration is expected to be within the distribution or range calculated when the reported THC concentration is combined with the measurement of uncertainty. The use of MU for purposes of determining the acceptable hemp THC level does not alter Federal law with regard to the definition of hemp or marijuana. As stated above, the 2018 Farm Bill defines hemp as the plant species Cannabis sativa L. and any part of that plant, including the seeds thereof and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a delta-9 THC of not more than 0.3 percent on a dry weight basis. Likewise, the Federal (CSA) definition of marijuana continues to include those parts of the cannabis plant as specified in 21 U.S.C 802(16) (and derivatives thereof) that contain more than 0.3 percent THC on a dry weight basis. The foregoing provisions of Federal law remain in effect for purposes of Federal criminal prosecutions, as well as Federal, civil, and administrative proceedings arising under the CSA. The definition of ``acceptable hemp THC level'' is also retained in this final rule. States and Indian Tribes shall adopt this concept in their plans. This definition explains how to interpret test results that include the MU with an example. The application of the MU to the reported delta-9 tetrahydrocannabinol concentration on a dry weight basis produces a distribution, or range. If 0.3 percent or less is within the distribution or range, then the sample will be considered to be hemp for the purpose of compliance with the requirements of State, Tribal, or USDA hemp plans. For example, if a laboratory reports a result as 0.35 percent with a measurement of uncertainty of +/-0.06, the distribution or range is 0.29 percent to 0.41percent Because 0.3 percent is within that distribution or range, the sample, and the lot it represents, is considered hemp for the purpose of compliance with the requirements of State, Tribal, or USDA hemp plans. However, if the MU for that sample was 0.02 percent, the distribution or range is 0.33 percent to 0.37 percent. Because 0.3 percent or less is not within that distribution or range, the sample is not considered hemp for the purpose of plan compliance, and the lot it represents will be subject to disposal. Thus the ``acceptable hemp THC level'' is the application of the MU to the reported delta-9 tetrahydrocannabinol content on a dry weight basis producing a distribution or range that includes 0.3 percent or less. As such, the regulatory definition of ``acceptable hemp THC level'' describes how State, Tribal, and USDA plans must account for uncertainty in test results in their treatment of cannabis. This definition affects neither the statutory definition of hemp, 7 U.S.C 1639o(1), in the 2018 Farm Bill nor the definition of ``marihuana,'' 21 U.S.C 802(16), in the CSA. Sections 297B(a)(2)(A)(iii) and 297C(a)(2)(C) of the AMA require that cannabis plants that have a THC concentration level of greater than 0.3 percent on a dry weight basis be disposed of in accordance with the applicable State, Tribal, or USDA plan. Because of this requirement, producers whose cannabis crop is not hemp will likely lose most of the economic value of their investment. Thus, AMS believes that there must be a high degree of certainty that the THC concentration level is accurately measured and is in fact above 0.3 percent on a dry weight basis before requiring disposal of the crop. The NIST Reference on Constants, Units, and Uncertainty states that ``measurement result is complete only when accompanied by a quantitative statement of its uncertainty. The uncertainty is required in order to decide if the result is adequate for its intended purpose and to ascertain if it is consistent with other similar results.'' \8\ Simply stated, knowing the measurement of uncertainty is necessary to evaluate the accuracy of test results.--------------------------------------------------------------------------- \8\ [*https://physics.nist.gov/cuu/Uncertainty/international1.html.---------------------------------------------------------------------------*](https://physics.nist.gov/cuu/Uncertainty/international1.html.---------------------------------------------------------------------------) Comments to the IFR generally expressed support for requiring that the measurement of uncertainty (MU) be accounted for when testing the THC concentration of hemp, due to the variability in laboratory testing equipment and complex mathematical principles involved. Comments also provided several suggestions on ways to improve the calculation of MU. Many comments advocated specifying an MU to create uniformity in testing across the nation. USDA does not recommend establishing an MU upper limit (maximum) because (1) MU is typically not standardized, but is controlled using standard test methods, and (2) USDA does not have the ***data*** to set an upper limit so setting it would be arbitrary, not scientific. The hemp and scientific industries are just beginning to discuss standard test methods and the final rule does not establish an explicit test method. Setting an upper limit or maximum MU does not resolve the core issue and would not encourage or drive labs to improve accuracy and precision. Setting an upper limit would in effect be setting a maximum or absolute MU. This may encourage labs to adopt the maximum MU as their MU, rather than drive for a smaller uncertainty. USDA may allow for establishing limits in the future, if needed, once methods are established and USDA has access to Proficiency Testing results and the reported MUs. We encourage States and Tribes to monitor, review and evaluate MU to evaluate trends and outliers, which may indicate ``lab shopping'' for higher MUs. The requirement for hemp[[Page 5604]]testing laboratories to incorporate a MU is being retained in this regulation.Laboratory Accreditation In the IFR, AMS requested input on establishing a fee-for-service hemp laboratory approval process or a requirement for laboratories to obtain ISO 17025 accreditation for labs that wish to offer THC testing services. Comments reflected a range of views across the industry, both in support of and in opposition to additional laboratory certification requirements. In general, commenters preferred more regulatory flexibility to address the widespread concern of insufficient laboratory capacity as a result of laboratory certification/registration/accreditation requirements. Other commenters were opposed to accreditation requirements due to the cost. While AMS strongly encourages laboratories to be accredited to ISO/IEC 17025 (by an International Laboratory Accreditation Cooperation Mutual Recognition Agreement (ILAC MRA) signatory accreditation body), we also acknowledge that ISO 17025 accreditation requires significant time and financial commitment to pursue and maintain. The time and cost involved is most challenging for smaller and start-up labs. The initial accreditation can cost $5,000-$10,000 (and in some case more) and yearly ongoing costs are $3,000-$8,000. Smaller labs may not have the resources to pursue accreditation in a timely manner or they may have to spend additional time and money for consultants to assist them in setting up a quality management system and to navigate the application and audit processes. Based on insufficient laboratory capacity at this time and the cost involved in adding this requirement, AMS will not provide an AMS administered lab approval program or require ISO 17025 accreditation. However, AMS remains committed to assisting the hemp laboratory testing community and is available to assist in the development of a laboratory approval program in the future. As explained in the IFR, if such hemp laboratory approval program is developed by AMS, such process will be conducted by USDA, AMS Laboratory Approval Service, which administers the Laboratory Approval Program (LAP). State and Tribal plans are free to include certain additional requirements for hemp testing laboratories, including ISO accreditation or other proficiency schemes.E. Disposal and Remediation of Non-Compliant Plants State and Tribal plans are currently required to include procedures for ensuring effective disposal or remediation of plants produced in violation of part 990. Plants that are removed as a result of poor plant health, pests, disease, or weather events, along with removal of male or hermaphrodite plants as part of a cross-pollination prevention plan, are not subject to the disposal requirements herein. This final rule retains the disposal requirements explained in the IFR but clarifies what ``disposal'' means and explains how the process must be conducted. This final rule also includes remediation as an option to remove non-compliant plants. As explained in the IFR, if a producer grows cannabis exceeding the legal 0.3 percent THC level, the material must be disposed of in accordance with the CSA and DEA regulations because such material constitutes marijuana, a Schedule I controlled substance under the CSA. The material must be ***collected*** for disposal by a person authorized under the CSA to handle marijuana, such as a DEA-registered reverse distributor, or a duly authorized Federal, State, Tribal, or local law enforcement officer. In the final rule, AMS is incorporating flexibilities for disposal that were announced on February 27, 2020 ([*https://www.ams.usda.gov/rules-regulations/hemp/enforcement*](https://www.ams.usda.gov/rules-regulations/hemp/enforcement)). Some of these new options include, but are not limited to, plowing under non-compliant plants, composting into ``green manure'' for use on the same land, tilling, disking, burial, or burning. These methods are intended to allow producers to apply common on-farm practices for the disposal of non-compliant plants. One of the top considerations in making this change was to minimize, to the extent possible, the resource impact to State, Tribal, and local law enforcement in handling hemp that is out of compliance. In addition, we are confident that any disposal options make the product unusable and therefore is not at risk for entering any streams of commerce. Based on comments received, AMS is permanently retaining these on-farm disposal flexibilities. AMS received comments on this requirement describing the expense associated with destroying cannabis in accordance with the CSA, primarily the requirement that disposal be conducted offsite by a reverse distributor or other law enforcement officer. Based on this input, AMS, in coordination with DEA partners, delayed enforcement of the disposal requirements in the IFR. In the final rule, producers have several options on how to handle non-compliant plants. Producers do not need to use a DEA-registered reverse distributor or law enforcement to dispose of non-compliant plants. Producers may dispose of the plants using one or more of the means described by AMS at [*https://www.ams.usda.gov/rules-regulations/hemp/disposal-activities*](https://www.ams.usda.gov/rules-regulations/hemp/disposal-activities). It is the Agency's intent that these methods allow producers to apply common on-farm practices as a means of disposal while rendering the controlled substance non-retrievable or non-ingestible. Under this final rule, State and Tribal plans must still include procedures to verify disposal. This may come in the form of in-person verification by State or Tribal representatives, or alternative requirements the direct growers to provide pictures, videos, or other proof that disposal occurred successfully. Producers under the USDA plan must document the disposal of all non-compliant plants. States and Indian Tribes operating under approved hemp production plans and producers under the USDA plan must notify USDA of any occurrence of non-conforming plants or plant material and provide the disposal record of those plants and materials monthly. State and Tribal plans must include procedures to verify disposal, whether through the use of in-person verification by State or Tribal representatives, or requirements for producers to provide pictures, videos, or other proof that disposal did in fact occur. State and Tribal plans must also include requirements to submit to AMS the monthly disposal and remediation report documenting any on-farm disposals or remediations that occurred during the prior month. As of November 2020, twenty States and nine Tribes operating under the 2018 Farm Bill reported 4,192 licensed producers representing 6,166 acres planted. Of these acres planted, there were 231 disposals representing 730 acres disposed due to not meeting the 0.3 percent acceptable hemp THC level. AMS did not provide additional remediation options in the IFR. The only remediation alternative was to completely dispose of the non-compliant material. AMS is adding remediation to this final rule based on comment. AMS received many comments suggesting the inclusion of procedures to allow for non-compliant cannabis to be ``remediated.'' AMS agrees with this suggestion and is publishing remediation techniques concurrently with this rule that can be[[Page 5605]]followed to remediate non-compliant plant material into compliant form. As described in the IFR, hemp exceeding the acceptable THC level may not be further handled, processed, or enter the stream of commerce. AMS believes that hemp producers should have the opportunity to remediate non-compliant crops in order to minimize financial risk associated with the loss of investment in their hemp crop. For this reason, this final rule allows remediation activities, either disposing of flower materials and salvaging the remainder of the plant or blending the entire plant into biomass plant material. Through both forms of remediation, producers may be able to minimize losses, and in some cases produce a return on investment while ensuring that non-compliant material does not enter commerce. If a producer elects to perform remediation activities as allowable under this final rule's provisions (referenced above), an additional sampling and testing of the post-remediated crop must occur to determine THC concentration levels. Only those successfully remediated crops will be allowed to enter the stream of commerce, and all other remaining non-compliant crops must then be disposed. AMS believes the inclusion of remediation and post-harvest sampling into the final rule provides the additional flexibility requested by commenters that expressed the need for producers to have greater opportunity for success as established and beginning farmers entering hemp production.F. Compliance With Enforcement Procedures, Including Determination of Negligence and Annual Inspection of Hemp Producers The IFR required State and Tribal plans to include compliance procedures to ensure hemp was being produced in accordance with the requirements of this part. Comments to the IFR were generally opposed to the compliance requirements, particularly as they relate to the definition of negligence. Producers, along with State and Tribal regulatory agencies, found the negligence requirements in the IFR overly harsh and strict. This final rule changes these compliance procedures, particularly how ``negligence'' is determined. In the context of this regulation, negligence is defined as a failure to exercise the level of care that a reasonably prudent person would exercise in complying with the regulation. The definition employed in this rule is derived from the definition of negligence in Black's Law Dictionary. See BLACK'S LAW DICTIONARY (10th ed. 2014) (defining negligence as ``[t]he failure to exercise the standard of care that a reasonably prudent person would have exercised in a similar situation''). This final rule increases the negligence threshold from 0.5 to 1.0 percent THC and clarifies how States and Indian Tribes determine when to suspend or revoke a producer's license. AMS believes that raising the negligence threshold from 0.5 percent to 1.0 percent THC will increase flexibility to farmers as they learn more about how to grow compliant hemp and as the availability of stable hemp genetics improves. In developing the compliance requirements for State and Tribal plans, AMS recognizes that there may be significant differences across States and Indian Tribes in how they will administer their respective hemp programs. This final rule provides that a producer shall not be subject to more than one negligent violation per calendar year. State and Tribal hemp plans must still include requirements to conduct annual inspections of, at a minimum, a random sample of hemp producers to verify hemp is not being produced in violation of this rule, along with a procedure for handling violations. In accordance with the 2018 Farm Bill, States and Indian Tribes with their own hemp production plans have certain flexibilities in determining whether hemp producers have violated their approved plans. However, there are certain compliance requirements that all State and Tribal plans must contain. This includes procedures to identify and attempt to correct certain negligent acts, such as failing to provide a legal description of the land on which the hemp is produced, not obtaining a license or other required authorizations from the State or Tribal government, or producing plants exceeding 0.3 percent total THC. States and Indian Tribes may include additional requirements in their plans. This final rule specifies that hemp producers do not commit a negligent violation if they produce plants that exceed the acceptable hemp THC level and use reasonable efforts to grow hemp and the plant does not have a THC concentration of more than 1.0 percent on a dry weight basis. AMS recognizes that hemp producers may take the necessary steps and precautions to produce hemp, such as using certified seed, using other seed that has reliably grown compliant plants in other parts of the country, or engaging in other best practices, yet still produce plants that exceed the acceptable hemp THC level. AMS believes that a hemp producer in that scenario has exercised a level of care that a reasonably prudent person would exercise if the plant does not have a THC concentration of more than 1.0 percent on a dry weight basis. AMS arrived at this increased tolerance based on input from commenters, particularly State ***agriculture*** departments that operated hemp research programs under the 2014 Farm Bill, along with ***data*** provided by laboratories testing hemp subject to 2018 Farm Bill requirements. The 0.5 percent was based on ***data*** from three states participating in the 2014 Farm Bill pilot program. AMS believes raising the negligent violation threshold from 0.5 percent to 1.0 percent in the final rule provides a greater buffer and reduces farmers' exposure to risk of violation accrual and license suspension. AMS recognizes the violation threshold may incentivize (or disincentivize) innovation by research institutions and producers. AMS acknowledges more innovation and research across industry will bring more stability to stakeholders. AMS believes the 1.0 percent threshold incentivizes innovation across industry more so than a 0.5 percent violation threshold. Further, comments addressed the negative impact of the accrual of negligent violations on the financial stability of the individual business. They described how a hemp grower's access to credit and insurance is jeopardized when negligent violations accumulate and lead to a determination of culpable negligence. Comments explained that lending institutions and insurance providers look for risk factors. They also raised questions about how the accrual of negligent violations may be interpreted by lender or providers. Comments said that many insurers will not cover crop losses if losses are due to the growers' negligence. AMS acknowledges institutional lenders view violations as risk factors in decision making. AMS also notes that not all culpable violations are derived from the accrual of negligent violations. Culpable violations may be the result of producers violating other parts of the 2018 Farm Bill. However, the 2018 Farm Bill explicitly considers certain actions as constituting negligent violations. AMS's intention is to provide a threshold between 0.3 percent THC level and what would be considered a negligent violation so not all hemp that tests over the 0.3 percent be considered a negligent violation. Because a producer will not have committed a negligent violation every time he or she grows hemp with a concentration of hemp above the 0.3 percent level, this will assist producers when requesting loans or other financial assistance.[[Page 5606]] Several comments suggested that a 0.5 percent negligence threshold threatens the survival of farmers in an emerging industry. Comments suggested that the low threshold is a barrier to entry for new farmers or farmers with no experience growing hemp, who risk high initial capital investments to establish operations. Comments argued that the low threshold favors larger farms using industrialized hemp varieties and production practices, and that the low negligence threshold in the IFR would unnecessarily criminalize farmers working with a legal ***agricultural*** commodity. Increasing this threshold to 1.0 percent benefits producers, including small and new farmers, that intended to grow hemp but whose crops tested ``hot'' even though they made reasonable efforts to grow hemp. In cases where a State or Indian Tribe determines a negligent violation has occurred, a corrective action plan shall be established. The corrective action plan must include a reasonable date by which the producer will correct the negligent violation. Producers operating under a corrective action plan must also periodically report to the State or Tribal government, as applicable, on their compliance with the plan for a period of not less than two calendar years following the violation. A producer who negligently violates a State or Tribal plan three times in a five-year period will be ineligible to produce hemp for a period of five years from the date of the third violation. Several comments explained how these requirements as written in the IFR were confusing and difficult to administer. Particularly, commenters explained how a producer could easily receive three negligent violations during one growing season, which would lead to an automatic licensing revocation for the following five years. For example, a producer may grow hemp in three different locations. If the hemp becomes non-compliant cannabis, all in one season, the producer would lose the license in one season. Commenters described this as too strict and too severe a penalty for honest mistakes that many first-year hemp producers will certainly make. AMS agrees and wishes to clarify that this is not the intent of the regulation. AMS acknowledges that producers may have more than one production area and that they may harvest at different times. Tests results may be over the allowable limit on those production areas but the planting was performed at the same time using the same seeds. Allowing for only one violation per season would help minimize duplication of enforcement. This final rule provides that a producer shall not be subject to more than one negligent violation per calendar year. As it is customary in ***agriculture***, practices vary due to many factors such as weather, availability of labor, transportation and storage capacity and more. Due to many factors, producers make determinations about planting and harvest cycles. In certain circumstances, producers may plant before the first cycle has been harvested specially when they plant in multiple locations. Calendar year is easier to administer and will allow for various growing seasons. Each geographical area has a growing season based on specific temperature, weather, soil or other factors in that region, therefore this rule is defining growing season as a calendar year. This will allow flexibility, including a year-round season if States and Indian Tribes have a warmer climate or greenhouse growing. Negligent violations are still not subject to criminal enforcement action by local, Tribal, State, or Federal government authorities under this regulation. State and Tribal plans also must contain provisions relating to producer violations made with a culpable mental state greater than negligence, meaning acts made intentionally, knowingly, or with recklessness. This definition is derived from the definition of negligence in Black's Law Dictionary. See BLACK'S LAW DICTIONARY (10th ed. 2014) (giving as a definition of negligence ``[t]he failure to exercise the standard of care that a reasonably prudent person would have exercised in a similar situation''). If it is determined a violation was committed with a culpable mental state greater than negligence, the State ***agriculture*** department or Tribal government, as applicable, shall immediately report the producer to the Attorney General, USDA, and the chief law enforcement officer of the State or Indian Tribe. State and Tribal plans also must prohibit any person convicted of a felony related to a controlled substance under State or Federal law from participating in the State or Tribal plan and from producing hemp for 10-years following the date of conviction. An exception applies to a person who was lawfully growing hemp under the 2014 Farm Bill before December 20, 2018, and whose conviction also occurred before that date. This exemption language must be included in all State and Tribal hemp plans, whether they administered a 2014 Farm Bill research pilot program or not. The 2018 Farm Bill does not define what it means to ``participate in the [State or Tribal] program.'' AMS is not requiring States and Indian Tribes to adopt a specific definition. Instead, they must define who those persons are in their plan. The definition must include one individual for whom a criminal history records check can be conducted for each license or authorization that the State or Indian Tribe issues. The final rule identifies and defines ``key participants'' as those participating in the USDA plan. State and Tribes may, but are not required, to adopt this definition for their plans. The State or Indian Tribe will need to review criminal history reports for each individual identified as participating in its program. The final rules defines ``criminal history report'' as the Federal Bureau of Investigation's Identity History Summary. The State or Indian Tribe may review additional reports or checks to determine whether an individual may participate in its plan. Finally, any person found by the USDA, State, or Tribal government to have materially falsified any information submitted to the program will be ineligible to participate.G. Information Sharing The IFR included requirements for State and Tribal plans to contain procedures for reporting specific information to USDA. Limited comments were received on these requirements. This information has been transmitted already by many States and Tribes to USDA. This information meets the requirements set in the 2018 Farm Bill. Therefore, the following requirements are the same as required under the IFR and are in subpart F of this final rule. This is separate from the requirement to report hemp crop acreage with FSA as discussed above. The information required includes contact information for each hemp producer covered under the plan, including name, address, telephone number, and email address (if available). If the producer is a business entity, the information must include the full name of the business, address of the principal business location, full name and title of each employee for whom the entity is required to submit a criminal history report, and an email address if available, and Employee Identification Number (``EIN'') of the business entity. Producers must report the legal description and geospatial location for each hemp production area, including each field, greenhouse, or other site used by them, as stated in section A of this preamble. The report also shall include the status of the license or other[[Page 5607]]required authorization from the State or Tribal government, as applicable, for each producer under a hemp production plan. States and Indian Tribes will submit this information to USDA not later than 30 days after the date it is received using the appropriate reporting requirements as determined by USDA. These reporting requirements are found at Sec. 990.70 in this final rule. Further explanation of the specific information to be submitted, the appropriate format, and the specific due dates for the information is discussed in Section X (Regulatory Analysis) of this final rule. This information submitted from each State and Tribal plan, along with the equivalent information ***collected*** from individuals participating under the USDA plan, will be assembled and maintained by USDA and made available in real time to Federal, State, Tribal, and local law enforcement, as required by the 2018 Farm Bill. All information supporting, verifying, or documenting the information submitted to USDA must be maintained by the States and Indian Tribes for at least three years. Under Sec. 990.70(c), States and Indian Tribes must also submit annual reports regarding the total planted, harvested, and disposed acreage. Additionally, because the final rule provides for remediation of plants, the final rule requires all remediated acreage to be reported as well. Similarly, under Sec. 990.71(c), all USDA hemp plan producers must submit annual reports to USDA detailing total planted acreage, total acreage disposed and remediated, and total harvested acreage.H. Certification of Resources All State and Tribal plans submitted for USDA approval must also have a certification stating the State or Indian Tribe has the resources and personnel necessary to carry out the practices and procedures described in their plan. Section 297B of the AMA requires this certification, and the information is important to USDA's approval of State and Tribal plans, in that all such plans must be supported by adequate resources to effectively administer them. This section has not changed from the IFR.I. State and Tribal Plan Approval, Technical Assistance and USDA Oversight Since the publication of the IFR, AMS has worked extensively with States and Indian Tribes in developing hemp production plans. As States and Indian Tribes begin the work of modifying their plans to incorporate the changes herein, we encourage States and Indian Tribes to continue working with and sharing information with AMS. States and Tribes may need to change plans based on changes in this final rule because their State or Tribal laws may no longer match the requirements in this final rule. Even though some of the changes in this final rule are less burdensome, State and Tribal plans must follow their own legislations. Accordingly. They must amend their plans. During the plan development and/or revision process, States and Indian Tribes are encouraged to contact USDA so we may provide technical assistance in developing plan specifics. Since the publication of the IFR, USDA approved over 60 State and Tribal plans within the 60-day requirement. USDA approved plans that comply with the 2018 Farm Bill and with the provisions of the IFR. For the 2021 planting season, the 2018 Farm Bill, amended by the Continuing Resolution (CR) (***Agriculture*** Improvement Act of 2018 (7 U.S.C 5940 note; Pub. L. 116-260)), provided that States and institutions of higher education can continue operating under the authorities of the 2014 Farm Bill until January 1, 2022. AMS clarified the avenues for Tribal participation under authorities in the 2014 Farm Bill to grow industrial hemp for research purposes. This clarification is available on the AMS website: [*https://www.ams.usda.gov/content/usda-clarifies-industrial-hemp-production-indian-Tribes*](https://www.ams.usda.gov/content/usda-clarifies-industrial-hemp-production-indian-Tribes). Due to this extension, many States decided to remain under the 2014 Farm Bill provisions and rescinded their previously approved plans. All States are eligible to remain or start programs under the 2014 Farm Bill provisions. As a result, USDA will oversee 20 State and 20 Tribal plans under the 2018 Farm Bill until new States and Tribes submit more plans under the 2018 Farm Bill provisions. As of November 2020, States and Tribes operating under the 2018 Farm Bill reported 4,192 licensed producers representing 6,166 acres planted. Of these acres planted, there were 231 disposals representing 730 acres disposed due to not meeting the 0.3 percent acceptable hemp THC level. This ***data*** is limited because even though many States and Tribes have approved plans, they have not all been fully implemented. USDA expects more ***data*** will be available as the 2021 season begins and States and Tribes implement their programs. USDA will use the procedures in this rule, which are substantively similar to those in the IFR, to review and approve State and Tribal plans. If a plan does not comply with the requirements of the Act and this regulation, it will not be approved. However, USDA has worked with many States and Tribes submitting plans to assist them in meeting the requirements and obtaining approval for their plans. If a plan is not approved, USDA provides a letter of notification outlining the deficiencies identified. The State or Tribal government may then submit an amended plan for review. If the State or Tribe disagrees with the determination made by USDA regarding the plan, a request for reconsideration can be submitted to USDA using the appeal process as outlined in section V of this document. Plans submitted by States and Indian Tribes must be approved by USDA before they can be implemented. States and Indian Tribes can submit their plans to USDA through electronic mail at [*farmbill.hemp@usda.gov*](mailto:farmbill.hemp@usda.gov) or by postal carrier to USDA. The specific mailing address is provided on the USDA Domestic Hemp Production Program website. If the State or Tribal plan application is complete and meets the criteria of this part, USDA issues an approval letter. Approved State and Tribal plans, including their respective rules, regulations, and procedures, are posted on USDA's hemp program website. A USDA-approved State or Tribal plan will remain in effect, unless approval is revoked by USDA pursuant to the revocation procedures discussed in this section or unless the State or Tribe makes substantive revisions to their plan or their laws that alter the way the plan meets the requirements of this regulation. Additionally, changes to the provisions or procedures under this rule or to the language in the 2018 Farm Bill may require plan revision and resubmission to USDA for approval. Changes to applicable Federal and State or Tribal statutes may also require plan revision and resubmission to USDA for approval and may lead to plan revocation if the plan is not amended. Should States or Indian Tribes have questions regarding the need to resubmit their plans, they should contact USDA for guidance. A State or Tribal government may submit an amended plan to USDA for approval if: (1) The Secretary disapproves a State or Tribal plan; or (2) the State or Tribe makes substantive revisions to their plan or to their laws that alter the way the plan meets the requirements of this regulation, or as necessary to bring the plan into compliance with changes in other applicable law or regulations. If the plan previously approved by USDA needs to be amended because of[[Page 5608]]changes to the State's or Tribe's laws or regulations, such resubmissions should be provided to USDA within 60 days from when the new State or Tribal law or regulations are effective. Producers will be held to the requirements of the previous plan until such modifications are approved by USDA. If State or Tribal government regulations in effect under the USDA-approved plan change, but the State or Tribal government does not resubmit a modified plan within 60 days of the effective date of the change, USDA will issue a notification to the State or Tribal government that approval of its plan will be revoked. The revocation will be effective no earlier than the beginning of the next calendar year. If a plan is revoked, producers previously subject to an approved plan would be eligible to apply to USDA for a license. This is a change from the IFR that allowed for resubmission because of a change in State or Tribal law or regulations within a calendar year. This modification is due to USDA's need to know in a timelier manner, since such laws and regulations are the foundations of the hemp plans. The words of the plans do not have meaning if they are not aligned with current authorities. USDA has the authority to audit States and Tribes to determine if they are in compliance with the terms and conditions of their approved plans. If a State or Indian Tribe is noncompliant with their plan, USDA will work with that State or Indian Tribe to develop a corrective action plan. However, if additional instances of noncompliance occur, USDA has the authority to revoke the approval of the State or Tribal plan for one year or until the State or Tribe become compliant. AMS still believes that one year is sufficient time for a noncompliant State or Indian Tribe to evaluate problems with their plan and make the necessary adjustments. Should USDA determine the approval of a State or Tribal plan should be revoked, such a revocation would begin after the end of the current calendar year, so producers will have the opportunity to adjust their operations as necessary. This will allow producers to apply for a license under the USDA plan so that their operations do not become disrupted due to the revocation of the State or Tribal plan.III. Department of ***Agriculture*** Plan The 2018 Farm Bill requires USDA to administer a hemp production plan for producers in jurisdictions where hemp production is legal but is not covered by an approved State or Tribal plan. The USDA licensing remains available to producers in States and Tribal territories without a USDA-approved hemp plan. All hemp produced in a jurisdiction without an approved State or Tribal plan must meet the requirements of the USDA plan. The requirements for producers operating under the USDA plan are similar to those operating under approved State and Tribal plans. Regulatory requirements for producers licensed under the USDA plan in this final rule differ in some cases from corresponding requirements in the IFR and are explained in the following section. Comments submitted to the IFR generally did not address these requirements specifically; rather they focused on the broader requirements around sampling, testing, and disposal, to which all hemp producers are subject, whether licensed by a State, a Tribe, or USDA.A. USDA Hemp Producer License and Criminal History Report To produce hemp under the USDA plan, producers must apply for and be issued a license from USDA. USDA has been accepting applications from producers since October 2019. Any license issued by USDA prior to publication of this final rule will remain in effect and subject to the original expiration date. As of the issuance of this final rule, USDA has issued 380 licenses under the USDA plan. While a State or Tribal government has a draft hemp production plan pending for USDA approval, USDA will not issue USDA hemp production licenses to individual producers located within that State or Tribal territory. Once USDA approves a hemp production plan from a State or Tribe, it will deny any license applications from individuals located in the applicable State or Tribal territory. If USDA disapproves a State or Tribal hemp production plan, individual producers located in the State or Tribal territory may apply for a USDA hemp production license, unless hemp production is illegal in the State or Tribal territory where they intend to produce hemp. Comments to the IFR described confusion around the application window for when USDA would receive and process applications as described in the IFR. The IFR said that for the first year after USDA began to accept applications, applications could be submitted any time. For all subsequent years, license applications and license renewal applications would have to be submitted between August 1 and October 31. AMS requested input on this application window, and commenters were generally opposed. Under this final rule, USDA will accept applications for USDA hemp production licenses on a rolling basis to better accommodate the needs of producers. AMS continues to encourage the submission of applications well before the planting season so AMS has adequate time to process the applications. All applications must comply with the requirements as described below. The license application is available online at the USDA Domestic Hemp Production Program website at [*https://www.ams.usda.gov/rules-regulations/hemp/information-producers*](https://www.ams.usda.gov/rules-regulations/hemp/information-producers). Applications may be submitted electronically or by mail. The producer license application requires contact information such as name, address, telephone number, and email address (if available). If the applicant represents a business entity, and that entity will be the producer, the application will require the full name of the business, address of the principal business location, full name and title of the key participants on behalf of the entity, an email address if available, and EIN of the business entity. All applications must be accompanied by a completed criminal history report. Several comments to the IFR expressed opposition to this requirement. AMS is retaining this requirement since verification of compliance with the felony restriction is a statutory requirement. If the application is for a business entity, a completed criminal history report must be provided for each key participant. Some commenters expressed concern with the requirements pertaining to ``key participants,'' particularly with the requirement that all key participants undergo a background check. To the extent the commenters equated a criminal history check with a background check, AMS is retaining this requirement, since key participants are those individuals responsible for ensuring compliance with the regulatory requirements contained herein. If key participants are not subject to criminal history checks, AMS cannot ensure statutory restrictions on individuals with felony convictions related to controlled substances are met per Section 297B(e)(3)(B)(i) of the AMA. AMS notes that it will not conduct any other checks into the background of key participants. Key participants are a person or persons who have a direct or indirect financial interest in the entity producing hemp, such as an owner or partner in a partnership. A key participant also includes a person in a corporate entity at executive levels including the chief executive officer, chief operating officer, and chief financial officer. This does not[[Page 5609]]include other management positions like farm, field, or shift managers. The final rule also specifies that the definition of key participant does not include a member of the leadership of a Tribal government who is acting in their capacity as a Tribal leader, except when that member exercises executive managerial control over hemp production. AMS added this specification to address concerns raised by Indian Tribes regarding issues that can arise when a Tribal leader is also involved in the production of hemp in their capacity as a Tribal leader. While AMS understands the issues that can arise when a Tribal leader is subject to the felony conviction restriction, AMS must also ensure that all required entities operating under a USDA plan comply with Section 297B(e)(3)(B) of the AMA. Therefore, the definition of key participants still encompasses Tribal leaders who exercise executive managerial control over hemp production. USDA will not accept criminal history reports completed more than 60 days before the submission of an application, because the 60-day window provides USDA with an expectation that the findings of the report are reasonably current and accurate. The criminal history report must indicate the applicant has not been convicted of a State or Federal felony related to a controlled substance for the 10 years prior to the date of when the report was completed. An exception applies to a person who was lawfully growing hemp under the 2014 Farm Bill before December 20, 2018, and whose conviction also occurred before that date. In addition to providing the information specified, the application will also require license applicants to certify they will adhere to the provisions of the plan. Once all the necessary information has been provided, applications will be reviewed by USDA for completeness and to determine an applicant's eligibility. USDA will approve or deny license applications unless the applicant is intending to produce hemp in a jurisdiction that has submitted a plan to USDA or has a plan approved by USDA, in which case the application for a USDA license will be denied. Applicants will be notified if they have been granted or denied a license either by mail or email. If an application is denied, the applicant will receive a notification letter or email specifying why the application was denied. If an application is denied because it is incomplete, the applicant will have the option of resubmitting a revised application. If the application was denied for other reasons, the applicant will have the opportunity to appeal USDA's decision in accordance with the appeals process outlined in the regulation in subpart D. Once a license application has been approved, USDA will issue the producer license. Licenses are not transferrable in any manner. An applicant whose application has been approved will not be considered a licensed producer under the USDA plan until the applicant receives their producer license. Licenses do not renew automatically and must be renewed every three years. Applications for renewal will be subject to the same terms and approved under the same criteria as initial applications unless there has been an intervening change in the applicable law or regulations since approval of the initial or last application. In such a case, the subsequently enacted law or regulation shall govern renewal of the license. Licenses will be valid until December 31 of the year that is at least three years after the license is issued. This date is not tied to the harvest and planting season. For example, if a producer applies for a license on August 1, 2021, and is granted a license on September 15, 2021, the license would expire December 31, 2024. A December 31 expiration date will allow licensed producers time to apply for a license renewal prior to their prior license's expiration and prevent a gap in licensing. A producer licensed by USDA must report their hemp crop acreage to FSA. Producers must provide specific information to FSA, including, but not limited to, USDA license number, the specific location where hemp is produced and the acreage, greenhouse, building, or site where hemp is produced. The specific location where hemp is produced must be identified, to the extent practicable, by the geospatial location. FSA will provide assistance in identifying the hemp growing location. Please refer to the Section II of this document on State and Tribal hemp production program requirements for further discussion on FSA reporting requirements. If at any time there is a change to the information submitted in the license application, a license modification is required. A license modification is required if, for example, the licensed business is sold to a new owner or hemp will be produced in a new location not described on the original application. Producers must notify USDA immediately should there be any change in the information provided on the license application.B. Sampling for THC The IFR stated that all hemp production must be sampled and tested for THC concentration levels. It is the responsibility of the licensed producer to pay any fees associated with sampling. AMS issued guidance on sampling procedures that meet the sampling requirements to coincide with publication of the IFR and will update the guidance with this final rule. AMS is requiring that all samples tested for THC concentration levels be conducted in DEA-registered laboratories. However, this requirement will not be applicable until December 31, 2022. Significant input was received on the IFR sampling requirements. Please refer to section B under State and Tribal plans above and the discussion of comments below for a summary of findings. Producers under the USDA plan are subject to the sampling and testing requirements as outlined in the USDA guidelines for sampling and testing. Since USDA cannot develop a one size fits all performance-based sampling program, all producers licensed under the USDA plan must comply with the USDA sampling guidelines. USDA licensed producers are responsible for obtaining the services of sampling agents and hemp testing laboratories themselves. USDA is updating guidance on sampling procedures and training for sampling agents with this rule. USDA does not provide sampling or testing services and will not pay for those services. State and Tribal hemp regulators have successfully developed sampling requirements that ensure adherence to State and Federal regulations, while allowing for flexibilities due to limited State resources and State and Tribal differences. They explained that, since most hemp in a given region is harvested at the same time, sampling must be completed within a very short time frame by only a few individuals. Several States also explained that perceived risk determines State requirements. Some States utilize different sampling requirements for broad end-use categories like ``fiber/grain'' hemp versus ``cannabinoid'' hemp, while others base their requirements on historical THC concentrations of certain varietals or on the characteristics and growing history of a certain farm or producer. AMS agrees that sampling requirements should allow States and Indian Tribes more flexibility in the management of their hemp regulatory programs.[[Page 5610]] AMS agrees that requiring sampling from every lot may be burdensome and expensive for State and Tribal regulatory entities and producers. AMS finds that it makes sense to allow States and Indian Tribes to consider performance-based alternatives when developing sampling plans that take into account unique sampling protocols for hemp growing facilities under their jurisdiction. The sampling requirements for State and Tribal plans allow for States and Indian Tribes to develop unique sampling protocols for hemp growing facilities under their jurisdiction. Sampling protocols must be sufficient at a confidence level of 95 percent that no more than one percent of the plants in each lot would exceed the acceptable hemp THC level and ensure that a representative sample is ***collected*** that represents a homogeneous composition of the lot. Alternatively, States and Indian Tribes may adopt a performance-based sampling protocol. A performance-based protocol must have the potential to ensure, at a confidence level of 95 percent, that the cannabis plants will not test above the acceptable hemp THC level. USDA encourages that the alternative protocol consider seed certification processes or process that identifies varieties that have consistently demonstrated to result in compliant hemp plants in that State or territory of the Indian Tribe, whether the producer is conducting research on hemp at an institution of higher learning or that is funded by a Federal, State, or Tribal government, whether a producer has consistently produced compliant hemp plants over an extended period of time, and other similar factors. AMS believes this will provide needed flexibility to States and Indian Tribes to develop logical and enforceable sampling requirements that take into consideration their unique circumstances. AMS will still require States and Indian Tribes to submit their individual sampling requirements for review as a component of the plan approval process. If a State or Tribal plan lacks a sampling protocol, every lot, and thereby every producer must be sampled and tested. When evaluating sampling protocols submitted by States and Indian Tribes, USDA will evaluate the risk of producing non-compliant material to determine approval or disapproval. In evaluating the risk, USDA will take into consideration whether the performance-based factors the State or Tribe used have the potential to ensure compliance at a 95 percent confidence level. Since USDA cannot develop performance metrics that would be applicable independently from where the producer is located, producers licensed under the USDA plan are subject to the sampling requirements in the rule. USDA guidelines provided on the USDA website at [*https://www.ams.usda.gov/rules-regulations/hemp/information-sampling*](https://www.ams.usda.gov/rules-regulations/hemp/information-sampling) describe best practices for complying with those requirements. However, USDA would consider a performance-based sampling scheme for producers under the USDA plan, and amend the sampling requirements accordingly, if information ***collected*** by USDA in the future is sufficient to make this determination. ***Data*** must be reliable and able to be applicable across the production areas in the U.S Samples must be ***collected*** by a USDA-approved sampling agent, or a Federal, State, Tribal, or local law enforcement agent authorized by USDA to ***collect*** samples. As explained above, USDA is expanding the training requirements for sampling agents and will provide a list of authorized sampling agents on the USDA website. It is the responsibility of the licensed producer to pay any fees associated with sampling and testing. Sampling and testing guideline documents are being updated as part of this proceeding and are available on the USDA website. The sampling procedures are designed to produce a representative sample for testing. They describe procedures for entering a growing area and ***collecting*** the minimum number of plant specimens necessary to accurately represent the THC content, through laboratory testing, of the sample to be tested.C. Testing Laboratories The THC level in representative samples must be at or below the acceptable hemp THC level. Testing must be conducted using post-decarboxylation or other similarly reliable methods where the total THC concentration level measured includes the potential to convert THCA into THC. Further, test results should be determined and reported on a dry weight basis, meaning the percentage of THC, by weight, in a cannabis sample, after excluding moisture from the sample. The moisture content is expressed as the ratio of the amount of moisture in the sample to the amount of dry solid in the sample. Based on AMS's review of scientific studies, internal research and information gathered from the United Nations Office on Drugs and Crime: ``Recommended Methods for the Identification and Analysis of Cannabis and Cannabis Products'' (ISBN 978-92-1-148242-3), AMS has determined that testing methodologies meeting these requirements include gas or liquid chromatography with detection. As discussed earlier and stated in Sec. 990.25(g), if a testing laboratory utilizes alternative testing methods, they must be reviewed and approved by USDA to assess their reliability, accuracy, and compliance with the requirements. As explained earlier in this document, AMS is requiring that all testing of samples for THC concentration levels be conducted in DEA-registered laboratories. Enforcement of this requirement has been delayed until December 31, 2022. Non-DEA-registered labs can continue testing hemp for THC concentration until that time. Labs testing hemp for THC must meet standards of performance described in this regulation. Standards of performance ensure the validity and reliability of test results; that analytical method selection, validation, and verification are appropriate (fit for purpose); and that the laboratory can successfully perform the testing. Furthermore, the standards ensure consistent, accurate, analytical performance and that the analytical tests performed are sufficiently sensitive for the purposes of the detectability requirements under this final rule. Laboratories conducting THC testing must also be registered with DEA to handle controlled substances under the CSA (21 U.S.C 822 and 21 U.S.C 844) and DEA regulations (21 CFR part 1301). USDA is adopting this requirement because of the potential for these laboratories to handle cannabis products testing above 0.3 percent THC. Such products are, by definition, marijuana, and a controlled substance. DEA registration requirements verify a laboratory's ability to properly handle controlled substances. As previously explained in the requirements for State and Tribal plans, AMS is not adopting requirements that hemp testing laboratories be approved under a USDA Laboratory Approval Program or undergo ISO accreditation. It is the responsibility of the licensed producer to select the DEA-registered laboratory that will conduct the testing and to pay any fees associated with testing. Laboratories performing THC testing for hemp produced under this program are required to share test results with the licensed producer and USDA. USDA will provide instructions to all approved labs on how to electronically submit test results to USDA. Laboratories may provide test results to licensed producers in whatever manner best aligns with their business practices, but producers must[[Page 5611]]be able to produce a copy of test results. For this reason, providing test results to producers through a web portal or through electronic mail, so the producer will have ready access to print the results when needed, is preferred. Samples exceeding the acceptable hemp THC level are marijuana and will be handled in accordance with the procedures discussed in section C below. Any licensee may request that the laboratory retest pre-harvest samples, if it is believed the original THC concentration level test results were in error. The licensee requesting the retest of the second sample would pay the cost of the test. The retest results would be issued to the licensee requesting the retest, and a copy would be provided to USDA or its agent.Research Institutions Sampling and Testing AMS also acknowledges that research institutions face special circumstances when conducting hemp research. Under the IFR, researchers and research institutions were required to comply with the same production requirements as commercial producers. Under this final rule, and as described in detail below, research institutions and the producers working with them are afforded greater sampling and testing flexibility to facilitate continued hemp research. Producers that produce hemp for research must obtain a USDA license. However, the hemp that is produced for research is not subject to the same sampling requirements provided that the producer adopts and carries out an alternative sampling method that has the potential to ensure, at a confidence level of 95 percent, that the cannabis plant species Cannabis sativa L. that will be subject to this alternative method will not test above the acceptable hemp THC level. The rule includes a performance-based standard for sampling for all licensed producers in section 990.24: ``at a confidence level of 95 percent that no more than one percent (1%) of the plants in the lot would exceed the acceptable hemp THC level.'' The performance-based standard for research is a modification of that standard: ``the potential to ensure, at a confidence level of 95 percent, that the cannabis plant species Cannabis sativa L. that will be subject to this alternative method will not test above the acceptable hemp THC level.'' We are comfortable with this modification to recognize that researchers may need flexibility to conduct their research and because the research hemp cannot enter the stream of commerce. USDA will monitor researchers' compliance with this standard as part of its normal oversight and compliance program. USDA licensees shall ensure the disposal of all non-compliant plants. USDA licensees shall also comply with the reporting requirements including reporting disposal of non-compliant plants. Research institutions that handle ``hot'' hemp must follow CSA requirements for handling marijuana. Performance based plans from research institutions where a State or Tribal plan is not in place will be reviewed by USDA. Notice and comment requirements under the PRA process will be followed before a final determination is made by USDA to move forward with approving performance-based plans for those producers under the USDA plan. States and Indian Tribes are allowed to develop performance-based requirements for these institutions. However, the alternative method must have the potential to ensure, at a confidence level of 95 percent, that the cannabis plant species Cannabis sativa L. that will be subject to the alternative method will not test above the acceptable hemp THC level. The research institutions must follow reporting requirements. AMS believes this exception is necessary to help support research and development as it relates to hemp production. This decision allows these types of research facilities and institutions to confidently oversee the study of hemp plants through trialing and genetics research. AMS believes this exception to be critical to the growth of industry, particularly in its infancy. Over time, the exception provided by this final rule will help to stabilize the industry by providing greater understanding of hemp genetics and how certain varietals respond differently to growing conditions in various geographic locations. All producers are expected to benefit from such knowledge as they will be made aware of the more stable and consistently reliable hemp varietals. Any non-compliant plants produced by research institutions as a result of research and development will still need to be disposed and verified through documentation. Research institutions must follow licensing and reporting requirements.D. Disposal of Non-Compliant Product Under the IFR, non-compliant product was required to be disposed of by persons authorized to do so under the CSA and had to be destroyed. As explained below, under this final rule, producers may handle non-compliant product disposal on the farm, and they have greater flexibility in remediating that product. USDA producers are required to follow procedures for ensuring effective disposal of cannabis plants produced in violation of this rule. Plants that are removed as a result of poor plant health, pests, disease, weather events, along with removal of male or hermaphrodite plants as part of a cross-pollination prevention plans, are not subject to the disposal requirements herein. This final rule retains the disposal requirements explained in the IFR, but clarifies what ``disposal'' means and explains how the process must be conducted. If a producer grew cannabis exceeding the acceptable hemp THC level, the IFR required that the material be disposed of in accordance with the CSA and DEA regulations because such material is marijuana, a Schedule I controlled substance under the CSA. The IFR required that material be ***collected*** for disposal by a person authorized under the CSA to handle marijuana, such as a DEA-registered reverse distributor, or a duly authorized Federal, State, Tribal, or local law enforcement officer. As explained earlier, AMS is now allowing the flexibility to conduct on-farm disposals and also allowing for remediation options. If the results of a test conclude that the THC levels exceed the acceptable hemp THC level, the laboratory will promptly notify the producer and USDA or its authorized agent. If a licensed producer is notified that they have produced cannabis exceeding the acceptable hemp THC level, the cannabis must be disposed of in accordance with the on-farm disposal options described herein. Licensed producers notified they have produced cannabis plants exceeding the acceptable hemp THC level must arrange for disposal or remediation of the lot represented by the sample in accordance with the procedures as specified above and described on the USDA website at [*https://www.ams.usda.gov/rules-regulations/hemp/disposal-activities*](https://www.ams.usda.gov/rules-regulations/hemp/disposal-activities). Producers must document the disposal or remediation of all non-compliant cannabis. This can be accomplished by providing USDA with a copy of the documentation of disposal or remediation using the reporting requirements established by USDA. These reports must be submitted to USDA following the completion of the disposal or remediation process.E. Compliance As described below, this final rule changes the THC threshold for a negligent violation from 0.5 percent[[Page 5612]]under the IFR to 1.0 percent. Further, rather than being liable for multiple negligent violations in each growing season as under the IFR, this final rule provides that producers can only incur one negligent violation in each growing season, which prevents producers from accumulating multiple negligent violations and losing program eligibility after a single growing season. USDA will maintain oversight of USDA-licensed hemp producers by conducting audits of USDA licensees and working with licensees with negligent violations to establish corrective action plans. Negligent violations by a producer may lead to suspension or revocation of a producer's license. While USDA has not yet conducted any random audits, the department may conduct random audits of licensees to verify hemp is being produced in accordance with Subtitle G of the AMA no more frequently than every three years, based on available resources. The format of the audit will vary and may include a ``desk-audit'' where USDA requests records from a licensee, or the audit may be a physical visit to a licensee's facility. When USDA visits a licensee's facility, the licensee must provide access to any fields, greenhouses, storage facilities, or other locations where the licensee produces hemp. USDA may also request records from the licensee, to include production and planting ***data***, testing results, and other information as determined by USDA. USDA will issue a summary of the audit to the licensee after the completed audit. Licensees who are found to have a negligent violation will be subject to a corrective action plan. Negligent violations include: (1) Failure to provide a legal description of the land on which the hemp is produced; (2) not obtaining a license before engaging in production; or (3) producing plants exceeding the acceptable hemp THC level. Similar to the requirements for State and Tribal plans, USDA will not consider hemp producers as committing a negligent violation if they produce plants exceeding the acceptable hemp THC level if they use reasonable efforts to grow hemp and the cannabis plant does not have a THC concentration of more than 1.0 percent on a dry weight basis. AMS believes that increasing the negligence threshold from 0.5 percent to 1.0 percent will increase flexibility to farmers as they learn more about how to grow compliant hemp and as the availability of stable hemp genetics improves. Further, producers may only receive one negligent violation per growing season, as determined by USDA based on a review of producer records. USDA will use a calendar year as a growing season. When USDA determines that a negligent violation has occurred, USDA will issue a Notice of Violation. This Notice of Violation will include a corrective action plan. The corrective action plan will include a reasonable date by which the producer will correct the negligent violation or violations and will require the producer to periodically report to USDA on its compliance with the plan for a period of not less than the next two calendar years. A producer who has negligently violated the provisions of this rule three times in a five-year period is ineligible to produce hemp for a period of five years from the date of the third violation. Negligent violations are not subject to criminal enforcement. Hemp found to be produced in violation of this regulation, such as hemp produced on a property not disclosed by the licensed producer or without a license, would be subject to the same disposal provisions as for cannabis testing above the acceptable hemp THC level. Further, if it is determined a violation was committed with a culpable mental state greater than negligence, USDA will report the violation to law enforcement. The 2018 Farm Bill limited the participation of certain convicted felons in hemp production. A person with a State or Federal felony conviction relating to a controlled substance is subject to a 10-year ineligibility restriction on producing hemp under the Act. An exception applies to a person who was lawfully growing hemp under the 2014 Farm Bill before December 20, 2018, and whose conviction also occurred before that date.F. Suspension of a USDA License There are no changes to the IFR provisions related to suspension of USDA licenses in this final rule. A USDA license may be suspended if USDA receives credible information that a USDA licensee has either: (1) Engaged in conduct violating a provision of this regulation; or (2) failed to comply with a written order from the AMS Administrator related to a negligent violation of this regulation. Examples of credible information are information from local authorities of harvested plants without testing or planting of hemp in non-licensed locations. Any person whose license has been suspended shall not produce hemp during the period of suspension. A suspended license may be restored after a waiting period of one year. A producer whose license has been suspended may be required to comply with a corrective action plan to fully restore their license. A USDA license shall be immediately revoked if the USDA licensee: (1) Pleads guilty to, or is convicted of, any felony related to a controlled substance; \9\ (2) made any materially false statement with regard to this regulation to USDA or its representatives with a culpable mental state greater than negligence; or (3) was found to be growing cannabis exceeding the acceptable hemp THC level with a culpable mental state greater than negligence or negligently violated the provisions of this regulation three times in five years.--------------------------------------------------------------------------- \9\ For a corporation, if a key participant has a disqualifying felony conviction, the corporation may remove that person from a key participant position. Failure to remove that person will result in a license revocation.--------------------------------------------------------------------------- If the licensed producer wants to appeal any suspension or revocation decision made by USDA as described in this section, they can do so using the appeal process explained in section V of this document.G. Reporting and Recordkeeping The 2018 Farm Bill requires USDA to develop a process to maintain relevant information regarding the land where hemp is produced. Reporting requirements under this final rule, particularly the requirement to report hemp crop acreage to FSA, are discussed extensively in Section B of the State and Tribal plan requirements and the same requirements are applicable to USDA licensed producers. In general, changes from the IFR allow producers more flexibility in defining for FSA the areas (instead of ``lots'') they use for hemp production. USDA hemp production licensees can apply for licenses on a rolling basis under this final rule, in contrast to the limited period provided under the IFR. Reporting requirements under this final rule are revised slightly to allow producers to account for on-farm disposal of non-compliant product. USDA's FSA is well suited to ***collect*** this information for the domestic hemp production program. FSA has staff throughout the United States who are trained to work with farmers to verify land uses. Many hemp producers are likely to be familiar with the FSA since they already operate traditional farms, and therefore already provide ***data*** to FSA on acres and crops planted. Producers may benefit from information to participate in other USDA programs through FSA offices. Licensed producers will be required to report their hemp crop acreage with FSA, and to provide FSA with specific[[Page 5613]]information regarding field acreage, greenhouse, or indoor square footage of hemp planted. This information must include street address, geospatial location or other comparable identification method specifying where the hemp will be produced, and the legal description of the land. Geospatial location or other methods of identifying the production locations are necessary, as not all rural locations have specific addresses. This information is required for each field, greenhouse, building, or site where hemp will be grown. USDA will use this information to assemble and maintain the ***data*** USDA must make available in real time to Federal, State, Tribal and local law enforcement as required by the 2018 Farm Bill and as described in section G below. Specific procedures for reporting hemp acreage to FSA will be posted on the USDA Domestic Hemp Production Program website. All information will be maintained by USDA for at least three calendar years. FSA will assist producers in identifying the hemp growing locations since they have maps that allow for better identification. This is a procedure that FSA employees are very familiar with since it is used for other USDA programs. This rule also revises the definition of ``lot'' to include other terms used by FSA with the same meaning. FSA uses terms like ``farm,'' ``tract,'' ``field,'' and ``subfield.'' FSA staff will not provide a ``lot number'' to producers as described in the IFR. Instead, FSA will assist producers to identify the area where hemp is grown. More details are provided under the States and Tribal plan Section B earlier in this final rule. Licensed producers are required to maintain copies of all records and reports necessary to demonstrate compliance with the program. These records include those that support, document, or verify the information provided in the forms submitted to USDA. Records and reports must be kept for a minimum of three years. Because the final rule allows producers to remediate plants, the final rule also requires producers to maintain records on all remediated cannabis plants. Under the USDA plan, there will be additional reporting requirements for licensed producers. These include information requested in the application for a license and the record and reporting requirements needed to document disposal or remediation of cannabis produced in violation of the provisions of this rule. Specific reporting requirements are detailed in Sec. 990.71 H. Information Sharing With Law Enforcement USDA is working to develop and maintain a database of all relevant and required information regarding hemp as specified by the 2018 Farm Bill. This database will be accessible in real time to Federal, State, local, and Tribal law enforcement officers through a Federal government law enforcement system. USDA AMS will administer and populate this database, which will include information submitted by States, Tribes, laboratories, and USDA licensed producers and information submitted to FSA. States and Tribes must provide information to USDA in a format that is compatible with USDA's information sharing system. USDA will work with States and Indian Tribes on system format and other information necessary to share information. USDA will use this information to create a comprehensive list of all domestic hemp producers. USDA will also gather the information related to the land used to produce domestic hemp. This information will be comprehensive and include ***data*** from both State and Tribal plans and will include a legal description of the land on which hemp is grown by each hemp producer and the corresponding geospatial location or other identifiable location. Finally, USDA will also gather information regarding the status of all licenses issued under State and Tribal government plans and under the USDA plan. This information will be made available in real time to Federal, State, local and Tribal law enforcement as required by the 2018 Farm Bill.IV. Definitions The following terms are integral to implementing Subtitle G of the AMA and establish the scope and applicability of the regulations of this final rule. The term ``Act'' refers to the ***Agricultural*** Marketing Act of 1946. The 2018 Farm Bill amended the ***Agricultural*** Marketing Act of 1946 by adding Subtitle G, which is a new authority for the Secretary of ***Agriculture*** to administer a national hemp production program. Section 297D of Subtitle G authorizes and directs USDA to promulgate regulations to implement this program. The ``***Agricultural*** Marketing Service'' or ``AMS'' is the ***Agricultural*** Marketing Service of the U.S Department of ***Agriculture*** is the agency the Secretary of ***Agriculture*** has been charged with the responsibility to oversee the administration of this new program. The term ``applicant'' means any State or Indian Tribe that has applied for USDA approval of a State or Tribal hemp production plan for the State or Indian Tribe they represent. This term also applies to any person or business in a State or territory of an Indian Tribe not subject to a State or Tribal plan, who applies for a hemp production license under the USDA plan established under this part. The term ``cannabis'' is the Latin name of the plant that, depending on its THC concentration level, is further defined as either ``hemp'' or ``marijuana.'' Cannabis is a genus of flowering plants in the family Cannabaceae, of which Cannabis sativa is a species, and Cannabis indica and Cannabis ruderalis are subspecies thereof. For the purposes of this part, cannabis refers to any form of the plant where the delta-9 tetrahydrocannabinol concentration on a dry weight basis has not yet been determined. This term is important in describing regulations that apply to plant production, sampling, or handling prior to determining its THC content. The ``Controlled Substances Act'' is the statute, codified in 21 U.S.C 801-971, establishing Federal U.S drug policy under which the manufacture, importation, exportation, possession, use, and distribution of certain substances are regulated. Because cannabis with THC content concentration levels of higher than 0.3 percent is deemed to be marijuana, a Schedule I controlled substance, its regulation falls under the CSA. Therefore, for compliance purposes, the requirements of the CSA are relied upon for the disposal of cannabis that contains THC concentrations above the stated limit of this final rule. The rule includes a definition of ``conviction'' to explain what is considered a conviction and what is not. Specifically, a plea of guilty or nolo contendere or any finding of guilt is a conviction. However, if the finding of guilt is subsequently overturned on appeal, pardoned, or expunged, then it is not considered a conviction for purposes of part 990. This definition of ``conviction'' is consistent with how some other agencies conducting criminal history record searches determine disqualifying crimes. A ``corrective action plan'' is a plan agreed to by a State, Tribal government, or USDA for a licensed hemp producer, to correct a negligent violation or non-compliance with a hemp production plan, its terms, the applicable law(s) or this regulation. Corrective action plans may also be a plan set forth by a State or Tribal government with an approved[[Page 5614]]hemp production plan to correct a non-compliance of their program with their USDA-approved plan. This term is defined in accordance with the 2018 Farm Bill, which mandates certain non-compliant actions to be addressed through corrective action plans. ``Culpable mental state greater than negligence'' is a term used in the 2018 Farm Bill to determine when certain actions would be subject to specific consequences. This term means to act intentionally, knowingly, willfully, recklessly, or with criminal negligence. The term ``decarboxylated'' refers to the completion of the chemical reaction that converts THCA into delta-9 THC, the intoxicating component of cannabis. The decarboxylated value is also calculated using a molecular mass conversion ratio that sums delta-9 THC and eighty-seven and seven tenths (87.7) percent of THC-acid ((delta-9 THC) + (0.877\*THCA)). ``Delta-9 tetrahydrocannabinol,'' also referred to as ``Delta-9 THC'' or ``THC'' is the primary psychoactive component of cannabis, and its regulation forms the basis for the regulatory action of this part. As mandated by the Act, legal hemp production must be verified as having THC concentration levels of 0.3 percent on a dry weight basis or below. For the purposes of this part, delta-9 THC and THC are interchangeable. The term ``disposal'' means the action or process of getting rid of cannabis that is non-compliant. ``DEA'' is an acronym for the ``Drug Enforcement Administration,'' a United States Federal law enforcement agency under the United States Department of Justice. The DEA is the lead agency for domestic enforcement of the Controlled Substances Act. The DEA plays an important role in the oversight of the disposal of marijuana, a Schedule I controlled substance, under the regulations of this part. The DEA is also instrumental in registering laboratories to legally handle controlled substances, including cannabis samples that test above the 0.3 THC concentration level. ``Dry weight basis'' refers to a method of determining the percentage of a chemical in a substance after removing the moisture from the substance. Percentage of THC on a dry weight basis means the percentage of THC, by weight, in a cannabis item (plant, extract, or other derivative), after excluding moisture from the item. The ``Farm Service Agency (FSA)'' is an agency of the U.S Department of ***Agriculture*** that provides services to farm operations including loans, commodity price supports, conservation payments, and disaster assistance. For the purposes of this program, FSA will assist in information ***collection*** of land being used for hemp production. ``Gas chromatography'' or GC, is a scientific method (specifically, a type of chromatography technique) used in analytical chemistry to separate, detect, and quantify each component in a mixture. It relies on the use of heat for separating and analyzing compounds that can be vaporized without decomposition. Under the terms of this part, GC is one of the valid methods by which laboratories may test for THC concentration levels. For the purposes of this part, the term ``geospatial location'' means a location designated through a global system of navigational satellites used to determine the precise ground position of a place or object. The term ``handle'' is commonly understood by AMS and used across many of its administered programs. For the purposes of this part, ``handle'' refers to the actions of cultivating or storing hemp plants or hemp plant parts prior to the delivery of such plant or plant part for further processing. In cases where cannabis plants exceed the acceptable hemp THC level, handle may also refer to the disposal of those plants. ``Hemp'' is defined by the 2018 Farm Bill as ``the plant species Cannabis sativa L. and any part of that plant, including the seeds thereof and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis.'' The statutory definition is self-explanatory, and USDA is adopting the same definition without change for part 990. ``Liquid chromatography (LC)'' is a scientific method (specifically, a type of chromatography) used in analytical chemistry used to separate, identify, and quantify each component in a mixture. It relies on pumps to pass a pressurized liquid solvent containing the sample mixture through a column filled with a solid adsorbent material to separate and analyze compounds. Under the terms of this part, LC is one of the valid methods by which laboratories may test for THC concentration levels. Ultra-Performance Liquid Chromatography (UPLC) is an additional method that may also be used as well as other liquid or gas chromatography with detection. ``Indian Tribe or Tribe'' is defined in the 2018 Farm Bill by reference to section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C 5304). The statutory definition is self-explanatory, and USDA is adopting the same definition without change for part 990. A ``key participant'' is a person or persons who have a direct or indirect financial interest in the entity producing hemp, such as an owner or partner in a partnership. A key participant also includes persons in a corporate entity, including tribally-owned corporation individuals, at executive levels, including chief executive officer, chief operating officer, and chief financial officer. This does not include such management personnel as farm, field, or shift managers. This definition also does not include a member of the leadership of a Tribal government who is acting in their capacity as a Tribal leader except when that member exercises executive managerial control over hemp production. ``Law enforcement agency'' refers to all Federal, State, Tribal, or local law enforcement agencies. Under the 2018 Farm Bill, State and Tribal submissions of proposed hemp production plans to USDA must be made in consultation with their respective Governors and chief law enforcement officers. Moreover, the 2018 Farm Bill contemplates the involvement of law enforcement in compliance actions related to offenses identified as being made under a ``culpable mental state greater than negligence.'' To assist law enforcement in the fulfillment of these duties, the 2018 Farm Bill also mandates information sharing that provides law enforcement with real-time ***data***. The term ``lot'' refers to a contiguous area in a field, greenhouse, or indoor growing structure containing the same variety or strain of cannabis throughout. In addition, ``lot'' is a common term in ***agriculture*** that refers to the batch or contiguous, homogeneous whole of a product being sold to a single buyer at a single time. Under the terms of this part, ``lot'' is to be defined by the producer in terms of farm location, field acreage, and variety (i.e , cultivar) and to be reported as such to FSA. For FSA reporting purposes, FSA staff will determine the appropriate designation for the specific location(s) where hemp is being grown using FSA terminology such as ``farm,'' ``tract,'' ``field,'' and ``subfield'' to mean ``lot'' for the purpose of this rule. ``Marijuana,'' or, as defined in the CSA, ``marihuana,'' means all parts of the plant Cannabis sativa L., whether growing or not; the seeds thereof; the resin extracted from any part of such plant; and every compound, manufacture, salt, derivative, mixture, or preparation of such plant, its seeds, or resin. The term ''marihuana'' does not include hemp, as defined in section 297A of the ***Agricultural*** Marketing Act[[Page 5615]]of 1946, and does not include the mature stalks of such plant; fiber produced from such stalks; oil or cake made from the seeds of such plant; any other compound, manufacture, salt, derivative, mixture, or preparation of such mature stalks (except the resin extracted therefrom), fiber, oil, or cake; or the sterilized seed of such plant which is incapable of germination (7 U.S.C 1639o(1)). ``Marihuana'' also means all cannabis that tests as having a THC concentration level on a dry weight basis of higher than 0.3 percent. ``Negligence'' is a term used in the 2018 Farm Bill to describe when certain actions are subject to specific compliance actions. For the purposes of this rule, the term means failure to exercise the level of care that a reasonably prudent person would exercise in complying with the regulations set forth under this final rule. Used in relation to the other terms and regulations in this part, ``phytocannabinoids'' are cannabinoid chemical compounds found in the cannabis plant, two of which are Delta-9 tetrahydrocannabinol (delta-9 THC) and cannabidiol (CBD). Testing methodologies under this part will refer to the presence of ``phytocannabinoids'' as either THC or CBD. Under the terms of this program, ``plan'' refers to a set of criteria or regulations under which a State or Tribal government, or USDA, monitors and regulates the production of hemp. ``Plan'' may refer to a State or Tribal plan, whether approved by USDA or not, or the USDA hemp production plan. The 2018 Farm Bill mandates that all cannabis be tested for THC concentration levels using ``post-decarboxylation'' or similar methods. In the context of this part, ``post-decarboxylation'' means testing methodologies for THC concentration levels in hemp, where the total potential delta-9-tetrahydrocannabinol content, derived from the sum of the THC and THCA content, is determined and reported on a dry weight basis. The post-decarboxylation value of THC can be calculated by using a chromatograph technique using heat, known as gas chromatography, through which THCA is converted from its acid form to its neutral form, THC. The result of this test calculates total potential THC. The post-decarboxylation value of THC, or total THC, can also be calculated by using a liquid chromatograph technique, which keeps the THCA intact, and requires a conversion calculation of that THCA to calculate total potential THC. See also the definitions for decarboxylation and total THC. The term ``produce,'' when used as a verb, is a common ***agricultural*** term that is often used synonymously with ``grow,'' and means to propagate plants for market, or for cultivation for market, in the United States. In the context of this part, ``produce'' refers to the propagation of cannabis to produce hemp. ``Producer'' means a producer as defined in 7 CFR 718.2 specifically of hemp. The 2018 Farm Bill mandates that USDA maintain a real-time informational database that identifies registered hemp production sites, whether under a State, Tribal, or USDA plan, for the purposes of compliance and tracking with law enforcement. AMS will maintain this system with the information ***collection*** assistance of FSA. In order to maintain consistency and uniformity of hemp production locations, USDA is using FSA to ***collect*** this information through their crop acreage reporting system. In this context, a common use of the term ``producer'' is essential to maintaining a substantive database. For this reason, the definition of ``producer'' incorporates the FSA definition of ``producer'' with the additional qualifier that they are a producer specifically of hemp. All producers are required to be licensed or authorized to produce hemp under the USDA Domestic Hemp Production Program. ``Remediation'' refers to techniques utilized to transform non-compliant cannabis into something useful and compliant while disposing of non-compliant parts. Remediation can occur by removing and destroying flower material, while retaining stalk, stems, leaf material, and seeds. Remediation can also occur by shredding the entire plant into a bio-mass like material, then re-testing the shredded biomass material for compliance. ``Secretary'' means the Secretary of ***Agriculture*** of the United States Department of ***Agriculture***. Section 297A of the Act defines ``State'' as any of one of the fifty States of the United States of America, the District of Columbia, the Commonwealth of Puerto Rico, and any other territory or possession of the United States. The statutory definition is self-explanatory, and USDA is adopting the same definition without change for part 990. The term ``State department of ***agriculture***'' is defined by the 2018 Farm Bill as the agency, commission, or department of a State government responsible for ***agriculture*** in the State. The statutory definition is self-explanatory, and USDA is adopting the same definition without change for part 990. The term ``store'' is related to the term ``handle'' under this part and means to deposit hemp plants or hemp plant product in a storehouse, warehouse, or other identified location by a producer for safekeeping prior to delivery to a recipient for further processing. The term ``Territory of the Indian Tribe'' means (a) all land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, including rights-of-way running through the reservation, (b) all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a State; (c) all Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same; and (d) any lands title to which is either held in trust by the United States for the benefit of any Indian Tribe or individual or held by any Indian Tribe or individual subject to restriction by the United States against alienation and over which an Indian Tribe exercises jurisdiction. The IFR defined the Territory of the Indian Tribe as ``Indian Country'' in 18 U.S.C 1151 because section 1151 is a commonly acceptable approach to determine a Tribal government's jurisdiction. The final rule retains the language of section 1151, but adds item (d) to the definition of ``Territory of the Indian Tribe.'' This addition does not significantly expand the definition because many of the lands encompassed by item (d) were already considered as ``Territory of the Indian Tribe'' under the IFR. For example, off-reservation trust land, if not considered part of a reservation under section 1151(a), is generally considered within a dependent Indian community under section 1151(b). See Club One Casino, Inc. v. Bernhardt, 959 F.3d 1142, 1149-50 (9th Cir. 2020); Felix Cohen, Cohen's Handbook of Federal Indian Law, section 3.04 (Nell Jessup Newton ed. 2012). Also, restricted fee lands outside of a reservation are often considered part of a dependent Indian community, provided the lands satisfy the two requirements of a dependent Indian community--lands that are (1) set aside by the Federal Government for the use of the Indians and (2) under federal superintendence. Citizens Against Casino Gambling in Erie Cty. v. Chaudhuri, 802 F.3d 267, 281 (2d Cir. 2015).[[Page 5616]] However, because ``dependent Indian communities'' is an oft-litigated term that is interpreted varyingly amongst the courts, USDA decided to add item (d) to the definition of ``Territory of the Indian Tribe'' to add clarity and ensure nationwide consistency regarding the jurisdictional boundaries of regulatory authority over the production of hemp. ``Total THC'' is the post-decarboxylation value of THC, either after testing with gas chromatography or LC after using a conversion factor. LC does not use decarboxylation as part of the process and this addition is to account for the conversion of THCA into THC if decarboxylation was part of the process. The addition of 87.7 percent of THCA is applicable if the testing laboratory uses LC with detection to measure the THC. Total THC is the measured THC plus 87.7 percent of THCA. As defined by the 2018 Farm Bill, the term ``Tribal government'' means the governing body of an Indian Tribe. The statutory definition is self-explanatory, and USDA is adopting the same definition without change for part 990. The ``U.S Attorney General'' is the Attorney General of the United States. ``USDA'' is an acronym that stands for the ``United States Department of ***Agriculture***.''V. Appeals The following paragraphs explain when and how to appeal a USDA decision. State or Tribal plans may include similar appeal procedures. No changes were made to this section based on comments. An applicant for a USDA hemp production program license may appeal a license denial to the AMS Administrator. USDA licensees can appeal denials of license renewals, license suspensions, or license revocations to the AMS Administrator. All appeals must be submitted in writing and received within 30 days of the denial. Appeals may be submitted by mail or electronic form. This submission deadline should provide adequate time to prepare the necessary information required for the appeal. The Administrator will take into account the applicant or USDA licensee's justification for why the license should not be denied, suspended, or revoked, and then issue a final determination. Determinations made by the Administrator under the appeals process will be final unless the applicant or USDA licensee requests a formal adjudicatory proceeding to review the decision, which will be conducted pursuant to the U.S Department of ***Agriculture***'s Rules of Practice Governing Formal Adjudicatory Proceedings, 7 CFR part 1, subpart H, which USDA will amend to add the Domestic Hemp Production Program. If the applicant or USDA licensee does not request that the Administrator initiate a formal adjudicatory proceeding within 30 days of the Administrator's adverse ruling, such ruling becomes final.Appeals Under a State or Tribal Hemp Production Plan A State or Tribe can appeal the denial of a proposed hemp production plan, or the proposed suspension or revocation of a plan by USDA. USDA will consult with States and Tribes to help ensure their draft plans meet statutory requirements, and that existing plan requirements are monitored and enforced by States and Indian Tribes. If, however, a proposed State or Tribal plan is not approved, or an existing plan is suspended or revoked the decision may be appealed. If the AMS Administrator grants a State or Indian Tribe's appeal of a disapproval of its hemp plan, the proposed State or Tribal hemp production plan shall be approved as proposed. If the AMS Administrator denies an appeal, prospective producers located in the State or Tribal Territory can apply directly to USDA for a hemp license. Similarly, if an appeal of a denied proposed State or Tribal plan is denied, producers located in the impacted State or Tribal territory may apply for licenses under the USDA plan. A State or Tribe appealing the suspension or revocation of their hemp production plan must explain the reasoning for the appeal and the appeal must be filed within the time-period provided in the letter of notification or within 30 business days from receipt of the notification, whichever occurs later. This timeframe should be adequate for the assembly of the information required to be submitted as part of the appeal.VI. Interstate Commerce Nothing in this rule prohibits the interstate commerce of hemp. No State or Indian Tribe may prohibit the transportation or shipment of hemp produced in accordance with this part and with section 7606 of the 2014 Farm Bill (expires January 1, 2022) through the State or the territory of the Indian Tribe, as applicable.\10\--------------------------------------------------------------------------- \10\ See section 10114 of the 2018 Farm Bill and the USDA General Counsel's Legal Opinion on the Authorities for Hemp Production at [*https://www.ams.usda.gov/content/legal-opinion-authorities-hemp-production.---------------------------------------------------------------------------VII*](https://www.ams.usda.gov/content/legal-opinion-authorities-hemp-production.---------------------------------------------------------------------------VII). Outreach As part of this rulemaking process, AMS held numerous meetings with State and Tribal governments and their representatives, industry organizations, groups and individuals with experience in the hemp industry, and representatives of law enforcement, as well as other Federal agencies. In addition, USDA also conducted a listening session on March 13, 2019, that had more than 2,100 participants, and included comments from 46 separate speakers representing States, Tribes, producers, end-users, hemp organizations, and others. The recording of the listening session is available on the USDA website at [*https://www.ams.usda.gov/rules-regulations/hemp*](https://www.ams.usda.gov/rules-regulations/hemp). On May 1 and 2, 2019, USDA also participated in Tribal consultation meetings for a total of 52 and 38 participants, respectively. On September 24, 2020, AMS conducted another Tribal Consultation with approximately 90 participants. AMS published an interim final rule on October 31, 2019 (84 FR 58522), that established a temporary hemp production program and invited public comments on the program's provisions. The initial 60-day comment period was extended by 30 days on December 18, 2019 (84 FR 69295). The comment period was reopened for another 30 days on September 8, 2020 (85 FR 55363). A total of approximately 5,900 comments were submitted by States, Tribes, farmers, industry associations, and other interested groups and individuals during the combined comment periods expressing their views on the provisions of the IFR and suggesting modifications, many of which have been incorporated into this final rule. Finally, in November 2019, AMS posted an informational webinar about the domestic hemp production program on its website (in English and Spanish) at [*https://www.ams.usda.gov/rules-regulations/hemp*](https://www.ams.usda.gov/rules-regulations/hemp). AMS has also posted additional useful information for regulated entities and other interested persons on its website at [*https://www.ams.usda.gov/rules-regulations/hemp*](https://www.ams.usda.gov/rules-regulations/hemp). As required by the Farm Bill, the Secretary developed this final rule and related guidelines in consultation with the U.S Attorney General. In addition, USDA has submitted information to, and consulted with, the Committee on ***Agriculture*** of the House of Representatives and the Committee on ***Agriculture***, Nutrition, and Forestry of the Senate regarding updates on the[[Page 5617]]implementation of the hemp requirements in the Farm Bill.VIII. Severability This final rule includes a severability provision. This provision helps address the status of the regulations should a court vacate a particular provision. This section provides that if any provision of part 990 is found to be invalid, the remainder of the part shall not be affected.IX. Comment Analysis AMS accepted comments during an initial comment period from October 31, 2019 through December 31, 2019. On December 18, 2019 (84 FR 69295), this initial comment period was extended for an additional 30 days, ending January 29, 2020. AMS reopened the comment period for 30 additional days on September 8, 2020 (85 FR 55363), ending October 8, 2020. Comments may be accessed through Regulations.gov.\11\ Reopening the comment period gave interested persons an additional opportunity to comment on the IFR. Comments were solicited from all stakeholders, notably those who were subject to the regulatory requirements of the IFR during the 2020 production cycle.--------------------------------------------------------------------------- \11\ [*https://www.regulations.gov/searchResults?rpp=25&po=0&s=AMS-SC-19-0042&fp=true&ns=true..---------------------------------------------------------------------------*](https://www.regulations.gov/searchResults?rpp=25&po=0&s=AMS-SC-19-0042&fp=true&ns=true..---------------------------------------------------------------------------) AMS specifically requested comments on the 15-day sampling and harvest timeline; the possibility of establishing a fee-for-service hemp laboratory approval process for labs that wish to offer THC testing services; the possibility of requiring all laboratories testing hemp to have ISO 17025 accreditation; the number of labs already ISO 17025 accredited; additional examples of reasonable efforts to illustrate actions hemp producers can take in order to avoid committing a negligent violation under the program; the sufficiency of the hemp license application period; whether the information ***collection*** for the program is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility; the accuracy of the agency's estimate of the burden of the proposed ***collection*** of information, including the validity of the methodology and assumptions used; the ways to enhance the quality, utility, and clarity of the information to be ***collected***; the ways to minimize the burden of the ***collection*** of information on those who are to respond, including the use of appropriate automated, electronic, mechanical, or other technological ***collection*** techniques or other forms of information technology; whether there is information or ***data*** that may inform whether or not the market will experience a significant shift, either positive or negative, in the developing hemp market and on consumers; any ***data*** or information on what impacts the regulation may have on current and future innovation in the areas of industrial hemp usages and how much such impacts on innovation may affect rural communities; the potential for innovation and the uncertainty and its impact on the hemp market vis a vis steady State; and additional reliable ***data*** sources on the annual receipts of industrial hemp producers. AMS received approximately 5,900 comments. Comments represented the views of States, Indian Tribes, hemp farmers and processors, universities, laboratories, trade associations, carriers, non-profit associations, other Federal government agencies, consumers, and other interested individuals. A summary of the comments and AMS's analysis and response follows.Extention of Comment Period Several commenters urged AMS to extend the public comment period to allow for small businesses to meaningfully participate in this rulemaking process. One reason given was that the comment period fell in the middle of the harvest season for much of the mid-Atlantic and southern hemp growers, excluding those who grow indoors, and therefore were too busy to comment. Other reasons given were the ongoing global pandemic as well as many other ongoing natural disasters nation-wide that have presented additional strains and unique challenges to ***agricultural*** operations. AMS Response: AMS provided an initial 60-day comment period and a 30-day extension and then reopened the comment period for 30 additional days in order to receive feedback from stakeholders thus giving ample time to interested parties to submit comments. In order to finalize the Domestic Hemp Promotion Program before the 2021 production cycle begins, AMS decided not to extend the comment period and to finalize this rule.Extension of 2014 Pilot Program Under the 2014 Farm Bill, State departments of ***agriculture*** and institutions of higher education were permitted to produce hemp as part of a pilot program for research purposes. Congress extended this authority under the 2021 Continuing Appropriations Act until January 1, 2022. After January 1, 2022, domestic hemp production must comply with Subtitle G of the AMA and this final rule. Comments: Numerous comments praised the hemp production regulatory schemes established by States and Universities under the 2014 Farm Bill authority. Many comments reflected on the perceived increase in regulatory burden under the IFR, as opposed to the regulatory scheme that has been applied to domestic hemp production until now. Many comments, while making recommendations with regards to specific aspects of the IFR provisions, also encouraged USDA to continue to regulate domestic hemp production under the 2014 Farm Bill until satisfactory resolution of industry concerns can be achieved. Further, several comments stated that the extension of the pilot programs under the 2014 Farm Bill for another two to three years would give the industry time to adjust to the new requirements and to develop hemp genetics to more easily comply with the regulations. A few comments opposed extension of the 2014 Farm Bill pilot program, asserting that States now operating under the more restrictive 2018 Farm Bill provisions are placed at a disadvantage. AMS response: The extension of the 2014 Farm Bill authority is not within the authority of USDA. Congress only extended this authority under the 2021 Continuing Appropriations Act (Pub. L. 116-260), until January 1, 2022.THC Limit The IFR adopts the 2018 Farm Bill definition of hemp as the plant species Cannabis sativa L. and any part of that plant with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis. Further, the IFR requires that THC levels in representative samples test at or below the acceptable hemp THC level. Testing must be conducted using post-decarboxylation or other similarly reliable methods, where the total THC concentration level measured includes the potential to convert THCA into THC. Finally, the IFR provides that hemp testing higher than the acceptable hemp THC level is considered a controlled substance and requires disposal. Comments: Some comments supported the 2018 Farm Bill's hemp THC level of 0.3 percent, and some explained that States had successfully incorporated that limit into programs authorized under the 2014 Farm Bill. Some comments thanked USDA for clearly defining the delta-9 THC standard in the IFR, which commenters[[Page 5618]]said would foster uniformity across hemp production in all States. However, a greater number of comments from various stakeholder groups, including producers, States, Indian Tribes, and hemp organizations, asserted that the 0.3 percent threshold is too low and impractical in a program intended for multiple end uses of hemp. Comments argued that individuals interested in obtaining cannabis for intoxication purposes are unlikely to be interested in material containing 1.0 percent THC--or perhaps higher, and that setting the threshold at even 1.0 percent THC would give farmers, breeders, and researchers a lot more flexibility and confidence in producing compliant crops. One commenter reported that their State recognizes hemp with THC concentrations of up to 0.39 percent, with most crops testing between 0.31 and 0.39 percent THC, and no end products testing higher than 0.3 percent THC. The comment suggested USDA should raise the THC limit to at least 0.39, if not up to 0.5 percent. Other comments recommended revising the threshold to a higher level, asserting that there is no scientific evidence that supports use of the 0.3 percent level. Some comments recommended increasing the threshold to 0.8 or 1.0 percent, while some suggested 2.0 percent and others as much as 5.0 percent. Comments explained that a THC concentration of 5 percent is not viable for recreational marijuana markets and that USDA should consider the end-use potential when determining a threshold. One comment recommending a THC threshold of at least 2.0 percent included a news story reporting that marijuana plants confiscated by law enforcement routinely have THC concentrations of 12 percent or higher.\12\--------------------------------------------------------------------------- \12\ McCullough, Jolie. ``Marijuana Prosecutions in Texas Have Dropped by More than Half Since Lawmakers Legalized Hemp.'' The Texas Tribune, 3 January 2020; [*www.texastribune.org/2020/01/03/texas-marijuana-prosecution-drop-testinghemp/.---------------------------------------------------------------------------*](http://www.texastribune.org/2020/01/03/texas-marijuana-prosecution-drop-testinghemp/.---------------------------------------------------------------------------) Several comments suggested that the IFR's level of 0.3 percent delta-9 THC on a dry-weight basis is ``more aspirational than practical.'' Comments explained that THC levels vary with plant maturity and other factors. Comments urged USDA to build greater flexibility into the rule so producers don't unwittingly become illegal marijuana farmers as a result of factors beyond their control. One comment suggested USDA establish a wider gap between the THC levels that define controlled substances and ***agricultural*** commodities such as hemp to create an environment where hemp producers are presumed innocent until proven guilty of intentionally producing a controlled substance. Several comments recommended that university and other research programs be given more leeway as they work toward developing more compliant, regionally appropriate varieties through breeding. Some comments noted that hemp containing more than 0.3 percent THC is not eligible for crop loss or replant payments under USDA Risk Management Agency regulations. Comments said further that if USDA is not certifying seed because of the regional effects of growing conditions on genetics, farmers are at risk and should be able to obtain comprehensive insurance coverage for crops with negligible overage above the acceptable THC level. Comments explained that while the genetics of most U.S crops have been developed over many years, hemp has not enjoyed that history, and it will take time to develop compliant but commercially viable crops with marketable CBD content for different regions. Comments asserted farmers will have fewer planting options because of the lack of a national hemp seed certification protocol and limited agronomic research on hemp varietals and production practices. Comments inferred that the 0.3 percent THC threshold would effectively demand that farmers plant a nationwide monoculture with little genetic diversity, which they said would leave U.S hemp crops vulnerable to pests and diseases. Many comments questioned the selection by Congress of the 0.3 percent THC threshold to legally distinguish hemp from marijuana.\13\ Comments frequently referenced a 1976 publication, A Practical and Natural Taxonomy for Cannabis, in which horticulturalists Dr. Ernest Small and Arthur Cronquist used 0.3 percent THC as a threshold to distinguish hemp from marijuana in their scientific study on cannabis.\14\ Comments highlighted statements made by Small and Cronquist, saying the researchers openly acknowledged that they ``arbitrarily adopt a concentration of 0.3 percent delta-9 THC (dry weight basis) in young, vigorous leaves of relatively mature plants as a guide to discriminating two classes of plants,'' and that the number was never intended to define hemp from a legal perspective. According to the comment, Small and Cronquist made no conclusionary statement on the use of the 0.3 percent THC threshold.--------------------------------------------------------------------------- \13\ Johnson, Renee. ``Hemp as an ***agricultural*** commodity.'' Congressional Research Service (2014). \14\ Small, Ernest, and Arthur Cronquist. ``A practical and natural taxonomy for Cannabis.'' Taxon (1976): 405-435.--------------------------------------------------------------------------- Several comments reported that countries determined to compete in the global marketplace, including Switzerland, Australia, Thailand, Uruguay, and Ecuador, recognize an acceptable hemp THC limit of 1.0 percent. According to comments, the international market settled on the 1.0 percent THC limit after numerous countries tested hemp over many years. Comments recommended the IFR incorporate the same standard. Comments asserted that the rights of Indian Tribes and small Tribal farmers should be protected by allowing greater flexibility in the hemp production regulations overall, consistent with Tribal self-government. For example, comments said that Indian nations should be recognized to have authority to grow hemp with up to 1.5 percent THC and should not be restricted to 0.3 percent. One comment explained that their company has focused on breeding efforts to develop genetics that produce CBD-rich hemp with the lowest possible THC concentrations. The commenter claimed their company has harvested millions of pounds of hemp compliant with the 0.3 percent total THC standard since 2017. The comment said they produced 25 million rooted cuttings this spring--enough, according to the comment, to produce biomass for the entire country, and the commenter assumed they were not the only ones who had done so. The comment asserted further that the global standard for THC concentration is 0.2 percent and that to be competitive, U.S production must adhere to a similarly strict standard. Although asserting that the IFR hemp THC level of 0.3 percent is not commercially reasonable, some comments acknowledged that only Congress could change the statute to allow a higher limit, and some commenters offered to serve as resources in that effort. Other comments urged USDA to work with Congress to raise the THC threshold. AMS response: Congress defined hemp in the 2018 Farm Bill as Cannabis sativa L. with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis. Any change to the statutorily established threshold of THC concentration requires an amendment to the statute. The CSA defines marijuana as cannabis that is over the 0.3 percent THC level. AMS has no discretion to change the THC level or to treat States and Tribes differently as the 2018 Farm Bill applies to all production of hemp in[[Page 5619]]the U.S Tribes do not have the authority to grow hemp with up to 1.5 percent THC as this would violate the 2018 Farm Bill and the CSA. Tribes' powers of self-government may be constrained by acts of Congress in accordance with Congress' constitutional authority to regulate commerce with Indian Tribes. AMS notes that there seems to be confusion amongst some commenters on the THC level stated in the 2018 Farm Bill and the IFR's definition of acceptable hemp THC level. The acceptable hemp THC level in this final rule includes the 0.3 percent established in the Farm Bill plus any measure of uncertainty due to laboratory testing. Regarding the comment citing the news story, AMS believes the commenter misconstrued the article's meaning. The article cited by the commenter explained that following passage of Texas's law that legalized hemp in early 2019, the number of marijuana prosecutions in the State plummeted, due in part to the lack of adequate and affordable criminal laboratory resources. According to the article, prosecutors were less likely to expend resources on low-level marijuana charges where the likelihood of conviction is low. The article described anticipated release of a new lab testing method that only determines whether THC concentration is above or below 2 percent for criminal testing purposes. According to the article, even though 2 percent is higher than the State's legal hemp limit of 0.3 percent, such testing would nevertheless be adequate for Texas law enforcement purposes, since nearly all marijuana plant prosecutions in the State involve THC concentrations of 12 percent or more. AMS believes neither the article nor the State are advocating legalization of hemp THC concentrations of up to 2 percent, but that Texas law enforcement is merely using that limit as a convenient way to determine whether to pursue criminal prosecution. In response to concerns that producers could unwittingly become illegal marijuana farmers without greater flexibility in the rule, AMS has modified the negligent violation threshold as explained in the section responding to comments on the negligent violation threshold. AMS also notes, however, that it does not have any authority over how the DEA chooses to enforce compliance with the CSA. In the final rule, AMS is implementing a nation-wide domestic hemp production program as contemplated by the 2018 Farm Bill. It is not amending Risk Management Agency's regulations regarding crop loss or repayment payments. Thus, comments regarding those regulations are outside the scope of this rule.Testing for Total THC The IFR requires that when hemp THC levels are measured using post-decarboxylation or other similarly reliable methods, the total THC concentration level measured must include the potential to convert THCA into THC. Comments: Some comments agreed that the measurement of delta-9 THCA should be added to the measurement of delta-9 THC and reported as total THC used for determining compliance with the hemp program requirements, as this is what many hemp producing States are already doing under State programs. A comment from an association of Departments of ***Agriculture*** reported that many States responding to their survey supported testing for total THC in this manner. Other commenters disagreed. According to one comment, only 22 of 47 States with State-level hemp programs test for total THC. The comment said that 18 States do not currently test for total THC, and that 7 States' rules are ambiguous on this point. Other comments reported that State programs currently testing for only delta-9 THC are confident that producers are not selling ``hot'' crops. One comment said it is irrational to subject hemp biomass to decarboxylation when most biomass harvested for processing into increasingly popular consumer goods or industrial products will never even be decarboxylated. Another comment explained how USDA cannot alter the definition of hemp as set forth in the 2018 Farm Bill. The comment said that there should not be a ``total'' THC mandate and, rather, the plain reading of the 2018 Farm Bill establishes that delta-9 THC is actually the determinative factor. The comment went on to explain how other State and Federal agencies also rely only on delta-9 THC when making critical distinctions with respect to hemp, such as the DEA and the FDA, to determine whether a substance is controlled and subject to criminal penalties. The comment presented an alternative testing methodology where testing methods must be able to determine the potential for THCA to convert into delta-9 THC, and the test result must reflect that ability as well as the aggregate computation, but the controlling factor whether a crop meets the definition of hemp and is within the ``acceptable hemp THC level'' relies only upon the delta-9 THC element. Thus, for compliance purposes, delta-9 THC is the standard, and the lab report must at least reflect THCA, delta-9 THC, and the Total THC results, but Total THC should not be determinative in whether a farmer has to destroy his crop. Industry impacts. Commenters asserted that testing for THCA concentration, a component they argued which is not psychoactive, would vastly undermine the efficient production of hemp and the growth of the industry. Some comments supported the 0.3 percent THC standard, but said requiring testing for total THC goes beyond what is statutorily required, to the detriment of producers. Commenters argued that the difference between levels of delta-9 THC and total THC in hemp is significant, and that crops that would otherwise be compliant measuring only for delta-9 THC would not be compliant when measuring for Total THC. Comments asserted that testing for total THC with a threshold of 0.3 percent effectively lowers the allowable hemp THC level to an even lower limit. Comments also described the correlation between total CBD and total THC production and explained that producers trying to maximize CBD production will not be able to do so successfully if total THC levels are restricted to 0.3 percent. One comment claimed that a farmer can produce hemp plants with up to 25 percent cannabinoid content while staying under 0.3 percent delta-9 THC limit, but that the farmer would have to plant twice as many acres of a less potent hemp variety to produce the same amount of CBD end product and stay compliant under the IFR's Total THC limit. Several comments reported that some CBD hemp processors reject product with CBD amounts of less than 8 percent. According to comments, breeders have worked years to develop cultivars that meet the 0.3 percent delta-9 THC threshold, but many cultivars would not be compliant under the total THC limit. Comments predicted that with a standard of 0.3 percent total THC, growers will stop growing hemp for CBD because the risk is too high that their hemp crops will exceed the limit and be destroyed, defeating the purpose for growing crops for the potential high returns related to CBD production. Comments further lamented that the industry would lose investments they've already made. According to comments, many States that have only been measuring delta-9 THC under 2014 Farm Bill pilot programs have developed companion[[Page 5620]]marketing programs that have been tailored to complement State hemp production programs. Comments asserted the total THC limit in the IFR would significantly impact these new and emerging markets and cripple the industry in those States, preventing them from selling their product. Some comments claimed that common industry practice is to measure THC and THCA independently. Comments recommended USDA treat THC and THCA as two separate molecules and only be concerned with the amount of THC in a sample, rather than total available THC. One comment recommended that if USDA wants to test for total THC, the limit should be raised to 0.694 percent, with negligence set at 1.094 percent, and that growers whose samples measure between the two limits should be allowed to retest samples with up to two certified labs of their choice at a cost of $500 each. Another comment recommended that samples be tested for THC and THCA separately, with limits of 0.3 and 1.0 percent, respectively. AMS response: The 2018 Farm Bill requires that State and Tribal plans provide a procedure for testing, using post-decarboxylation or other similarly reliable methods, delta-9 tetrahydrocannabinol concentration levels of hemp. In order to use post-decarboxylation, the sample must be heated or a conversion made to account for the lack of heating process. This means that the total THC must account for THCA and delta-9 THC. Currently, some States and Indian Tribes use gas chromatography (GC) to test hemp. In GC testing, heat is applied to the sample which THCA, producing delta-9 THC (a psychoactive compound), so that the final delta-9 THC result is actually a total THC result. GC is the more traditional technique used for THC testing and GC results are typically reported as ``delta-9 THC'' without distinguishing that the reported delta-9 THC is actually total THC. Liquid chromatography (LC) testing typically does not involve the use of heat, so the THCA in a sample does not decarboxylate. In LC, results for THCA and delta-9 THC are obtained separately and can be reported separately. Cannabis naturally contains more THCA than delta-9 THC; if the THCA concentration is ignored while testing by LC, it is improbable to correctly distinguish hemp varietals from drug varietals. A total THC needs to be calculated post-testing in order to determine the ``post-decarboxylation'' delta-9 THC value as required by the 2018 Farm Bill. In this way, all testing methodologies report the same information. AMS acknowledges that some States do not currently test for total THC and that switching to testing for total THC may have a negative impact on those State programs. Most laboratories that use LC obtain THCA results and delta-9 THC results in the same analysis, so the information should be readily available to incorporate a calculation for Total THC. The opposite is also true. If USDA was to ignore the statutory requirement of using post-decarboxylation or other similarly reliable methods and allow for THC levels that do not account for decarboxylation, States and Tribes that currently require testing for total THC could experience a negative impact. When States or Tribes use different methods to measure THC, it impacts commerce because producers are not all on the same playing field. Also, since total THC at 0.3 percent is harder to obtain, those States and Tribes currently using total THC have been potentially selling less or destroying more hemp. Further, many in the industry have already made the switch to total THC since the IFR was published, diminishing the impact. AMS consulted with the Departments of Justice and Health and Human Services to develop the IFR. The Drug Enforcement Administration's Analysis of Drugs Manual cites GC methodology, initially labeling results as delta-9 THC and then defining total THC and instructing how to determine compliance using total THC. In order to provide flexibility to States and Indian Tribes administering their own hemp production programs, alternative testing protocols will be considered by AMS if they are comparable and similarly reliable to the baseline mandated by section 297B(a)(2)(ii) of the AMA and established under the USDA plan and procedures. Updated USDA procedures for sampling and testing will be issued concurrently with this rule and will be provided on the USDA website. This final rule covers hemp production. Hemp products are regulated under the Food and Drug Administration and its various statutes.\15\--------------------------------------------------------------------------- \15\ The 2018 Farm Bill explicitly preserved the authority of the U.S Food and Drug Administration (FDA) to regulate hemp products under the Federal Food, Drug, and Cosmetic Act (FD&C Act) and section 351 of the Public Health Service Act (PHS Act).--------------------------------------------------------------------------- Statutory Compliance and Congressional Intent: Several comments expressed concern about regulatory inconsistency between the 2018 Farm Bill language testing methods and the IFR requirements. Commenters urged USDA to reconsider the legislative record and Congress's intent in passing the 2014 and 2018 Farm Bills. According to numerous comments, the plain language of the 2018 Farm Bill statute does not support the IFR's requirement to test for total THC. Commenters asserted that if Congress had intended samples to be tested for total THC, they would have so specified, rather than making the specific reference to delta-9 THC in the statute. Comments concluded that concentrations of THCA in hemp should be irrelevant to its legal status under the regulations. One comment characterized ``decarboxylated value'' as a new legal term and questioned USDA's authority under the 2018 Farm Bill to create such a term. One comment went on to say that the term ``potential conversion'' as appearing in the IFR is offensive because Federal criminal law does not convert a legal substance into an illegal one simply because the substance has the ``potential'' to be converted. Several comments cited a letter from Senators Merkley and Wyden,\16\ authors of the Hemp Farming Act of 2018 that was included in the 2018 Farm Bill, as evidence that the IFR wrongly requires testing of Total THC. In that letter, Senators Merkley and Wyden asserted that requiring hemp samples to be tested using methods by which the reported THC concentration accounts for the conversion of THCA to THC ``is a complete reversal of the Congressional intent expressed in that law and requires testing that Congress specifically did not include.'' Comments also asserted that the Farm Bill definition of hemp is clear in that ``all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not'' of the hemp plant are expressly lawful so long as the pant does not contain a delta-9 THC concentration of above 0.3 percent. Thus, according to these comments, the IFR required measurement of a lawful plant-based acid when distinguishing between hemp and marijuana under the Controlled Substances Act, and such a requirement contradicts the plain language of the Farm Bill and the spirit of the law.--------------------------------------------------------------------------- \16\ [*https://www.merkley.senate.gov/news/press-releases/wyden-merkley-to-dea-interim-rule-on-hemp-contradicts-congressional-intent-by-criminalizing-intermediate-steps-in-hemp-processing-2020#:~:text=Authors%20of%20the%20provision%20in,by%20seriously%20misunderstanding%20hemp%20processing*](https://www.merkley.senate.gov/news/press-releases/wyden-merkley-to-dea-interim-rule-on-hemp-contradicts-congressional-intent-by-criminalizing-intermediate-steps-in-hemp-processing-2020#:~:text=Authors%20of%20the%20provision%20in,by%20seriously%20misunderstanding%20hemp%20processing). See [*https://beta.regulations.gov/comment/AMS-SC-19-0042-0884.---------------------------------------------------------------------------*](https://beta.regulations.gov/comment/AMS-SC-19-0042-0884.---------------------------------------------------------------------------)[[Page 5621]] One comment asserted that requiring test reports of THC concentration to account for conversion of THCA into THC effectively mandates that only test methods relying on post-decarboxylation be used, nullifying Congressional intent that other similarly reliable methods that don't require conversion of THCA to THC should be authorized. The comment recommended revising the rule to comply with the Congressional mandate to allow testing through other similarly reliable methods. AMS response: AMS is not making a determination of Congressional intent when passing the 2018 Farm Bill provision for hemp. Instead, AMS is following the plain statutory language that states that a State or Tribal plan shall be required to include ``a procedure for testing, using post-decarboxylation or other similarly reliable methods, delta-9 tetrahydrocannabinol concentration levels of hemp produced in the State or territory of the Indian Tribe''. International Impact: Some comments asserted that the average global delta-9 THC limit is 1.0 percent. Others claimed that Europe has adopted a 0.3 percent THC limit, but that it applies only to delta-9 THC and not total THC. Comments contend that American hemp production required to comply with at 0.3 percent total THC limit will be disadvantaged in the international marketplace. Comments proposed that matching a global standard by establishing a higher delta-9 THC threshold or total THC limit would strengthen U.S producers' market competitiveness. Other comments warned that reducing the domestic hemp supply by imposing the IFR's 0.3 percent total THC limit will incentivize importation of hemp biomass and hemp derivatives produced in countries with lower labor costs and less restrictive regulatory regimes, and that domestic hemp and hemp derivatives will be priced out of the market. AMS response: The 2018 Farm Bill authorizes USDA to issue regulations to regulate the production of hemp and defines hemp in terms of the concentration of THC in a Cannabis sativa L. plant. A Cannabis sativa L. plant is considered hemp, and therefore not a controlled substance, if the THC concentration is not more than 0.3 percent on a dry weight basis. AMS does not have the discretion to change this threshold in the definition of hemp even if this threshold could impact the global competitiveness of U.S -produced hemp.Calculating Total THC The 2018 Farm Bill and IFR identified and described the procedure for testing THC concentration using post-decarboxylation or other similarly reliable methods. The term decarboxylated was defined in the IFR as the completion of the chemical reaction that converts THC-acid (THCA) into delta-9 THC, the intoxicating component of cannabis. The decarboxylated value is also calculated using a conversion formula that sums delta-9 THC and eighty-seven and seven tenths (87.7) percent of THC-acid. The term decarboxylated is also commonly used in science and is the precursor to the term ``post-decarboxylation,'' which appears in the 2018 Farm Bill's mandate on the acceptable cannabis testing methodologies for identifying THC concentration levels. AMS adopted this definition in this final rule. Conversion Efficiency: Many stakeholders opposed USDA's conversion formula described in the IFR. Comments claimed the IFR was based on 100 percent conversion efficiency, which is only achievable under controlled laboratory testing conditions and is not possible outside of a laboratory environment. One comment stated the IFR failed to account for the inefficiency of the decarboxylation process. Numerous other comments characterized the USDA formula as theoretical and explained that the realistic conversion efficiency is between 30 and 75 percent. For example, several commenters cited a peer reviewed study which found 72 percent to be a viable efficiency factor and provided the calculation formula: Total Potential THC = (0.72) x [(0.877 x THCA) x delta-9THC)]. Additionally, a commenter suggested USDA utilize three different conversion factor tiers (0, 30, or 70 percent) depending on the end-use varietal because the THC concentration varies by varietal. The commenter argued that the conversion factors should reflect the different end-uses. One comment said the calculation for ``Total Potential THC'' should be defined and incorporated into the final rule because the decarboxylation percentage definition is critical for standardization and uniformity in the industry. Otherwise, according to the comment, States could adopt different decarboxylation percentages in their equations, causing confusion for growers. The comment gave the following formulas as examples: (Total potential THC = 0.877 x percent THCA + percent delta-9 THC) as compared to (Total Potential THC = 0.877 x 0.70 x percent THCA + percent delta-9 THC), assuming a 70 percent THCA decarboxylation to delta-9 THC rate. Another comment explained the need to include delta-8 THC into any calculation for the future state delta-9 THC. AMS response: Delta-8 THC only exists in a trace amount in marijuana which has a high Delta-9 THC concentration. The Delta-9 THC amount is already low in hemp, so the concentration of Delta-8 THC would be basically undetectable in hemp. A quote from the ``WHO Expert Committee on Drug Dependence Critical Review--Isomers of THC'' regarding the relative amount of Delta-8 THC to Delta-9 THC that can be found at [*https://www.who.int/medicines/access/controlled-substances/IsomersTHC.pdf?ua=1*](https://www.who.int/medicines/access/controlled-substances/IsomersTHC.pdf?ua=1). The above range means that Delta-8 THC occurs at a level that is roughly 1000 times less than Delta-9 THC. So, if Delta-9 THC was observed at 0.3 percent in hemp, then the Delta-8 THC concentration would be roughly around 0.0003 percent. This contribution is completely negligible and contributes nothing significant to the total THC content. The trace amount of Delta-8 THC is about 100 times less than the uncertainty (MU) of the test method, further demonstrating that it is insignificant and not worthy of consideration in the final assessment of THC for hemp compliance. AMS is adopting the calculation provided in the IFR for determining total THC. However, the calculation has been clarified to explain the use of the molar conversion ratio to mathematically convert THCA to delta-9 THC. As written in the IFR, the calculation may have been misunderstood as containing a conversion efficiency factor, which is not the case. THCA cannot be added to delta-9 THC without accounting for the difference in molecular mass. Using stoichiometry, a molar conversion ratio (0.877) is used to mathematically convert THCA in terms of delta-9 THC. The molar mass of THCA is 358.47 g/mol and the molar mass of delta-9 THC is 314.45 g/mol. In other words, the mass of THCA has to be adjusted or multiplied by 0.877 to be comparable to the mass of delta-9 THC. The 2018 Farm Bill requires that the THC content be expressed post-decarboxylation, which means that the conversion of THCA into delta-9 THC to account for the potential total THC in a sample must be taken into account. The term ``potential'' is used because it is not possible to readily, consistently, and reliably calculate the precise extent of[[Page 5622]]the conversion of THCA to THC under any and all circumstances. Therefore, the calculation for total THC assumes 100 percent conversion efficiency and is hereby retained in this regulation. The calculation for total THC [total THC = (0.877 x THCA) + (delta-9 THC)] assumes that 100 percent of the THCA is decarboxylated, producing to delta-9 THC, meaning that it gives the maximum (or potential, or theoretical) total THC. The final rule includes a definition for total THC to provide more specificity on this issue. This is standard procedure for how theoretical yield is calculated in chemistry. The issue is that theoretical yield does not always equal actual yield. Just because a maximum total THC can be calculated does not mean that the maximum is always obtained; however, there is potential for this maximum to be obtained. The amount of THCA that actually decarboxylates, producing delta-9 THC, is dependent on multiple variables; primarily, the amount of heat it is exposed to and the amount of time it is exposed to that heat. These variables, in turn, depend on what is being done to a cannabis sample (tested via LC, tested via GC, used for smoking, used for extraction, etc.). Incorporating the use of a conversion efficiency factor into the calculation is problematic due to these variables. Designating different conversion efficiency factors based on intended end use is not practical as the factors can still vary. For example, if an end-use of extraction is intended, there are many different types of extraction processes and even within one specific process there are still many different variables that will affect the conversion efficiency. Ultimately, there is no way to standardize a conversion efficiency factor based on end-use, methodology, or processing. The infrastructure does not currently exist to measure and monitor conversion efficiency. In terms of conversion during instrumental analysis, many commenters referenced a study conducted by Dussy \17\ that determined a conversion efficiency factor for a specific GC setup. The author of the study recommends determining THCA and delta-9 THC separately and calculating total THC (using the equation the IFR stated to use). The author says that ``every total [Delta]9 THC value determined after decarboxylation [by using GC] gives a minimal content rather than an exact value''. Therefore, the author proposes that labs using GC should calculate their own method's conversion efficiency and then apply their efficiency to their result to increase their total THC value to make it comparable to LC. This is the opposite of what many commenters are proposing in that they wanted LC methods to incorporate conversion efficiency into their LC results to make total THC lower. The further complication of this ``opposite'' approach is that it is impossible without having a single conversion efficiency which, as stated previously, cannot be agreed upon and can vary widely. Furthermore, no matter how the conversion efficiency was to be applied, requiring each lab to determine their own method's efficiency would require significant effort.--------------------------------------------------------------------------- \17\ Dussy F.E ; Hamberg, C.; Luginb[uuml]hl, M.; Schwerzmann, T.; Briellmann, T.A Isolation of [Delta]9 THCA-A from hemp and analytical aspects concerning the determination of [Delta]9 THC in cannabis products. Forensic Science International, 149, 3-10, 2005.--------------------------------------------------------------------------- Delta-8 THC is a cannabinoid that can be formed from delta-9 THC. It is typically only found in very small quantities in plants, if it is found at all, and is more often obtained by growing a plant with high delta-9 THC and then converting the delta-9 THC into delta-8 THC through an extraction and conversion process in a lab to make a distillate product. It is rarely included in total THC calculations and many labs do not test for it. Delta-8 THC is unrelated to the 0.3 percent delta-9 THC limit or the ``post-decarboxylation delta-9 THC'' that are defined and required in this final rule.Similarly Reliable Testing Methods The 2018 Farm Bill states that State, Tribal, or USDA plans shall include ``a procedure for testing, using post-decarboxylation or other similarly reliable methods, delta-9 tetrahydrocannabinol concentration levels of hemp.'' The IFR included two examples of standard industry post-decarboxylation testing methods that meet 2018 Farm Bill requirements: Gas and liquid chromatography with detection. AMS selected these standard methods of chromatography as the best options for testing but also provided flexibility for alternative sampling and testing protocols if they are comparable and similarly reliable to the baseline mandated by the 2018 Farm Bill and established under the USDA plan and procedures. Comments: Some comments expressed support for the use of post-decarboxylation. One comment described liquid chromatography as a preferable testing method over gas chromatography because there are no published methods for gas chromatography that show 100 percent conversion of THCA to THC. Comments suggested liquid chromatography is more accurate and representative than gas chromatography. USDA received a comment that because Tribes often do not have ready access to gas chromatography and may only be able to access liquid chromatography, the rules need to allow for a more lenient formula. Many more comments opposed the IFR requirement to use post-decarboxylation testing methods on the grounds that the IFR too strictly interpreted or unnecessarily developed regulatory requirements that are not consistent with the statutory language of the 2018 Farm Bill. Comments stated that USDA should be flexible and allow for measuring THC levels with ``similarly reliable methods,'' as provided in the statute. Comments claimed that the IFR's exclusive endorsement of gas or liquid chromatography methods ignores this statutory flexibility. Comments further asserted that these two methods may overstate THC levels in hemp samples and that USDA should approve alternative reliable methods that may produce more accurate results. According to some comments, reliable testing methods have emerged that do not necessitate decarboxylation to accurately measure THC concentrations. For example, comments claimed that some States recognize genetic testing that measures the ratio of cannabidiol to THC in a sample or that confirms a stable cultivar's taxonomic determination in lieu of post-decarboxylation testing to verify compliance with THC limits. Comments explained that genetic testing could include testing seed or testing during early plant growth stages, instead of depending on chemical analyses to measure THC levels in mature plants, which may be inconsistent under unpredictable growing conditions or dependent upon the time of sampling or the specific part of the plant that is sampled. Comments advocated removing the Total THC testing requirement and recommended USDA work with scientific and ***agricultural*** communities to ensure testing standards are established and similarly reliable methods are developed that will accurately identify and measure THC without the forced conversion of other cannabinoids, isomers, and/or acids. States Operating under 2014 Farm Bill Authority: Comments said that USDA should recognize that States have been effectively regulating hemp production using approved testing methods under 2014 Farm Bill pilot[[Page 5623]]programs. Comments argued that by applying the IFR's new testing standard, certain hemp plants that are legally grown under one or more of the existing pilot programs are converted into plants that violate the 2018 Farm Bill. Comments contended that while USDA will argue that States and Tribes can propose a testing method other than post decarboxylation, the alternative method still has to measure potential conversion of THCA into THC. Comments said further that the IFR must consider that hemp testing is an evolving science and that THC testing methods are likely to change over time. They stated that imposing new testing requirements is adding costs for growers, marketers, and regulators, and is limiting the number of labs that can perform these tests, for unnecessary and possibly impermissible reasons. Finally, comments questioned whether USDA has the authority to impose new testing requirements when the statute spells out the testing standards to be applied in granting approval to State and Tribal plans. A comment cited case law that held that under the Administrative Procedure Act (APA), agency decisions must be reasonable and based on factors and evidence that support the decision, divergent views notwithstanding. It suggested the IFR is arbitrary and capricious under the APA because USDA (1) ``has relied on factors which Congress has not intended it to consider, '' (2) ``entirely failed to consider an important aspect of the problem,'' (3) ``offered an explanation for its decision that runs counter to the evidence before the agency,'' and (4) has made a decision that ``is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.'' It further claimed that a court must sustain an agency's action unless it determines that the agency committed a ``clear error in judgment.'' The commenter asked that their comment be considered within the context of these legal standards, and argued that THCA is not psychoactive; but can be converted into delta-9 THC through a chemical reaction, and that such a reaction may cause otherwise lawful hemp plants to test ``hot.'' The comment projected further that such ``hot'' plants will require disposal, causing a significant and unnecessary loss of hemp production, which will in turn reduce economic development and job growth in many rural communities. The comment said post-decarboxylation testing was not required under the 2014 Farm Bill pilot program and the same plants that are legal under 2014 Farm Bill could be illegal under the IFR. The comment recognized that the pilot program will not be authorized after 2021 but said current disparate treatment under the two laws is problematic. AMS response: The 2014 Farm Bill included a 0.3 percent THC level but did not include the requirement for this measurement to account for decarboxylation. Thus States have the flexibility to determine testing methodologies. The 2018 Farm Bill states that procedures for testing use post-decarboxylation or other similarly reliable methods to determine delta-9 tetrahydrocannabinol concentration levels in hemp. AMS stated in the IFR and further adopts the language in this final rule that at this time two methods meet this requirement for decarboxylation. The current acceptable testing methods include gas and liquid chromatography, including LC with UV detection. As other testing methods and alternatives are developed by industry, AMS will review and evaluate their compliance with the 2018 Farm Bill. At this time, genetic testing has not been determined to be a similarly reliable testing methodology. This final rule provides States and Indian Tribes the option to develop different sampling methodologies based on end use, including grain and fiber, to better account for differences in these plants. Biomass only needs to be tested after remediation to ensure that the sample that represented the plant that once tested above the acceptable THC level did not result in the plant being a controlled substance. This final rule does not set requirements for testing final products--but hemp plants, regardless of their end use, must still use the same testing procedures. Although the USDA plan does not allow for sampling based on end use, AMS will study the experience of States and Tribes that adopt methodologies based on end use. If it appears that the ***data*** and experience of those States and Tribe suggest that their methodologies may be adaptable to the USDA plan, AMS may explore a sampling scheme based on end use for producers under the USDA plan in the future through notice and comment rulemaking.License Application Period AMS received comments on the timeframe established in the IFR for submitting applications for a USDA license. The application period extends between August 1 and October 31. Comments: Several comments opposed the August-through-October window for USDA license applications and renewals. They explained that many outdoor hemp crops are harvested in September and October and that farmers are busy with harvest activities related to other crops as well during that time of year. Comments noted that farmers typically finalize decisions about the coming crop year during the winter, after having time to attend industry and trade conferences, enter into production contracts, and obtain crop loans and insurance. Thus, according to comments, a longer application window or a later application window would give farmers time to plan for the coming year and submit hemp production license applications as appropriate. Comments also noted that a longer application period would give producers time to complete the mandatory background check. Some comments recommended the application period be extended to December 31. Others recommended a winter application period of January 1 to March 15. Other comments recommended even greater flexibility in application periods. Comments explained that harvest cycles for hemp growers may vary regionally and by operation type. They said a significant number of hemp operations involve year-round cultivation, maintenance of mother clones, clone propagation, indoor cultivation, and/or tissue culture. Time and resources to gather and submit paperwork would not coincide with the down-cycles in productivity and would strain these types of operations. Some recommended USDA adopt a year-round, rolling application period with different deadlines for different operation types or sizes. One comment said it was unclear in the IFR whether State and Tribal plans were required to adhere to the same window provided for under USDA's plan. Several comments urged USDA to provide greater regulatory flexibility at the State and Tribal levels to determine the appropriate application and renewal timeframes for their jurisdictions. An example was given of a State's ***agriculture*** department transitioned enrollment from a restricted to an unrestricted timeframe to better manage the logistical challenges related to the enrollment period. AMS response: AMS agrees with the commenters opposed to a limited USDA license application window and will allow for applications to be submitted for a USDA license year-round. This will provide greater flexibility to hemp producers to determine when to apply for a license or renew their license. This decision recognizes the different regional harvest timetables and production types used by hemp producers, and how flexible timetables[[Page 5624]]may allow producers to prepare applications during lower level periods of production activity thereby reducing some of producers' burden on time and resources when the producer is planning the next planting cycle(s). States and Tribes can determine their license application window as it best meets their programs.FSA Reporting and Information Sharing AMS received comments on the IFR requirement that hemp producers report acreage and provide licensing information to USDA's Farm Service Agency (FSA). Hemp producers must provide FSA information about their hemp crop acreage, such as its location and size, and must provide the producer license or authorization number issued under the hemp production plan under which they operate. States, Indian Tribes, and USDA must ***collect*** the same information, as well as other producer information, under their respective plans. USDA then assembles and maintains FSA and plan information and makes it available to law enforcement agencies, as required under the 2018 Farm Bill. Comments: Several comments expressed strong support for FSA programs generally, acknowledging that FSA programs provide farmers valuable access to Federal programs and funding, and that registering crop acreage with FSA would help mainstream hemp production within ***agricultural*** communities. Comments noted that requiring hemp growers to register with FSA is similar to registration requirements for growers of other commodities and that FSA already compiles reports about other crops. However, many commenters opposed the requirement to register with FSA when they are already required to provide the same information to their licensing authority. Comments argued that the duplicative reporting requirement is unnecessarily burdensome to farmers, could be confusing, and could discourage farmers from seeking hemp production licenses or from growing hemp. One comment speculated that confusion about the duplicative requirement could lead to unintended violations by growers who don't comply. Other comments speculated that lower program participation would inhibit industry growth and deprive States and Indian Tribes of licensing fees that enable them to fund their respective production plans. Comments noted that the statute does not specify dual reporting of crop acreage to both FSA and the plan authorities under which they operate. Several comments took exception with the IFR's assumption that most hemp farmers are already registered and familiar with FSA and its programs. Comments from some State ***agriculture*** departments asserted that within their jurisdictions most farmers in general do not already work with FSA. One comment asserted that participation in FSA programs is voluntary and that hemp growers should not be precluded from participating in the commenter's State program because they forego FSA registration. Other comments suggested that farmers growing hemp for personal use and hemp farmers also growing medical marijuana may be hesitant to register crop acreage with Federal agencies. One comment expressed concern about FSA staffing in rural areas and asked USDA to increase funding to support additional reporting obligations. Another comment suggested USDA develop and fund one standardized reporting program for all plans and growers that would decrease program reporting burdens for all entities. Some comments encouraged streamlining ***collection*** of crop acreage information by allowing the use of open-source GIS mapping instead of FSA ***data*** and reporting tools. Comments also suggested USDA could rely on States and Tribes to provide grower crop acreage and registration information since they already ***collect*** it. Several comments recommended eliminating the FSA registration requirement altogether. AMS response: AMS acknowledges the FSA reporting requirement may present a hurdle for certain hemp producers, particularly new and beginning farmers, farmers in rural locations, and farmers located in Tribal territories. However, AMS determined that the FSA reporting requirement is essential for two key reasons: Real-time ***data*** ***collection*** and field-based resources. First, USDA is required under the 2018 Farm Bill to provide law enforcement with certain ``real-time'' information about who is growing hemp, whether their license is in good standing with the regulatory body issuing the license, and the location(s) of where hemp is being grown. The daily ***collection*** of this information through FSA county offices enables USDA to easily transmit the required information to law enforcement. FSA maintains the technology necessary for ***data*** ***collection*** and geographical land identification. These tools will provide easy access to information needed for law enforcement and for other ***agricultural*** programs. This information is compiled in one system, using an information sharing mechanisms currently used by law enforcement and which they are familiar with, and transmitted to law enforcement in a safe manner, which otherwise would not be as readily available through State and Tribal reporting. States and Tribes must provide information to USDA in a format that is compatible with USDA's information sharing system. USDA will work with States and Tribes on system format and other information necessary to share information. Secondly, FSA's county network is expansive with over 2,000 field office locations. FSA offices provide services both in person and virtually to accommodate the needs of producers. Its mission runs parallel to other USDA agencies including Risk Management Agency, Natural Resources and Conservation Service, and Rural Development, each of which provide a wide range of benefits and services to local communities. AMS noted that in many cases, FSA is co-located with other Federal, State and county-level government offices which means a variety of services are provided through one central location. These services frequently include information on insurance and risk management programs, conservation and irrigation technical expertise, ***agricultural*** credit for operating or marketing, and rural housing loans. As such, the requirement is considered by AMS to be particularly important to new and beginning farmers who traditionally are not familiar with the wide range of programs and services offered by Farm Service Agency and the other USDA agencies.Definition of ``Lot'' AMS received comments on the definition of ``lot'' for providing geographical determination of hemp production and for sampling purposes. One comment explained that nursery operators and their field operating counterparts may need to file hundreds of permits for a single greenhouse under the IFR. The comment described as an example one greenhouse at a nursery, which may have upwards of 36 benches, in which each bench could have 20 different hemp varieties growing at any one time. The comment said that the IFR would require that single greenhouse to have 720 ``lots,'' and based on most States' current rules, 720 containment plans, destruction plans, and transportation notices when any plants are moved--all possibly requiring agency approval prior to any action[[Page 5625]]being taken. It further explained that the growing cycle for nursery stock could be as short as five to six weeks, and different varieties could take their place. The comment said a nursery with five or six greenhouses on a relatively small acreage may have to register thousands of lots and submit thousands of associated plans. It recommended that such a nursery should only be required to designate the actual greenhouse or indoor growing structure itself as used for the cultivation of hemp generally, and the term ``lot'' should not be defined to include any restriction or limitation to the same hemp varietal. The comment proposed revising the definition of ``lot'' to mean a contiguous area in a field, greenhouse, or indoor growing structure used for the cultivation of hemp. AMS response: In this final rule, AMS is clarifying that the term ``lot'' has the same meaning as other terms used by FSA, as found in 7 CFR 718.2, to mean the same production area, such as ``farm,'' ``tract,'' ``field,'' and ``subfield.'' AMS uses the term ``lot'' to help growers and oversight officials identify farm locations, field acreage, and variety (i.e , cultivar). Although a hemp producer must report their ``lot'' information to FSA, when a producer visits the FSA office to report hemp crop acreage, FSA staff will determine the appropriate designation for the specific location(s) where hemp is being grown. FSA staff will not provide a ``lot number'' to producers as described in the IFR, but instead designate either a ``field'' or ``subfield'' as the unique identifying number. This number is considered equivalent to a ``lot number.'' A lot must always contain the same variety or strain of cannabis throughout the area because the final rule requires lot-based testing.Certified Seed The IFR explains that under the 2014 Farm Bill, various States developed seed certification programs to help producers identify hemp seed that would work well in their specific geographic areas. Comments: Some comments concurred with USDA's decision not to introduce a hemp seed certification program with the IFR. Numerous commenters said that such a program would not be appropriate, that it would be too difficult to regulate, or that it would be premature now. Other comments said a federal hemp seed certification program is not necessary because some States and Indian Tribes had already developed such programs for their jurisdictions or are capable of doing so. Numerous comments said they recognized the difficulty of developing a hemp seed certification program but nonetheless urged USDA to pursue what they characterized as an important effort to allow for consistency among hemp producers when resources permit. One comment asserted that seed certification is key to a regulated hemp industry and explained that certification is a common practice in the international seed industry. Several comments contended that USDA must develop a seed certification program to prevent hemp growers from purchasing and planting seed of unproven quality--or of the wrong varieties for their purposes--and risking unnecessary financial loss and regulatory violations. Comments claimed that hemp farmers already have difficulty verifying the origin, genetics, and reliability of hemp varieties currently on the market, and that a seed certification program would help farmers know whether seed they purchase is appropriate for their growing conditions or intended hemp product end-use. Numerous comments inferred that a seed certification program would identify hemp varieties that had been tested and proven to reliably produce compliant hemp plants in specific geographic areas. Some comments argued USDA should not engage in hemp seed certification because plant genetic expression is influenced by environmental conditions and seed certifiers cannot guarantee plants will have THC concentrations within the acceptable range. Other comments countered that assertion and referenced a comment that reported on the analysis of cannabis genome trials and concluded that cannabinoid concentration is 80 percent or more controlled by genetics rather than environmental conditions. Comments claimed that hemp varieties developed under proper breeding programs and certified in the European Union and Canada had been proven to have stable cannabinoid profiles across multiple regions. They suggest that comparable results could be achieved under a USDA seed certification program. A comment claimed that the lists of acceptable/approved varieties provided by the processor and/or the governing authority in the State in which the hemp is grown needs to be updated soon and regularly. The policy language may be acceptable, but these lists need attention quickly so that ill-suited varieties are not planted and insured when planted outside of the area and not likely to perform as well. Some comments asserted it is not necessary for USDA to develop a seed certification program now because the Association of Official Seed Certifying Agencies (AOSCA) has already established national standards for hemp field crop cultivars and is reviewing issues related to the development of certification standards for feminized seed and clones of CBD hemp. Other comments recommended USDA adopt AOSCA standards in the development of a Federal seed certification system, and several comments said that some States have already adopted AOSCA protocols for production of certified seed for commercial sale to farmers. For example, a comment stated that a state currently recognizes 17 hemp seed varieties that have been certified for use in that state in accordance with AOSCA standards. The comment said the state encourages farmers to use certified seed when possible and the state intends to rely on certified seed to streamline the hemp testing program in the future. A comment clarified that there is a difference between seed that has been certified according to AOSCA standards (or an international equivalent standard) for varietal purity, and seed that has been tested for THC or other compounds. It asserted that some State programs have confused the terminology and urged USDA to clarify the difference and promote use of certified seed for varietal purity. The comment said the hemp industry has access to numerous proven varieties and that plant breeders are making strides to develop more varieties with specific characteristics. Numerous other comments reinforced the need for seed certification programs that ensure hemp seed meets high standards for proper labeling, reliable germination rates, purity, and the ability to produce healthy plants. Some comments supported seed certification under State or Tribal programs, claiming such localized programs have proven successful in areas where they've been developed and used, and saying that such programs promote crop predictability and reduce uncertainty for farmers. One comment asserted that not only seed, but clone certification is a must, to ensure that growers are getting what they think they are when they purchase clones from nurseries. Some comments asserted confidence in certified seed could be extended to crop insurers, who could provide coverage at prices that reflect reduced risk. Some comments suggested growers using seed certified under a Federal certification program should be indemnified against legal liability or financial losses related to production of hemp that tests higher than the acceptable THC level. Some comments suggested States and Tribes that adopt seed certification programs[[Page 5626]]for cultivars reliably producing compliant plants should be authorized to exempt such cultivars from hemp sampling and testing requirements or to employ random, risk-based sampling schemes supported by ***data*** about those cultivars. AMS Responses: AMS is not establishing a seed certification program for hemp. The IFR explained USDA's decision to not establish a seed certification program was due to a lack of accurate ***data*** and the advanced technology necessary to develop such a program. The term ``certification,'' as used here, means tested or verified and does not necessarily mean certified for seed varietal purity or genetics. AMS understands that some seed certification-related studies are already under way in different locations and that results of these studies are helpful in production risk mitigation. AMS recommends the use of hemp seed from varieties that have undergone a variety review, following the process outlined in the Federal Seed Act and associated regulations, (7 U.S.C 1551-1611 and 7 CFR part 201), and produced according to AOSCA standards. These types of seed have been screened and tested for purity and are properly labeled. This final rule maintains flexibility for stakeholders to continue with trials of seed varietals and does not prohibit the use of any hemp varietals by industry. Updating the varieties list is a State and Tribal issue, as they developed them. This final rule does not address seed certification. However, USDA will consider such a program in the future if enough information is available. If there is sufficient ***data*** to support a program, USDA will explore adopting one through rulemaking under the APA. Separately from this hemp production regulation, AMS administers the Plant Variety Protection Office (PVPO). This office actively accepts applications of seed-propagated hemp for plant variety protection. Under the U.S Plant Variety Protection Act, PVPO examines new applications and grants certificates that protect varieties for 20 years (25 years for vines and trees). PVPO provides intellectual property protection to breeders of new varieties of seeds and tubers. Certificate owners have rights to exclude others from marketing and selling their varieties, manage the use of their varieties by other breeders, and enjoy legal protection of their work.Regulations for Different Operations The 2018 Farm Bill requires any producer growing hemp to be licensed either by their applicable State or Tribal authority or USDA. The IFR further required that an authorized sampling agent ***collect*** samples from floral material for THC concentration testing in order to determine compliance with the Federally established THC threshold. Some operations growing hemp do not grow to the stage where flower material is present and as such cannot test the floral material. Clones and Cloning: Comments noted there are a significant number of grower operations that cultivate and produce hemp plants year-round. Some of these operations grow hemp varietals and maintain mother clones and/or grow plants for clonal propagation or tissue culture propagation purposes. Comments explained that hemp varietals grown in these types of production systems do not usually reach full maturity. According to comments, before achieving the floral stage of development, many of these hemp varietals are sold and enter the stream of commerce as starter plants that other licensed hemp growers may transplant to a field or greenhouse to be raised to full maturity and harvest. Comments questioned how immature or juvenile hemp plants with no floral material to test can demonstrate regulatory compliance under the IFR. Microgreens: Comments raised similar concerns about hemp raised and marketed as microgreens or other types of immature plants intended for human consumption, noting that these plants cannot be tested for regulatory compliance because they have no floral material to test. Comments encouraged USDA to develop a regulatory process in which THC concentration testing may occur for immature, non-flowering hemp varietals so that operations like those producing clones or microgreens can support the development of the hemp industry. One comment representing a hemp cultivation and distribution corporation in several states provided a pre harvest test on a microgreen variety grown in two different States. One State test reported 0.17 percent total cannabinoids and the other test reported 0.0193 percent total cannabinoids. Based on these tests, commenter indicated that hemp leaf greens/microgreens and related crops are not in danger of excess THC. Hemp Research: Numerous comments stated the need for a separate regulatory scheme to support hemp research. Comments explained that the plant breeding process by its nature requires breeders to bring multiple varieties of plants to maturity in order to evaluate their characteristics and potential use in ongoing hybridization projects. They said, for example, that plants with desirable characteristics such as frost and drought tolerance or pest resistance must be identified and preserved, while plants with unwanted genetic traits or diseases must be separated and destroyed in order to stabilize the genetics for THC expression and other desirable traits and understand how environmental factors, disease, and insect pressure affect the expression of those traits. According to comments, the THC concentration in such plants could exceed the acceptable THC level in the IFR and plant breeders could find themselves in violation of the law. As well, they explained that the IFR's disposal requirement could force breeders to destroy valuable plant material and waste years of work, as well as funding. Other comments asked USDA to support research into hemp pollination and drift. Comments reported industry concern that cross pollination could reduce the value of neighboring CBD flower crops. They asked USDA to focus on grain producing geographic areas and varieties to provide the science to support large acreage growers. Comments explained that the IFR's THC threshold of 0.3 percent reduces the incentive to conduct hemp variety research because of the likelihood that many plants will exceed that threshold. For example, comments suggested the THC limit for hemp plants in licensed breeding programs could be raised to 0.6 percent or 1.0 percent or higher. They suggested breeders be allowed to raise plants to maturity, ***collect*** ***data*** and save seed for further research, and be required to destroy noncompliant plant material at the end of the growing season. Other comments suggested that breeders and researchers should not have to wait for hemp plants to flower and undergo testing before they can remove and destroy those plants with undesirable traits. Comments asserted that hemp strains used in genetic studies authorized by the 2014 Farm Bill and compliant with other program regulations may now be in jeopardy due to the uniform application of the IFR's 0.3 percent THC threshold and plant disposal requirements. They noted how a regulation that requires the disposal of what was previously compliant hemp will undermine the efforts and millions of dollars invested by farmers and researchers. Other comments indicated that not having the ability to replicate certain genetic traits from a plant that is noncompliant can slow the development of industry. Comments from and about university research programs suggested that USDA make land grant universities eligible for special research carve-outs or regulatory[[Page 5627]]exemptions to allow them to continue research efforts. Other comments suggested USDA define criteria under which researchers and other plant breeders could be eligible for special research program exemptions. They suggested USDA develop criteria for certification or qualification of hemp researches and breeders, and some suggested those meeting specified criteria could be exempt from the IFR's crop destruction and reporting requirements, provided they adhere to other restrictions, such as prohibiting research material from entering the chain of commerce, disposing of non-compliant plant material, and limiting plot size. Some commenters noted that without such allowances their university administrators would not allow them to continue research with any form of cannabis, including hemp, due to concerns about Federal grant disqualification. One commenter requested an exemption for Tribal research facilities so that they will not have to destroy all non-compliant plants. Comments noted that USDA's National Institute of Food and ***Agriculture*** had not issued requests for applications on hemp research and that hemp was not listed for funding under the Specialty Crop Research Initiative. Comments suggested more agronomic research is needed to address current gaps in knowledge related to hemp production and management and to standardize seed. AMS response: Due to the variability in immature plants across producers, States, and Tribes, and the lack of consistency across varietals, USDA is unable to establish or standardize an approach to dealing with immature plants for USDA licensees. However, AMS acknowledges operations that grow hemp for certain purposes that do not bring plants to their flowering stage like clones and microgreens, may not need to meet the same sampling and testing requirements as operations that grow flowering hemp. The final rule provides States and Tribes the flexibility to consider performance-based sampling protocols to address these concerns. As allowed under the AMA, States and Indian Tribes can be more restrictive and may impose sampling and testing requirements on these producers. USDA also acknowledges that research institutions face special circumstances when conducting hemp research. Accordingly, this rule provides sampling and testing flexibility to these institutions and producers working with them to conduct hemp research under the USDA plan. Producers that produce hemp for research must obtain a USDA license or a State or Tribal license. However, the hemp that is produced for research is not subject to the same sampling requirements or the requirements pertaining to non-compliant plants, provided that the producer adopts and carries out an alternative sampling method that has the potential to ensure, at a confidence level of 95 percent, that the cannabis plant species Cannabis sativa L. that will be subject to this alternative method will not test above the acceptable hemp THC level. USDA licensees will need to submit an alternative sampling method to USDA for approval and shall ensure the disposal of all non-compliant plants. USDA licensees shall also comply with the reporting requirements including reporting disposal of non-compliant plants. AMS views this flexibility as necessary to help support research and development as it relates to hemp production by industry, particularly in its infancy. This decision allows these types of research facilities and institutions to oversee the study of hemp plants through trialing and genetics research. Over time, the flexibility provided by this final rule will help to stabilize industry by providing greater understanding of hemp genetics and how certain varietals respond differently to growing conditions in various geographic locations. All producers are expected to benefit from such knowledge as information about more stable and consistently reliable hemp varietals becomes available. Any non-compliant plants produced by research institutions as a result of research and development will still need to be disposed and disposal will need to be verified with documentation. Research institutions that handle ``hot'' hemp must follow CSA requirements for handling marijuana.Sampling Agents This final rule reiterates that samples of hemp ***collected*** for purposes of testing THC must be ***collected*** by sampling agents, or by Federal, State, Tribal or local law enforcement agents authorized by USDA to ***collect*** samples. Requirements and training materials for sampling agents are provided on USDA's website. Third-party Sampling Agents: Some comments supported the use of third-party sampling agents to help offset the cyclical demand for hemp sample ***collection*** and to ensure integrity in the sampling process. Comments noted that some State ***agriculture*** departments have relied on in-house personnel to perform sampling activities and that these States did not use or require third-party sampling agents during piloting. One comment reported use of third-party certified samplers for the 2020 season, and as of the date of their comment, had employed 74 certified sampling agents. The commenter said the State recommends producers make appointments with sampling agents 30 days in advance prior to intended harvests, and that they had not received any feedback regarding unavailability of sampling agents based on the 15-day window. The comment went on to report that the State had received numerous anecdotes of next-day availability for sampling, which the comment suggested would not be possible without the use of third-party sampling agents. Resources: Several commenters worried that there would be insufficient numbers of appropriately trained, USDA-approved sampling agents available during harvest periods to ensure that all crops could be sampled, tested, and harvested within the 15-day window specified in the IFR. They asserted that sampling backlogs and delayed testing and harvesting would cause crops to mature beyond the acceptable hemp THC content concentration, resulting in crop disposals and financial losses for farmers. Several comments said producers in rural and remote mountainous areas would be particularly impacted, since sampling agent travel into those areas would require extra time and expense. Comments described how some States developed sustainable hemp oversight programs using risk-based sampling methodology to support regulatory monitoring of hemp growers. They asserted these same States would find it difficult to meet the IFR's sampling requirement because of a limited budget to hire and train additional personnel for sampling all hemp production. Comments reported having to make appointments for sample ***collection*** a week in advance under risk-based sampling plans and predicted it would be even harder to arrange for sample ***collection*** on a timely basis under the IFR's requirement that all hemp lots be sampled and tested. Commenters presented two proposals to alleviate this strain--allowing producers to ***collect*** their own samples and reducing the volume of farms and plants from which samples are ***collected***. Some commenters requested that USDA compile a publicly available national list of sampling agents.[[Page 5628]] Sampling Agent Training: Comments highlighted the importance of providing robust training for sampling agents and recommended subsequent annual, documented refresher training be required. Some comments recommended USDA develop and implement a sampling agent certification scheme, while others suggested States and Tribes retain the authority to develop sampling agent training. Other comments suggested including a sampling agent training application on the USDA website. Other Comments on Sampling Agents: Other comments objected to the IFR's provision that sampling agents be given unlimited access to all areas listed in the producer's license. Comments claimed that this provision, in addition to the fact that default sampling agents may also be law enforcement representatives, seems to associate the now legal hemp industry with potential illegal activity. Comments stated further that while State, Tribal, and USDA personnel may require such access for audits or other purposes, broad access is not necessary for sampling hemp, and that sampling access should be limited to cannabis plant material being cultivated as hemp. Other commenters suggested that sampling agents should be ***agricultural*** specialists rather than law enforcement specialists in order to alleviate possible tension between Indian Tribes and law enforcement, and would ensure that the sampling agents have an understanding of the ***agricultural*** product they are working with. AMS response: AMS agrees with the many commenters that sampling agent training should be enhanced. Standardized training for sampling agents will help achieve regulatory consistency. As such, AMS will provide training documents for sampling concurrently with publication of this final rule. The revised sampling agent training will establish uniform and standardized criteria, including sampling processes and procedures, to ensure the sampling agents understand regulatory provisions of this final rule and the appropriate processes associated with sampling activities. This will help ensure that sampling done by different agents will be conducted similarly. AMS anticipates this will minimize variances in sampling practices that may affect the samples and ultimately the test results. Training documents will explain how sampling agents can meet the sampling requirements of this final rule. States and Indian Tribes with an approved plan may require the sampling agents used by their licensed producers to take the USDA training, or they may develop their own custom training. This decision does not change the requirement that designated agents ***collect*** samples. We are retaining the requirement from the IFR that the use of third-party agents is acceptable. Requiring sample ***collection*** by trained agents ensures that samples are ***collected*** consistently throughout the industry and no conflict of interest exists between the sampler and grower. Further, AMS has addressed commenters' concerns about adequate resources by allowing for States and Indian Tribes to design a sampling plan in accordance with the AMA and this final rule that suits their needs and resources. Additional discussion of sampling methodologies and flexibilities is included elsewhere in this final rule. AMS agrees with the concerns that sampling agents be given unlimited access to all areas listed in the producer's license and is clarifying that sampling agents need access only to areas where the hemp is grown and stored so they can perform their sampling work. AMS agrees with comments that allowing third-party individuals to become certified hemp sampling agents creates jobs, gives producers greater flexibility during the harvest season, and allows the States and Tribes to reallocate resources. The final rule does not limit sampling agents to law enforcement officers and does not prevent ***agricultural*** specialists operating as sampling agents. Because States and Indian Tribes with approved plans may approve their own sampling agents, USDA encourages States and Tribes to maintain their own lists of sampling agents.Sampling Methodology AMS posted supplemental Sampling Guidelines for Hemp Growing Facilities on its website. The guidelines describe sampling procedures, including the number of cuttings to take for sampling each lot and how to pace a hemp field when sampling. A few comments addressed the Sampling Guidelines and recommended alternative sample volumes and field sampling patterns. End-use/risk-based sampling: Comments asserted that hemp sampling requirements should differ based on the crop's end-use, primarily whether the crop is used for grain and fiber production or for cannabinoid extraction. They contended that the IFR requirement to sample every hemp lot, regardless of the crop's end-use, is expensive and burdensome for States, Indian Tribes, and individual growers. Comments generally discouraged requiring sampling and testing every lot for THC since THC concentration is significantly lower in male plants and grain/fiber varietals. Comments from State ***agriculture*** departments that administer pilot programs under the 2014 Farm Bill also explained how risk-based sampling requirements under their programs function. Comments emphasized that a ``one-size-fits-all'' regulation is inappropriate and discourages innovation as there are different risk-profiles for hemp based on its end-use. Comments maintained that grain and fiber varietals are less likely than cannabinoid crops to exceed the THC threshold and argued that assessing all hemp by the same standard may result in strained oversight resources and inefficiencies. One comment asserted that THC concentration in varietals grown for grain is reduced dramatically by the production of seeds in the flower and, therefore, hemp grown for grain is at lower risk of exceeding the THC limit. Comments also noted that the flower parts, where a majority of the THC is concentrated, do not fairly represent the THC content of the entire plant, which is used in biomass and fiber production. One State ***agriculture*** department noted that many of the seed and fiber varietals being grown in their State were originally bred in Canada and have been selected for low THC content as part of Canada's hemp program for many years. Several trade association comments noted that hemp grain/seed is not a source of cannabinoids, and that grain and fiber varietals are largely developed from certified, pedigreed seed that meets all THC testing standards. Commenters contrasted that with hemp crops grown for cannabinoids, and that the latter show higher phenotypic variability and lack of uniformity in the field because they have received less focus in breeding programs. One comment stated that hemp varietals grown for cannabinoid production often have questionable origins and are at a greater risk of producing higher THC than varieties grown for grain or fiber. Another comment claimed there are currently no certified varieties of hemp for CBD production. Many comments agreed that hemp grown for cannabinoid production is more likely to exceed acceptable THC limits. ***Data*** from 2019 submitted with a comment showed that 13 percent of hemp samples tested exceeded 0.3 percent THC, and all were CBD varietals. The comment further recommends that certified seed varieties should be sampled and tested from a random selection of hemp grain and[[Page 5629]]fiber fields 30 days prior to harvest. For uncertified varieties, it recommends requiring a post-harvest test, as well as a pre-harvest test of a random selection of fields within 30 days of harvest. According to comments, those hemp crops being grown for cannabinoids should be subject to higher scrutiny and more frequent testing. Another commenter cited ***data*** from the Midwestern Hemp Database \18\ showing that many publicly available varieties are exhibiting a linear (or curvilinear) relationship between Total CBD (%) and Total THC (%). Given this presumed relationship, Total CBD percentages are often not able to exceed 8 percent without exceeding the regulatory threshold of 0.3 percent THC. The commenter said these moderate levels of CBD production can have significant impacts on profitability as growers and therefore a whole plant testing methodology would help to mitigate this linear relationship.--------------------------------------------------------------------------- \18\ [*https://farmdoc.illinois.edu/field-crop-production/hemp/midwestern-hemp-database-a-new-tool-for-hemp-growers.html.---------------------------------------------------------------------------*](https://farmdoc.illinois.edu/field-crop-production/hemp/midwestern-hemp-database-a-new-tool-for-hemp-growers.html.---------------------------------------------------------------------------) Comments identified States and other institutions where they think risk-based oversight modeling works to ensure hemp is at 0.3% acceptable hemp THC level. For example, the Kentucky Department of ***Agriculture*** publishes a ``Varieties List'' to track THC content across hemp varieties. Comments characterized this as a useful tool for hemp farmers when planning production cycles and selecting hemp varietals. Several comments also described how, at the State level, other measures support risk-based oversight, like randomized sampling crops of a percentage of the total grower population or the use of risk criteria to identify ``high risk'' growers. Commenters credited these types of practices and activities with allowing states to efficiently oversee hemp production under pilot programs. Other comments described how financial institutions routinely incorporate risk-based modeling into the risk assessment of lending decisions, and that similar modeling should be adopted by USDA for sampling and testing. Comments argued that subjecting all varietals to the same regulatory requirements under the final rule will compound logistical challenges to oversight bodies, strain resources, and increase costs for low-risk farmers. They said testing based on hemp's end-use created a more flexible approach to oversight while benefiting the farmer. Two state department of ***agriculture*** comments supported end use or risk-based sampling methods in order to account for producers using certified seed, producing hemp for industrial use purposes, fiber, grain, seed, extraction of biomass, and indoor producers growing plants only in vegetative state for research or resale that pose a low risk for detectable THC content. Several other comments suggested ways USDA could incorporate risk-based sampling into the domestic hemp production program. Comments recommended USDA evaluate and consider allowing greater regulatory flexibility for States and Tribes to develop and use risk-based modeling to guide their sampling and testing activities. According to comments, this approach would help offset the anticipated strain on resources during peak sampling that would otherwise result under the IFR requirements. Two State ***agriculture*** departments recommended that crops produced from AOSCA-certified seed, which they said currently only include grain and fiber varietals, be considered low-risk for testing and compliance purposes. Comments said that as more CBD hemp varietals are developed and certified, they could also be subject to less stringent testing protocols. A few comments suggested the adoption of a random risk-based sampling and testing scheme to reduce grower costs and relieve pressure on approved labs by reducing the number and volume of required tests. One comment indicated State hemp regulators have successfully developed sampling requirements for end-use that ensure adherence to State and Federal regulations, while allowing for flexibilities around State resources. Other comments sought requirements establishing a minimum number of cuttings per lot (e.g , ``5'' cuttings per lot regardless of size.) For example, one comment suggested that when sampling lots of less than 1 acre, taking cuttings of one plant will not allow for a representative sample, so a minimum of 5 plants be identified for cuttings. Another comment said that the sampling requirements in the IFR, as applied to a 170-acre field, could require the sampling of as many as 110 plants from that field which would be impossible for a state department of ***agriculture*** to meet. As an alternative, USDA might provide a fixed sliding scale (for example, a lot of less than 10 acres requires 5 plants; a lot between 10 acres and 20 acres requires 6 plants; and so on) rather than leaving those calculations to each state. Alternatively, another comment explained how their state sampling protocol currently utilizes the parameters of a minimum of 6 cuttings per lot or acre, whichever is smaller, with the option for producers to increase the quantity of cuttings ***collected*** as they see fit (up to 150 cuttings per lot). Another comment described how contracted labs for their state have requested at least 40 grams of wet material and up to 60 grams if the licensee is also needing additional testing such as heavy metals, pesticides and mycotoxins. One comment reported the results of a 2019 controlled study where the top 12 inches of the plant and the top 2 inches of flowering material were ***collected*** from each of 83 plants, for a total of 166 samples. The samples were tested using gas chromatography with flame ionization detection. Test results showing total delta-9 THC of the 2-inch cuttings were, on average, 0.0273 percent higher than results for the 12-inch cuttings. The comment interpreted the results to suggest that including vegetation from the entire plant yields lower THC results, and that all parts of hemp plants should be sampled because producers generally harvest the entire plant. One comment reported that their State requires samples for any size lot to include 30 buds (subsamples) to insure there is large enough volume of material to provide for adequate sample testing. Another comment reported that State staff are directed to look at a cultivar and evaluate it for uniformity with respect to maturation, height, color, and basic plant architecture. According to the comment, uniformity within a cultivar results in fewer plants sampled than a cultivar exhibiting greater phenotypic diversity for the same acreage. The comment supported providing States with authority to establish sampling protocols, given the significant variation in plant counts between fields (on a per acre basis) and phenotypic diversity within and between cultivars. The comment also recommended that AMS provide guidance on a recommended number of plants to be sampled per unit area, including the plant density for each sample number recommendation. One comment advocated revisions to USDA's sampling guidelines. The commenter said the State has had to deviate from USDA's sampling table, specifically for smaller lots. According to the comment, taking a sample from one plant does not provide enough material for lab testing, and the State has had to bear the cost of taking a second sample. The comment mentioned that some of the State-contracted labs have requested at least 40 grams of wet material and up to 60 grams, if the licensee is also requesting additional testing, such as for heavy[[Page 5630]]metals, pesticides, and mycotoxins. The comment also explained that to keep from delivering excess material from large lots to labs, inspectors take the required number of cuttings, then homogenize the sample, keep the required 40 to 60 grams, and leave the remaining sample material in the field. The comment supported a sampling protocol that would provide adequate testing material without unnecessarily overcutting plants material. One comment reported results of a poll they conducted among States after the end of the 2018 growing season. According to the comment, three States--New York, Pennsylvania, and Minnesota--reported they had analyzed the THC content in microgreens, and none were found to be above 0.3 percent total THC. One comment reported that their State has tested every hemp lot produced in Minnesota in the past five years, and that hemp grown for grain and fiber has never tested above the 0.3 percent total THC limit. According to the comment, varieties grown in Minnesota are certified varieties found either on the Health Canada List of Approved Cultivars or the European Union's Organization for Economic Co-operation and Development List of Varieties Eligible for Seed Certification. One comment reported their State has implemented a risk-based sampling frequency schedule, under authorities provided for in the 2014 Farm Bill, using end-use and certified seed as guidance. According to the comment, official total THC results ***collected*** from regulatory samples and formal research samples showed that hemp grown from certified seed have a low risk of testing above 0.3 percent. Additionally, the grain or stalk components of hemp have zero to negligible levels of total THC. The comment recognizes that more research is needed in this area but is confident that the utilization of hemp variety categories to determine the department's sampling frequency has been successful to date. AMS response: AMS agrees that States and Indian Tribes need more flexibility in developing sampling methodologies. For States and Indian Tribes with primary regulatory authority, USDA is altering the sampling requirements in this final rule to allow performance-based sampling methodologies. Information submitted by States that participated in the 2014 pilot program show various ways these States are already using performance-based sampling. Some States are using a list of varieties that work in their geographical area while others rely on evaluation on what they consider high risk producers. USDA finds the ***data*** submitted by commenters to be reliable because these States have been growing hemp since the 2014 pilot program started and they have sufficient ***data*** to develop their sampling plans. AMS agrees with commenters that the performance-based concept is the same method that financial institutions use. Further, performance-based programs are also used by other scientific and Federal agencies such as USDA's Food Safety and Inspection Service and FDA. AMS finds that it makes sense to encourage States and Indian Tribes to consider performance-based alternatives when developing sampling plans. The final rule provides the standard; however, States and Indian Tribes have the flexibility to determine how to achieve that standard tailored to their specific needs. The sampling requirements for State and Tribal plans allow for States and Indian Tribes to develop unique sampling protocols for hemp licensees under their jurisdiction. State and Tribal plans must include a procedure for accurate and effective sampling of hemp that meets the requirements of the final rule. The method used for sampling must be sufficient at a confidence level of 95 percent that no more than one percent of the plants in each lot would exceed the acceptable hemp THC level. Alternatively, States and Indian Tribes may design a sampling method that is performance-based that ensures, at a confidence level of 95 percent, that plants will not test above the acceptable hemp THC level. This plan must be part of the State or Tribal plan. A performance-based method may consider: (1) A seed certification process or process that identifies varieties that have consistently demonstrated to result in compliant hemp plants in that State or territory of the Indian Tribe; (2) whether a producer is conducting research at an institution of higher learning or that is funded by a Federal, State, or Tribal government; (3) whether a producer has consistently produced compliant hemp plants over several years or several seasons; and other similar factors. USDA believes this will provide needed flexibility to States and Indian Tribes to develop logical and enforceable sampling requirements that take into consideration their unique circumstances. AMS will still require States and Indian Tribes to submit their individual sampling requirements for review as a component of the plan approval process. Sampling protocols submitted by States and Indian Tribes must comply with the thresholds established by the 2018 Farm Bill and this final rule. If performance-based sampling requirements are not included in a State or Tribal plan, every lot, and thereby every producer must be sampled and tested. When evaluating sampling protocols submitted by States and Indian Tribes, USDA will take into consideration whether the performance-based factors the State or Indian Tribe used have the potential to ensure compliance at a 95 percent confidence level. USDA licensed producers are required to comply with the sampling requirements in this final rule. Additional guidance on sampling for USDA licensees or States and Indian Tribes that decide to use these guidelines is available on the USDA website at [*https://www.ams.usda.gov/rules-regulations/hemp/information-sampling*](https://www.ams.usda.gov/rules-regulations/hemp/information-sampling). USDA may develop a performance-based sampling in the future if ***data*** is available and if it deems appropriate. Separate rulemaking and comment process will be necessary to establish a performance-based sampling plan by USDA. USDA plans to audit State and Tribal activities to assess program compliance with all Federal requirements, which includes review of the performance-based sampling implemented by States and Indian Tribes. Sampling Guidance: A comment noted that although the sampling protocol was issued as a guideline, it appears to be binding with regard to how hemp must be sampled. The comment said AMS should clarify that there may be other acceptable sampling procedures that would meet the IFR's sampling requirement. The comment explained further that some States operating hemp programs under the 2014 Farm Bill have established detailed hemp sampling protocols that producers are used to and should be allowed to continue. Another comment appreciated the IFR's provision that the AMS Sampling Guidelines may need continual updating and refinement as industry, academia, and government discover new evidence, science, products, and innovations. A comment described the hemp field sampling plan they adopted from Florida's nematode sampling plan. The plan recognizes that nematodes are unlikely to be evenly distributed throughout an orchard or field, which would also allow for accurate detection of THC fluctuation within a hemp field. The comment said Florida's sampling plan is accepted by every State and country to whom they send citrus plant material that has been screened for nematodes and recommended AMS[[Page 5631]]revise the hemp Sampling Guidelines to incorporate Florida's sampling plan. A comment said Kentucky requires cuttings from five plants per lot, believing this standard provides a reasonably representative sampling of the plants in each lot. It opposed the sliding scale in AMS's Sampling Guidelines, saying the sliding-scale calculation relies upon a decades-old pesticide residue sampling regime that may or may not be appropriate for calculating confidence levels in a hemp plant's THC levels. The comment asserted the sliding scale formula, which depends on a variable factor based on historical ***data***, is likely to create state-to-state variations in the number of samples that must be ***collected***, and would require States with historically lower rates of non-compliant THC test results to take more samples per lot than those States with historically higher rates of non-compliance, which the comment found to be illogical. The comment explained that applying the Sampling Guidelines' sliding scale calculation to a 170-acre field could require the sampling of as many as 110 plants from that field. It went on to say that sampling a single field under that scenario would overburden available sampling and laboratory staff, make transporting sample material difficult, and make grinding sample material an impossible workload. The comment recommended AMS specify a single number of plants to be sampled from every lot, regardless of the lot's size, or publish a fixed sliding scale for industry-wide use, rather than leaving those calculations to each State. This comment was supported by several state departments of ***agriculture***. A comment noted the importance of moisture content consistency in compliance sampling and recommends 8-12 percent moisture content standardization. They also noted the need for best practices to be identified for drying sample material. Several comments said USDA's sliding scale sampling protocol results in too little a sample for small acreages and too large a sample for large acreages. Comments asserted, for example, that one cutting for four acres or less would not be suitable to ***collect*** a representative sample and could put small acreage farmers at a higher risk of being violative or not might be sufficient to capture uncertainty related to population variability in a newly established crop. Another comment said that a true representative sample needs to entail multiple subsamples ***collected*** spatially across a field and pooled into an average sample. Further, according to the comment, since cannabinoids tend to increase along the height of the plant, floral material should be sampled at random heights from plants rather than all from the tops of plants to be representative. Another comment recommended revisions to the Sampling Guidelines to provide that sampling agents should sample fields in a zig-zag pattern. The comment further recommended that AMS revise the Sampling Guidelines to provide that three cuttings should be taken from every plant sampled, and that the three cuttings should be taken of floral, stem, leaf and stalk material at three different points on the plant. It argued that floral material makes up only 25 to 30 percent of hemp plants and that, to be truly representative of the sampled plant, the sample should consist of cuttings of all plant materials from throughout the plant. One comment recommended requiring that samples consist of a minimum of 4 ounces of material to provide an adequate amount for testing. Another comment suggested USDA research and review multiple sampling protocols and select the best among them. AMS response: AMS agrees that establishing clear and standardized Sampling Guidelines is important for all hemp producers and States and Indian Tribes with primary regulatory authority over hemp. AMS issued Sampling Guidelines and is updating that guidance to reflect the changes from the IFR to this final rule. States and Indian Tribes with USDA-approved hemp production plans may develop their own sampling procedures that take into account regional and other differences and are performance-based, so long as those procedures meet the requirements in the regulations at Sec. 990.3 The entirety of the State or Tribal sampling plan, including any guidelines, must be included in the State or Tribal plan submitted to USDA for approval. When developing such plans the State or Indian Tribe must follow the requirements of this final rule that relate to where the cutting takes place including only flower material, and the number of inches necessary for sampling. Specific to sample size or weight of a cutting, AMS does not agree that establishing a specific volume is prudent given the variances in flower size and densities, and different scales of hemp production. It would be difficult to consistently sample at an exact weight of plant material across the spectrum of producers and therefore is not included in this final rule. Rather, AMS specifies a length (approximately five to eight inches) from the ``main stem'' (that includes the leaves and flowers), ``terminal bud'' (that occurs at the end of a stem), or ``central cola'' (cut stem that could develop into a bud) of the flowering top of the plant. This is considered appropriate and fair to balance the ***collection*** of sufficient plant material necessary for compliance laboratory testing while avoiding the need to cut excessive and unreasonable amounts of plant material. Further, AMS determined this final rule must provide some additional degree of flexibility for States and Indian Tribes in the development of their sampling plans, which is why as an alternative, this final rule allows for performance-based sampling methodologies in State and Tribal plans. Flexibilities afforded to States and Indian Tribes developing their own hemp production plans will allow them to incorporate best practices, as those change and develop over time. For example, States and Indian Tribes can adapt field-walking patterns to various sized and shaped hemp grower operations. AMS believes that a national standard would be difficult to consistently apply given the various grower operations and that standard ``zig-zag,'' or letters ``M'' or ``Z'' walk patterns may not be feasible for sample ***collection*** of micro-acreage producers, very large scale producers or those with polygonal hemp lots. As an alternative option, AMS has updated the Sampling Guidelines and Protocols in conjunction with the publication of this final rule. This resource document is available online and offers guidance States or Indian Tribes can adopt and incorporate into their own USDA-approved sampling procedures.Flower Versus Whole Plant Sampling The IFR requires the ***collection*** of samples from the flower material of hemp plants for laboratory testing. Comments: Several comments expressed support for sampling only hemp flowers, as provided in the IFR, although many recommended changes to the overall flower material sampling requirements. Those recommendations and commenters' explanations for them are addressed in another section of the comment analysis. Numerous comments opposed the IFR's floral material sampling requirement, preferring instead composite sampling of the flowers, stems, stalks, and seeds, and asserting such samples would be more truly representative of the entire plant and lot. Numerous comments agreed that cannabinoid concentrations are higher in the flower than in other parts of the plant, and many comments[[Page 5632]]argued that sampling only floral material would cause more samples to inappropriately and unfairly test ``hot'' and lead to unwarranted and costly crop disposals. Several comments said that sampling only the flowering material of the hemp plant is inconsistent with the definition of industrial hemp, as amended by the 2018 Farm Bill, which refers to the whole hemp plant. Comments asserted that the statute did not limit sampling to floral material and challenged USDA's interpretation of the statutory sampling requirement. As well, comments argued that requiring sampling of only flowering material could lead to legal challenges from producers who would be forced to destroy hemp that may be statutorily compliant, but not compliant with the IFR. They recommended that the regulations provide for sampling the whole plant and that USDA define the term ``whole plant'' to include the flower, stalk, and leaves. Some comments stated that sampling only flower material ignores the hemp grown for seed and stalk end-uses, and not for cannabinoids. Comments claimed that sampling and testing only flowering material would limit industry diversification in terms of producing hemp for biomass intended for uses other than THC production. To address this, several recommendations for revisions to the IFR's sampling requirements were offered. Some comments recommended taking larger samples from prescribed parts of hemp plants that would include other than flowering material. For example, both State departments of ***agriculture*** and Indian Tribes recommended taking branch samples from two or more specified parts of plants that would include flowers, stems, stalks, and seeds, and proposed a range of sample lengths they considered appropriate, from 4 to 18 inches. Some recommended taking samples of the lower part of branches as well as flowering tips from the same plant. Several comments urged USDA to adopt risk-based sampling requirements that would better align with the intended end-use of hemp crops, like grain and fiber. Other comments recommended revising the IFR to allow States and Indian Tribes to design sampling requirements to meet the particular needs of producers in their jurisdictions, like producers who are well experienced with growing hemp and understand the potential to grow a non-compliant crop. Commenters expressed the widely shared view that cuttings for hemp samples must come from various locations on the plant, not just the top third as indicated by the Sampling Guidelines. They explained that marketable hemp product comes from a composite of the entire plant, not just the top, and asserted that flower material samples should likewise come from the entire plant to ensure the sample accurately reflects the lot from which it is taken. Comments also voiced the need for greater regulatory clarity on the size of the floral cuttings due to concerns that no regulatory requirements address floral ***collection*** by authorized sampling agents, and variances in types of materials ***collected*** may affect test results. Cannabinoid Concentrations: Comments described phytochemical characteristics of Cannabis sativa L and argued that samples taken from only one part of the plant are not representative of the whole plant. Some comments contended that flowers at the top of the plant have higher concentrations of THC and other cannabinoids--by as much as 30 percent, according to some--than flowers elsewhere on the plant. One comment cited a study \19\ that found that top-only sampling, as prescribed in many State testing programs, leads to an overestimation of THC content by nearly 37 percent. The study stated that to better represent total crop THC levels, samples should be taken from the top, middle, and bottom of plants in equal quantities. Commenters asserted that sampling flowers from only the top of the plant could lead to incorrect conclusions about the lot's compliance and lead to inappropriate and costly lot disposals.--------------------------------------------------------------------------- \19\ ``THC Distribution in Field Grown Hemp Prior to Harvest,'' J. Scott Lowman, Jack He, Mike Clark, and Mark Gignac; The Institute for Advanced Learning and Research (IALR), Danville, Virginia.--------------------------------------------------------------------------- Other comments contended that THC concentrations are not necessarily higher at the top of the hemp plant. One comment used ***data*** to show that the distribution of THC concentrations throughout hemp plants is not consistent between varieties. It cited a 2019 comparison study in which 4-inch cuttings of floral material from two hemp varieties were taken from the top, middle, and bottom sections of plants. In one variety, total THC was highest in samples taken at the top, and lowest in samples taken from the bottom of plants. In the other variety, total THC varied little between samples from plant top, middle, and bottom positions. The comment said the ***data*** refutes the belief that THC levels are highest at the top of the plant and supports sampling from all parts of the plant to obtain an accurate representation of each lot's composite marketable hemp product. Sampling technique: Some comments cautioned that inconsistent potency measurements may be the result of divergent sampling approaches and recommended that USDA provide regulatory clarity as to the proper sampling process. A comment encouraged USDA to establish clear numeric designations of how much floral material is taken from each plant. Comments varied in their suggestions on sample cut including: 12 inches per plant; cuts from the top and bottom 18 inches of a terminal branch of the plant to achieve a more representative sample; cutting from the top twenty centimeters from the main stem of the female plant; eight to ten inches of the plant's primary stem; whole plant sampling whereby the top 1/3rd, middle 1/3rd and bottom 1/3rd are each sampled; and to ground the whole plant--not only the top 1/3rd--as that is not representative of the delta-9 THC level of the plant. AMS response: The IFR required the ***collection*** of samples from the flower material of hemp plants for laboratory testing. Following the publication of the IFR, AMS made available at [*www.ams.usda.gov/rules-regulations/hemp*](http://www.ams.usda.gov/rules-regulations/hemp) a supplemental document addressing Sample Guidelines as a reference resource to industry. This resource document indicates that hemp samples are comprised of cuttings from just underneath a flower material located at the top one-third of the plant. Following review of public comment from various stakeholders, AMS determined this final rule will allow for additional sampling methodologies for determining the sample size from the lot as described previously under the ``Sample Size'' discussion. However, since THC is concentrated in the flower material of the plant, the flower material is more appropriate to test than the entire plant. The final rule specified pre-harvest samples shall be approximately five to eight inches from the ``main stem'' (that includes the leaves and flowers), ``terminal bud'' (that occurs at the end of a stem), or ``central cola'' (cut stem that could develop into a bud) of the flowering top of the plant. This aligns provisions of this final rule with the common practices of several States that significantly participated in the 2014 Farm Bill hemp pilot programs. This decision further balances the need to ***collect*** a sufficiently large portion of the plant's flower, where THC and other cannabinoids are at their most concentrated, and the need to avoid cutting a portion of the hemp plant that[[Page 5633]]poses logistical challenges to shipment, drying and preparing for laboratory tests. AMS believes this provision will help standardize sampling across the nation. AMS considered the differences of pre-harvest vs. post-harvest sampling and determined the most practicable way to identify THC concentrations of the plant is through pre-harvest sampling since the floral material is still intact. Floral material must be intact to assure the material submitted for testing is in fact the flower part of a hemp plant and it has not been compromised or mixed with other plant parts. AMS also considered the many commenters who endorsed ``whole plant'' sampling. AMS concluded that measuring THC concentration through floral material testing is more appropriate and practicable than testing the entire plant because testing the entire plant will dilute the THC concentration in the sample, except as allowable under remediation, as discussed elsewhere in this final rule. Further, the study cited by a commenter that shows THC concentrations throughout hemp plants are not consistent between varieties does not support the use of whole plant sampling because it compares different plant varieties, not the THC level on different parts of the same plant variety where the sample is taken. Accordingly, sampling the top part of the plant will provide the most accurate results. Since THC is concentrated in the flower material of the plant, the flower material is more appropriate to test than the entire plant. AMS will modify the sampling requirement to state that the sample shall be approximately five to eight inches from the ``main stem'' that includes the leaves and flowers, ``terminal bud'' that occurs at the end of a stem, ''or ``central cola'' (cut stem that could develop into a bud) of the flowering top of the plant. AMS believes this consistency will help establish a level playing field for all U.S hemp producers. The Sampling Guidelines issued concurrently with this rule includes additional details. AMS also includes additional flexibilities for disposal and remediation of ``hot'' hemp that would reduce the costs to producers. These are discussed later in this final rule and in separate guidelines published concurrently.Measurement of Uncertainty (MU)--Field Sampling The IFR did not address the subject of uncertainty when conducting field samples and only speaks to the measurement of uncertainty in performing laboratory tests for regulatory compliance. Comments: Several comments noted that not accounting for MU in sampling is a potential oversight that should be addressed in the final rule. Several comments note that field sampling is the largest source of variability in any testing process, due to the choices individual sampling agents make and field condition variability. Comments argued that there is a wide degree of variability among individual plants in a hemp crop and that this contributes to further uncertainty in field sampling. Due to this uncertainty in the field during sample ***collection***, commenters suggested that an MU for field sampling be included in the final rule. Several State ***agriculture*** departments argued that the MU value should account for variability in the steps that occur before a sample reaches the laboratory. Comments noted the various steps in the field sampling process, such as cutting, bagging, sealing, transporting, and handling, and explained that each increases uncertainty in the THC testing results before the sample even arrives at the laboratory for compliance testing. Commenters asserted that uncertainty related to each step in the field sampling ***collection*** process should be accounted for in the MU. Several comments argued that, without a standardized MU for field sampling, some hemp crops with specific end-uses would be disproportionately impacted. According to comments, hemp crops grown for cannabinoids show the most phenotypic variability and lack of uniformity in the field. Comments said this variability should be accounted for before the sample reaches the laboratory. One comment suggested following the ISO 15189 standards that take into account uncertainty sources during the analytical phase where the measurement actually occurs. Several comments requested that USDA establish a standardized method of calculating uncertainty resulting from sample ***collection*** procedures and for uncertainty in laboratory testing methods. One comment noted that USDA's Sampling Guidelines do not require the USDA-approved sampling agent to communicate to the laboratory anything related to crop variations or the agent's sampling methodologies that may contribute to uncertainty in testing the hemp crop for compliance. A comment suggested a method for calculating MU that would include pre- and post-laboratory activities: MU would be calculated as the square root of the sum of squared values for pre- and post-laboratory activities, or, (a) squared plus (b) squared = (c) squared, where (a) is field sampling activities and (b) is laboratory MU. The comment offered this example: If the in-laboratory measurement of uncertainty (b) is calculated as 0.0300 percent, and the field sampling measurement of uncertainty (a) is estimated to be 0.0400 percent, then the total measurement of uncertainty (c) would be 0.0500 percent. An institute that commented discussed research which found that sampling from the whole plant more accurately reflected what was observed in a field. The comment explained how the current USDA method, which analyzes only the top \1/3\ of the plant, generates ***data*** that is error-prone and results that likely do not represent the actual THC levels that are present in the hemp plants in the field as a whole. It said, for example, in one research field, THC levels ranged from 0.06 percent to 2.46 percent in the top \1/3\ plant samples when individual plants were evaluated separately. The research also found significant variation in THC concentration across plants, which the commenter attributed to the lack of ability of the sampling procedure to generate a consistent, reproducible sample from any given hemp field. The research found if the field contains plants that are not completely uniform in their THC levels relative to each other, it is possible that this small subsample in any given analysis could over-represent plants that have higher levels of THC, thereby leading to failure of the field. On the other hand, equally possible, that analysis could over-represent plants that have lower levels of THC, leading to passing the field. The research stated that the most likely result of a sampling test is an inaccurate assessment of the total THC levels based on the method used to sample the plants in the field and then prepare them for extraction. A comment from a private laboratory noted that when field sampling and pre-analysis handling and processing is done properly and uniformly, the pre-analysis measurement uncertainty can be reduced to 5-10 percent. The comment suggested that test results might be more consistent and uniform when ***collecting*** samples in a ``W'' pattern with a minimum of 10-15 individual cuttings taken from the top and middle third of the plant. Some comments recommended USDA conduct or fund a study to determine appropriate requirements for calculating sampling uncertainty. AMS response: AMS appreciates the different suggestions submitted by commenters on ways to handle potential[[Page 5634]]variability and uncertainty associated with sampling. AMS recognizes that a variability in sampling may contribute to the overall uncertainty of the final result. For reasons explained below, AMS in unable to adopt a national standard for calculating the MU for sampling. However, States and Indian Tribes, may include one in their State or Tribal plan as part of their performance-based alternative method for sampling under Sec. 990.3(a)(2)(iii). In order to develop a standardized approach to sampling MU, a sampling plan must first be well-established, standardized, and studied to accurately account for uncertainty differences in sampling methodologies. To measure uncertainty of the complete process, from primary sampling through analytical determination, all steps in the process must be included. There are many intermediary steps that must be measured, such as sampling conditions, sample preparation, sample preservation, and transportation, all of which are not always present and/or completed the same each time sampling occurs. States producing hemp under the 2014 Farm Bill have developed sampling plans that vary widely; sampling MU is not something that can be easily studied, calculated, or broadly standardized. Due to the variability in sampling across producers, States, and Indian Tribes, and the lack of available ***data***, USDA is unable to establish or standardize a specific MU value or boundaries (upper or lower) for general use. In the future, standards organizations, such as ASTM International through their Committee (D37) on Cannabis, will be establishing sampling standards that States, Indian Tribes, and producers could use to improve or help control sampling uncertainty. USDA also recognizes that States and Indian Tribes may have or will conduct their own study of the sampling uncertainty within their States or territories taking into account the conditions that may affect sampling. Those States and Indian Tribes may be able to calculate or standardize the MU for sampling within their States and territories. For those reasons, States and Indian Tribes may incorporate a sampling MU as part of an alternative method for sampling under Sec. 990.3(a)(2)(iii).Post-Sample Harvest Window The IFR required testing for total delta-9 tetrahydrocannabinol concentration levels and sampling for such testing was required to occur within 15 days prior to the anticipated harvest of cannabis plants. The IFR required sampling to be conducted by a Federal, State, local, or Tribal law enforcement agency or their designee. Comments: Numerous comments expressed opposition to the 15-day post-sample harvest window. Comments argued that a 15-day window is too short and urged AMS to make it longer, providing several examples of anticipated difficulties with the 15-day window. According to comments, the 15-day sampling window in the IFR did not allow enough flexibility to reckon with adverse weather conditions that could delay or preempt field sampling and harvest activities. Comments said that isolated producers and others with limited access to harvest machinery might not be able to complete harvests within 15 days of sampling if weather prevents them from getting into the fields. Comments also noted that in some hemp production areas, climate changes are trending toward wetter harvest seasons, with frequent and catastrophic flooding in recent years. Other comments provided examples of climate variations across the U.S and explained that the 15-day window is not uniformly suitable for all regions, some of which may be more prone to early freezes and other conditions that could forestall a timely harvest or force producers to harvest before receiving test results in order to save their crops. Comments also pointed out that a 15-day window does not adequately accommodate a commonly employed two-phase harvest technique, wherein farmers first harvest the seeds and flowers and then the plant's stalks. Comments additionally stated logistical challenges related to sampling on larger hemp farms or farms with several varietals. They asserted that the number of required samples greatly increased under the IFR from what was required under most State administered pilot programs, and that ***collecting***, drying, and submitting samples for those additional lots will be very difficult within the 15-day window. A commenter stated that, in 2019, Colorado sampled only 23 percent of all registered hemp lots within a 30-day sampling window under the pilot program, while under the IFR requirements, they would need to ***collect*** more than four times as many samples in half the time. Many commenters--from producers, state departments of ***agriculture***, and Tribal governments--anticipated bottlenecking delays at laboratory testing facilities due to the limited number of DEA-registered laboratories available to provide testing. Comments from laboratories agreed that the increased demand for hemp testing would strain existing resources and make it difficult to return results to farmers in time to complete harvesting within the 15-day window. One commenter from a private laboratory also noted the strain on human resources this would create to oversight activities because laboratory employees are required to accompany sampling agents through the sampling process within the window. Other comments noted a possible shortage of available farm workers during a tight harvest window. Comments from Indian Tribes stated that the requirement to test within 15 days prior to harvest by DEA registered laboratories is not practical for Indian Tribes, explaining that many Indian Tribes were moved to desolate lands where growing crops is hampered by location, quality of the land, available water and infrastructure, and access to ready transportation. Further, Indian Tribes said growers are hampered by the economies of size. Comments suggested that in much of the Indian Tribe territories, Tribes will not be able to develop large farms that reduce risk. Many comments recommended increasing the sampling window to 30 days. Some suggested that producers be allowed to harvest before the return of laboratory results, but not be allowed to release product until test results are obtained. One comment added that allowing post-harvest testing would incentivize farmers to monitor their crops prior to harvest in order to minimize the need to destroy crops. Another comment recommended that all hemp testing labs be required to return results to growers within 15 days of receiving samples. Other comments proposed revising the regulations to require only that harvest commence, rather than be completed, within the specified period following sampling. ***Data*** on compliance testing from North Carolina \20\ cited a recent study showed an average of 12.65 days taken to receive test results, with a range of between 2 days and 41 days. It estimates that 50 percent of growers would begin to harvest before receiving the results of their THC compliance test and 22.5 percent would complete their harvest without receiving their results.--------------------------------------------------------------------------- \20\ [*https://beta.regulations.gov/comment/AMS-SC-19-0042-5294.---------------------------------------------------------------------------*](https://beta.regulations.gov/comment/AMS-SC-19-0042-5294.---------------------------------------------------------------------------) Another State department of ***agriculture*** said it has been operating their pilot program utilizing a 25-day harvest window but noted that 25 days has proved an insufficient amount of time in their experience managing their pilot program. They recommend the[[Page 5635]]final rule utilize, at minimum, a 30-day sampling window. A State extension service cited ***data*** from the Midwestern Hemp Database and reports from Rock River Laboratory which shows that 68 percent of the requests for THC compliance testing were submitted during the period of September 8th-October 1st and note this will create a tight peak window during which samples will be submitted. Due to this peak timeframe of compliance testing needs, several State departments of ***agriculture*** note that during these peak times there will be staffing shortages, delays in sampling, delays in analyzing material, delays in the reporting of results and delays due to unsuitable harvest conditions. Another State department of ***agriculture*** recommends that certified seed varieties should be sampled and tested from a random selection of hemp grain and fiber fields 30 days prior to harvest. For uncertified varieties, it recommends requiring a post-harvest test, as well as a pre-harvest test of a random selection of fields within 30 days of harvest. One commenter discussed ***data*** showing that different cultivars accumulate cannabinoids at different rates and at different times. Given the rapid changes in cannabinoid levels, the comment said its ***data*** highlights the challenges of scheduling pre[hyphen]harvest regulatory samples and harvest dates. Finally, a few comments asked for clarification about the 15-day window. Some said it was unclear whether harvest must commence or be completed within the window. Others asked whether a producer is prohibited from harvesting before testing is completed. One comment stated that the 2018 Farm Bill does not contain a timing requirement. One comment reported that their current sample-to-harvest window is 25 days, and that it does not appear to be long enough to sample all the State's outdoor hemp crops maturing concurrently. One comment reported that the IFR's 15-day harvest window is not feasible to implement and puts incredible stress on the developing State's hemp industry. According to the comment, the State applied a 30-day sample-to-harvest window during the four years it participated under the 2014 pilot program. During the 2020 growing season, the State reported it has struggled to sample and test the 5,809 acres and 1.46 million indoor square feet that comprise the fields and facilities of the State's 700 licensed growers within 20 days. The comment claims that the State does not have the financial capability or staff resources to ensure sampling can be achieved at every field within the optimal and correct time. ***Data*** analysis provided by North Carolina State University \21\ evaluated the 2018-2020 turnaround times for labs reporting THC test results to growers on 3,317 lots. The analysis found that in 22.5 percent of cases, growers would have had to commence harvest with no knowledge of their test results to meet the 15-day harvest window requirement in the IFR. The comment asserted that in reality, growers would need lab results in 10 days or less in order to make informed harvest decisions, in which case they assumed approximately 50 percent of the state growers would have had to start harvesting without knowing their test results. The comment referenced NCSU farm cost studies that showed farmers with some equipment at their disposal will spend approximately $14,000 per acre on hemp cultivation. Noting that of those costs, seed/plant acquisition and labor are the greatest expenses, the comment asserted that harvest is the most labor-intensive activity, and that requiring farmers to harvest without knowing whether their hemp crop is compliant or marketable puts them at great financial risk. The comment recommended extending the post sampling harvest window to 30 days to reduce financial risk for farmers.--------------------------------------------------------------------------- \21\ Ibid.--------------------------------------------------------------------------- A comment from another state noted that given the State's size and geography, distances between hemp production sites could be greater than 2000 miles, making the 15-day sample-to-harvest window impractical for them. The comment recommended allowing States and Tribes, who are better aware of their geographies and resources, to determine their own windows, up to 30 days. One comment reported the State has three inspectors geographically dispersed throughout the State, servicing approximately 200 farms harvesting within the same 8-week time period. The comment advocated extending the harvest window to 30 days to cope with unforeseen weather events, extended travel, lab turnaround, resampling and testing, and other delays. One comment contained preliminary findings from an ongoing 2020 study \22\ conducted by a state and a state university that showed different cultivars of hemp accumulate cannabinoids at different rates and at different times in plant maturity. Study ***data*** showed that some cultivars can rapidly accumulate THC and CBD, with weekly changes of as much as 0.1 percent THC and 1.5 percent CBD in some cases. The study found that the rates of THC and CBD accumulation were parallel in the four cultivars studied, with the CBD:THC ratio staying consistent around 24:1. The study concluded that given the rapid rate of change in cannabinoid levels, samples taken 2, 3, or 4 weeks prior to harvest may not accurately reflect the cannabinoid profile of the harvested material. The study further concluded that a larger harvest window increases the likelihood that non-compliant plant material will be harvested and potentially rejected at market, costing the grower the additional expense of harvesting.--------------------------------------------------------------------------- \22\ Pearce, Bob et al. Sequential Sampling of Four Hemp Cultivars for Cannabinoids--2020; University of Kentucky, College of ***Agriculture***, Food, and Environment and Kentucky Department of ***Agriculture***. [*https://beta.regulations.gov/comment/AMS-SC-19-0042-5762.---------------------------------------------------------------------------*](https://beta.regulations.gov/comment/AMS-SC-19-0042-5762.---------------------------------------------------------------------------) AMS response: AMS recognizes weather and climate-related factors affect all cycles of ***agricultural*** production including pre-planting, planting, management, and harvest. AMS also understands these factors may vary by region from year to year, and that certain conditions might cause some farmers to alter their normal harvest timeframe as a result of factors beyond their control as mentioned in several comments. It is common ***agricultural*** practice to harvest crops taking into consideration weather patterns such as rain, wind or freezes. Producers also harvest crops based on the availability of labor and transportation, crop rotation and market demand among many factors. A 15-day harvest window may not allow producers the flexibility needed to take all these factors into consideration. AMS considered the impact of the 15-day window on resources needed for sampling and testing activities. We acknowledge that sample ***collection*** may require an authorized sampling agent to visit multiple farms of varying sizes over a very short period of time. AMS further understands that in some places, the sampling agent may visit a farm on multiple occasions due to the size and harvest cycle of the farm. AMS also considered the turnround time for producers to receive results from laboratory testing. This final rule allows farmers to commence harvests before receiving test results, as did the IFR. However, crops may not be released in commerce or further processed until tests confirm that the lots in question are compliant with the regulations. Harvests must be completed within the 30-day timeframe[[Page 5636]]provided by the final rule. AMS does not believe harvests should occur after that time because, generally, total THC levels continue to increase with time and there is too great a risk that the levels would increase after 30 days and thus the sample that was tested would not be an accurate reflection of the total THC of the harvested crop. Regarding comments on laboratory resources, AMS considered input from our Science and Technology Program, which conducts laboratory testing for numerous ***agricultural*** commodities and oversees our third-party laboratory approval program. AMS assessed testing activities, which include the receiving, selection, drying, processing (through liquid or gas chromatography), analysis, storage, and reporting of hemp test results. AMS considered the time necessary to ship samples to the laboratory and to issue test results back to the grower, recognizing that not all farms have readily available internet to expedite receipt of electronic laboratory notifications. Standard mail may be the primary means of communication for rural populations in certain regions and Tribal lands. AMS also considered the level of routine work at testing facilities across the nation and their capacity to efficiently process hemp samples while continuing unrelated, non-hemp laboratory activities. AMS agrees that it may be difficult at the peak of the season for high-volume laboratories to consistently issue timely results to growers, as producers experienced and DEA acknowledged, impacting growers' ability to make harvest decisions. Based on comments received and knowledge of ***agricultural*** practices, AMS determined that the post-sampling harvest window should be extended to allow hemp harvests to be completed within 30 days after sampling. AMS believes allowing the additional time will provide flexibility for dealing with unforeseen weather events and other ***agricultural*** factors, and better accommodate complicated harvest processes. AMS also believes this will reduce strain on testing resources and ensure test results can be returned to growers on a timely basis.Laboratory Accreditation--Laboratory Approval Program (LAP) and International Standards Organization (ISO) The IFR required hemp growers to obtain testing from DEA-registered laboratories to ensure proper handling, disposal, and reporting of samples that exceed allowable THC limits for hemp and may therefore be controlled substances. As part of the IFR, AMS asked stakeholders whether laboratory accreditation should also be required for hemp testing labs. Specifically, AMS asked about accreditation through AMS's LAP, through the ISO standards (ISO 17025), or through both, and if so, which would be preferable. Comment: Comments reflected a range of views across the industry, both in support of and opposition to additional laboratory certification requirements. In general, commenters preferred more regulatory flexibility to address the widespread concern of insufficient laboratory capacity as a result of laboratory certification/registration/accreditation requirements imposed by USDA regulation. Supportive of LAP and ISO: Some comments supported requiring additional accreditation through both LAP and ISO. Comments explained that LAP accreditation imposes analytical standards and limits that ensure reliable and consistent results across hemp labs, while ISO 17025 accreditation ensures that labs adhere to their own established protocols. Comments asserted that additional accreditation is essential to ensure that laboratories, government entities, and farmers comply with regulations. One comment that supported requiring both accreditations said the scope of the ISO 17025 standards should include hemp testing methods. One comment said requiring LAP and/or ISO accreditation in conjunction with DEA registration is a step in the right direction because current standards are subpar and do the industry a disservice, while adding LAP and/or ISO accreditation would provide a baseline standard that benefits all stakeholders, including consumers. Either LAP or ISO: Other comments advocated requiring additional accreditation through either LAP or ISO, but not both. Comments said that requiring one or the other would be adequate to provide testing integrity, but that requiring both would unnecessarily overburden labs and create a testing bottleneck as labs worked toward accreditation. One comment said that since hemp products are consumable, public health and safety should be of paramount concern when choosing a lab accreditation program. Comments supporting LAP accreditation specifically said such accreditation would improve grower access to qualified labs and would improve the efficiencies and protect the competitive interests of non-DEA labs. Comments favoring LAP accreditation pointed out that LAP already incorporates ISO 17025 standards and includes regular audits and records management requirements. Comments added that incorporating ISO standards into LAP accreditation lends confidence in testing procedures and results, which in turn creates a fair marketplace for hemp. They asserted that the benefits of LAP accreditation outweigh the costs because they emphasize quality controls and accurate analytical performance by knowledgeable and trained staff. One comment suggested that using LAP-approved labs would facilitate USDA's hemp program oversight and the development of an evidence-based ***data*** tracking system. Another comment pointed out that LAP offers growers a complete online listing of qualified labs from which to choose. Some comments argued against adopting LAP accreditation, saying the accreditation process is expensive and burdensome for laboratories, and that the user-fee program benefits only USDA. One comment said that it is unclear from the IFR how LAP differs from ISO and whether LAP accreditation offers more confidence in test results than ISO accreditation. Another comment said that LAP accreditation would be redundant to ISO accreditation and is not necessary. Some comments favored the use of laboratories with ISO 17025 accreditation in addition to or instead of DEA-registration. Comments noted that hemp laboratories in many States already have ISO accreditation, although some are not DEA-registered. They suggested use of those labs should be grandfathered into approved hemp production plans. Some comments asserted that between LAP- and ISO-accreditation, ISO is the best alternative for the hemp industry because it meets the needs of the hemp industry, and at a reported cost of $25,000, it reduces unnecessary expense and regulatory burden for labs and growers. One comment recommended that USDA specify that the most current ISO 17025 standard be required for accreditation--the 2017 version. Neither LAP nor ISO: Several comments opposed requiring additional laboratory accreditation on top of DEA-registration. Some comments called it ``overkill,'' and said requiring additional accreditation would put an undue strain on laboratories and delay testing and reporting results for growers. None of the Above: Several comments opposed specifying any particular laboratory registration or accreditation and recommended instead that States and Indian Tribes be authorized to determine appropriate standards for hemp testing laboratories under their respective production plans. Comments said that allowing States and Indian Tribes to determine their own lab[[Page 5637]]certification schemes would allow them to maintain appropriate testing capability while finding the best fit for the economic profile of their regulated jurisdictions. One comment suggested USDA encourage laboratories to participate in the Hemp Proficiency Testing Program established by the University of Kentucky, rather than building an accreditation program from scratch through LAP. Other Alternatives: One comment asked USDA to clarify why any additional accreditation should be required. Another comment suggested that if laboratory accreditation is necessary, AMS should explore the most cost-effective choice from among LAP, ISO, or other commercial accreditations to minimize costs for growers. A comment suggested that DEA-registered labs not be required by the rule but be allowed as backups for labs with other accreditations. Another comment speculated that if only LAP or ISO accreditation were required, and DEA registration was not, growers would test their crops more frequently. Some comments recommended that no specific accreditation be required because the process is too costly and time consuming and would discourage labs from participating in the program. One comment suggested that USDA encourage labs to adhere to ISO 17025 standards, but not require accreditation. Some comments suggested that LAP accreditation would be beneficial to the industry, but that such a program should be developed incorporating the expertise of former DEA or other chemists with experience testing cannabis. Other comments supported using ISO-accredited labs until LAP accreditation can be fully developed and used on a trial basis to gather adequate experience and ***data***. One comment suggested allowing States, Tribes, and USDA to contract with commercial labs or use private labs that adhere to ISO standards. AMS response: AMS noted that commenters generally preferred more regulatory flexibility to address the widespread concern of insufficient laboratory capacity as a result of laboratory registration requirements outlined in DEA regulations. Adding ISO 17025 or other accreditation requirement to laboratories would decrease the number of laboratories available to perform hemp tests. AMS also noted some commenters opposed accreditation requirements due to cost implications and additional burden. While we strongly encourage laboratories to be accredited to ISO/IEC 17025 (by an International Laboratory Accreditation Cooperation Mutual Recognition Agreement (ILAC MRA) signatory accreditation body), because it will help ensure lab results are more accurate, ISO 17025 accreditation requires significant time and financial commitment to pursue and maintain. This it is most challenging for smaller and start-up labs. The initial accreditation can cost $5,000-$10,000 (and in some case more) and yearly ongoing costs are $3,000-$8,000. Smaller labs may not have the resources to pursue accreditation in a timely manner or they may have to spend more time and money for consultants to assist them in setting up a quality management system and to navigate the application and audit processes. Based on this input, AMS will not require USDA administered lab approval program or require ISO 17025 accreditation because doing so would increase the financial burden on producers and reduce the availability of laboratories that can test for THC level in hemp. AMS is committed to continue looking into this option.DEA Laboratory Registration Requirement The IFR required that laboratory testing of hemp for the purpose of determining compliance under the program be conducted by laboratories appropriately registered with DEA. However, on February 27, 2020, USDA announced guidance delaying the requirement to use laboratories registered with DEA for testing. Under this guidance, testing can be conducted by labs that are not yet DEA-registered until the final rule is published, or Oct. 31, 2021, whichever comes first. This deadline was later extended to December 31, 2022. This change was intended to allow additional time to increase DEA-registered analytical lab capacity. Comments: A few comments supported the DEA-registration requirement. Some comments favored dual laboratory accreditation (e.g , DEA and ISO 17025 accreditation or DEA and AMS LAP accreditation) saying that such combinations would assure technically competent, unbiased testing and results reporting. One comment agreed with DEA lab registration but said that labs that have applied for DEA registration by Nov 1, 2020, should be allowed to continue testing (as under pilot programs) as the certification process takes so long. It further observed that while the IFR seemed settled on HPCL as the testing method, the rule does not specify the detection method as it should. The comment recommended mass spectrometry as the most accurate. Another comment agreed with DEA lab registration, saying that otherwise, any lab could be handling controlled substances without observing stringent DEA requirements. The comment argued that allowing any lab to test hemp creates an unfair business advantage for non-DEA labs that do not have to pay high costs of maintaining DEA registrations. Further, those non-DEA labs would be handling controlled substances inconsistent with Federal law. More commonly, comments opposed the DEA-registration requirement for hemp testing laboratories. Commenter concerns were as follows: Logistics: Numerous comments stated there are not enough DEA-registered labs to handle the volume of samples required under the IFR's sampling and testing regulations. Comments predicted that such limited capacity would exacerbate existing bottlenecks, greatly increasing the likelihood that THC levels in sampled crops would continue to rise while farmers wait for test results. Several comments noted that the IFR allowed farmers to harvest sampled crops before receiving test results, however many prefer not to expend time and money harvesting a crop that might not be marketable. Comments also anticipated growers' testing fees would increase to cover the addition of testing resources at existing DEA-registered labs. Some comments noted that not all States or Tribal lands have DEA-registered labs within or near their boundaries. According to comments, where DEA labs do exist, they are generally located in urban areas at some distance from rural farms. They explained that the scarcity of DEA-registered labs in reasonable proximity to farms will increase costs for transporting samples and increase the turnaround time for obtaining test results. Some comments submitted by Indian Tribes also asserted that the DEA had failed to consult with Tribes about its accreditation process and that it failed to timely respond to Tribes' requests for lab results. Accreditation: Comments said that DEA-registration is costly and time consuming for laboratories and that such expenses would discourage existing labs from seeking DEA registration. One comment said that DEA accreditation is too expensive to be required for ``low-level THC testing.'' Comments suggested alternatives, including: Allow testing by labs accredited under ISO 17025 Allow testing by labs approved under AMS's LAP[[Page 5638]] Allow testing by labs accredited by States or Tribes Allow testing by labs accredited under other accreditation programs Allow testing by labs with dual accreditation (e.g DEA and ISO, or DEA and LAP) Allow continued testing by labs approved to do so under the 2014 Farm Bill Allow for a transition period to allow labs time to work toward registration One comment suggested that allowing for alternative laboratory accreditation would increase competition between labs, reduce costs for growers, and reduce the potential bottleneck created by allowing for only DEA-registered lab testing. Another comment argued that although accreditation is costly, relying on it could help enforce strict standards and ensure less variability between testing labs. Some comments suggested USDA fund accreditation of private labs to help offset the cost of expensive accreditations and encourage more labs to seek necessary accreditation. Other comments suggested DEA expedite its lab approval process and make it easier for existing labs to obtain DEA registration. Other commenters stated that the DEA lab accreditation process requires State approval and not Tribe approval and that this is unworkable because of occasionally difficult relationships between some Tribes and States and because hemp is prohibited in a couple of States. Finally, several comments recommended AMS provide a phase-in period of as much as two years to allow existing labs to continue hemp testing while they work toward DEA registration so the industry will have access to adequate testing options during its development. DEA and Controlled Substances: Comments expressed concern about many aspects of DEA's involvement with the hemp program. Comments argued that hemp is a legal ***agricultural*** commodity under the 2018 Farm Bill and requiring testing by DEA labs insinuates hemp is a controlled substance regulated under the Controlled Substance Act. Commenters asserted that treating hemp as a controlled substance exceeds the intent of the 2018 Farm Bill. Comments also suggested USDA's IFR impeded Congressional intent to foster the development of a new ***agricultural*** sector. One commenter representing a processor of hemp, specifically for CBD products, said they were concerned about an IFR published by DEA and that the rule by DEA could inadvertently criminalize hemp at various stages of its production process. They encouraged USDA to eliminate DEA's involvement. Comments also said DEA involvement in USDA's program discourages participation by laboratories and by growers, neither of whom may care to risk prosecution for inadvertent criminal acts if a test result indicates they raised or possess a controlled substance. Some comments said private labs with ISO or other accreditation don't want to obtain DEA accreditation, fearing the tension it will cause between themselves and their grower customers because of the requirement to report potential criminal activity. Other comments said growers fear repercussions related to possible felony prosecution for growing crops considered illegal, including loss of chemical application permits that allow them to manage other crops. One comment argued that it isn't necessary to involve DEA in hemp testing, that it distracts that agency from other vital Federal work. According to some comments, most DEA-registered laboratories are crime labs that do not offer commercial testing services. As reported by a State, the DEA may be reluctant to even visit--let alone approve--certain laboratories because of the handling and testing of marijuana, although considered legal by the State. Other States with legal medical and/or recreational marijuana provisions commented that their labs may not want to seek DEA registration because they choose to focus on marijuana testing. Some comments said labs that handle marijuana may not in fact obtain DEA registration, thus laboratory capacity to process hemp samples at the volume and speed required by the IFR may not materialize. One comment assumed DEA-registered labs might test only for cannabinoids, while other commercial labs would be able to perform additional testing, for instance for microbes, heavy metals, and pesticide residues, saving growers the additional expense of multiple tests. Some comments recommended USDA waive the requirement to use DEA-registered labs in States where recreational marijuana is legal, thus increasing the number of labs available for hemp testing. Other comments recommended DEA change its standards to allow labs that handle legal marijuana to also handle hemp. Cost Management: A few comments suggested that restricting hemp testing to DEA-registered labs creates a monopoly among labs that already have such accreditation or have the financial backing of large, vertically integrated companies to enable them to do so. Comments recommended that existing State, Indian Tribe, university, or other Federal labs with demonstrated ability to perform testing according to USDA standards be allowed to do so, thus providing opportunities for more interested participants and keeping testing costs down for growers. Some comments suggested USDA contract with State, Tribe, or Federal labs to provide required testing. Other comments recommended capping costs for DEA-registered lab testing at $25-$50 per test. Alternatives: One comment asked USDA to clarify whether all independent labs must be DEA-registered to test hemp or whether only State labs needed to obtain that accreditation. AMS response: In consultation with the Department of Justice, AMS determined it must retain the provisional requirement that laboratories testing hemp for the purposes of regulatory compliance be registered with DEA. This requirement further extends to any laboratory testing hemp throughout the growing season to informally monitor THC concentration. The basis for this determination is rooted to the statutory requirements of the Controlled Substances Act (CSA), which requires any laboratory that might potentially handle a controlled substance to undergo the DEA registration process. The CSA states that it is unlawful to possess a controlled substance (21 U.S.C 844) and requires any laboratory that might potentially handle a controlled substance to undergo the DEA registration process (21 U.S.C 822) with a few specific exemptions. Further, 21 CFR 1301.13 includes categories that require registration with DEA, including chemical analysis where laboratories fall. AMS is aware through stakeholder comment that many stakeholders oppose the DEA registration requirement. AMS is also aware of widely held concern among stakeholders, especially Indian Tribes, that an insufficient number of DEA-registered laboratories exist and have limited accessibility to those in rural or regional locations away from metropolitan areas. AMS understands how this combination of variables leads to delays in sample processing by DEA-registered laboratories and how this affects producers' harvest timetables. AMS also knows that since the IFR was published, numerous laboratories have applied for registration and DEA is[[Page 5639]]working diligently to process these requests. For this reason, DEA is delaying enforcement of this requirement until December 31, 2022. AMS anticipates this delay will provide adequate time for testing facilities to obtain DEA registration. While we understand the commenters' concern about DEA involvement, the 2018 Farm Bill distinguishes hemp from marijuana, a controlled substance under DEA's regulatory authority, based on the THC concentration level in the cannabis plant. Although a producer may have intended to cultivate hemp, it is possible that the plant is marijuana because of the THC concentration level. If that is the case, the producer would then be subject to DEA regulations and jurisdiction. USDA coordinated with DEA so that producers that inadvertently produce marijuana may be able to take remediation steps consistent with DEA's regulations to avoid potential criminal liability. Additionally, the 2018 Farm Bill makes clear that negligent production of hemp will not subject the producer to criminal enforcement activity. See 7 U.S.C 1639p(e)(2)(C). AMS also acknowledges that some laboratories believe the DEA-registered laboratories are crime labs that do not offer commercial testing services and DEA may be reluctant to approve laboratories because of the handling and testing of marijuana, although considered legal by the State. However, AMS does not have any information that would support this belief. AMS is aware that DEA continues to add laboratories to their approved list. Accordingly, any laboratory testing hemp for purposes of regulatory compliance must be registered by DEA to conduct chemical analysis of controlled substances (in accordance with 21 CFR 1301.13). Registration is necessary because laboratories could potentially handle cannabis that tests above the 0.3 percent concentration of THC on a dry weight basis, which is, by definition, marijuana and a Schedule 1 controlled substance. Instructions for laboratories to obtain DEA registration, along with a list of approved laboratories, are available on the USDA Domestic Hemp Production Program website. Laboratory accreditation options are discussed earlier in this rule. USDA does not have any authority over the DEA's laboratory accreditation process. DEA's IFR published August 21, 2020, (85 FR 51639) is out of the scope of this final rule.Measurement of Uncertainty (MU)--Laboratory Testing The IFR required that laboratories calculate and include the measurement of uncertainty (MU) when they report THC test results. Comments: Several comments expressed support for requiring that the MU be accounted for when testing the THC concentration of hemp due to the variability in laboratory testing equipment and complex mathematical principles involved. Comments generally emphasized that the inclusion of a standardized MU was needed for the industry to develop, as hemp farmers should not be exposed to risks of economic loss that are created by mathematical inconsistencies within an individual laboratory's computations. Several comments emphasized the importance of USDA clarifying the method for MU calculation in the rule because it is part of what determines whether hemp must be disposed. One commenter cited a study \23\ that found that test results on samples from each field sent to five different labs deviated significantly, ranging from a low of 22 percent deviation to a high of 41 percent depending on the field.--------------------------------------------------------------------------- \23\ Evaluation of methods used to sample hemp for regulatory compliance testing;'' Gang, David R. and Anna Berim; Washington State University, Pullman, WA; 2020.--------------------------------------------------------------------------- Some comments expressed the need for a standard, specific MU in the final rule to prevent licensees from ``shopping around'' for laboratories with the most lenient testing. Comments noted there is no universally accepted way to calculate MU, so differences in MU values used by various laboratories are just as likely to result from differences in calculation method as they are from differences in instrument quality or use. Several comments explained that the lack of a standardized MU in the rule incentivizes inaccuracy by potentially driving customers to laboratories willing to use MUs with greater ranges. Many comments advocated specifying an MU to create uniformity in testing across the nation. One comment noted that variation in MU values could be problematic for interstate commerce and result in a hemp crop that is compliant in one state being shipped to another state where it would be considered noncompliant. Other comments argued that it may be too soon in the scientific process for USDA to include a standard MU because laboratories, particularly in States that didn't previously have cannabis programs, haven't had time to do the research necessary to determine an appropriate MU. Comments from States that administered pilot programs under the 2014 Farm Bill offered several suggestions on approaches to MU calculations. A comment recommended using laboratories participating in the University of Kentucky--Division of Regulatory Services' Hemp Proficiency Testing Program to establish an MU through a set of guidelines rather than in the rule. The commenter concluded that the Hemp Proficiency Testing Program could be tasked with calculating and announcing an MU that would be used for compliance testing purposes on a nationwide basis. The comment added that including the MU in the guidelines rather in the rule would allow it to be refined over time as instrumentation and calculations develop, rather than having to modify the hemp regulation. Some comments advocated having multiple testing methodologies to choose from and including requirements for calculating MU for each method. Other comments recommended that instead of requiring a specific MU, USDA should determine a maximum threshold for allowable MU value. Comments argued that a maximum threshold would prevent forum shopping by consumers looking for laboratories with the most lenient MU ranges, but still allow laboratories to use their own calculations. One comment recommended revising the MU provision of the IFR to include a maximum uncertainty level that laboratories cannot exceed and suggested the maximum uncertainty value should be one-third or less of the target uncertainty. Another comment suggested USDA use guidelines from the United States Pharmacopeia for determining THC concentration, which include calculations for significant figures such as MU. A comment asked USDA to clarify the role of significant figures in using MU to determine total THC concentration because, they argued, in both of the IFR's examples for determining compliance, the lower end of the range can be written as 0.3 percent, if rounding to match significant figures. It suggested requiring the lower value of the THC calculation distribution range, which accounts for uncertainty, to be less than or equal to 0.30 percent rather than 0.3 percent. One commenter stated that for the cannabis plants exceeding the acceptable THC levels, USDA should incorporate a MU for laboratory deviation of .0500 percent for the many different variable ways that a sample arriving at a laboratory could result in an inaccurate test. This includes cutting,[[Page 5640]]bagging, sealings, transporting, handling, and other pre-laboratory activities. One comment cited guidance from the National Institute of Standards and Technology providing that assigned uncertainty should be small relative to the total uncertainty targeted for test samples. The comment asserted that, as a rule of thumb, assigned uncertainties should be about one-third or less of the target uncertainty to ensure that uncertainty in the certified value will have negligible influence on the results of measurements. According to the comment, laboratories with well-developed processes will provide the most accurate and precise results and their uncertainty will be very small. The comment advocated that USDA provide an uncertainty range that cannot be exceeded by participating laboratories, thereby reducing the risk that producers will shop for laboratories with the widest uncertainty. The comment asserted that such a provision would also improve ***data*** comparability across the hemp industry. AMS response: AMS appreciates the different suggestions submitted by commenters on ways to improve the calculation of MU and also acknowledges the variability in laboratory testing equipment that may exist. However, based on the input received and limited ***data*** available at the time of its review, AMS will only require that hemp testing laboratories complete a MU calculation as part of the mathematical test result for THC concentration. This final rule does not establish or standardize an upper or lower boundary for general use by laboratories to calculate a measurement of uncertainty. MU is typically not standardized, but rather is controlled using test methods controlled by performance standards (e.g , AOAC Standard Method Performance Requirements 2019.003 that can be found at [*https://www.aoac.org/resources/smpr-2019003/*](https://www.aoac.org/resources/smpr-2019003/)). USDA does not recommend establishing a MU upper limit (maximum) because (1) MU is typically not standardized, but is controlled using standard test methods, and (2) USDA does not have the ***data*** to set an upper limit, so setting it would be arbitrary, not scientific. The hemp and scientific industries are just beginning to discuss standard test methods, and the final rule does not establish an explicit test method. Setting an upper limit or maximum MU does not resolve the core issue and would not encourage or drive labs to improve accuracy and precision. Setting an upper limit would in effect be setting a maximum or absolute MU. This may encourage labs to adopt the maximum MU as their MU, rather than drive for a smaller uncertainty. USDA may allow for establishing limits in the future, if needed, once methods are established and USDA has access to Proficiency Testing results and the reported MUs. Additionally, this rule retains the flexibility for State and Tribal Departments of ***Agriculture*** to include specific requirements regarding MU for laboratories conducting hemp regulatory testing under their specific state or Tribal hemp programs if they meet the minimum standard set in this final rule. AMS encourages State and Tribal regulatory agencies to coordinate in developing proficiency and testing methods, similar to the program administered by the University of Kentucky, but participation in these types of programs is not required by this regulation.Disposal The IFR stipulated that cannabis exceeding an acceptable THC level must be disposed of in accordance with the CSA and DEA regulations because such material constitutes marijuana, a Schedule I controlled substance under the CSA, rather than hemp. Destruction vs. Disposal: Several comments noted that the 2018 Farm Bill specifies only ``disposal,'' of hemp testing above the acceptable THC level, yet the IFR required ``destruction'' of such material. Comments argued that the IFR's destruction requirement is an overreach. Comments asked USDA to revise the regulations to require only disposal of non-compliant plants or plant parts, and to provide either general parameters or specific provisions regarding acceptable methods of disposal. Several comments asked AMS to provide or expand the requirements for disposal of non-compliant material. Although a few comments supported destroying non-compliant hemp crops, most comments that addressed the topic argued against total crop destruction if alternative disposal methods are available and practical. Comments explained that crop loss is financially devastating to growers--and doubly punitive if the grower must pay to destroy the crop--as well as a waste of valuable resources that could be repurposed and provide at least some return to growers. Comments explained that crop destruction can be a drain on limited official resources, depending on the availability of law enforcement personnel and equipment for the potential need to ***collect***, transport, and oversee the destruction of non-compliant plant material. Further, a comment from an Indian Tribe noted that requiring crop destruction is culturally offensive to indigenous people that traditionally use every part of every animal and plant that can be utilized. Disposal Methods: Several comments asserted that the only disposal methods available under DEA regulations are incineration or chemical digestion and argued that the current rules under the CSA are designed for disposal of pharmaceuticals and chemical-based illegal drugs, not for the disposal of ***agricultural*** crops. Comments asserted that incineration by DEA is not efficient or environmentally sound, and in some places may not be allowed. They noted that burning crops releases harmful carbon dioxide and other pollutants into the air, contributes to the risk of wildfires, and wastes valuable plant ***nutrients*** that could be used elsewhere. Numerous comments stated that the rule should provide alternative methods of disposal for non-complaint hemp plants to protect growers against total crop loss and preserve valuable resources. Several comments recommended USDA adopt disposal rules established under their various State and Tribal regulations. Comments suggested growers be allowed to mulch or disc the non-compliant crop into the soil at the farm, which would build up soil ***nutrients***, improve soil water holding capacity, and improve soil tilth. Other comments suggested growers could recuperate some of their investment by marketing non-compliant crops for other non-ingestible or non-consumable products like fiber, building materials, biofuel, biochar, bioplastics, and animal bedding. A few comments suggested growers should be permitted to export or ship non-compliant hemp to countries or States that have legalized recreational or medical marijuana. Numerous comments recommended a surgical approach to disposing of non-compliant plants by allowing for the removal and disposal of only the plant parts testing over the acceptable THC level, while allowing growers to market the remaining parts. One comment suggested the Federal Government could buy non-compliant crops for no less than 50 percent of the market value and use them to manufacture paper, plastics, and fuel for government and military uses. Other comments proposed remediation as an alternative to crop destruction; comments on remediation are discussed in another section of this comment analysis. One comment suggested further research be conducted to identify appropriate alternatives for crop disposal, and one comment[[Page 5641]]suggested that industry stakeholders, governments, regulators, and law enforcement officials work together to develop disposal options under the program. Disposal Oversight: Several comments recommended that States, Indian Tribes, or local authorities be allowed to determine appropriate crop disposal methods for their jurisdictions. Comments further recommended that State, Tribal, or local regulatory officials be authorized to oversee disposal of non-compliant hemp, as several have done prior to the establishment of the Domestic Hemp Production Program. One comment recommended further that hemp disposals handled by the State should not imply criminal intent on the part of growers. Comments said that allowing for local oversight would reduce strain on DEA and other law enforcement resources and ensure disposals can be handled on a timely basis. One comment from a State ***agriculture*** department said that when law enforcement officers have been invited to attend crop disposals in their jurisdiction, officers are typically unavailable. Other comments argued that growers should automatically become DEA-registered reverse distributors if their test results exceed acceptable hemp THC levels so they can dispose of the non-compliant crops themselves and provide acceptable evidence (e.g , photo or video) that they have done so, or so they can do so in the presence of regulatory officials. Some said USDA should pay for official oversight of crop disposal or there should be no charge for that service. Comments noted that AMS had not yet posted disposal guidelines on its website at the time those comments were submitted, although the IFR had committed AMS to doing so. Some comments said interested entities were unable to complete applications for program participation because AMS had not yet provided disposal requirements. Several comments asserted that DEA regulations do not mandate specific disposal methods, so long as the ``desired result'' is achieved. Comments asked for more specifics on DEA disposal procedures, including what disposal methods or processes were allowed under the IFR, what the timeline is for disposal, and what results are desired. One comment asked whether all of a grower's crops would be disposed if one of the lots tested above the acceptable hemp THC level. Others asked whether marketing non-compliant crops for non-ingestible and non-consumable products would be considered a form of disposal. One comment asked whether USDA would consider providing crop insurance for losses due to disposal of ``hot'' crops. One comment asked whether stored hemp product produced under previous programs that allowed for higher THC levels would be disposed under the new program, or could be ``grandfathered'' in. One comment contended that certain language in the IFR was inconsistent, and as a result, the IFR could be interpreted to require disposal of hemp that does not meet the IFR's definition of hemp, rather than the disposal of hemp that does not meet the acceptable hemp THC level. AMS response: AMS received significant comments on this requirement from State and Tribal regulatory agencies, producers, and other hemp industry stakeholders and based on this input, AMS determined it necessary to include specific on-farm hemp disposal activities and to provide oversight flexibilities. As explained in the IFR, State and Tribal plans are required to include procedures for ensuring effective disposal of plants produced in violation of this Part. As part of its review, AMS noted the cultural implication of the use of the term `destruction' and accordingly amended the regulatory provision to clarify the disposal activities required of growers in cases when a sample tests above the acceptable total THC level. AMS also determined that producers benefit from greater regulatory flexibility to control on-farm disposal activities according to production schedules that are not dictated by the availability of reverse distributors to physically witness disposal activity. State and Tribal plans must still include procedures to verify disposal. This may come in the form of in-person verification by State or Tribal representatives, or alternative requirements the direct growers to provide pictures, videos, or other proof that disposal occurred successfully. State and Tribal plans must also include requirements to submit to AMS the monthly disposal report documenting any on-farm disposals that occurred during the prior month. Additional information on specific disposal methods is available to producers, State, and Tribal oversight agencies is available on the AMS website. Disposal through the ***agricultural*** practices appearing in this final rule reflected those allowable under the IFR, and previously published to the AMS web page in February 2020. These included plowing under, mulching/composting, disking, bush mower/chopper, deep burial, and burning. These activities align with normal and routine production actions by farmers. AMS believes specifying these activities help hemp growers determine which activity best supports their operation to transition non-compliant crop into a non-retrievable or non-ingestible form. These methods also allow recycling non-compliant plant materials back into the earth, a viewpoint AMS learned through public comment to be especially relevant for producers practicing cultural conservation practices. AMS recognized that controlled burning is the closest farm practice to incineration but controlled burns may not be a viable option for producers in some places due to wildfire risk or state prohibition against using controlled burns.Remediation The IFR stipulated that cannabis exceeding the acceptable THC level must be disposed of in accordance with the CSA and DEA regulations because such material constitutes marijuana, a Schedule I controlled substance under CSA, rather than hemp. In addition, the IFR stated that noncompliant plants may not be further handled, processed, or enter the stream of commerce, and that the licensee shall ensure the lot is disposed. The IFR did not stipulate any provisions to allow for remediation activities that reduce the THC concentration to levels within the acceptable limit. Remediation of non-compliant crops into compliant plant biomass: Numerous comments expressed support for remediation of non-compliant plants to help farmers mitigate against financial loss. Comments claimed that not having remediation options would be a barrier to industry growth because farmers would be unable to bear the financial risk of losing crops. One commenter used 2019 production and economic ***data*** to project that applying the IFR to 2019 statewide non-compliant test rates (17 percent), farmgate losses due to crop destruction could have totaled $842.6 million in Colorado.\24\ According to the comment, adding losses related to lost processing and manufacturing due to the same crop destruction could have brought the economic cost to approximately $1.2 billion. It suggested that allowing for remediation of non-compliant crops testing between 0.3 and 1.0 percent THC in the same scenario would preserve[[Page 5642]]about $798 million in direct farmgate value, or $1.1 billion of total economic value for the State.--------------------------------------------------------------------------- \24\ Polis, Jared; Phillip J. Weiser; and Kate Greenwood: State of Colorado Comments in Response to USDA Establishment of a Domestic Hemp Production Program; [*https://beta.regulations.gov/comment/AMS-SC-19-0042-3358.---------------------------------------------------------------------------*](https://beta.regulations.gov/comment/AMS-SC-19-0042-3358.---------------------------------------------------------------------------) Numerous comments explained that non-compliant plants can be remediated by chemical processes that either remove and destroy THC or dilute THC concentrations, thereby transitioning the remaining material into biomass blends which then test at or below the Federally allowable THC threshold of 0.3 percent. Thus, according to comments, crop remediation through one of these processes is a viable alternative to total crop loss. Some comments suggested processors could be registered with DEA to handle such remediation processes to ensure THC is extracted, handled, and disposed or marketed legally. Other comments suggested that USDA could issue processor permits to allow them to handle hot crops to bridge the perceived legal gap between farmer and consumer. Some comments further suggested growers could bear processing costs then retake possession of the remaining biomass for use or sale elsewhere. Several comments suggested growers themselves could be allowed to merge ``hot'' lots with lots testing below allowable hemp THC limits to create a compliant, homogenized blend. Some comments suggested non-compliant crops could be remediated by removing the only flowers and retaining the seeds and stalks for other use. Other comments argued that the IFR testing provisions conflict with CSA provisions that exempt seeds and stalks of plant material from the definition of marijuana, and several comments urged USDA to modify the IFR to require only that the parts of the plant exceeding the THC limit be destroyed. One comment advocated that States be allowed to remediate non-compliant crops through milling and blending the harvest lot to include the entire plant to a homogenized state, then retesting the lot. The comment included the results of a comparative analysis based on crops that initially tested over the legal threshold of 0.3 percent total THC during Arizona's 2019-2020 growing season.\25\ According to the comment, producers opted to attempt remediation as described for a total of 25 lots representing 568.6 acres of hemp. Of the 25, 19 lots representing 507 acres successfully reduced the total THC amount to be compliant, for an 89.71 percent recovery of acres that would otherwise have required disposal. The comment reported that the average amount of THC was reduced by 31.61 percent, and suggested that while this remediation process might not be successful for crops that are significantly over the legal threshold, and while the market value of the resulting biomass may be reduced, the process may allow growers to recover some of their losses.--------------------------------------------------------------------------- \25\ Caravetta, John: Arizona Department of ***Agriculture*** Additional Comments on USDA Interim Final Rules on Domestic Hemp Production; [*https://beta.regulations.gov/comment/AMS-SC-19-0042-5645.---------------------------------------------------------------------------*](https://beta.regulations.gov/comment/AMS-SC-19-0042-5645.---------------------------------------------------------------------------) One comment \26\ reported on a survey of all Minnesota hemp growers who had experienced lot failures since the beginning of their pilot program in 2016. According to the comment, reported losses varied greatly, ranging between $22,000 and $70,000 per year. The comment further described the State's analysis of 1,492 hemp lot samples from 2016 through September 2020, which showed that 10.3 percent tested at or above 4.0 percent total delta-9 THC, although there was no indication of non-compliance with program rules or of illegal drug activity on the part of growers. The comment recommended that States and Tribes be allowed to develop remediation plans to salvage non-compliant crops.--------------------------------------------------------------------------- \26\ Petersen, Thom: Minnesota Department of ***Agriculture*** Comments on USDA Interim Rule: Establishment of a Domestic Hemp Production Program; [*https://beta.regulations.gov/comment/AMS-SC-19-0042-5548.---------------------------------------------------------------------------*](https://beta.regulations.gov/comment/AMS-SC-19-0042-5548.---------------------------------------------------------------------------) Post-harvest sampling and retesting: Several comments suggested retesting post-harvest samples to confirm THC levels. Comments provided examples of some State ***agriculture*** departments that implemented post-harvest sampling and testing processes under the 2014 Pilot Programs. For instance, one comment cited results from the 2018 season in which they allowed post-harvest retesting of hemp plots that originally tested between 0.4 and 1.0 percent THC. The comment said under Kentucky rules, farmers were allowed to choose between immediate destruction of the leaf and floral material of the crop, without additional testing, or paying the $250 fee for a post-harvest retest of harvested and ground up hemp material, in which the THC concentration was diluted. It stated that of 29 growers whose lots tested between 0.4 and 1.0 percent THC, 22 chose retesting and none of those returned a second measurement above 0.3999 percent THC. Thus, those growers were able to realize a return on their investment. The remaining seven cases did not elect to retest--five elected to destroy the entire plant and 2 destroyed only floral and leaf materials, salvaging the stalks. The ***data*** showed the acreage destroyed represented approximately one percent of total acreage. The comment concluded that post-harvest grinding and retesting offers a viable economic solution for farmers seeking to recuperate their investment on crops that initially test non-compliant. Other comments urged USDA to provide for retesting provisions, including remediation activities, that more favorably support farmers who seek to salvage crop value. Some of these comments requested that USDA clarify retesting procedures if a harvest has already occurred. Statutory implications: Comments from Tribes and other stakeholders expressed concern that the 2018 Farm Bill only requires ``procedure for effective disposal,'' and urged USDA to allow producers greater regulatory leniency as they become familiar with growing a new crop by permitting alternative remediation methods that do not require crop destruction. AMS Response: This final rule covers testing of the hemp plant to determine acceptable THC levels as required by the 2018 Farm Bill. This final rule does not cover testing for seeds and stalks individually nor does it cover processing or the licensing of processors. As described in the IFR, hemp exceeding the acceptable THC level may not be further handled, processed, or enter the stream of commerce. The licensee shall ensure the disposal of the noncompliant crop. Before such disposal occurs, AMS believes it important and necessary that hemp growers be provided the opportunity to remediate THC from non-compliant crops in order to stave off financial risk associated with the loss of investment in their hemp crop. AMS agrees with comments that consider remediation as a viable activity for farmers to minimize crop loss and to salvage the value of remaining compliant plant material. For this reason, the final rule provides regulatory flexibility that allows remediation activities--either disposing of flower materials and salvaging the remainder of the plant or blending the entire plant into biomass plant material. Through both forms of remediation, the farmer may be able to minimize losses and, in some case, produce a return on investment. A guidance document will be published with this rule to illustrate approved remediation techniques. USDA will also finalize the guidance document on disposal techniques. Additionally, AMS determined that pre-harvest sampling and testing yield the truest measurement of THC concentration at the point of harvest. AMS further maintains this position in this final rule. AMS notes that if the test results show the original THC[[Page 5643]]concentration exceeded the Federally allowable limit, the licensee may request the laboratory retest the pre-harvest sample. This retest would not entail the use of post-harvest plant material. However, if the farmer elects to perform remediation activities under a USDA, State or Tribal plan, an additional sampling and testing of the remediated crop must occur to determine THC concentration levels. Only those crops testing below the acceptable hemp THC level limit will be considered successfully remediated and thus allowed to enter the stream of commerce. All other remaining non-compliant crops must then be properly disposed. AMS believes the inclusion in the final rule of remediation and post-harvest sampling after remediation provides the additional flexibility requested by commenters that expressed the need for farmers to have greater opportunity of success entering the hemp production industry.Reverse Distributors The IFR requires the ***collection*** and destruction of noncompliant material by a person authorized under the CSA to handle marijuana, such as a DEA-registered reverse distributor, or a duly authorized Federal, State, or local law enforcement officer or their designee. Comments: Comments largely opposed the use of DEA-registered reverse distributors to dispose of noncompliant material. Comments asserted that many States and producers operating under the 2014 Farm Bill have implemented policies related to disposal of non-compliant material that do not require DEA involvement. Comments argued there are relatively few registered reverse distributors on DEA's 2019 list and pointed out that some of the major hemp production States have very few or no registered reverse distributors. Comments claimed existing DEA-registered reverse distributors haven't the resources or training to oversee destruction of large plots of ***agricultural*** crops in remote areas, and that such limitations would create a compliance bottleneck. Comments asked USDA to clarify who would be responsible for paying DEA reverse distributors for crop disposal services. One comment asserted that DEA regulations prohibit reverse distributors from accepting controlled substances from other than DEA registrants, making it impossible for hemp farmers to release non-compliant hemp directly to DEA reverse distributors. One comment suggested that hemp growers could automatically become reverse distributors if their hemp samples test above acceptable THC levels so growers could legally manage crop destruction on their own. Another comment asked whether DEA would allow for a waiver from the current limitation on reverse distributors to allow reverse distributors to accept cannabis material for disposal from individuals or entities who cultivate hemp in accordance with their state's approved plan, but who do not hold a Schedule I DEA registration. Numerous other comments expressed concern that alternative law enforcement agencies (non-DEA) will face the same resource constraints as the DEA. Comments described how State law enforcement officials are typically unwilling or unavailable to participate in the disposal of noncompliant crops and suggested this is due to the lower prioritization of hemp compliance oversight in light of more pressing public safety and crime intervention responsibilities. For example, a comment representing rural counties said this conflict in priorities is particularly acute in rural areas where resources are already stretched too thin. The comment asserted that while preventing serious violations of controlled substances laws is a priority for law enforcement agencies, hemp with slightly elevated THC levels is unlikely to be sold as marijuana. The comment advocated formulating hemp disposal procedures entirely outside the scope of law enforcement. One comment worried about the stress and stigma on growers having law enforcement personnel descend upon their farms in connection with hemp disposals. Other comments supported allowing State regulatory authorities to oversee or authorize disposal of non-compliant material, asserting that States can safely and efficiently complete the process at a much lower cost to producers and States. Some comments supported disposal of non-compliant material by law enforcement. Some suggested that States, rather than Federal agencies, work with State and local law enforcement to handle disposals. One comment suggested that the definition of ``duly authorized Federal, State, or local law enforcement officer'' be modified to include disposal under the authority of State or local law enforcement in order to address the anticipated increase in required disposals. Finally, comments from Indian Tribes urged USDA to expand the definition of law enforcement in the final rule to include Tribal law enforcement. AMS response: AMS acknowledges the many stakeholders who expressed through comment concerns about the ***collection*** of non-compliant plants by DEA-registered reverse distributors, or duly authorized Federal, State, or local law enforcement. AMS notes that law enforcement policies and priorities are not set by USDA and the 2018 Farm Bill does not provide this authority. To address public comment, this final rule will retain disposal requirements stated in the IFR but will further clarify what ``disposal'' means relative to the role of reverse distributors. AMS relaxed the disposal requirements enacted under the IFR in February 2020. This decision followed consultation with DEA. This provided growers the added flexibility to conduct on-farm disposal activities themselves, without required onsite law-enforcement supervision. Based on positive feedback received from State and Tribal oversight agencies and producers following the relaxation of disposal requirements, AMS is permanently allowing for on-farm disposal flexibility in the final rule. Under this final rule producers do not need to use a DEA-registered reverse distributor or law enforcement to dispose of non-compliant plants (7 CFR 990.3(a)(3)(iii)(E) and 990.27) if the producer disposes of the plants using one or more of the means described by USDA at [*https://www.ams.usda.gov/rules-regulations/hemp/disposal-activities*](https://www.ams.usda.gov/rules-regulations/hemp/disposal-activities). It is the agency's intent that these methods allow producers to apply common on-farm practices as a means of disposal while rendering the controlled substance non-retrievable or non-ingestible. Producers must document the disposal of all non-compliant plants in accordance with Sec. 990.27 Reporting can be accomplished by providing USDA with a completed: ``USDA Hemp Plan Producer Disposal Form.'' Cannabis with a THC level of over 0.3 percent on a dry weight basis is a controlled substance, that must be disposed of onsite according to the disposal methods approved by USDA. The State, Indian Tribe or the state's department of ***agriculture*** wishing to have primary regulatory responsibility have the responsibility for establishing protocols and procedures to ensure non-compliant plants are appropriately disposed of in compliance with applicable State, Tribal, and Federal law. States and Indian Tribes operating under approved hemp production plans must notify USDA of any occurrence of non-conforming plants or plant material and provide the disposal record of those plants and materials monthly. There is a similar requirement for producers operating under the USDA plan. Additionally, USDA will conduct[[Page 5644]]random audits of licensees to verify hemp is being produced in accordance with the provisions of the rule. State and Tribal plans must still include procedures to verify disposal but would have the additional flexibility to use in-person verification where deemed necessary or, when practicable, require producers provide pictures, videos, or other proof of disposal. AMS believes this decision will further alleviate the strain to oversight resources and allow State and Tribal authorities to more efficiently and autonomously monitor hemp production in their jurisdictions. Additionally, the final rule expands the definition of ``law enforcement'' to include Tribal law enforcement.Negligent Violation Threshold The IFR specified that a producer commits a negligent violation when a reasonable effort to grow hemp is made and the total THC dry weight concentration exceeds 0.5 percent. Supporting an increase of negligent violation threshold: Most comments that addressed negligent violations opposed the 0.5 percent total THC threshold in the IFR, and many advocated raising the threshold to 1.0 percent or higher, offering suggestions ranging between 0.99 and 5.0 percent total THC. Comments said the 0.5 percent threshold can be too easily breached by prudent farmers for any number of environmental or genetic factors that are beyond grower control. One comment supported the 0.5 percent negligence threshold, and others noted it but signaled neither support for nor opposition to the threshold particularly. Some comments suggested that a 1.0 percent threshold would provide a safe environment in which both new and veteran farmers can operate comfortably. Comments in favor of a 1.0 percent negligence threshold noted that several States and other countries have established a 1.0 percent threshold for their jurisdictions that seems reasonable and achievable in most situations. A few comments pointed out that a 1.0 percent threshold is relatively low compared to the THC levels in marijuana, which commenters said typically range from 10 to 15 percent. Other comments advocated higher thresholds that they claim would give farmers the peace of mind to continue building an industry that is just taking off. Finally, one comment asked whether an MU was figured into the IFR's negligent violation threshold and advocated setting the threshold at 1.5 percent THC and specifying that that threshold includes the MU. A state department of ***agriculture*** estimates that 42 licenses would need to be revoked at 0.5 percent stated in the IFR. They further estimate that this number would shrink to only about 12 licenses were the threshold increased to 1.0 percent under the final rule. A state hemp steering committee commented that a 0.5 percent threshold will deter the experimentation of different varietals and that this research is essential to discovering which varietals work best in different climate zones and soil types as well as for the development of better genetics. Another state department of ***agriculture*** explained that 13 percent of the hemp samples taken in 2019 tested over the THC limit. The average THC level in those failures was 1.07 percent Delta-9 THC post-decarboxylation. A hemp association within the state agreed with the commenter's recommendation that the level defined for negligence should be increased to 1 percent THC. One comment reported that more than 5.5 percent of the pre-harvest samples ***collected*** under the State's plan in 2019 were found to have a THC concentration of greater than 0.5 percent. Another comment reported that 13 percent of hemp samples taken in 2019 tested over the THC limit. According to the comment, ***data*** for all years through September 2020 show that most hemp lot failures occur between 0.4 percent and 1.0 percent THC. ***Data*** submitted with a comment from a State University researcher showed that 8.5 percent of 3,508 samples tested during 2018-2020 exceeded the IFR's negligent violation threshold of 0.5 percent THC. The comment said that 65 percent of those would not be considered negligent violations if the threshold were raised to 1.0 percent. Framing study results another way, the comment explained that at a negligence threshold of 0.5 percent, the State would have revoked 42 producer licenses, whereas at a 1.0 percent threshold, the State would have revoked only 12 licenses, given three negligent violations in a five-year period, a reduction of 72 percent in revocations by changing the threshold to 1.0 percent. One comment reported that based on test results they'd seen this year, 1.0 or 1.5 percent would be a more appropriate threshold for negligence, due to the heterogeneity of the plant and the awareness of the industry. Implementation timeframe: Some comments suggested that it is too early in the industry's development to determine a realistic numeric threshold, and they recommended USDA delay fixing a uniform standard until the industry has more experience and better understanding of the relationship between all the hemp production factors. Still other comments asserted that negligence should not be determined numerically at all, but by a determination about the farmer's intent. Several comments said that ``negligence is a state of mind, not a number.'' General comments on 0.5 percent threshold: Several comments argued USDA arbitrarily determined the 0.5 percent negligence threshold. One comment asked USDA to provide the research reports used to inform the selection of the 0.5 percent negligence threshold. Another questioned whether USDA used test results based on the total THC standard established in the IFR to set the negligence threshold, since it was the commenter's experience that producers routinely report difficulty meeting that standard. One comment reported anecdotally that its farm sends three samples from the same composite lot sample to three testing laboratories and gets three different results, which the comment ascribes to the variation in lab procedures. Another comment said that there are no established uniform standards for cannabinoid testing, such that even from reputable labs it will not be entirely clear what the results mean. The impact of the 0.5 percent threshold on production: Several comments said the 0.5 percent negligence threshold in the IFR provided very little buffer (at 0.2 percent) between the 0.3 percent THC allowed under the program and the 0.5 percent threshold for determining a negligible violation. What several comments called a ``safe harbor'' for growers was nevertheless considered too narrow by many, saying that it left virtually no room for error. Comments argued that requiring growers to both exercise reasonable care and produce crops with only 0.5 percent THC or less is too stringent a standard and does not really offer the ``safe harbor'' intended. One comment argued that USDA cannot provide a ``safe harbor'' for violations of the 0.3 percent THC cap because that cap is enforced by other Federal and State agencies. A few comments said that the THC levels in 2014 DEA confiscations averaged 11.84 percent THC and argued that the negligence level under USDA hemp program rules should be closer to the average DEA culpability level. A comment from a state department of ***agriculture*** used 2019 production and testing ***data*** to demonstrate that raising the IFR's threshold from 0.5 percent to 1.0 percent could theoretically reduce[[Page 5645]]the number of its farmers exceeding the negligent violation threshold by more than 75 percent. Several comments advocated a 2.0 percent threshold, while others suggested the elimination of the negligence threshold altogether. Comments highlighted uncertainty in the genetic variation of hemp varietals and other factors like weather conditions, soil type, plant disease, and pest pressures that may further exacerbate the risk of exceeding the 0.5 percent threshold. As well, comments explained that hemp plants mature rapidly just before harvest. One commenter described seeing plants go from 0.18 to 0.62 percent total THC in one week. Comments suggested that enforcing the 0.5 percent negligence threshold on growers who truly do not intend to grow marijuana is excessive penalization when THC levels can change that rapidly. Comments argued that it is not appropriate to add further penalties to hot crop destruction. Other comments suggested that administrative and logistical factors beyond the grower's control, such as bottlenecks in sampling and testing, can likewise create compliance risks for growers under the 0.5 percent threshold. AMS response: Based on these comments, AMS is increasing the negligent violation to a 1.0 percent threshold. AMS acknowledges that a lower total THC threshold will result in a higher number of negligent violations. AMS also understands that factors beyond the control of farmers may cause an increase in total THC-levels, such as seed genetic, weather and climate, and may contribute to crops exceeding the negligent violation threshold. AMS believes that the ***data*** provided in the comments clearly showed that increasing the negligent violation threshold to 1.0 percent would diminish the risk that producers would incur negligent violations without adding a greater risk of non-compliant material reaching channels of commerce. AMS also reviewed the test results of certified hemp varieties planted in Kentucky in 2017 and 2018 under its 2014 Farm Bill program. Kentucky has a certified seed program that it believes will yield hemp. The plants from the certified varieties tested below 0.8 percent THC concentration level. Additionally, AMS reviewed the test results of varieties that were eligible to be cultivated under the Nevada 2014 Farm Bill program in 2018. The plants from those varieties tested below 0.9 percent THC concentration level. Given those test results based on varieties that those two states believed would yield hemp, AMS determined that a 1 percent THC concentration level for negligence would account for the fact that a reasonable reliance on certified or eligible varieties may still yield a plant that tests above the acceptable hemp THC level. The impact of the 0.5 percent threshold on crop research: Comments described the IFR's 0.5 percent negligent violation threshold as a rate limiting factor to industry innovation and hemp research. One comment said that hemp farmers, growing under pilot authorization of the 2014 Farm Bill, routinely planted multiple varieties of hemp to see which performed best. According to the comment, the low negligence threshold in the IFR discourages such hemp trialing and innovation because farmers face greater risk of receiving three negligent violations in one or two seasons and losing eligibility to grow hemp for another five years. Comments from research universities found the IFR's negligent violation provisions unworkable for institutions testing numerous varieties and production variables each season for the same reason. Comments suggested a higher threshold for negligent violation would give industry the regulatory flexibility to conduct research with reduced risk of violating regulatory requirements. AMS response: AMS recognizes the violation threshold may incentivize (or disincentivize) innovation by research institutions and producers. AMS acknowledges more innovation and research across industry will bring more stability to stakeholders. The 1.0 percent negligent violation threshold provides new and existing producers across States and Indian Tribes additional flexibility to innovate and research with reduced risk for noncompliance. AMS believes the 1.0 percent threshold incentivizes innovation across industry more so than a 0.5 percent violation threshold. Statutory implications: Some comments argued that establishment of the 0.5 percent negligence threshold in the IFR was arbitrary and capricious under the APA and asked USDA to provide more information about how the threshold for negligence was determined. Some comments asserted that negligence is a well-established legal doctrine, and they argued that USDA cannot artificially and arbitrarily declare a threshold for negligence. A couple of comments suggested that putting farmers on probation, suspending them from program participation, and requiring them to destroy their crops based on an arbitrary number rather than on court findings is a violation of due process under the U.S Constitution's Fifth Amendment. AMS response: Congress established the definition of hemp and defined the threshold of THC concentration at 0.3 percent dry weight. The statute did not define negligent violation. USDA derived the definition of negligence from the definition of negligence in Black's Law Dictionary (10th ed. 2014). USDA set the level of total THC concentration at 0.5 percent for a negligent violation to establish a clear buffer so that any crop testing out of compliance would not automatically trigger a violation. The 0.5 percent was based on ***data*** from three states participating in the 2014 Farm Bill pilot program. AMS believes raising the negligent violation threshold from 0.5 percent to 1.0 percent in the final rule provides a greater buffer and reduces farmers' exposure to risk of violation accrual and license suspension. Oversight Authority: Several comments suggested the government should have the ability to determine negligence and culpability based on facts and circumstances surrounding violations and not solely on a numeric threshold. Other comments asserted that the 2018 Farm Bill's language leaves room for an Indian Tribe to apply its own negligence standard. Similarly, other comments from the industry said that States should be allowed to evaluate potentially negligent violations of State plans. AMS response: With regard to violations and culpability determination, AMS seeks to establish a regulatory framework that ensures consistency in oversight activities of hemp production. Variations of criteria or the use of subjectivity in oversight could result in bias against or leniency to some hemp farmers simply based on location. Leaving the decision of what constitutes a negligent violation to abstract factors rather than objective metrics may result in differences between States and Indian Tribes. Because farmers may grow hemp in different locations, and in some cases are subject to multiple oversight authorities, it is important the thresholds for violations are consistent across oversight authority jurisdictions to which the grower is responsible. Having a threshold that is well established and transparent provides a minimum framework to producers. In developing the compliance requirements for State and Tribal plans, USDA recognizes that there may be significant differences across States and Indian Tribes in how they will administer their respective hemp programs. Accordingly, if, at a minimum, the requirements of the 2018 Farm Bill and applicable parts of this[[Page 5646]]regulation are met, States and Indian Tribes are free to determine whether or not a licensee under their applicable plan has taken reasonable steps to comply with plan requirements. As previously stated, this final rule provides that a producer shall not be subject to more than one negligent violation per calendar year. State and Tribal plans may tailor the timing around this requirement to align with their growing season or other applicable dates. Financial and business risk: Several comments linked the 0.5 percent THC threshold with a greater likelihood of producers committing negligent violations, receiving corrective action plans, and even committing culpable negligent violations. Comments stressed that a low negligence threshold puts farmers at higher risk of accumulating negligent violations, even when growers take reasonably prudent steps to mitigate against the production of noncompliant plants. According to comments, this, in addition to the loss of the crop, jeopardizes farmers' access to crop insurance and business loans. Comments addressed the negative impact of the accrual of negligent violations on the financial stability of the individual business. They described how a hemp grower's access to credit and insurance is jeopardized when negligent violations accumulate and lead to a determination of culpable negligence. Comments explained that lending institutions and insurance providers look for risk factors. They also raised questions about how the accrual of negligent violations may be interpreted by lender or providers. Comments said that many insurers will not cover crop losses if losses are due to the growers' negligence. Commenters implored USDA to explain how violations can lead to determinations of culpable negligence and to provide guidance about how a reasonable farmer can avoid growing noncompliant hemp. AMS response: AMS acknowledges institutional lenders view violations as risk factors in decision making. AMS also notes that not all culpable violations are derived from the accrual of negligent violations. Culpable violations may be the result of producers violating other parts of the 2018 Farm Bill. However, the 2018 Farm Bill explicitly considers certain actions as constituting negligent violations. AMS's intention is to provide a threshold between 0.3 percent THC level and what would be considered a negligent violation so not all hemp that tests over the 0.3 percent be considered a negligent violation. Because a producer will not have committed a negligent violation every time he or she grows hemp with a concentration of hemp above the 0.3 percent level, this will assist producers when requesting loans or other financial assistance. AMS will provide risk mitigation activities such as remediation and disposal provisions as well as increasing the negligent violation threshold to 1.0 percent to diminish the number of violations that are considered negligent. Some producers have more than one field or farm in a state or across state boundaries. Assigning more than one negligent violation might be detrimental to these producers. For example, if a producer uses the same seed in multiple locations, and that seed results in a THC level over 0.3 percent, all of that production must be disposed or remediated. All of these locations could be determined a separate violation. However, AMS wants to clarify that a producer may not be found to have committed more than one negligent violation per year. Barriers to entry: Several comments suggested that a 0.5 percent negligence threshold threatens the survival of farmers in an emerging industry. Comments suggested that the low threshold is a barrier to entry for new farmers or farmers with no experience growing hemp, who risk high initial capital investments to establish operations. Comments argued that the low threshold favors larger farms using industrialized hemp varieties and production practices, and that the low negligence threshold in the IFR would unnecessarily criminalize farmers working with a legal ***agricultural*** commodity. AMS response: All persons interested in growing hemp must meet the eligibility criteria established in the 2018 Farm Bill and this final rule. Negligent violations document instances when the statue or rule are violated such as when a grower fails to report a legal description of land on which hemp is grown or fails to dispose of a noncompliant crop. All farmers, regardless of the size of their operations, face the same set of requirements. Even though the 2018 Farm Bill sets the THC concentration level at 0.3 percent, it does not define what THC level in cannabis will give rise to a negligent violation. Left undefined, this lack of definition is troublesome as it could make enforcement uneven among States and Indian Tribes. The IFR provided that hemp producers do not commit a negligent violation if they make reasonable efforts to grow hemp and the marijuana does not have a THC concentration of more than 0.5 percent. Increasing this threshold to 1.0 percent benefits producers, including small and new farmers, that intended to grow hemp but whose crops tested ``hot'' even though they made reasonable efforts to grow hemp. Resources and enforcement: One State commented that it currently enforces a 1.0 percent negligence threshold. According to the comment, lowering the threshold to 0.5 percent would significantly increase the rate of negligent violations in that State, require more State and Federal resources to enforce the regulation, and be financially burdensome to novice farmers. It stated that the 0.5 percent negligence threshold is lower than the threshold DEA designates as the upper THC limit for ``inconclusive marijuana/hemp.'' The comment found the IFR's 0.5 percent threshold inconsistent with some laboratories' testing capabilities and suggests raising the rule's threshold to 1.0 percent. AMS response: AMS anticipates that the closer the negligent violation threshold is to 0.3 percent total THC, the greater the likelihood that oversight authorities issue more negligent violations. Moreover, whenever a producer commits a negligent violation, the oversight authorities must also establish a corrective action plan as required by regulation. AMS believes that increasing the negligent violation threshold to 1.0 percent would therefore reduce some burden to oversight authorities by reducing the number of negligent violations and corrective action plans that oversight authorities must issue and administer. AMS notes that regardless of the negligent violation threshold, any crop exceeding the Federal allowable total THC concentration must be disposed of according to regulatory requirements. AMS disagrees that the DEA's enforcement program for marijuana should affect how AMS manages its compliance program for hemp.State and Tribal Resources The IFR required States and Tribal governments to certify they have the resources and personnel to carry out the practices and procedures of their respective plans. Further, the IFR provided for audits of State and Tribal plans to include review of the resources and personnel employed to administer and oversee its approved plan. Finally, the IFR specified audit reporting requirements and remediation steps for States and Tribal governments found to be non-compliant with USDA requirements. Comments: Comments from many States expressed enthusiasm for partnering with USDA in the regulation[[Page 5647]]of domestic hemp production. The comments were supportive of establishing a national regulatory framework that would bring clarity and consistency to the regulation of hemp production across the U.S They emphasized that many States have enacted legislation to facilitate the regulation of hemp production. No comments received from the States demonstrated a reluctance to work with USDA in establishing regulations. The requirement for States and Indian Tribes to certify to USDA that they have the capacity to administer a domestic hemp program was not addressed explicitly in any of States' comments. However, many of the comments from the States and Indian Tribes registered concerns with some aspects of the IFR. Most of the comments from States and Indian Tribes delineated areas where the burden of regulatory oversight might be reduced, or efficiencies realized, by revisions to the regulations. Several comments expressed concern that State and Tribal governments would not be able to perform their responsibilities under the program as currently established. One comment said the lack of appropriate personnel, training, and protocol would lead to an untenable backlog in the ***collection*** and testing of samples. Many comments focused on the sheer number of samples that must be ***collected***, processed, and tested under the program. The shortage of DEA-registered labs in the States and the new sample ***collection*** protocols were also areas of concern, although that was addressed shortly after the IFR went into effect with the announcement of enforcement discretion.\27\ Points of potential weakness in the States' and Tribal governments' implementation of the IFR were raised by many commenters, both explicitly and in implied remarks. Many of the comments referenced State and Tribal government infrastructures being strained under the new regulatory requirements, especially during peak harvest intervals, and that those factors could contribute to the failure of the States and Indian Tribes to fulfill their oversight obligations. A number of comments alluded to the burden of any breakdown in the regulatory scheme being borne by hemp producers directly, as with samples that are not timely ***collected*** by State inspectors and the samples then testing ``hot'' without any remediation options, or labs that are not able to process samples due to capacity issues.--------------------------------------------------------------------------- \27\ [*https://www.ams.usda.gov/rules-regulations/hemp/enforcement.---------------------------------------------------------------------------*](https://www.ams.usda.gov/rules-regulations/hemp/enforcement.---------------------------------------------------------------------------) Numerous comments made recommendations to address the increased regulatory burden on States and Tribal governments. Many recommended changing the 15-day post-sample harvest period to 30 days to allow more time for States and Tribal governments to ***collect*** and process samples, balance workloads, and alleviate potential backlogs. In addition, several comments contended that the increased sampling requirements in the proposal (i.e requiring sampling of every lot) would burden the process and contribute to delays in growers receiving results. Those comments recommended revising the sampling protocol (reducing number of samples required per producer) to help relieve the strain on government resources. Lastly, comments suggested that allowing labs that are ISO 17025 accredited to process samples, as opposed to only allowing labs with DEA registration, would enhance the State's ability to provide validated, accurate, and timely testing. One commenter said they had talked with a number of States that expressed strong concerns over the additional burdens as a result of the IFR. The commenter further stated that some states they are considering whether to ``opt-out'' of administering a hemp production plan themselves in favor of USDA administering a plan. Lastly, one comment stated that if there was a bureaucratic slow down or insufficient resources on the part of USDA, a farm should be allowed to have some recourse to be able to harvest. That comment, and others that were similar in spirit, effectively questioned what mitigation efforts would be undertaken for producers in the short run if a State or Indian Tribe ultimately lacks the necessary resources and personnel to administer its plan and fails to perform the obligations it certified it could undertake. AMS Response: The issues raised in these comments are mostly addressed under other sections in this rule (e.g , 15-day harvest window, laboratory accreditation). AMS agrees that there are regulatory burdens of this program, which are discussed in this rule. States and Indian Tribes have multiple options that would allow producers in their States or territories to grow hemp. States and Indian Tribes can develop their own plan, send their producers to grow under the USDA plan, or States can continue under the 2014 Farm Bill pilot program. Many States and Indian Tribes assess fees on producers to cover their expenses for sampling, oversight and other costs of this program. These options provide producers different alternatives to grow hemp under different regulatory schemes. Additionally, USDA has decreased the risk of the regulatory burden on States and Indian Tribes being borne by hemp producers by addressing various issues commenters identified that could cause States and Indian Tribes to be unable to timely fulfill their responsibilities such as by modifying the sampling protocol and changing the 15-day post-sample harvest period to 30 days. Other burdens associated with this final rule that the producer must cover should be considered by producers, as in any ***agricultural*** business, before a decision to grow hemp is made.Appeals--Denial of Application and Appeal of Test Results The IFR addressed the denial of applications to grow hemp in Part V. APPEALS. The IFR also provided an option to appeal test results in which producers can request that a second test be performed if they disagree with the first test results. Comments: A comment recommended that USDA establish a clear deadline for applicants who wish to appeal the denial of their grower applications. The comment noted that the IFR already required a State or Indian Tribe appealing the suspension or revocation of a hemp production plan to file an appeal ``within the time-period provided in the letter of notification or within 30 business days from receipt of the notification, whichever occurs later.'' The commenter noted that no such similar deadline is identified for applicants who have been denied USDA hemp grower licenses. One comment asserted that denials of ``licensure'' may occur for ``whatever reason.'' Two other commenters submitted examples of State regulatory language from California and Ohio, each of which include provisions for the denial of applications for license. Several comments suggested USDA establish an appeals process through which someone with a felony conviction may demonstrate completion of appropriate steps to become eligible hemp producers. AMS response: This rule retains the IFR provision that an applicant for a USDA hemp production program license may appeal a license denial to the AMS Administrator. USDA licensees may appeal denials of a license, renewals, license suspensions, or license revocations to the AMS Administrator must be submitted in writing and received within 30 days of the receipt of notification of the denial or within the time-period provided in the letter of notification, whichever occurs later. State and Tribal plans reviewed and approved by USDA are[[Page 5648]]required to include an appeal process for producers to appeal licensure decisions. In response to the comment that USDA should establish an appeals process through which someone with a relevant felony conviction may demonstrate completion of appropriate steps to become eligible hemp producers, it is important to note that limitations as a result of relevant felonies are set in the 2018 Farm Bill.Appeals--Technical The IFR stated that producers can request a second test be performed if they disagree or have doubts about the original test results. Comments: One comment indicated that if there is a discrepancy between compliance testing for THC concentration, there needs to be a process for farmers to appeal. Another comment noted that no administrative appeal process exists for producers who wish to challenge a decision they believe adversely affects them, such as test result. Another commenter cited personal experience with one State ***agriculture*** department and described as ``unfair'' a regulatory system that does not allow for an appeal process through which a farmer may contest test results. AMS response: USDA is maintaining its position that producers under a USDA plan are able to request a second test be conducted when they do not agree or have questions about a test result. This rule provides flexibility to allow States and Indian Tribes to provide for retesting if the State or Indian Tribe chooses to do so.Transportation and Shipping Documents Under the 2018 Farm Bill and the IFR, neither States nor Indian Tribes may interfere with the transportation of lawfully produced hemp through States or Tribal territories, even if hemp production is prohibited within a particular State or Tribal territory. Public comments related to transporting hemp focused primarily on facilitating the interstate transportation of hemp. Interstate commerce: Many comments applauded the IFR's reiteration of the statutory provision that allows for interstate shipments of lawfully produced hemp and hemp products without interference by State or Tribal law enforcement. Some asked USDA to clarify that prohibited interference includes that from State, Tribal, or Federal law enforcement, including DEA. Other comments wanted confirmation that interstate commerce includes entry into and egress from Tribal territories and that Tribal hemp production licenses be honored for purposes of interstate commerce transport and commerce. Commenters stated they had already encountered situations where States passed temporary regulations conflicting with the 2018 Farm Bill and impeding interstate commerce. For example, comments noted an Idaho Executive Order--Transportation of Hemp--issued in 2019, that they claimed would ``excessively frustrate interstate hemp transportation and growth of the hemp industry.'' One airline carrier comment explained that under this Order, ``transporters may have to stop, get inspected, and be subject to detention each time they cross jurisdictional boundaries'' and that airlines would avoid carrying hemp if this issue is not remedied. Comments from Indian Tribes expressed concern that despite the 2018 Farm Bill, Tribes transporting hemp through States have a bias against Tribal hemp production. There were suggestions of the use of a USDA form or stamp authorizing transportation to address these obstacles. One commenter also requested that USDA provide for recourse for Indian Tribes that are prohibited from moving hemp through neighboring States. AMS Response: At this time, USDA recommends that transporters carry a copy of the producer's license or authorization, as well as any other information the governing State or Indian Tribe recommends or requires that will validate that the transporter is transporting legally-grown hemp. As allowed under the 2018 Farm Bill, States and Indian Tribes can be more restrictive, which includes possible transportation paperwork requirements by States or Indian Tribes. USDA is not adding transportation paperwork requirements to this rule because it does not have jurisdiction over common carriers or other types of transporters. Comment: A comment asserted that intrastate commerce of hemp that does not meet all the requirements of the IFR should remain under the State's authority, and farmers producing hemp compliant with the 2018 Farm Bill but not the IFR should be allowed to do so, as long as that hemp is not transported across State lines. The comment advocated for no Federal preemption, citing to section 297B(a) of the 2018 Farm Bill, which provides that ``nothing in this subsection preempts or limits any law of a State or Indian Tribe that (i) regulates the production of hemp; and (ii) is more stringent than this subtitle.'' AMS Response: The 2018 Farm Bill does not preempt State law provided that the State adopts a plan that is approved by USDA and the plan may provide for more stringent requirements. A State has the responsibility for enforcing the requirements of its plan. Thus, hemp that is produced under a State's plan should meet the requirements of the final rule. Shipping Documentation: Several comments encouraged USDA to facilitate the unimpeded flow of hemp in interstate commerce by implementing identity preservation or tracking systems or requiring the use of standardized shipping labels, packaging, or other documentation to certify to stakeholders and law enforcement authorities that the cargo in transport is Federally legal hemp. Comments suggested the use of USDA-issued stamps or forms that are recognizable, understood, and accepted by all law enforcement authorities. Several Indian Tribes made this suggestion because they are concerned about law enforcement transportation issues, particularly in Idaho, South Dakota, Maine, New York and Wisconsin. According to comments, such forms could verify that cargo hemp is compliant with USDA-approved production plans. Other comments suggested the use of a standardized bill of lading across the industry that sets out essential information about the shipment for easy reference by transporters, regulators, processors, and law enforcement officials to ensure all loads have been lawfully produced in accordance with Federal, State, or Tribal law. A comment from an association of county ***agriculture*** commissioners and sealers suggested USDA require the officially certified lab report to accompany shipments of hemp product during interstate shipment. Comments suggested various commercial systems for recognizing legally produced hemp in transport. Other comments asked USDA to devise a standard documentation system for hemp carriers that would more easily absolve them of legal liability related to transporting hemp. Comments recommended that USDA coordinate with the hemp industry; Federal agencies such as DEA, the Department of Transportation, and the Department of Justice; and State agencies, including law enforcement and transportation departments, to develop such documentation. Some comments additionally recommended adopting specific hemp packaging and labeling requirements on the basis that they would support compliance and enforcement tasks. Some comments advised USDA to provide specific regulations for testing hemp in transit so that such testing, if[[Page 5649]]necessary, be conducted in a standard manner, consistent with the requirement that all pre-harvest Total THC testing be conducted by DEA-registered laboratories. Other comments recommended that hemp loads be sealed to ensure their integrity and mitigate the interference of illicit products. Comments advocated that USDA host a central hemp database for reporting ***data*** applicable to all phases of hemp production that would be ``read only'' to law enforcement, saying such a system would be particularly beneficial in resolving questions related to interstate commerce. One comment advocated for the use of a centralized hemp clearinghouse to capture hemp flower transfer to processors or manufacturers for CBD extraction, including information on the licensed producers and receivers of raw materials, the total weight of materials being transferred, testing certificates indicating THC levels of the materials being transferred, and other State-mandated criteria, as well as information on the vehicles being used to transport the materials. It further recommended USDA evaluate methods to physically identify and segregate products containing hemp-derived CBD to differentiate legitimate from potentially illicit products. AMS response: AMS understands the importance of ensuring safe passage of hemp across states and Tribal jurisdictions. Section 10114 of the 2018 Farm Bill specifically states that ``Nothing in this title or an amendment made by this title prohibits the interstate commerce of hemp.'' USDA issued a memorandum addressing this issue.\28\ Several States already identified documents to facilitate transportation of hemp across states. AMS strongly encourages producers of hemp and carriers providing transportation services to provide the following documentation accompanying the hemp cargo: Copies of the laboratory testing report(s), hemp grower license, invoice/bill of lading, and contact information of buyer and seller. The 2018 Farm Bill does not provide specific authority to USDA to This final rule does not adopt any requirement for interstate transportation of hemp. As required by the 2018 Farm Bill, USDA is developing a database that will share information about hemp production with law enforcement. The database will identify the contact information for the producer, a legal description of the land on which hemp is produced, and status of the producer's license or other required authorization from the State or Indian Tribe.--------------------------------------------------------------------------- \28\ Memorandum from Stephen Vaden, Office of General Counsel to Sonny Perdue, Secretary of ***Agriculture***, Legal Opinion on Certain Provisions of the ***Agriculture*** Improvement Act of 2018 Relating to Hemp (May 29, 2019).---------------------------------------------------------------------------``In-Process'' Material Comments: Several comments mentioned ``in-process material,'' described as material made from otherwise qualifying hemp plant material, such as crude CBD oil and distillate, or as any hemp material that is compounded, blended, ground, extracted, sifted, sterilized, derived by chemical reaction, or processed in any way for use in the manufacture of hemp products. Commenters asked USDA to clarify that once hemp has been tested and allowed to enter commerce, it should be considered legal material thereafter. One comment suggested the establishment of specifications or guidance for any part in the ``in-process material'' manufacturing record where control is necessary to help ensure that specifications are met for the identity, purity, strength, and composition of the hemp products and, as necessary, for limits on those types of contamination that may adulterate or may lead to adulteration of the finished batch of the hemp product. One comment explained the perception that in-process materials are not allowed to transfer freely between processors, causing bottlenecks in product processing. According to the comment, some hemp processors may be limited to performing only one step of a multi-step process to derive hemp products, such as distilling CBD oil and isolating the CBD molecule. It said processor-to-processor transfers of in-process hemp materials should be authorized between U.S States with valid hemp programs, which would open a processing bottleneck and allow both hemp materials and cash to flow more freely. The comment asserted such authorization would improve prices for CBD end-products, which would trickle down to hemp growers. Some commenters stated that it is commonly known that THC levels in initially compliant hemp may rise above the 0.3 percent delta-9 THC limit during subsequent processing. Commenters expressed concern that some jurisdictions believe the ``in-process material'' should be diluted to always maintain the level below 0.3 percent delta-9 THC, even during transportation to another processor. However, several comments argued that ``in-process material'' is neither consumer ready nor a ``finished'' product and that dry-weight measurements related to hemp THC levels are calculated on the initial plant material and not the finished product to ensure compliance with the threshold. AMS response: The 2018 Farm Bill directed USDA to establish a national regulatory framework for hemp production in the U.S , and the final rule outlines provisions for this mandate. The IFR and this final rule do not cover hemp or its products beyond production. Further, DEA has issued regulations covering some of these products or ``in-process materials''.\29\ Accordingly, this final rule does not address ``in-process materials,'' processors, end-products, processing of CBD or other cannabinoids or anything that may contain hemp or hemp byproducts.--------------------------------------------------------------------------- \29\ [*https://www.govinfo.gov/content/pkg/FR-2020-08-21/pdf/2020-17356.pdf.---------------------------------------------------------------------------Equal*](https://www.govinfo.gov/content/pkg/FR-2020-08-21/pdf/2020-17356.pdf.---------------------------------------------------------------------------Equal) Treatment for Tribes Comments: Some commenters said that final rule should provide Indian Tribes at least as many opportunities regarding hemp production and regulation as those granted to States and that the final rule should allow Indian Tribes to catch up quickly with States that have been allowed to develop production methods and markets under the 2014 Farm Bill provisions. AMS Response: This final rule does not distinguish between States and Indian Tribes. USDA recognizes that both State and Tribal governments have the ability to authorize and to regulate the production of hemp within their States or territories consistent with the 2018 Farm Bill and the final rule.Psychoactive Effects of Cannabinoids Delta 9 THC or THC is the primary psychoactive component of cannabis. As mandated by the 2018 Farm Bill, hemp must be verified as having THC concentration levels of 0.3 percent or below on a dry weight basis. Comments: Several comments referenced different studies to support conflicting positions regarding the psychoactive effects of THC and used study findings to argue that the IFR's THC limit should be revised. Many comments cited the ``Defining Hemp: A Fact Sheet'' from the Congressional Research Service, updated March 22, 2019, that said a level of about 1 percent THC is considered the threshold for cannabis to have a psychotropic effect or an intoxicating potential. Other commenters argued THC levels of 5 percent or more are necessary for marijuana to have a psychoactive impact or commercial value. Comments noted that hemp is generally characterized as plants that are low in delta-9 THC and high in levels of CBD,[[Page 5650]]the primary non-psychotropic compound. Many comments stated that research shows that CBD affects the ability of THC to bind to CB1 receptor in cells, thus blocking the psychoactive effects of THC. Other comments representing health organizations stated that research is challenging the widely accepted premise that CBD is not intoxicating. They further stated that the THC found in CBD products can be intoxicating and has caused significant and serious consequences in terms of job loss, health, and exposure to pediatric populations. Some comments provided personal testimony that while using CBD for health benefits they had not experienced psychoactive or intoxicating effects. Other comments reported that the United Nations standard STR/NAR/40 uses a ratio of ([THC] + [CBN])/[CBD] to determine whether a plant is likely to have a psychoactive effect. AMS response: AMS appreciates understanding different views on the psychoactive effects of THC. However, this topic is outside the scope of the final rule, and AMS made no revisions to the program based on these comments. The 2018 Farm Bill defined hemp as having a THC concentration of 0.3 percent or less. Medicinal use of hemp or CBD is covered under the Federal Food, Drug, and Cosmetic Act, 21 U.S.C ch. 9, sec. 301, et seq. and under the FDA's jurisdiction.Miscellaneous Comments Comments: One comment pointed out that the IFR's hemp definition did not include the application of an MU, but that the definition of acceptable hemp THC level does. The comment said references to the definition of hemp should be changed to refer to acceptable hemp THC level so there is uniformity across the final rule. AMS Response: USDA has made references to acceptable hemp levels when appropriate. The acceptable hemp levels include the MU to account for differences in laboratory conditions or environments. There is no intention to change the definition of hemp that is stated by the 2018 Farm Bill. Comments: Another comment recommended improving the clarity of the final rule by deleting the words ``or THC'' from the definition of delta-9 THC, as well as deleting the sentence ``For the purposes of this part, delta-9 THC and THC are interchangeable.'' The comment further recommended that the definition of Total delta-9 THC be expanded to clarify that it includes delta-9 THC combined with delta-9 THCA to account for the conversion of delta-9 THCA into delta-9 THC when the plant material is dried. Finally, the comment recommended that in all cases where ``THC'' is referenced throughout the final rule document with no further clarification, ``THC'' should be changed to ``delta-9 THC.'' The comment said these clarifications will be helpful in administration of the rule. AMS Response: AMS is adding a definition of ``Total THC'' to clarify the use of the term in this rule. Total THC accounts for the conversion of THCA into THC. We believe using THC and delta-9 THC interchangeably is appropriate. Comment: One comment claimed that making the IFR effective immediately gave farmers preparing for imminent harvest no time to comply with the new testing and threshold requirements, increasing their risk of producing plants that were legal under the 2014 and 2018 Farm Bill statutes but potentially illegal under the IFR. AMS response: USDA's decision to make the IFR effective immediately was to provide a framework for the 2020 growing season. However, States had the option to continue operating under the 2014 Farm Bill. States and Indian Tribes were provided time to develop plans on time for their planting and harvest season. Comment: USDA should work with other agencies, including DEA and DOJ, to develop cohesive information and guidance regarding enforcement related to hemp. AMS response: AMS has worked with DEA and other agencies in developing these regulations to assure that the intent of the 2018 Farm Bill provisions for hemp are met. USDA is responsible for the regulatory oversight of hemp production and DEA and other law enforcement agencies are responsible for enforcing the law regarding marijuana.Miscellaneous Comments--Out of Scope In addition to addressing specific provisions of the IFR, comments also addressed other topics related to the hemp industry. Comments: One comment advocated the creation of a USDA commodity checkoff program for one or more categories of hemp (e.g grain, fiber, CBD) and recommended that USDA work with hemp industry trade organizations and stakeholders to administer checkoff funds to support hemp agronomic and market development. Another comment included a newsletter item quoting USDA as saying that such a program could be developed. One comment asked USDA to support the hemp industry by adding hemp seed foods to those offered through school lunch and other government feeding programs. One comment said that hemp extracts and concentrates and byproducts from hemp should be afforded the same legal status and protections as the hemp from which they originated. One comment suggested that the IFR did not consider compliant hemp topical products that make up a large portion of the market or other applications that cannot be inhaled or ingested. One comment advocated that hemp and CBD should be covered and protected under the Perishable ***Agricultural*** Commodities Act (7 U.S.C 499 et seq.). Some comments said farmers should only be allowed to sell hemp to licensed brokers, handlers, and processors, and not directly to the public. They further advocated requiring license information to be part of the documentation that accompanies hemp shipments. A couple of comments urged USDA to establish good manufacturing practices for CBD manufacture. One comment claimed that chemical and seed providers have developed aggressive tactics which may be used to hamper hemp producers. One comment requested updating banking regulations to allow banks to do business with entities whose income is derived from hemp and/or legal cannabis. Another comment requested an examination on how bonding could protect hemp farmers against companies and contracts that have not been honored, causing financial harm to the grower. One commenter suggested to discontinue the program totally or at least discontinue the CBD portion because there is too much potential for abuse and waste of taxpayer dollars. The commenter stated that it could be okay to continue the coverage for the seed and fiber. They also stated that USDA should not be in the marijuana business. AMS received comments on the impact of the current statutory and regulatory structure on banking and insurance related to hemp production. Commenters expressed concern that the 0.3 percent THC ceiling and the required disposal of cannabis testing above 0.3 percent THC would hinder the ability of hemp producers to obtain insurance, loans, or other financial services. One commenter also urged AMS to clarify if the preemption language in section 10114(a) of the 2018 Farm Bill encompasses interstate banking, financial services, and[[Page 5651]]insurance transactions and if USDA intends to supersede, coordinate, or adopt guidance issued by other Federal agencies related to hemp production. A comment suggested banks could offer insurance for crop losses if the hemp had a THC concentration that was greater than 0.3 percent but less than or equal to 0.5 percent, similar to offering coverage for losses due to factors beyond the grower's control, depending on various USDA culpability findings. Another comment advocated that crop insurance be available for hot hemp. A comment stated that Non-Irrigated (NI) acreage should be uninsurable because good producers who are serious about growing the crop would not bother with NI acreage. Another comment discussed establishment of ``Earliest Plant Dates'' (EPD), Late Plant Period (LPP), and Final Plant Date (FPD), and references sections of what may be a State or Tribe plan and the difficulty of finding farmers growing hemp in comparable environments for determining such dates and insurance coverage. It also recommended developing a Replant Endorsement (with premium associated) to insure 50 to 75 percent of seed costs for replant. Finally, a commenter stated that germination tests should be required before the crop is planted and set a minimum standard of 85 percent germination--and those under that standard would be uninsurable. Several commenters argued that USDA should (1) ban hemp and hemp related products imported into the United States; (2) establish import limits on the number of clone material; (3) eliminate all imported hemp and concentrates into the U.S for the next 2 years, except for trades to the Canadian marketplace, but exportation must still be open for our country and product markets outside the United States; and (4) establish clear rules on how imported hemp and hemp products will be regulated. One commenter expressed concern about the current regulation of CBD as a prescription drug arguing that the prescription-only status for CBD is unwarranted and will facilitate the illegal market that continues to exist for these products. One commenter noted that the regulatory ambiguity resulting from the FDA's lack of guidance on CBD negatively impacts hemp producers and requires greater clarity. One commenter raised concerns about the ability of farm workers seeing U.S naturalization to be able to participate in hemp production based on a fear that U.S Immigration and Customs Enforcement will view work in hemp production as an ``exclusionary activity'' that would be a barrier to naturalization. Several commenters expressed concern regarding hemp production in close proximity to other ***agricultural*** crops. Commenters also expressed concern regarding drying and processing of hemp near other crops and residential areas. One commenter suggested that AMS support research on pollination and drift related to hemp production. One comment asked USDA to clarify whether section 10114(a) of the 2018 Farm Bill extends to interstate banking, insurance, or financial services involving hemp and hemp products. According to the comment, it is not clear whether interstate commerce in hemp and hemp products necessarily includes the payment for any hemp and hemp products through various methods, such as wires, checks, automated clearinghouse transactions, credit card or other financial transactions, including loan proceeds. One comment advocated the use of their company's blockchain technology to address industry and law enforcement concerns about chain-of-custody in sampling, transporting, and testing hemp. One comment requested that a clear statement be included in the final rule that USDA concurs that the exportation of hemp and hemp products is legal. It noted that the 2018 Farm Bill does not prohibit exports, and stated, without providing any empirical evidence, that there is sufficient interest in exporting hemp and hemp products from the U.S It also suggested that a dedicated tariff code for hemp and hemp-derived products be established to facilitate export trade. AMS Response: These comments all address issues that are beyond the scope of the rule. This rule only covers the production of hemp. Issues such as promotion of hemp under a research and promotion program; adding this product to other programs including feeding programs or PACA; importing or exporting of hemp; who can produce hemp in the U.S ; processing the commodity; insurance and banking; research or setting production boundaries; requirements on further products such as CBD; or other subjects mentioned above, are not the subject of this rulemaking or within other USDA or federal, State, Tribal, or private industry responsibilities and authorities.Comments on the IFR's Regulatory AnalysesCivil Rights Review The IFR included a Civil Rights review that found the rule would not have adverse effects on protected persons or groups, deny them program benefits, or subject them to discrimination. Comments: One comment indicated that small farmers face challenges related to costs of seed. Another commenter associated the destruction of non-compliant hemp as posing a great risk of economic hardship on hemp farmers, especially the small minority farmers. Several comments from Indian Tribes explained that certain provisions of the IFR, for example laboratory DEA-registration requirements, the definition of key participants, and Tribal law enforcement availability, did not sufficiently account for the specific circumstances and challenges facing Indian Tribes across the nation such as the remote location of many Indian Tribes, the limited economic resources of Indian Tribes, and Tribal decision-making structures. Comments pointed out that this final rule must ensure Tribal civil regulatory authority to help Tribal nations build and implement successful plans. Other Tribal comments identified the requirements for the complete destruction of the plant as, ``disproportionately economically disastrous for our small Native American farmers,'' explaining that Native American farmers tend to be significantly smaller and operate on very small margins. One commenter suggested that AMS reconsider the potential civil rights implications of this rule on the convicted felons because the IFR, if unchanged, will have a disproportionate negative impact on both Black and Latino Americans, who according to DOJ ***data***, represent 38.8 percent and 37.2 percent (respectively) of the total population of Federally sentenced drug offenders. The commenter compares this ***data*** to the ***data*** from U.S Department of Health and Human Services' rates of illicit drug use among White Americans (9.5%), Black Americans (10.5%,) and Latino American (8.8%). Another commenter claimed that using ``flawed/inaccurate science with lower standards is a direct example of failing to preserve the protection of the public at large,'' and ``USDA cannot legally implement their proposed rules without violating the mission statement of the agency.''[[Page 5652]] AMS response: AMS considered the potential civil rights implications of this rule on minorities, women, and persons with disabilities to ensure that no person or group shall be discriminated against on the basis of race, color, national origin, gender, religion, age, disability, sexual orientation, marital or family status, political beliefs, parental status, or protected genetic information. Additionally, this rule would not deny any persons or groups the benefits of the program or subject any persons or groups to discrimination. This rule is neutral and of general applicability. We also note that some of the burdens or hardship described in the comments are required by the 2018 Farm Bill. First, the 10-year ineligibility restriction applicable to persons convicted of a State or Federal felony is a requirement of the 2018 Farm Bill. Also, as stated previously the basis for the DEA lab registration is rooted to the statutory requirements of the Controlled Substances Act, that requires any laboratory that might potentially handle a controlled substance to undergo the DEA registration process and thus cannot be eliminated. Additionally, the 2018 Farm requires effective disposal of non-compliant plants. Moreover, AMS conducted a Civil Rights Impact Analysis in accordance with USDA's Departmental Regulation 4300-004: Civil Rights Impact Analysis.\30\ AMS's analysis did not find any evidence that the final rule would adversely or disproportionality impact hemp producers in protected groups, regions or Tribes as compared to the general population of hemp producers or State Departments of ***Agriculture***.--------------------------------------------------------------------------- \30\ [*https://www.ocio.usda.gov/sites/default/files/docs/2012/CRIA%20DR%204300-004-final.pdf.---------------------------------------------------------------------------Regulatory*](https://www.ocio.usda.gov/sites/default/files/docs/2012/CRIA%20DR%204300-004-final.pdf.---------------------------------------------------------------------------Regulatory) Impact Analysis Executive Orders 12866 and 13563 direct agencies to assess all costs and benefits of available regulatory alternatives when an action is deemed to have significant impacts. If regulation is necessary, then agencies must select the action that maximizes net benefits, including potential economic, environmental, public health and safety effects, and equity. Executive Order 13771 mandates that agencies provide the best approximation of total costs associated with a new or repealed regulation. AMS prepared a Regulatory Impact Analysis (RIA) with the purpose of accomplishing these objectives. Comments: Very few comments addressed the RIA specifically, but we received many comments with information related to assumptions that fed into the RIA such as percent of hot hemp, testing burdens, lab registration burdens. AMS addressed these comments in the general comment section and took into consideration information provided for the RIA. One comment acknowledged that USDA's economic analysis was based on sound and reasonable methodology but said that its expectations were not confirmed by actual market events in 2019. The commenter compiled production ***data*** provided in other comments in an effort to present a more current analysis of the hemp market. The comment pointed out that the RIA underestimated the number of hemp production licenses that would be issued and hemp acres that would be planted in the 2019 growing season. According to the comment, while the RIA called only for a doubling of licenses beyond the 2018 benchmark, the actual rate of licenses increased by 476 percent in 2019. Similarly, the comment reported actual planted hemp acreage in 2019 to be close to 230,000 acres, well over the 155,000 acres assumed by the RIA. The comment went on to say that the rate of growth for new licenses outpaced the rate of growth for consumer sales by 3:1, while the RIA had assumed a 1:1 rate over the next four years. The comment explained that supply growth has outstripped demand and created significant market imbalance and, as a result, market prices have dropped and driven down revenues to hemp producers. The comment cited the gross revenue for floral material estimated in Table 1 of the RIA, which ranges from $2,333 to $24,000 per acre under the assumption that two-thirds of an acre is planted for floral material. Based on market ***data*** published in November 2019, after the IFR's publication, the comment suggested that the actual range of gross revenue for floral material per two-thirds of an acre was $2,728 to $17,261. The comment then applied the variable cost of planting one full acre of floral material estimated in the RIA, $28,638 per acre, to this range of gross revenue. This calculation resulted in a loss of $11,377 to $25,910 per acre, which the comment said is incorrect given that the variable cost per acre of floral material was deducted from the gross revenue per two-thirds of an acre. For an accurate estimate of net revenue, it stated that gross revenue and costs must be represented in terms of the same unit of measurement. The comment suggested that the downstream effects of an unbalanced economic supply equation would further disrupt the profitability of sectors that are intended to support the transportation, processing, and retail sales of the product. It cited sales ***data*** reporting a 50 percent decline in the price of CBD extracts and concentrates from April 2019, stating that the oversupply of hemp has affected the entire commercial supply chain. The commenter disagreed with the methodology used to project the net social benefit of hemp per acre in the IFR, saying that methodology assumed social benefit is a static figure. The commenter asserted instead that social benefit is ``a fluid figure that is heavily influenced by time and supply and demand economics'' and that it will likely fall over time.\31\--------------------------------------------------------------------------- \31\ [*https://beta.regulations.gov/comment/AMS-SC-19-0042-1490.---------------------------------------------------------------------------*](https://beta.regulations.gov/comment/AMS-SC-19-0042-1490.---------------------------------------------------------------------------) Further, it argued that the estimated 2019 societal willingness to pay of $2,650 per acre, which was calculated in the RIA using Kentucky grower sales and planted acreage, is not representative of the rest of the United States. Based on the hemp product sales in Chart 1 of the RIA, the estimated return to producers of processor sales of 31 percent, which was calculated in the RIA by comparing Kentucky grower and processor sales, and total U.S planted acres estimated in Table 3 of the RIA, the comment calculates a 2019 national societal willingness to pay of $2,325 per acre. This result indicates that the societal willingness to pay based on Kentucky ***data*** is 14 percent higher than the estimate for the United States as a whole. The comment also calculates a national societal willingness to pay for 2018 of $4,047, which illustrates that a decline in societal willingness to pay of 42.5 percent occurred in 2019. The comment cautioned that the net social benefit calculated in the IFR was over inflated because it represents a point in time during the industry's infancy. The comment argued that the industry faces a market depression and recommended a quota system for licensing classified by intended use. In this recommendation, the comment offered a detailed approach to estimating acreage required to meet demand for hemp grown for use in the CBD market. The analysis resulted in an estimated 44,509 acres required to meet demand in 2020, 83,336 acres for 2021, 188,558 acres for 2022, 255,899 acres for 2023, and 309,773 acres for 2024. The comment expanded upon its recommendation of a quota licensing system, suggesting that a number of licenses be granted by range of acreage, thereby ensuring that a share of licenses is reserved for small farmers. Another comment asserted that unless the IFR definition of hemp is revised to include cannabis with a total THC level[[Page 5653]]of not more than 1.0 percent on a dry weight basis, it will not be economically viable to grow hemp for flower in the U.S According to the comment, if the THC limits of the IFR are maintained in the final rule, the RIA should be revised to reflect the impact of the rule on total yield and CBD concentration of harvestable flowers, reduced value of CBD hemp seed, and the unknowable market value of CBD. The comment predicted that although the value of hemp seed for flower might be reduced marginally, other input costs would remain very high. One comment recommended differentiation between hemp biomass and hemp flowers in the IFR's analysis of market prices for floral material. The comment said that hemp biomass refers to full plant material, including stems, leaves, and flowers, while hemp flower refers to the part of the plant that contains trichomes which houses richly and densely populated cannabinoid content. The comment said the prices in the RIA are consistent with prices for hemp biomass, and suggested prices for hemp flowers ranging from $25 to $800 per pound, depending on the percentage of CBD present. Two comments asserted that USDA grossly underestimated the sampling time and cost in the IFR. Comments were concerned that readers might assume hemp sampling and testing costs fees are preset. The comments suggested that hemp sampling is a more complex logistical problem than contemplated in the IFR because of the geography and scope of sampling on farms. The comments encouraged USDA to calculate anticipated sampling costs to include a minimum number of hours for each step in the sampling process, and to consider factors such as travel time and coordination of supplies and personnel for the sampling effort. One comment disagreed with the IFR statement that the new hemp production program would expand production and sales of domestic hemp, benefitting U.S growers and consumers. The commenter said that production costs for his CBD hemp farm were approximately $16,000 per acre, but because of the IFR's restrictiveness and his resulting inability to bring the crop to full maturity, the crop would likely only return $9,000 per acre. The commenter said they were unwilling to make that kind of risky investment and was unwilling to decide whether to plan for future crops until USDA finalizes its rule. AMS response: AMS is aware that the number of licenses and amount of acreage that were estimated in the RIA of the IFR were underestimated. Entrance of producers into the market spiked at an unexpected rate in 2019, driving up acreage along with licenses. AMS utilized the most current ***data*** available to it in its analysis of the hemp market in the IFR and the final rule. Regarding the estimate in one comment of net loss ranging from $11,377 to $25,910 per acre, it is important for gross revenue and costs to be represented in the same unit of measure for an accurate net revenue calculation, which, in this case, they are not. The variable cost per one acre of floral material was deducted from the gross revenue per two-thirds of one acre of floral material, resulting in a larger loss than if calculated using the same unit of measurement. AMS has adjusted the calculation of net revenue in the table below using the market price ***data*** cited by the comment. AMS appreciates the comment's citation of its sources and utilized similar sources in the RIA of this final rule.---------------------------------------------------------------------------------------------------------------- Planted acres Yield Price Gross revenue Variable cost Net revenue---------------------------------------------------------------------------------------------------------------- Low estimate----------------------------------------------------------------------------------------------------------------2/3............................. 1,000 $4.09 $2,727 $19,092 $(16,365)1............................... 1,000 4.09 4,090 28,638 (24,548)---------------------------------------------------------------------------------------------------------------- High estimate----------------------------------------------------------------------------------------------------------------2/3............................. 1,200 21.58 17,264 19,092 (1,828)1............................... 1,200 21.58 25,896 28,638 (2,742)---------------------------------------------------------------------------------------------------------------- Furthermore, AMS understands and appreciates the commenter's argument that net social benefit andsocietal willingness to pay are over inflated in the IFR. Due to the relative scarcity of industry ***data***, AMS made many assumptions in its analysis in the IFR, some of which were not realized. In order to caution industry stakeholders of the volatility of the hemp market, however, AMS used variable cost estimates to calculate net returns to producers, which ranged from a loss of nearly $17,000 to a gain of $6,240. In the single year since publication of the IFR, a greater amount of ***data*** has become available to AMS, which allows the analysis in the final rule to rely less on assumptions that may not be actualized. AMS only has the authority regarding hemp regulation granted to it by the 2018 Farm Bill. The recommendations to establish a quota system for issuing licenses based on intended use and to revise the definition of hemp such that it includes cannabis with up to 1.0 percent total THC on a dry weight basis are outside of the authority of USDA. The 2018 Farm Bill provided USDA no authority to regulate production volume. Additionally, USDA cannot adjust the statutory definition of hemp. AMS has also reviewed the sampling procedures and costs characterized in approved state and Tribal plans to better estimate the time and resultant fees that will be charged to producers for sampling in the hemp program.Small Business Impacts AMS performed a Regulatory Flexibility Analysis (RFA) in conjunction with the IFR that considered the effects of the rule on small businesses particularly. Comments: One organization that represents the views of small entities stated that small hemp producers have significant startup costs that affect their ability to be competitive in the hemp industry. The comment notes that hemp production is labor-intensive and has licensing and regulatory costs that are not typically incurred by producers of other ***agricultural*** crops. Small entities indicated that only those businesses with adequate capital and large-scale operations would be able to survive and comply with the requirements of this rule. Further, comments conveyed that this rule will raise real barriers to entry for small and disadvantaged producers and could prevent these critically important producer groups from even entering the hemp industry. Other comments stated that the negative effects of the regulatory incongruence in the IFR[[Page 5654]]disproportionately affect farmers, in particular new and small farmers--and small or already disadvantaged hemp farmers will face additional risks if the IFR is not changed. One comment claimed the 2014 and 2018 Farm Bills presented an innate prejudice for institutional research, including State departments of ***agriculture*** and institutions of higher education and this prejudice continued in the IFR. The commenter says this is similar to the bias of California's draft State plan, where individuals permitted to be grower or breeders, but the program's compliance burdens are effectively beyond the reach of most individuals. Commenters stated that this rule will disrupt small producers who were successfully producing hemp under prior pilot programs. One organization reported that hemp producers have stopped growing hemp altogether until they can be certain about what the requirements for producing hemp. Comments also reported that some hemp buyers have not renewed their contracts. Comments stated that several of the provisions of this rule impose unnecessary burdens on small entities. Comments suggested that many of the sampling and testing requirements should be revisited and alternatives should be considered and analyzed to minimize the burden to small producers. In addition, comments said that small business are very concerned about the risk of losing their economic investment due to mandatory disposal, the lack of control over growing conditions, genetics of neighboring crops, and timing and precision of the testing. Comments from State departments of ***agriculture*** expressed strong concern as to the additional burdens they would incur as a result of the rule. These burdens may be directly passed to small producers in the form of delayed responses to license applications, renewals, and appeals; testing backlogs; duplicative reporting requirements; new license fees; and other programmatic issues. One comment claimed that, based on six years of administering their hemp program, many of the most rigid requirements of the IFR are not only unnecessary, but also likely to have a disproportionately adverse impact on new farmers and farmers with smaller operations. According to the comment, these farmers already face great risk in the current marketplace, and need regulatory help, rather than impediments, in order to grow and thrive. The comment urged AMS to provide a more sensible, flexible, and practical regulatory scheme to encourage industry growth. AMS response: AMS understands that there is a great deal of uncertainty in the hemp industry currently and has made efforts to minimize any burden which may befall producers as a result of this rule. To that end, USDA is not charging producers any fees for licensing or ***collecting*** any fees from producers to support AMS' administration of the hemp program. The fee structure developed by States and Indian Tribes to administer their hemp programs lies outside of the purview of USDA. On average, AMS anticipates total fees paid by producers under a State or Tribal Plan to amount to $800 per grower. This amount includes licensing and other fees intended to generally fund the operations of States or Tribal Programs. Fees for sampling and testing, on average, amount to about $300 per lot. The cost for an annual background check for three key participants is $54. AMS estimates an annual reporting and recordkeeping burden of $129 per grower. Altogether, these costs total $1,283 per grower, assuming one lot requires sampling and testing. This total cost is 0.1 percent of $1 million, which is the largest amount in annual receipts that a grower may receive to be considered to be a ``small business'' under the Small Business Size Standards of the U.S Small Business Administration (SBA). In response to comments, AMS has revised its sampling and testing methodology to allow for performance-based sampling, which should reduce the burden on all producers, large and small. Section 990.3 details this revised methodology. In addition, AMS has modified its disposal requirements, and allows for remediation of noncompliant crops. These remediation options are described in Sec. 990.27 AMS understands the concerns raised by state departments of ***agriculture*** regarding the requirements of administering a commercial hemp program. For this reason, AMS has made every effort to provide States and Indian Tribes flexibility to administer their hemp programs, including whether they charge for fees or other costs or cover those expenses from other State or Tribal resources. If the burden for a State or Indian Tribe to administer its own hemp program remains too great, however, the State or Indian Tribe may elect to participate in the Federal plan and allow AMS to administer the program. By providing this flexibility, USDA believes it is less likely that the burdens on State and Tribal resources will be passed on to small businesses.Tribal Matters The IFR provided that States and Indian Tribes may submit hemp production plans to USDA for approval. Individual producers from States or Tribal territories that do not have USDA-approved plans may file separate applications for hemp production licenses under the general USDA hemp production plan. Below are several comments and AMS's responses regarding matters of particular concern to Indian Tribes and Tribal members. Comments: Comments said the regulations fail to treat Indian Tribes on an equal basis with States by repeatedly failing to include the term ``Tribe'' when referring to the State and local jurisdictions. According to comments, by doing so, the regulations fail to respect Tribal sovereignty and self-government. AMS response: USDA agrees that Indian Tribes must be treated the same as States under the regulations. There were a few occasions where USDA mistakenly left out ``Tribe'' from the language in the regulation. USDA is correcting these mistakes in the IFR by revising the language of the final rule to insert ``Tribe'' after ``State'' in the definition of Law Enforcement Agency in Sec. 990.1; insert ``Tribe'' after ``State'' in Sec. 990.24(a); and revise Sec. 990.40(d), which incorrectly referred to ``States and territories of Indian Tribes,'' to refer to ``States and Indian Tribes''. Comments: Several comments asserted that USDA should not define ``territory of an Indian Tribe'' and claimed that by doing so, USDA violates Tribal treaty rights to farm on Tribal territories. Comments argued that such a definition should be left up to each Indian Tribe. Further, comments contended that the definition of ``territory of an Indian Tribe'' at Sec. 990.1 inappropriately refers to a criminal statute, 18 U.S.C 1151, to define an Indian Tribe's territory and regulatory jurisdiction. Other comments supported the use of the Indian country definition, but asked for the removal of the requirement that the lands must be within the Indian Tribe's jurisdiction, primarily because it causes uncertainty as to whether Indian Tribes may regulate hemp production on non-Indian owned fee lands within a Tribe's territorial boundaries. Comments also asked that AMS clarify that States cannot interfere with hemp production within the territory of an Indian Tribe. AMS Response: If an Indian Tribe does not assume primary jurisdiction over the Tribe's Indian territory, USDA has jurisdiction over the hemp production on an Indian Tribe's[[Page 5655]]territory pursuant to the 2018 Farm Bill. USDA, therefore, must know the limits of its jurisdiction over such Indian territory, just as it must know its jurisdiction over lands ordinarily within State jurisdiction. The IFR defined ``territory of the Indian Tribe'' at 7 CFR 990.1 as having the same meaning as ``Indian Country'' in 18 U.S.C 1151. Upon consideration of comments submitted by Indian Tribes, USDA concurs that reference to the criminal law definition of Indian country could be confusing. Therefore, in the final rule USDA revised the definition of ``territory of the Indian Tribe'' to incorporate language from other Federal statutes, but without explicitly cross-referencing such statutes. Specifically, the final rule defines ``territory of the Indian Tribe'' to mean (a) all land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, including rights-of-way running through the reservation; (b) all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a state; (c) all Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same; and (d) any lands title to which is either held in trust by the United States for the benefit of any Indian Tribe or individual or held by any Indian Tribe or individual subject to restriction by the United States against alienation and over which an Indian Tribe exercises jurisdiction. In the 2018 Farm Bill, Congress provided authority for any Indian Tribe to seek USDA approval to become the primary regulator of hemp production within the ``territory of the Indian Tribe.'' The 2018 Farm Bill did not provide a definition of the term territory of the Indian Tribe, and there is no universally accepted definition of that term, or similar terms, within the field of Federal Indian law. In describing jurisdictional boundaries associated with Indian Tribes, various Federal statutes use several terms, including Indian country, Indian lands, Federal Indian reservations, and areas within the Indian Tribe's jurisdiction, among others. Thus, by its very nature and history, the statutory term ``territory of the Indian Tribe'' is ambiguous. According to the Indian canon of construction, ``statutes are to be construed liberally in favor of the Indians, with ambiguous provisions interpreted to their benefit. . . .'' Montana v. Blackfeet Tribe of Indians, 471 U.S 759, 766 (1985) (citations omitted). In addition, USDA may address ambiguities in a statute that it administers, with any reasonable interpretation of the ambiguous term entitled to judicial deference. Chevron U.S.A Inc. v. Nat. Res. Defense Council, Inc., 467 U.S 837, 842-43 (1984). In this case, Congress provided no indication that the term ``territory of the Indian Tribe'' should apply more narrowly than similar terms that have been defined and interpreted in other Federal statutes and programs. Moreover, a narrow interpretation that excluded nontribal fee lands within reservations would perpetuate the problem of checkerboard jurisdiction over lands within Indian reservations, adding unnecessary confusion and uncertainty to the challenges of implementing the hemp program in Indian country. Therefore, the USDA includes a regulatory definition of the term ``territory of the Indian Tribe'' that is based on the definition of Indian country in 18 U.S.C 1151 and the definition of Indian lands in the Indian Gaming Regulatory Act, 25 U.S.C 2703(4). The definition includes all lands within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, which encompasses on-reservation parcels held in fee simple by non-members of the Indian Tribe. Similar provisions are found in the criminal jurisdiction definition of Indian country, 18 U.S.C 1151; in the Clean Water Act, 33 U.S.C 1377(h); the Clean Air Act, 42 U.S.C 7601(d)(2)(B). The U.S Environmental Protection Agency (``EPA'') interpreted the statutes that it administers as providing authority to Indian Tribes over non-Tribal fee lands within Indian reservations. EPA Final Rule: Indian Tribes--Air Quality Planning and Management, 63 FR 7254 (Feb. 12, 1998); EPA Interpretive Rule: Revised Interpretation of Clean Water Act Tribal Provision, 81 FR 30,183 (May 16, 2016). EPA found that the Clean Water Act and Clean Air Act provided a delegation of authority to Indian Tribes over non-Tribal fee land within reservations. See Arizona Public Serv. Co. v. EPA, 211 F.3d 1280 (D.C Cir. 2000). The agency found legislative intent and a common-sense reasoning to treat Indian reservations holistically for purposes of environmental regulation. Similarly, USDA interprets the 2018 Farm Bill as authorizing Indian Tribes to become--with USDA's approval of a hemp plan--the primary regulators of hemp production within their territories, including on nontribal fee lands within reservations. This authority applies without regard to the Indian Tribe's ability to demonstrate inherent regulatory authority over non-Indians under the factors set forth in Montana v. United States, 450 U.S 544 (1981). Additionally, this definition will make clear the area over which USDA will have regulatory authority including licensing if the Indian Tribe does not have an approved plan or a plan submitted to USDA for approval. Comment: Some comments said Indian Tribes did not have the benefit of operating under the 2014 Farm Bill and, consequently, have not developed the farming techniques and regulatory systems that States have. Therefore, according to comments, Indian Tribes should be given a grace period while they develop best practices. AMS response: Not all States operated under the 2014 Farm Bill, and some Indian Tribes did enter into Tribal--State agreements under the 2014 Farm Bill. Therefore, establishing a regulatory grace period for Indian Tribes only is not workable. Indian Tribes may take advantage of training and technical assistance offered by the USDA and other entities to ensure that they implement the best systems possible. Comments: Some comments claimed that negligent violations by Indian Tribes under Sec. 990.6 may cause Indian Tribes to be ineligible for other programs. AMS response: The 2018 Farm Bill describes three types of negligent violations under State and Tribal plans. The negligent violations detailed in Sec. 990.6 are required to be included in State and Tribal plans pursuant to the 2018 Farm Bill. Comment: A comment contended that the requirement for a geospatial site identification at Sec. 990.3(a)(1)(ii) is too expensive for Indian Tribes, unnecessary, and not readily available. Comments said the Department of the Interior has land records that could be used to obtain necessary information. AMS response: A legal description of the land where hemp is grown is required by the 2018 Farm Bill. Geospatial location is one form of meeting such requirement. Producers are required to provide information to FSA on the geographical location of hemp production. FSA offices will provide assistance in identifying such location at no cost to producers. Comments: Some comments said USDA should conduct more Tribal consultations and provide USDA and DEA training for hemp producers. One Indian Tribe requested more time to[[Page 5656]]allow Indian Tribes to organize a Tribal Advisory Council of Tribal Leaders to continue with the development and implementation of federal hemp policy. AMS Response: In addition to previous Tribal consultations and extending and reopening the IFR's comment period, USDA added a September 2020 Tribal consultation to receive additional information, particularly from 2020 growing season producers. See the section on E.O 13175 Consultation and Coordination with Indian Tribal Governments in this document for further discussion about the consultations. If Indian Tribes organize a Tribal Advisory Council of Tribal Leaders, USDA would appreciate any future feedback. Additionally, USDA is available to provide technical assistance when requested, including training. USDA is adding training for sampling to its website. Comments: Comments said that Indian Tribes and individuals within the territory of the Indian Tribe should not have to be regulated by States, but should be able to go directly to USDA for licensing if the Indian Tribe opts out of developing its own Tribal plan and the Indian Tribe does not otherwise prohibit hemp production. AMS Response: Subpart C, the USDA Hemp Production Plan, governs hemp producers in the absence of a Tribal plan. Therefore, any Indian Tribes or individuals wishing to produce hemp must comply with those regulations if not covered under a State or Tribal plan. If an Indian Tribe decides not to develop its own hemp plan, a producer may directly apply for a USDA license. States were not delegated authority under the 2018 Farm Bill to regulate hemp production within the territory of an Indian Tribe. Comment: Indian Tribes should be allowed to implement their Tribal preference laws. AMS Response: Nothing in the IFR or the final rule prevents Indian Tribes from implementing their Tribal preference laws. Comment: A comment said that Tribal ordinances and interstate commerce regulations need to address price gouging in seeds and input. AMS Response: This comment is outside the scope of this rule. Comment: A comment said the Bureau of Indian Affairs and USDA should review 25 CFR part 162 governing ***agriculture*** and business leases to ensure that the hemp regulations here do not conflict with that part or cause additional regulatory hurdles. AMS response: 25 CFR part 162 establishes certain requirements for leasing trust or restricted Indian lands. USDA conferred with the Department of the Interior, the agency regulating Indian land, and did not identify any conflicts between the two sets of regulations. Comment: A comment suggested USDA hire an Indian law expert to assist with development of the final rule. AMS response: USDA agreed and hired a consultant with 40 years-experience as an Indian law attorney to assist with the development of the final regulations and the review of Tribal plans. Comment: Comments said the criminal history checks required by the IFR should be expanded to include the Department of Justice Tribal Access Program (TAP). According to comments, those using TAP would then be able to directly access criminal history checks. Comments also said the regulations need to clarify whether the criminal history check can be a name check or a finger-print check. AMS Response: USDA conferred with the DOJ Office of Tribal Justice and was informed that Indian Tribes can use the TAP program to access the FBI Identity History Summaries. The FBI Identity History Summaries may be based on name check or a finger-print check. Comment: Comments noted that the term ``key participant'' is defined at Sec. 990.1 in a manner that is not necessarily consistent with an Indian Tribe's unique organization and methods of doing business. Comments explained, for example, that an Indian Tribe may be the owner of a hemp farm. Comments asserted that although the Indian Tribe's governing council may be the ultimate decision-maker as the owner, it would not be appropriate to include them in the felony and background investigations. Therefore, comments said Indian Tribes should be permitted to identify their own ``key participants'' if they are operating under a USDA plan and the requirements of Sec. 990.22 AMS Response: USDA understands the concerns raised by Indian Tribes regarding the application of the criminal history report requirement and the felony conviction restriction on Tribal leaders. However, USDA must ensure that entities operating under a USDA plan comply with the felony conviction restriction in the AMA. For reasons explained in the IFR, USDA believes that the appropriate approach in determining who participates in the program, and therefore subject to the felony conviction restriction, is to focus on those who exercise executive managerial control over hemp production. USDA also believes that this focus should be consistent across the USDA plan regardless of the person who is applying for a license. For the foregoing reasons, USDA has clarified the definition of key participants in the final rule to provide that the definition ``does not include a member of the leadership of a Tribal government who is acting in their capacity as a Tribal leader except when that member exercises executive managerial control over hemp production.'' AMS notes that an Indian Tribe may adopt its own hemp plans subject to USDA approval. When adopting a hemp plan, the Indian Tribe can determine who participates in its plan and will be subject to a criminal history check. Comment: USDA received a comment that it should affirm Tribal sovereignty by not allowing other federal agencies, such as the DEA, to interfere with Tribal hemp remediation. AMS Response: USDA does not have the authority to control the actions of other federal agencies acting properly within their authority. Comment: USDA received comments that USDA owes a trust responsibility to Indian Tribes. According to commenters, that trust responsibility requires acknowledging the unique challenges that Indian Tribes face including that (1) most tillable land was taken from Indian Tribes during homesteading; (2) Tribes' participation in the farm program results in only a 60 percent yield of their non-Indian counterparts; (3) the finance system is usurious as financiers discount the value of Tribal assets or refuse to consider them at all; and (4) American Indian producers will be disproportionately disadvantaged because their farms are significantly smaller and are generally run with only one crop by families with small margins. AMS Response: USDA acknowledges that it has a special government-to-government relationship with Indian Tribes, and believes that, in preparing and issuing this final rule it has acted in accordance with that relationship. In response to concerns regarding the unique challenges Indian Tribes face, as explained in the Civil Rights Review of this final rule, AMS conducted a ``Civil Rights Impact Analysis'' and did not find any evidence that the final rule would adversely or disproportionality impact Indian Tribes or Tribal members producing hemp as compared to the general population of hemp producers or State Departments of ***Agriculture***. Indian Tribes may take advantage of training and technical assistance offered by the USDA to ensure that they[[Page 5657]]implement the best systems possible. Additionally, USDA is available to provide technical assistance when requested.State and Tribal vs. Federal Regulation The preamble of the IFR stated that ``[n]othing preempts or limits any law of a State or Indian Tribe that regulates the production of hemp and is more stringent than the provisions in the 2018 Farm Bill.'' Further, Section 297B of the AMA expressly states that it does not preempt a State or Indian Tribe's ability to adopt more stringent requirements or to prohibit the production of hemp. This was codified in the IFR in Sec. 990.3(b)(1), which provides that nothing in the part preempts or limits any law of a State or Indian Tribe that regulates the production of hemp and is more stringent than this part or Subtitle G of the Act. Comments: Many of the comments received stated that the provisions of the IFR were more stringent than the regulations of pilot programs established by States under the authority of the 2014 Farm Bill. In fact, the majority of all comments received either took exception to the perceived increase in regulatory requirements for hemp production under the IFR, or presented recommendations for alternative requirements under the final rule that would not be as restrictive or burdensome as the provisions in the IFR. No comments were received that either affirmed or opposed the rights of States and Indian Tribes to promulgate more stringent regulations for their jurisdictions. However, one comment said rather than using the flexibility allowed in the law to let states develop sensitive state plans, the IFR had rigid controls not required by law or correlated to the relatively low-level risk of non-compliant hemp. The comment further said USDA should establish baseline requirements but provide States flexibility to consider the dynamics of ***agricultural*** production that depend on farm and field conditions, weather, and the timing appropriate for planting, harvesting, the varieties being cultivated and the marketing of crops. Other comments agreed with recommendations to allow States and Indian Tribes to determine certain provisions that are not central to the minimum regulatory requirements of the IFR, such as application windows and reporting. AMS response: The 2018 Farm Bill expressly preserved the ability for State and Tribal hemp production plans to establish additional provisions stricter than the baseline regulations required by the 2018 Farm Bill. These baseline regulations require all State and Tribal plans to include certain minimum requirements for licensing, sampling, testing, disposal, and information ***collection***. These requirements could certainly be considered ``more burdensome'' than certain State hemp production plans operated under 2014 Farm Bill pilot program provisions, but they are intended to provide consistency and transparency among the U.S hemp industry as it matures. Prior to the passage of the 2018 Farm Bill, States operating hemp pilot programs could administer these programs with minimal Federal oversight, and without baseline requirements around sampling, testing, and other program requirements because the 2014 Farm Bill programs are for research. The 2018 Farm Bill established baseline requirements for hemp production for hemp production across the U.S regardless of the purpose of the production.Preemption Comment: AMS received comments asserting that the IFR did not abide by the mandate of the 2018 Farm Bill that there be no preemption of state or Tribal laws that regulate the production of hemp and are more stringent than the hemp provisions in the federal statute. AMS response: Section 297B(a)(3) of the AMA provides that for States and Indian Tribes with primary regulatory jurisdiction over the production of hemp, there is no preemption if that State or Indian Tribe both regulates the production of hemp and that regulation is more stringent than the 2018 Farm Bill or the implementing regulations. Thus, the no preemption provision of the 2018 Farm Bill is to make clear that more stringent requirements are not preempted. AMS finds that the 2018 Farm Bill requires the implementation of federally mandated minimum standards, which all jurisdictions must follow, allowing for certain further restrictions by States and Indian Tribes.Recordkeeping Requirement Comment: One commenter argued that the recordkeeping requirements of the IFR violated the 4th Amendment's prohibition against unreasonable search and seizure and was ``arbitrary and capricious'' and a violation of the APA. AMS Response: The 2018 Farm Bill established a hemp production program in the U.S subject to oversight from the Secretary of ***Agriculture***. Part of that congressional mandate is for the Department of ***Agriculture*** to establish a plan by which it ***collects*** information from producers to ensure compliance. While hemp is no longer a Schedule 1 drug, USDA can only make the determination of whether the crop is legal hemp (which it regulates) or illegal marihuana (which it does not regulate) through the mechanisms Congress has authorized. Recordkeeping requirements are paramount to that determination, which is required by Congress. AMS is retaining the recordkeeping requirements of the IFR.APA Notice and Comment Concerns Comment: Some commenters claimed that in issuing an IFR, AMS acted arbitrarily and capriciously in violation of the APA. Commenters argued that the good cause statement included in the IFR was not adequate to support its issuance rather than going through notice and comment rulemaking. AMS Response: AMS does not agree with these comments and believes that there was good cause to issue the IFR. AMS has encouraged public input on the IFR since its issuance and has provided many opportunities for public comment.Criminal Background Checks and Definition of Key Participants Comment: Several commenters argued that the restrictions on participation in hemp production for people with criminal convictions related to a violation of a state or Federal controlled substance law are not necessary and that hemp should be treated the same as all other commodities, which do not have similar restrictions. Commenters argued that there should be an exception for people with disqualifying criminal convictions who could demonstrate rehabilitation and that this restriction conflicts with state statutory requirements in some states. One commenter argued that USDA should conduct all criminal background checks rather than States or Indian Tribes. AMS Response: AMS acknowledges various stakeholders' advocacy for reduced restrictions to entry in hemp production. However, the restriction on participation-based on a criminal conviction for violation of a state or Federal law related to controlled substances is a requirement established by statute and AMS does not have the authority to change to waive this restriction.Definition of Key Participants Comment: Some commenters requested that AMS change the definition of key participants to more clearly state which individuals within a business entity would be required to submit a criminal history report. One commenter requested that AMS align the definition of key participant with[[Page 5658]]the definitions of ``legal entities'' and ``beneficial owners'' in Department of Treasury regulations. Another commenter suggested that AMS define who must submit a criminal history report in States and Indian Tribes that have an approved plan for primary regulatory authority over hemp in their jurisdiction. AMS Response: AMS acknowledges various stakeholders' advocacy for a single definition of ``key participants'' for all hemp producers. However, AMS will not require that States or Indian Tribes with an approved plan for primary regulatory authority over the production of hemp in their jurisdiction adopt the USDA definition of ``key participants.'' States and Indian Tribes are free to incorporate the AMS definition of key participants into their plan but they are not required to do so. They must, however, define who participates in their plan and, for each license or authorization they issue, must identify at least one individual who will be subject to a criminal history check. The Department of Treasury definitions of ``legal entities'' and ``beneficial owners,'' while similar to the definition of ``key participants'' adopted herein apply broadly to the corporate structure of a business entity. USDA finds the ``key participant'' definition to best describe those individuals responsible for compliance with this program or ``leadership structure of a business entity.''X. Regulatory AnalysesPaperwork Reduction Act In accordance with section 3507(d) of the Paperwork Reduction Act of 1995 (44 U.S.C 3501 et seq.), the Domestic Hemp Production Program's information ***collection*** requirements have been previously approved by Office of Management and Budget (OMB) and assigned OMB No. 0581-0318. The 60-day public comment period was imbedded in the interim final rule (IFR) which was published on October 31, 2019, and ended on December 30, 2019. Because of the very tight timeline for publishing the IFR, OMB granted conditional emergency approval of these seven forms on December 3, 2019. The USDA Office of Chief Information Officer (OCIO) published the 30-day Notice for the three-year renewal at 85 FR 36828 on Thursday, June 18, 2020. While writing the IFR there was very limited ***data*** available to make the initial burden calculations under the Paperwork Reduction Act (PRA). Since the IFR was published, USDA has been able to gather much more accurate ***data*** on the number of producers, disposal rates, and time burdens for completing the forms. Because of this new information, AMS is updating the burden calculations currently approved by OMB. AMS will submit an updated Information ***Collection*** to align the new calculations in the FR with the 0581-0318 package. AMS received over 4,600 comments in the first public comment period and 1,100 during the second comment period on the overall regulation. A specific analysis of each topic area in the comment analysis section of the final rule. AMS did not receive public comments specifically on the PRA nor on the time burden hour calculations to complete any of the forms. One comment from the Alabama Department of ***Agriculture*** wrote that 10 minutes for a State or Tribal producer license application was too low, so that has been increased to 20 minutes. AMS used an initial estimate of 9,000 total producers for the IFR. This was based on the limited ***data*** from State Departments of ***Agriculture*** and the hemp advocacy group, Vote Hemp. Based on a review of hemp production ***data*** from State Departments of ***Agriculture***, and the ***data*** reporting services from Hemp Benchmarks and Vote Hemp, AMS now estimates 20,000 producers as a yearly average to use for the purposes of reporting calculations. These numbers will be updated every three years. While the current percent of hemp growers licensed under USDA is drastically smaller than this, AMS assumes approximately 20 percent or 4,000 producers will be licensed under the USDA plan, and the other 80 percent or 16,000 producers licensed under State and Tribal USDA-approved programs. The description and function of the seven reporting forms remains the same from the IFR and initial OMB approval. These forms require specific information be submitted by States and Tribes operating their own domestic hemp plans, from producers participating in the USDA Plan, and from laboratories testing for THC content. Reporting and recordkeeping burdens reflecting revised reporting hours and the projected additional producers are described in the following sections. All time and cost figures have been approximated to the nearest whole number. The table below explains these changes numerically.Costs of Reporting and Recordkeeping The initial estimate of 100 State and Tribal plans remains accurate since the majority of States and Indian Tribes will have their own programs. As of the Fall of 2020, USDA has already approved 65 individual State and Tribal programs, with more to come. The amount of State approved programs will also increase once the 2014 Farm Bill pilot authority expires and those additional States submit plans. States and Indian Tribes with approved plans are required to report certain information to USDA through three Forms: The ``State and Tribal Hemp Producer Report'', the ``State and Tribal Hemp Disposal Report'', and the ``State and Tribal Hemp Annual Report''. USDA ***collects*** information from all hemp producers under a State, Tribal or USDA program through the FSA report form ``Report of Acreage''. USDA ***collects*** information from USDA producers through the ``USDA Producer Application'', the ``USDA Annual Report'' and the ``USDA Disposal Report''. Laboratories provide information on the ``Laboratory Test Report''. AMS has updated PRA calculations using the Occupational Employment ***Statistics*** Survey of the Bureau of Labor and ***Statistics*** \32\ using the 2019 ***data***. The mean hourly wage of a compliance officer, as reported in May 2019, was $35 per hour. This is the same numerical value as the May 2018 report. Assuming 39 percent of total compensation accounts for benefits, the total compensation of a compliance officer is $57 per hour. This $57 per hour will be used throughout the PRA section.--------------------------------------------------------------------------- \32\ [*https://www.bls.gov/oes/home.htm.---------------------------------------------------------------------------Respondents:*](https://www.bls.gov/oes/home.htm.---------------------------------------------------------------------------Respondents:) States or Tribes With Approved Plans AMS initially estimated that the time required for States and Indian Tribes to fill in the information for each of these forms will be 20 minutes or 0.33 hours with a 5 minute or 0.08 hours record keeping burden. This estimate has been updated from 20 minutes to 60 minutes or one hour. The ``State and Tribal Hemp Producer Report'' and the ``State and Tribal Hemp Disposal Report'' are due to USDA every month. The ``State and Tribal Hemp Annual Report'' form must be submitted to USDA once per year. Similar to the other two State and Tribal forms, the annual time burden was initially 20 minutes but has been updated to 60 minutes. The time burden for each State and Indian Tribe to complete and maintain these three forms is now 12 hours for each monthly form and 1 hour for the annual report, for a total of 25 hours per State and Tribe with an approved plan. Given the estimated number of approved State and Tribal plans is 100, the total cost is 250 hours and $14,250.[[Page 5659]]Respondents: Producers Under State or Tribal Plans (Information Only, Not Completing the Forms) The time required of producers to supply the information for the ``State and Tribal Hemp Disposal Report'' and the ``State and Tribal Hemp Annual Report'' will stay the same at 10 minutes for reporting and 5 minutes for recordkeeping burden for each producer for these two forms. The ``State and Tribal Hemp Producer Report'' time estimate is now increased to 20 minutes with a 5 minute record keeping burden for each producer, per the suggestion from the Alabama Department of ***Agriculture***. In the IFR, AMS originally estimated that the majority of States and Indian Tribes would have three-year producer licenses, and producers would only submit this information once every three years. Since approving 60 State and Tribal plans, the majority of State and Tribal licenses are issued on a yearly basis instead. AMS estimates that the 16,000 State and Tribal producers will submit license information each year for State and Tribal programs. In addition to obtaining a license, all hemp producers are required to prove that they do not have prior drug related convictions that would disqualify them from participation in the program. States have some flexibility in what they require of applicants to make this demonstration. However, for purposes of this analysis, AMS will use the cost of the FBI Identify Summary, $18, as a proxy cost for all background reports, and 3 key participants for each license each year, although if we were to take into account comments, it is likely there will be more than 3 key participants each year. In the chart below is a cost breakdown of the application and background check for producers under a State or Tribal program.-------------------------------------------------------------------------------------------------------------------------------------------------------- Cost of Plus burden FBI Identity Summary Number of Number of Total annual \* 3 Key background cost of Total cost respondents responses resposes participants check ($18) application--------------------------------------------------------------------------------------------------------------------------------------------------------Cost for State and Tribal producers (3 16,000 1.0000 16,000.00 48,000.00 $864,000.00 $379,666.00 $1,243,666.00 key participants every year)...........-------------------------------------------------------------------------------------------------------------------------------------------------------- In the IFR, AMS estimated that 20 percent of lots will need to be disposed even though the current rate of disposal is closer to 12%. This assumption is based on the increased number of new entrants to the market who may not be successful in their first year or two. AMS is introducing a new performance-based method to sampling, which will decrease the amount of testing and noncompliant tests. Therefore, AMS estimates that 1,600 lots will be disposed under State and Tribal programs. The producers under a State or Tribal program will provide their disposal information to their individual regulatory body. The States and Indian Tribes will then use that information to complete the monthly ``State and Tribal Hemp Disposal Report''. These are just the costs and burden of ***collecting*** and maintain the information associated with the disposal, not the actual disposal. The actual cost of disposing of the non-compliant ``hot'' hemp is discussed in the RIA. In total, producers under a State or Tribal program provide information and hold records for three forms. The total time burden for these producers providing and maintaining this information is estimated at 11,061 total hours and $630,466.Respondents: Producers Participating in the USDA Plan To produce hemp under the USDA Plan, a producer, which may be an individual producer or a business, completes the ``USDA Hemp Plan Producer Licensing Application'' and an FBI Identity Summary. If all parts of the application and summary are valid, AMS issues a license. The total burden per respondent of this form will maintain the same as in the IFR; 10 minutes for the time and 5 minutes for record keeping for a total of 15 minutes, or .25 hours. Licenses under the USDA Plan must be renewed every three years, so each producer only submits this information once every three years. In the IFR, AMS initially estimated that there will be 1,000 participants in the USDA Plan. AMS has now updated this estimate to be 20 percent of the total hemp producers, or 4,000 producers each year. Because the USDA license is valid for three years, approximately 1,332 producers will complete this form each year. The total annual burden for this form is 544 hours and $31,603. In addition to the ``USDA Hemp Plan Producer Licensing Application'' submitted once every three years, producers must submit criminal history reports for each of their key participants. AMS estimates each producer to have three key participants submit criminal history reports to USDA. The cost of a criminal history report is $18 apiece, so three key participates would cost $54 per participant. As stated previously, AMS estimates that it will receive 1,332 license renewals in each year. Each of these 1,332 renewals will include a background summary for three key participates. Adding the cost of 1,332 renewals at $71,928 with the cost of the background check is $31,603 for the renewals and means there is an annual cost of $103,531.-------------------------------------------------------------------------------------------------------------------------------------------------------- Number of Cost of Plus burden FBI Identity Summary Number of responses per Total annual \* 3 Key background cost of Total cost respondents respondents resposes participants check ($18) application--------------------------------------------------------------------------------------------------------------------------------------------------------Cost for USDA producers (3 key 4,000 0.3330 1,332.00 3,996.00 $71,928.00 $31,603.00 $103,531.00 participants every three years)........--------------------------------------------------------------------------------------------------------------------------------------------------------[[Page 5660]] Similar to the required annual report submitted by States and Indian Tribes to USDA, producers operating under the USDA Plan must submit the ``USDA Hemp Plan Producer Annual Report'' to USDA each year. AMS estimates the time burden of submitting this form will maintain the same, at 25 minutes, or 0.42 hours, per respondent. AMS has updated the initial estimate of 1,000 participants in the USDA Plan, to 4,000 producers. Therefore, the total burden of this form has increased from 416 hours to 1,665 hours, costing $94,916 annually. When a hemp sample tests above the acceptable hemp THC level, the material from the specific lot must be disposed. The producer and disposal agent must complete the ``USDA Hemp Plan Producer Disposal Form''. The burden for this form will stay at 25 minutes, or 0.42 hours, per respondent. Using the same assumptions regarding the prevalence of non-compliant crops and the costs of disposal that were used in generating the estimates of hemp disposal reporting (and disposal) for State and Tribal programs, the 4,000 producers that will participate in the USDA Plan will generate 400 samples that test high for THC content. The total reporting burden of this form will amount to 167 hours and cost $9,492 annually. Altogether, the annual burden for the USDA producers completing and maintain the three USDA forms ``USDA Hemp Plan Producer Licensing Application'', the ``USDA Hemp Plan Producer Disposal Form'', and the ``USDA Hemp Plan Producer Annual Report'' amounts to an annual total of 2,386 hours and a cost of $136,011.Respondents: Laboratories The 2018 Farm Bill requires that all domestically produced hemp be tested for total THC content on a dry-weight basis, whether produced under a State or Tribal Plan or the USDA Plan. Using ***data*** from FSA the initial estimate of two lots of hemp per producer remains accurate. However, the new performance-based sampling process will decrease the number of total samples that are ***collected*** and tested. AMS requires all laboratories testing hemp for THC to submit all test results, whether passing or failing, via the ``Laboratory Test Results Report''. AMS maintains the estimated reporting and recordkeeping burden for this form at 35 minutes, or .58 hours. AMS originally estimated that 7,700 total hemp producers would submit 15,400 samples to test. AMS has updated this estimate to 8,000 total tests annually. Therefore, the total annual burden of these tests and the accompanying ``Laboratory Test Results Report'' form decreased from 8,399 hours to 4,664 hours, and costs $265,848.Respondents: All Producers The FSA ***collects*** information on crop acreage through the ``Report of Acreage'' form. Hemp producers under all plans are required to fill in the information for this form once they receive their license or authorization from USDA, a State, or Indian Tribe and have planted the crop. AMS will keep the initial reporting burden and record keeping burden at 35 minutes, or 0.58 hours. AMS has added 60 minutes or one hour for the travel time to and from the FSA office, for a total of 90 minutes. With the increased number of producers and the addition of travel time, AMS estimates the burden for the 20,000 producers will be 31,660 hours and cost $1,804,620.Total Reporting and Recordkeeping Costs for All Respondents Altogether, the annual burden for reporting and recordkeeping for all respondents is 52,296 hours, costing a total of $2,980,864 per year. This is the sum of the annual burden of reporting and recordkeeping to States and Indian Tribes operating their own plans, to producers participating in the State and Tribal Plans, to producers participating in the USDA Plan, including the cost of a criminal history report for three key participants, and to laboratories testing samples for THC content.[[Page 5661]] Table---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------- Number of Total Annual hours Name Form Number of responses per Total annual Hours per reporting Number of per record Total record Total hours x $57 respondents respondent responses response hours record keepers keeper keeping hours---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------- State and tribal forms----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------State and Tribal Hemp Producer Report AMS-23........................ 100 12.0000 1,200.00 0.3333 399.96 100 0.083 8.30 408.26 $23,270.82 (Old).State and Tribal Hemp Producer Report AMS-23........................ 100 12.0000 1,200.00 1.0000 1,200.00 100 0.083 8.30 1,208.30 68,873.10 (Update).State and Tribal Producer Responses information only.............. 8,000 0.3330 2,664.00 0.1670 444.89 2,664.00 0.083 221.11 666.00 37,962.00 (Old).State and Tribal Producer Responses information only.............. 16,000 1.0000 16,000.00 0.3333 5,332.80 16,000 0.083 1,328.00 6,660.80 379,665.60 (Update).State and Tribal Hemp Disposal Report AMS-24........................ 100 12.0000 1,200.00 0.3333 399.96 100 0.083 8.30 408.26 23,270.82 (Old).State and Tribal Hemp Disposal Report AMS-24........................ 100 12.0000 1,200.00 1.0000 1,200.00 100 0.083 8.30 1,208.30 68,873.10 (Update).State and Tribal Producer Disposal information only.............. 2,680 1.0000 2,680.00 0.1670 447.56 2,680 0.083 222.44 670.00 38,190.00 Responses (20% then x 2 for 2 lots/ producer) (Old).State and Tribal Producer Disposal information only.............. 1,600 1.0000 1,600.00 0.1670 267.20 1,600 0.083 132.80 400.00 22,800.00 Responses (25% of lot from 80% of producers) (Update).State and Tribal Hemp Annual Report AMS-25........................ 100 1.0000 100.00 0.3333 33.33 100 0.083 8.30 41.63 2,372.91 (Old).State and Tribal Hemp Annual Report AMS-25........................ 100 1.0000 100.00 1.0000 100.00 100 0.083 8.30 108.30 6,173.10 (Update).State and Tribal Hemp Annual Report information only.............. 6,700 1.0000 6,700.00 0.1670 1,118.90 6,700 0.083 556.10 1,675.00 95,475.00 Response (Old).State and Tribal Hemp Annual Report information only.............. 16,000 1.0000 16,000.00 0.1670 2,672.00 16,000 0.083 1,328.00 4,000.00 228,000.00 Response (Update).---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------- USDA Producer Forms----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------USDA Hemp Plan Producer Licensing AMS-26........................ 1,000 0.3330 333.00 0.1670 55.61 333 0.083 27.64 83.25 4,745.25 Application (Old).USDA Hemp Plan Producer Licensing AMS-26........................ 4,000 0.3330 1,332.00 0.1670 222.44 4,000.00 0.083 332.00 554.44 31,603.31 Application (Update).USDA Hemp Plan Producer Disposal Form AMS-27........................ 400 1.0000 400.00 0.3333 133.32 400 0.083 33.20 166.52 9,491.64 (20% x 2 lots for 2 lots/producer) (Old).USDA Hemp Plan Producer Disposal Form AMS-27........................ 400 1.0000 400.00 0.3333 133.32 400 0.083 33.20 166.52 9,491.64 (25% x lots from 20% of all producers) (Update).[[Page 5662]] USDA Hemp Plan Producer Annual Report AMS-28........................ 1,000 1.0000 1,000.00 0.3333 333.30 1,000 0.083 83.00 416.30 23,729.10 (Old).USDA Hemp Plan Producer Annual Report AMS-28........................ 4,000 1.0000 4,000.00 0.3333 1,333.20 4,000 0.083 332.00 1,665.20 94,916.40 (Update).---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------- All Producer Forms----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------Report of Acreage (Old)................. FSA-578....................... 7,700 1.0000 7,700.00 0.5000 3,850.00 7,700 0.083 639.10 4,489.10 255,878.70Report of Acreage (Update + 60 min FSA-578....................... 20,000 1.0000 20,000.00 1.5000 30,000.00 20,000 0.083 1,660.00 31,660.00 1,804,620.00 travel time).Laboratory Test Results Report (2 lots/ AMS-22........................ 7,700 2.0000 15,400.00 0.5000 7,700.00 7,700 0.083 639.10 8,339.10 475,328.70 all producers) (Old).Laboratory Test Results Report (100% of AMS-22........................ 8,000 1.0000 8,000.00 0.5000 4,000.00 8,000 0.083 664.00 4,664.00 265,848.00 CBD; 50% of fiber; 50% of grain) (Update). ----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------- Total for Updates................... .............. .............. .............. .............. .............. .............. .............. .............. 52,295.86 2,980,864.25----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------Each column is a section of the burden estimate, with the cost of $57 per hour calculated in the last column. Each row represents the old or the new reporting calculations.[[Page 5663]]E-Government Act AMS is committed to complying with the E-Government Act, to promote the use of the internet and other information technologies to provide increased opportunities for citizen access to Government information and services, and for other purposes. We recognize using an electronic system will promote efficiencies in developing and implementing the new USDA Domestic Hemp Production Program. Since this is a new program, AMS is working to make this process as effective and user-friendly as possible.Civil Rights Review AMS has considered the potential civil rights implications of this rule on minorities, women, and persons with disabilities to ensure that no person or group shall be discriminated against on the basis of race, color, national origin, gender, religion, age, disability, sexual orientation, marital or family status, political beliefs, parental status, or protected genetic information. This review included persons that are employees of the entities who are subject to these regulations. This final rule does not require affected entities to relocate or alter their operations in ways that could adversely affect such persons or groups. Further, this rule does not deny any persons or groups the benefits of the program or subject any persons or groups to discrimination. This final rule reflects AMS's response to public comment and input provided by stakeholders. The final rule provides States and Indian Tribes the regulatory authority over hemp production in their jurisdictions. It also establishes a Federal plan for hemp producers located in States or territories of Indian Tribes that do not have their own USDA-approved hemp oversight plan. There is no evidence that the final rule will potentially adversely or disproportionality impact hemp producers in protected groups, regions or Indian Tribes differently than the general population of hemp producers or State Departments of ***Agriculture***.Executive Order 13132--Federalism AMS has examined the effects of provisions in this final rule on the relationship between the Federal Government and the States, as required by Executive Order 13132 on ``Federalism.'' Our conclusion is that this rule does have federalism implications because the rule has substantial and direct effects on States, on the relationship between the National Government and States, and on the distribution of power and responsibilities among the various levels of government. The federalism implications of the rule, however, flow from and are consistent with the underlying statute. Section 297B of the AMA, 7 U.S.C 1639p, directs USDA to review and approve State plans that meet statutory requirements and to audit a State's compliance with its State plans. Overall, the final rule attempts to balance both the autonomy of the States with the necessity to create a Federal framework for the regulation of hemp production. Section 3(b) of E.O 13132 recognizes that national action limiting the policymaking discretion of States will be imposed ``. . . only where there is constitutional and statutory authority for the action and the national activity is appropriate in light of the presence of a problem of national significance.'' Section 297B of the AMA is the statutory authority underlying the rules for USDA to review, approve, disapprove, or revoke State plans for hemp production. Until the passage of the 2018 Farm Bill, hemp was a Schedule I controlled substance as it fell within the CSA definition of marijuana. When hemp was exempted from the definition of marijuana as part of the 2018 Farm Bill, in connection with removing it from that list, Congress established a national regulatory framework for the production of hemp. Because cannabis plants with a THC level higher than 0.3 are marijuana and on the Federal controlled substances list, ensuring that hemp produced under this program is not marijuana is of national significance. In addition to establishing a national regulatory framework for hemp production, Congress expressly preempted State law with regard to the interstate transportation of hemp. Section 10114 of the 2018 Farm Bill States that ``[n]o State or Indian Tribe shall prohibit the transportation or shipment of hemp or hemp products produced in accordance with subtitle G of the ***Agricultural*** Marketing Act of 1946 (as added by section 10113) through the State or the territory of the Indian Tribe, as applicable.'' Thus, States and Indian Tribes may not prevent the movement of hemp through their States or territories even if they prohibit its production. Congress also expressly preempted a State's ability to prosecute negligent violations of its plan as a criminal act in section 297B(e)(2)(c). That preemption is incorporated into this rule. Section 3(d)(2) of the E.O 13132 requires the Federal Government to defer to the States to establish standards where possible. Section 4(a), however, expressly contemplates preemption when there is a conflict between exercising State and Federal authority under Federal statute. Section 297B of the AMA requires State plans to include six practice and procedures and a certification. It also expressly states that it does not preempt a State's ability to adopt more stringent requirements or to prohibit the production of hemp. Section 297D of the AMA requires USDA to promulgate regulations to implement subtitle G of the AMA, which includes section 297B. Subpart B of the final rule repeats those requirements, providing more detail where necessary. States have wide latitude to develop the required practice and procedures. Subpart B includes more details on the testing and sampling of hemp plants to establish a national standard to determine whether the plants meet the statutory definition of hemp. Likewise, the final rule requires States to follow DEA requirements for disposal of marijuana for cannabis plants exceeding the acceptable hemp THC level. Finally, the final rule also reaffirms that States may adopt more stringent standards and prohibit hemp production within their jurisdiction. Section 6 of E.O 13132 requires consultation with State officials in development of the regulations. AMS conducted significant outreach with State officials including individual meetings, participation in conferences with State officials, and listening sessions where State officials from all States were invited. During our consultation with the States, representatives from various State agencies and offices expressed the following concerns about sampling and testing procedures. Most requested that USDA adopt uniform, national requirements to facilitate the marketing of hemp. Some States advocated that USDA defer to each State to determine the appropriate procedures for its plan. USDA recognizes the value of a national standard to promote consistency while allowing States the flexibility to adopt procedures that fit their circumstances. As explained above, USDA is adopting performance standards for sampling and testing. As long as the procedures in the State plans meet those standards, AMS will find those procedures acceptable. As AMS implements this new program, we will continue to consult with State officials to obtain their feedback on implementation. Finally, we have considered the cost burden that this rule would impose on States as discussed in the Regulatory Impact Analysis of this document. AMS has assessed this final rule in light of the principles, criteria, and[[Page 5664]]requirements in Executive Order 13132. We conclude that this final rule: Is not inconsistent with that E.O ; will not impose significant additional costs and burdens on the States; and will not affect the ability of the States to discharge traditional State governmental functions.Executive Order 13175 Consultation and Coordination With Indian Tribal Governments AMS examined the effects of provisions in the final rule on the relationship between the Federal Government and Tribal governments, as required by E.O 13175 on ``Consultation and Coordination with Indian Tribal Governments.'' We concluded that the final rule does have substantial direct effects on Tribal governments, on the relationship between the National Government and Tribal governments, and on the distribution of power and responsibilities among the various levels of government. The effects of the rule, however, flow from and are consistent with the underlying statute. Section 297B of the AMA, 7 U.S.C 1639p, directs USDA to review and approve Tribal plans that meet statutory requirements and to audit a Tribal government's compliance with its Tribal plans. Overall, the final rule attempts to balance both the autonomy of the Tribal governments with the necessity to create a Federal framework for the regulation of hemp production. As with States, Tribal governments will have wide latitude in adopting procedures including adopting requirements that are more stringent than the statutory ones. For reasons stated in the federalism analysis, AMS is adopting national standards for sampling, testing, and disposal of non-compliant plants that Tribal plans must also incorporate. AMS conducted extensive outreach to Tribal governments through individual discussions with Tribal representatives, by extending the regulatory comment periods and through the following more formal consultations. Tribal Consultation May 2019: On May 1 and 2, 2019, USDA held a formal Tribal consultation on the 2018 Farm Bill including a session on hemp production. This consultation occurred at the National Museum of the American Indian located in Washington DC. In addition to listening sessions for the general public, USDA hosted a listening session for Tribal governments following the formal Tribal consultation on May 2, 2019. USDA officials attended meetings with representatives of Tribal governments. On December 11, 2019, roughly 41 days after the publication of the domestic hemp production program interim final rule, USDA held a second formal Tribal consultation. This consultation provided information on the interim final rule. This consultation occurred in Las Vegas, Nevada, and attendees included USDA officials, Tribal leaders, Tribal proxies, non-consulting Tribal members, non-profit representatives, businesses, law firms, private individuals, and other government employees. On September 24, 2020, USDA held a third formal Tribal consultation and provided information on the interim final rule. This consultation occurred virtually and attendees included USDA officials, Tribal leaders, Tribal proxies, non-consulting Tribal members, non-profits representatives, Businesses, law firms, private individuals, and other government employees. During the May 2019 consultation, Tribal representatives from several Tribal Governments expressed their opinions that the 2018 Farm Bill permitted the USDA Secretary to allow AMS to approve Tribal plans ahead of issuing regulations of the USDA plan. Indian Tribes stated that approving hemp plans immediately would allow those Indian Tribes (and States) with a plan to begin planting for the commercial production of hemp in 2019. The USDA Secretary released a Notice to Trade (NTT) on February 27, 2019, to explain that Tribal and State plans would not be reviewed or approved until AMS finalized regulations ahead of the 2020 planting season. Additionally, the NTT stated that until regulations were in place, States, Indian Tribes, and institutions of higher education could continue operating under authorities of the 2014 Farm Bill. The 2018 Farm Bill extension of the 2014 authority expired 12 months after USDA had established the plan and regulations required under the 2018 Farm Bill. Congress extended this expiration until January 1, 2022. After the May Tribal consultation, USDA issued a second NTT on May 27, 2019, to clarify that Tribal governments through the authorities in the 2014 Farm Bill are permitted to grow industrial hemp for research purposes during the 2019 growing season. USDA appreciates the urgency in which the Indian Tribes wish to engage in this new economic opportunity. We worked expeditiously to develop and promulgate the IFR so that States and Indian Tribes could submit their plans in time for the 2020 season. Tribal Consultation December 2019: During this consultation Indian Tribes expressed how some provisions of the interim final rule are too rigid and that USDA did not consider practical problems and potential economic harm faced by Indian Tribes under the program. Indian Tribes requested more extensive Tribal consultation and the inclusion of other agencies involved in hemp production and enforcement. In response, USDA extended the public comment date by thirty additional days to January 29, 2020 and agreed to conduct an additional consultation after the first growing season. AMS also reopened the public comment period for thirty days in the Fall of 2020. Tribal Consultation September 2020: Consultation also occurred on September 24, 2020. Based on the comments and consultations received, we made changes to the final regulations. Although Indian Tribes will still incur costs in complying with final rule, those costs should be outweighed by the benefits that the Indian Tribes realize in commercial hemp production occurring within their territories.Executive Order 13175 This rule has been reviewed in accordance with the requirements of Executive Order 13175, Consultation and Coordination with Indian Tribal Governments. Executive Order 13175 requires Federal agencies to consult and coordinate with tribes on a government-to-government basis on policies that have tribal implications, including regulations, legislative comments or proposed legislation, and other policy statements or actions that have substantial direct effects on one or more Indian tribes, on the relationship between the Federal Government and Indian tribes or on the distribution of power and responsibilities between the Federal Government and Indian tribes. The USDA's Office of Tribal Relations (OTR) has assessed the impact of this rule on Indian tribes and determined, in agreement with AMS, that this rule has substantial direct tribal implications that require continued outreach efforts to determine if tribal consultation under E.O 13175 is required. Based on AMS outreach efforts to date, OTR does not believe that tribal consultation is necessary at this time. If a tribe requests consultation AMS will work with the OTR to ensure meaningful consultation is provided where changes, additions, and modifications identified herein are not expressly mandated by Congress.[[Page 5665]]Executive Orders 12866, 13563, and 13771 Executive Orders 12866 and 13563 direct agencies to assess all costs and benefits of available regulatory alternatives when an action is deemed to have significant impacts. If regulation is necessary, then agencies must select the action that maximizes net benefits, including potential economic, environmental, public health and safety effects, and equity. This rule meets the definition of an economically significant regulatory action under Executive Order 12866, as it is likely to result in an annual effect on the economy of $100 million or more. USDA considers this to be a deregulatory action as it allows the development of a niche market that cannot exist under the state pilot programs authorized under the ***Agricultural*** Act of 2014 (2014 Farm Bill). This action finalizes the interim final rule published on October 31, 2019, that expanded production options and enabled interested farmers to grow hemp. Executive Order 13771 mandates that agencies provide the best approximation of total costs associated with a new or repealed regulation. AMS has prepared this Regulatory Impact Analysis with the purpose of accomplishing these objectives. USDA considers this to be a deregulatory action under Executive Order 13771 as it allows for the development of a niche market that cannot exist under current regulation. This rule removes barriers to entry and enables domestic farmers to grow hemp.Regulatory Impact Analysis Regulations must be designed in the most cost-effective manner possible to obtain the regulatory objective while imposing the least burden on society. This rule finalizes and updates the interim final rule that established a national regulatory oversight program for the production of hemp. This program is necessary to effectuate the mandate in the ***Agriculture*** Improvement Act of 2018, known as the 2018 Farm Bill, to coordinate State and Tribal government hemp production regulations with the newly established federal regulations for hemp production in States and Indian Tribes not regulated by State or Tribal plans. This program is intended to provide consistency in production, sampling and testing of hemp product to ensure compliance with the acceptable hemp THC level. This rule has been reviewed under Executive Order 12988, Civil Justice Reform, and is not intended to have retroactive effect. The discussions on Executive Orders 13132 (Federalism) and 13179 (Consultation and Coordination with Tribal Governments), above, address the extent to which the rule preempts State law, and the impacts of the rule to Tribal governments. The discussion above regarding appeals under new part 990, subpart D, describes the administrative procedures that must be exhausted prior to a judicial challenge.Introduction On October 31, 2019, USDA promulgated an interim final rule establishing a national program for the production of industrial hemp. A regulatory analysis was performed in support of that regulation and published as part of the preamble to that rule. This analysis is intended to update the previous analysis to reflect additional information gained through the first year of operation of that program and to assess whether any of the modifications to the program made in response to public comment have significant impacts on the estimated costs or benefits of the final program. In the IFR, AMS estimated lower and upper bounds to calculate the total net benefits of the rule to society at large. These net benefits were calculated for 2020 through 2022 only due to lack of ***data*** for future years. In the IFR, 2020 estimated net benefits ranged from a loss of nearly $4 million to a gain of $17.6 million; for 2021, a net benefit of $23 million to $46 million; and, for 2022, a net benefit of nearly $49 million to $74 million. In this final rule, the estimated net benefits, as shown in Table 12, are $46 million in 2020; $87 million in 2021; $135 million in 2022; $190 million in 2023; $226 million in 2024; and, $351 million in 2025. The estimates of net benefits resulting from this final rule differ from those in the IFR due to a variety of factors. First of these is the large increase in planted acreage and market entrants in 2019, the scale of which was unexpected. (There may be other unexpected changes due to the pandemic, but we cannot estimate those at this time.) Changes in other variables, as well, contributed to the increase in net benefits in the final rule over the IFR. A comparison of the variables that are assumed constant (across years 2020 through 2025) in the IFR and the final rule is shown in Table 1 below. In the year between publication of the IFR and this final rule, additional information regarding the hemp industry has emerged to the benefit of this analysis. AMS believes that the modifications to the analysis from the IFR to the final rule represent the state of the hemp industry to the greatest extent practicable. The modifications in this final rule are intended to further support the hemp marketplace and provide the greatest flexibility possible while still ensuring the program complies with the 2018 Farm Bill. AMS suspects that this rule, compared to the IFR, will incentivize participation in the market and allow for more farmers to be successful. In particular, AMS attributes this to two policies. First, AMS anticipates that the flexibilities in disposal and remediation of non-compliant hemp will help minimize the risk to farmers, therefore increasing participation in the industry. Second, AMS anticipates that the increased threshold for negligent hemp (from 0.5 percent to 1.0 percent) will also reduce risk to farmers and allow for more innovation. AMS received numerous comments providing ***data*** on the different aspects of the hemp industry, that while informative, could not be incorporated in the RIA due to such factors as they were too regionally focused, small in sample size, or lacked the depth of ***data*** points to be representative of the national hemp market. An example of this is the portion of retests performed on hemp samples that initially tested higher than 0.3 percent THC.[[Page 5666]][GRAPHIC] [TIFF OMITTED] TR19JA21.031 The 2014 Farm Bill defined hemp as the plant Cannabis sativa L. and any part of that plant with concentrations of THC no greater than 0.3 percent on a dry weight basis. While belonging to the same species as the plant that produces marijuana, hemp is distinctive from marijuana in its chemical makeup. The marijuana plant contains high levels of the cannabinoid delta-9 tetrahydrocannabinol (THC), which is the chemical that produces psychoactive effects. Hemp may contain no greater than 0.3 percent THC on a dry weight basis. Prior to the 2014 Farm Bill, hemp had never been designated in a Federal law as different from cannabis generally. The first regulation of hemp occurred in 1937 with the Marihuana Tax Act, which required all producers of the species Cannabis sativa to register with and apply for a license from the Federal government. The ``Hemp for Victory'' Campaign during World War II promoted production of hemp for rope to be used by U.S military forces. At the end of the war, however, the requirements in the Marihuana Tax Act resumed. In 1970, Congress passed the Controlled Substances Act, granting the Attorney General the authority to regulate production of cannabis, including hemp. The 2014 Farm Bill authorized pilot programs, as permitted by State law, for hemp cultivation for research purposes to be administered by academic institutions and State departments of ***agriculture***. By 2019 approximately half of the states had developed such a pilot program. The research under these pilot programs included market research, which allowed cultivated hemp to enter the stream of commerce as inputs into various consumer products. For example, in Kentucky, one of the first states to enact a pilot program, producer sales to processors totaled $1.6 million in 2016, $7.5 million in 2017, $17.7 million in 2018, and $51.3 million in 2019.\33\ Hemp biomass contains concentrations of the cannabinoid cannabidiol, known as CBD. High prices for hemp harvested for cannabinoids, relative to those of other ***agricultural*** commodities, have fueled producer interest in hemp production since 2014.--------------------------------------------------------------------------- \33\ Kentucky Department of ***Agriculture***.---------------------------------------------------------------------------2018 Farm Bill The 2018 Farm Bill allowed the production and sale of industrial hemp either under a State or Tribal program approved by the USDA or under a Federal license for producers in areas with no approved plan and no explicit State or Tribal statute prohibiting the production of hemp. The 2018 Farm Bill explicitly preserved the authority of the U.S Food and Drug Administration (FDA) to regulate hemp products under the Federal Food, Drug, and Cosmetic Act (FD&C Act) and section 351 of the Public Health Service Act (PHS Act). Accordingly, products containing cannabis and cannabis-derived compounds are subject to the same authorities and requirements as FDA-regulated products containing any other substance. The 2018 Farm Bill removed hemp from the list of controlled substances, decontrolling hemp production in all U.S States, territories, and lands belonging to Indian Tribes, unless prohibited by State or Tribal[[Page 5667]]Law. This action eliminates the uncertain legal status at the Federal level of hemp production and allows the U.S Department of ***Agriculture*** (USDA) to provide hemp producers with crop insurance programs, potentially reducing risk to producers and providing easier access to capital. The statute also prohibits interference in the interstate transport of hemp by States, including those States that prohibit hemp production and sales. As a result, hemp producers will have access to nationwide markets.Need for Regulation The rule is necessary to facilitate the domestic cultivation of hemp for sale into the market for hemp products by creating a set of minimum standards to ensure that hemp being produced under this program meets all statutory requirements. The rule establishes minimum requirements for States and Indian Tribes to obtain program approval and, for producers operating under the Federal program to obtain a license and meet operating requirements under that license. Without these provisions, it would not be possible to grow hemp legally. Both the declassification of hemp, and the prohibition on interference with interstate transportation apply to hemp that is grown under an approved State or Tribal plan, or under a Federal license. As a result, this regulation facilitates provisions of the 2018 Farm Bill that would otherwise be self-implementing.Overview of the Action The 2018 Farm Bill granted regulatory authority of domestic hemp production to the State departments of ***agriculture***, Tribal governments, and USDA. States and Indian Tribes wishing to operate their own programs must submit to USDA plans that include provisions for maintaining information regarding the land on which hemp is produced, for testing the levels of THC, for disposal of plants that do not meet necessary requirements, and for procedures to ensure compliance with the requirements of the new part, including background checks of all key participants. State and Tribal Plans must be approved by USDA. This rule outlines requirements by which the USDA would approve plans submitted by States and Tribal governments for oversight of hemp production. The 2018 Farm Bill also directs USDA to develop a plan for use by hemp producers in States or Indian Tribes where no State or Tribal Plan has been approved and that do not prohibit the cultivation of hemp. These actions will promote consistency in regulations governing the legal production of hemp across the country.Baseline Definition The 2014 Farm Bill authorized hemp research pilot programs to be administered by states and universities. The 2018 Farm Bill repealed these pilot programs beginning one year from the publication of a USDA rule; however, the 2021 Continuing Appropriations Act extended the authorization of the 2014 pilot programs until January 1, 2022. From 2014 to 2018, planted acreage tripled in every year, reaching nearly 63,500 acres in 2018. In the year following the signing of the 2018 Farm Bill, planted acreage increased by more than 400 percent to 327,600 acres in 2019.\34\ The surge of entrants into the hemp market in 2019 left many producers with unsold inventory. In Kentucky alone, more than $100 million of hemp material went unsold due to lack of buyers in 2019. The large number of entrants into the market in 2019 caused a surplus of hemp production, which in turn caused prices to fall and revenue losses to producers.--------------------------------------------------------------------------- \34\ Sources include the following: State Departments of ***Agriculture***; Vote Hemp. 2016-2019 Crop Reports; and, Mark, Tyler, Jonathan Shepherd, David Olson, William Snell, Susan Proper, and Suzanne Thornsbury. February 2020. Economic Viability of Industrial Hemp in the United States: A Review of State Pilot Programs, EIB-217, U.S Department of ***Agriculture***, Economic Research Service.--------------------------------------------------------------------------- Despite the producer excitement that ensued in 2019 following the signing of the 2018 Farm Bill, only 17 states opted to participate in the new hemp programs in time for the 2020 growing season. These 17 states accounted for about 20 percent of the total estimated planted acreage in 2020. Given the apparent affinity by states for the 2014 pilot programs, AMS assumes that in the absence of the 2018 Farm Bill, the 2014 Farm Bill pilot programs would have continued indefinitely. Indeed, the 2014 Farm Bill offered no sunset date for these programs. In order to capture the impacts of this rule on affected entities, AMS attributes 20 percent of the estimated planted acreage from 2020 through 2025 to the 2018 Farm Bill and this rule which enables its prescriptions. This 20 percent reflects the amount of planted acreage in the 17 states that opted to participate in the 2018 Farm Bill hemp programs for the 2020 growing season. The 2020 growing season was the final opportunity for producers to cultivate hemp under the 2014 pilot programs until the 2021 Continuing Appropriations Act extended the authorization of the 2014 pilot programs to January 1, 2022. By enrolling in the new hemp programs, these 17 states expressed a preference for the hemp programs authorized by the 2018 Farm Bill over the 2014 Farm Bill pilot programs. The remaining 80 percent of planted acreage estimated from 2020 through 2025 will be treated as attributable to the 2014 pilot programs under the assumption that they would have continued in the absence of the 2018 Farm Bill which terminated them. In the interim final rule (IFR), AMS attributed 50 percent of the growth in producer sales from 2020 through 2022 to the 2018 Farm Bill and this enabling rule. In deriving this assumption, AMS considered the rate at which hemp acreage had increased in recent years, the number of States whose hemp pilot programs produced a crop in recent years, and the number of States that passed legislation following the signing of the 2018 Farm Bill in anticipation of this rule's enactment in time for the 2020 growing season. In the time between publication of the IFR on October 31, 2019, and the beginning of the 2020 growing season, 17 states representing 20 percent of planted acreage opted to participate in the hemp programs mandated by the 2018 Farm Bill. This portion of enrollment is less than AMS anticipated in the IFR.Affected Entities As of July 2020, States, Indian Tribes, and USDA had issued 19,121 producer licenses. This figure represents licenses issued in 44 States and one Tribe. About 70 percent of states reported at the time that they were still accepting applications, which indicates that the number of 2020 producer licenses issued is likely to grow. For this reason, AMS estimates that up to 20,000 producer licenses will be issued in 2020. Based on the slowed pace in growth of producer licenses from 2019 to 2020, AMS assumes an annual growth rate in producer licenses of 10 percent from 2020 through 2025, for the purposes of this analysis. The result is shown in Table 2. AMS is unaware of any estimates that exist regarding the number of producer licenses that will be issued in the coming years; however, the novelty of hemp as a commercial ***agricultural*** commodity, the resolutions of uncertainty surrounding regulations, the expected growth in demand for existing and new hemp products, and the effective establishments of State, Tribal, and Federal hemp programs may[[Page 5668]]continue to draw producers into the market. Table 2--Estimated Projection of Number of Producer Licenses Issued -------------------------------------------------------------------------------------------------------------------------------------------------------- Year 2020 2021 2022 2023 2024 2025--------------------------------------------------------------------------------------------------------------------------------------------------------Growers........................................... 20,000 22,000 24,200 26,620 29,282 32,210--------------------------------------------------------------------------------------------------------------------------------------------------------Sources and notes:2020 figure based on July 2020 National Industrial Hemp Regulators conference call.2021-2025 figures based on assumed annual growth rate of 10% in producer licenses. As of the writing of this analysis, three states had opted to participate in the USDA Federal Plan authorizing producers to cultivate hemp. These states are Hawaii, Mississippi, and New Hampshire. Together, they represent more than 300 producers in 2020. The number of licensed producers participating in the Federal Plan is likely to grow over time due to both greater entrance of producers into the market in these three states and additional states, Indian Tribes, and territories opting to participate in the USDA Plan. At the end of 2020, less than 2 percent of the total number of producers were licensed by USDA. The extension of the 2014 pilot programs to 2022, which was included in the 2021 Continuing Appropriations Act published October 1, 2020, resulted in fewer producers participating in the USDA Plan. Prior to the extension of the 2014 pilot programs, the portion of participants under the USDA Plan was about 10 percent of the total number of 2020 producers, with the expectation for further enrollment. For the purposes of this analysis, therefore, AMS assumes that 20 percent of the total number of licensed producers will be participants of the USDA Plan, and the remaining 80 percent will be participants of a State or Tribal Plan. In addition to hemp producers, this rule will impact state departments of ***agriculture***, Tribal governments, and USDA as these entities will bear the responsibility to ensure that hemp producers abide by the State and Tribal Plans and the USDA Plan for regulating hemp. At the time this document was written, more than 40 Indian Tribes, at least 40 states, and two U.S territories had plans approved by USDA or were in the process of submitting plans for USDA approval. At least three states have opted to participate in the USDA plan, and one state and one territory await legislation authorizing hemp production. AMS anticipates receiving further interest in both the Federal Plan and the plans administered by states, Indian Tribes, and territories in the coming months when the provisions of the 2014 Farm Bill expire and States and Tribes start implementing their programs. For the purposes of this analysis, AMS assumes that 100 states, Indian Tribes, and territories will administer their own plans in every year from 2020 through 2025. AMS acknowledges that this number is likely to change from year to year, depending on market conditions, which affect the ability of a state, tribe, or territory to manage its own hemp program. Because AMS has no way to predict future market or state political conditions, for simplicity, it assumes a constant of 100 states, Indian Tribes, and territories administering their own plans from 2020 through 2025. Finally, this rule will impact laboratories that will provide testing services to producers and program administrators. As of the writing of this analysis, there were 67 laboratories that test hemp that are registered with the DEA. USDA is requiring that all samples tested for THC concentration levels be conducted in DEA-registered laboratories; however, enforcement of this requirement has been delayed until December 31, 2022.Expected Costs and Benefits of the Rule The 2018 Farm Bill grants authorization for production of hemp to all states and Indian Tribes, unless prohibited by State or Tribal Law. This rule enables states, Indian Tribes, and USDA to regulate this authorization. This rule is expected to generate benefits and costs to hemp producers, state departments of ***agriculture***, Tribal governments, USDA, and laboratories. The benefits of this rule are expected to outweigh the costs, however, and the burden on the impacted entities is anticipated to be minimal.Producers Using figures from Hemp Industry Daily and the Brightfield Group, AMS estimates retailer sales of hemp products to range from $2.5 billion in 2020 to nearly $17 billion in 2025. Based on price spreads from farm to consumer, published by the Economic Research Service (ERS), AMS assumes a pass-through rate of 20 percent from retailer to producer.\35\ AMS also assumes that import values account for 15 percent of the producer share of retail sales. This estimate was derived using 2019 and 2020 import ***data*** from the Foreign ***Agricultural*** Service (FAS) of USDA. At the time of this analysis, import ***data*** for 2020 was only available for the months of January through August. In order to gauge what total 2020 imports might be, AMS applied to the figure of total imports for January through August 2020 ($55 million) the average percentage change that occurred in the four months from August through December of recent years (40 percent). Applying the assumptions of 20 percent price pass-through from retailer to producer and import values of 15 percent of the producer share of retail sales to the estimates of retailer sales results in estimated total producer sales of $432 million in 2020 to $2.9 billion in 2025, shown in Table 3.--------------------------------------------------------------------------- \35\ ERS. Price Spreads from Farm to Consumer. September 2020. Table 3--Estimated Retailer and Producer Hemp Product Sales [Millions]-------------------------------------------------------------------------------------------------------------------------------------------------------- Year 2020 2021 2022 2023 2024 2025--------------------------------------------------------------------------------------------------------------------------------------------------------Total retailer sales \1\................................ $2,540 $4,485 $6,740 $9,310 $10,995 $16,800[[Page 5669]] Producer share of retail sales \2\...................... 508 897 1,348 1,862 2,199 3,360Imports \3\............................................. 76 135 202 279 330 504Total producer sales \4\................................ 432 762 1,146 1,583 1,869 2,856--------------------------------------------------------------------------------------------------------------------------------------------------------\1\ Retailer sales estimates based on the following stores: 2020-2024 estimates from Hemp & CBD Industry Facebook 2019, Hemp Industry Daily, ``Annual U.S Hemp-Derived CBD Retail Sales Estimates.'' Published October 16, 2019. 2025 estimate from Brightfield Group. ``US CBD Market Forecast Reduced Due to Health Consolidation.'' Published July 31, 2020.\2\ Product of total retailer sales and 20% share of retail sales passed to producers; estimate of 20% share of retailer prices based on Economic Research Service publications of ``Price Spreads from Farm to Consumer''.\3\ Assumes imports account for 15% sales at the producer level; source for assumption is FAS 2015-2019 import ***data***, HTS codes 1207990320 and 5302100000.\4\ Difference of producer share of retail sales and imports. The estimates in Table 3 reflect total producer sales in aggregate. AMS is unaware of any ***data*** that currently exists that would indicate sales by individual producer. Given the varied nature of the hemp industry, producer sizes are anything but uniform; therefore, AMS has not attempted to project sales by individual producer as it would likely result in false conclusions and misleading information. Similarly, ***data*** comparing sales by producers under the 2018 Farm Bill and what sales under the 2014 Farm Bill may have been in the absence of the 2018 Farm Bill does not currently exist. Further, AMS believes that this estimate would not differ greatly given the greater access to nationwide markets and flexibilities provided to producers under the 2018 Farm Bill. In addition, AMS acknowledges that raw harvested hemp product may take years to enter the retail market after it passes through the supply chain. For instance, product sold at the retail level in 2021 may include hemp that was harvested in 2019. In acknowledging this, AMS understands that the estimated producer sales for a given year in Table 3 may not represent actual producer sales for that year, but rather, sales from prior years. AMS is unaware of any ***data*** that exists that would identify when a harvested hemp crop is sold into the retail market. For the purposes of this analysis, therefore, and for simplicity, AMS assumes that the producer sales estimated in Table 2 represent sales at the producer level for the same year as the retail sales from which they are derived. As discussed in the ``Baseline Definition'' section of this analysis, AMS estimates that 20 percent of the producer planted acreage from 2020 through 2025 will be attributable to the 2018 Farm Bill and this rule which enables its prescriptions. This 20 percent reflects the amount of planted acreage in the 17 states that opted to participate in the 2018 Farm Bill hemp programs in time for the 2020 growing season. The 2020 growing season was the final opportunity for producers to cultivate hemp under the 2014 pilot programs. By enrolling in the new hemp programs, these 17 states expressed a preference for the hemp programs authorized by the 2018 Farm Bill over the 2014 Farm Bill pilot programs. The remaining 80 percent of producer planted acreage estimated from 2020 through 2025 will be treated as attributable to the 2014 pilot programs under the assumption that they would have continued in the absence of the 2018 Farm Bill which terminated them. In Table 4, AMS has calculated total planted acreage inclusive of all domestic producers, using the estimates of total producer sales in Table 3 and assumptions that are stated and cited in the table. From the estimates of total planted acreage in Table 4, AMS calculated the planted acreage due to the rule in Table 5, along with the estimate of sales attributable to the rule. These estimates of sales due to the rule will be referenced as the benefits of the rule to producers in the calculation of net benefits in Table 10.BILLING CODE P[[Page 5670]][GRAPHIC] [TIFF OMITTED] TR19JA21.032BILLING CODE C To calculate total planted acreage nationwide in Table 4, from which planted acreage due to this rule will be estimated in Table 5, AMS assumed the following to remain constant in each year from 2020 through 2025: Portion of total sales by intended use; yields by intended use; prices per pound by intended use; portions of harvested volume sold by intended use; and the portion of planted acreage that is typically harvested. Using 2019 producer ***data*** from the Kentucky Department of ***Agriculture***, AMS estimates that of total sales of hemp products, cannabinoids accounts for 99 percent, and fiber and grain each account for 0.5 percent. Also based on ***data*** from the Kentucky Department of ***Agriculture***, AMS estimates that 65 percent of the harvested volume of hemp for cannabinoids is sold, 90 percent of hemp harvested for fiber is sold, and 95 percent of hemp harvested for grain is sold.\36\ This assumption is also referenced in Table 5. AMS compared the hemp enterprise budgets published by seven different academic institutions for yield estimates which[[Page 5671]]represent the growing conditions across the country. Aside from these seven, AMS is unaware of any other hemp enterprise budgets published by an academic institution.--------------------------------------------------------------------------- \36\ The Kentucky Department of ***Agriculture*** is widely recognized as a reliable source for hemp market ***data*** as it has ***collected*** ***data*** from its producers since the inception of its hemp program in 2014. Much of this ***data*** is publicly available and was cited by many commenters.--------------------------------------------------------------------------- Based on 2019 and 2020 prices published by the Jacobsen, AMS assumes constant per-pound prices for cannabinoids, fiber, and grain of $3.90, $0.09, and $0.53, respectively.\37\ AMS acknowledges that prices are unlikely to remain constant from year to year, particularly for cannabinoids; however, AMS has considered 68 weeks of cannabinoids prices in determining its estimate of $3.90 per pound. This price assumes 6 percent CBD at $0.65 per CBD percentage per pound. Using these prices and yield estimates, AMS calculated a price per acre for each intended use of hemp. Finally, the assumption that 75 percent of planted acreage is harvested was estimated using ***data*** from multiple state departments of ***agriculture***. The assumed constants of the portion of planted acreage that is harvested, yield by intended use, portion of harvested volume that is sold, and prices by intended use are also utilized in Table 5.--------------------------------------------------------------------------- \37\ The Jacobsen Publishing Company. Weekly hemp prices from July 2019 through August 2020. [GRAPHIC] [TIFF OMITTED] TR19JA21.033[[Page 5672]] In addition to the assumptions already identified in reference to Table 4, AMS assumes constant the portion of planted acreage due to the rule and portions of planted acreage by intended use. As described in the ``Baseline Definition'' section, AMS assumes that 20 percent of total planted acreage can be considered as attributable to the rule. This proportion represents the amount of planted acreage of the states that had plans approved by USDA for a hemp production program, as authorized by the 2018 Farm Bill, in time for the 2020 growing season. The 2020 growing season was the final opportunity for producers to cultivate hemp under the 2014 pilot programs. By enrolling in the new hemp programs, these states expressed a preference for the hemp programs authorized by the 2018 Farm Bill over the 2014 Farm Bill pilot programs. The Jacobsen estimated that of total planted acreage in 2020, 80 percent was for cannabinoids, 3 percent was for fiber, and 17 percent was for grain. AMS acknowledges that planted acreage by intended use is likely to change from year to year as a result of market conditions. The portion of acreage intended for cannabinoids has, indeed, decreased from its levels in 2019, with grain and fiber gaining greater consumer attention. AMS is unaware of any ***data*** that forecasts planted acreage by intended use in years beyond 2020. For the purposes of this analysis, and for simplicity, therefore, AMS assumes constant the portions of planted acreage by intended use as reported for 2020. To reiterate, AMS is aware that raw hemp product at the producer level may take years to enter the retail market. The analysis in Tables 4 and 5 is meant to show potential consumer demand for hemp products at the producer level in years 2020 through 2025, and not necessarily the producer sales of hemp cultivated in these specific years. These estimates are sensitive to changes in price. Because planted acreage is derived from total sales, a change in price causes an inverse change in the estimate of planted acreage; however, the relationship between price and sales is, of course, positive. Many states reported to AMS that the land on which hemp is currently grown was previously utilized for cultivation of corn. Using ***data*** from the National ***Agricultural*** ***Statistics*** Service (NASS) on the production value of corn for grain and acres harvested, AMS determines a value per harvested acre of corn of $630. This value is a national average of the three-year period of 2017 through 2019, which are the most recent years for which ***data*** is available.\38\ For the purposes of this analysis, this value of $630 per acre will serve as the opportunity cost to hemp producers. The opportunity cost is the potential returns that are foregone in pursuit of an alternative. The potential foregone returns, in this case, are $630 per acre for corn cultivation; and, the alternative is hemp cultivation. Applying this value to the estimates of acreage required to meet estimated producer sales as calculated in Table 5 results in the total opportunity cost to producers in years 2020 through 2025 as shown in Table 6.--------------------------------------------------------------------------- \38\ NASS. Quick Stats. Variable ``Corn, grain--production, measured in $'' divided by variable ``Corn, grain--acres harvested''. Table 6--Calculation of Opportunity Cost of Hemp Cultivation Under Rule------------------------------------------------------------------------ ------------------------------------------------------------------------2017-2019 average returns per acre of corn for grain \1\ $630------------------------------------------------------------------------ Year 2020 2021 2022 2023 2024 2025--------------------------------------------------------------------------------------------------------------------------------------------------------Planted acres due to rule \2\........................... 31,820 56,187 84,437 116,633 137,742 210,465Opportunity cost (millions) \3\......................... $20 $35 $53 $73 $87 $133--------------------------------------------------------------------------------------------------------------------------------------------------------Sources and notes:\1\ National Agriculural ***Statistics*** Service (NASS).\2\ See Table 5 estimate calculation.\3\ Product of 2017-2019 average retunns per acre of corn for grain and acres worth of hemp sold. In the IFR, AMS calculated an opportunity cost of $591 per acre, using an average of returns per acre for all cropland, weighted by area planted or bearing. This estimate utilized NASS crop totals for fruits, vegetables, and traditional field crops. At the time of the writing of the IFR, AMS had little information as to the prior uses of land currently being cultivated for hemp. To address this in the final rule, AMS sought input from state departments of ***agriculture***, most of which reported that the land on which hemp is currently grown was previously utilized for cultivation of corn. AMS has modified its sampling and testing requirements, which are described in the section in this rule titled ``Sampling for total THC'', to allow for ``performance-based sampling''. A performance-based protocol must have the potential to ensure at a confidence level of 95 percent that no more than one percent of the plants in each lot would exceed the acceptable hemp THC level. Performance-based sampling achieves defined objectives and focuses on results. It differs significantly from a prescriptive action in which licensees are provided detailed direction on how those results are to be obtained. A performance-based approach would simply set a performance objective (e.g , reliability of 95 percent) and allow the States and Indian Tribes considerable freedom in how to achieve that reliability objective with their sampling methodology. To estimate the number of lots to be sampled in each year, AMS employs the Cochran Formula:[GRAPHIC] [TIFF OMITTED] TR19JA21.034where n0is the sample size, Z is the z-value associated with a confidence interval, p is the estimated proportion of the population that has the attribute in question, and e is the margin of error or the desired level of precision. Inserting the z-value that corresponds to a 95 percent confidence interval, assuming maximum variability for p at 50 percent, and applying the margin of error of one percent results in the following sample size:[[Page 5673]][GRAPHIC] [TIFF OMITTED] TR19JA21.035 The Cochran Formula assumes an unlimited population size; however, the formula can be modified to return a smaller sample size for a finite population:[GRAPHIC] [TIFF OMITTED] TR19JA21.036where n is the modified sample size, n0is the Cochran Formula sample size, and N is the population size. Table 7 shows the number of sampled lots, n, required for a 95 percent confidence interval and one percent margin of error for each year's total number of lots, N. The total annual cost of sampling and testing borne by producers is calculated using a cost per lot of $565, which was estimated using hourly rates for inspectors and for laboratory services of $75 and $98, respectively; two hours, apiece, spent sampling, driving, and testing; 120 miles driven; and, $0.58 per mile compensation. In its calculation of total number of lots from total planted acreage, AMS utilized the portions of planted acreage by intended use, introduced in Table 5, and ***data*** from the Farm Service Agency (FSA) from which average lot sizes for hemp by intended use were derived.[[Page 5674]][GRAPHIC] [TIFF OMITTED] TR19JA21.037 Some portion of tested lots are likely to return results with THC concentrations greater than 0.3 percent. To estimate this percentage, AMS utilized ***data***, specific to this very question, ***collected*** by the National Industrial Hemp Regulators during a November 2019 meeting. The average portion of tests that would return results of THC concentrations greater than 0.3 percent, weighted by the number of tests administered in each state, was 25 percent. In Table 8, AMS applies this percentage to estimate total noncompliant lots in each year and the cost to dispose of noncompliant acreage. AMS is aware of other estimates of THC concentration failure rates. As of November 2020, States and Tribes operating under the 2018 Farm Bill reported 4,192 licensed producers representing 6,166 acres planted. Of these acres planted, approximately 12 percent were destroyed due to THC levels exceeding 0.3 percent. This ***data***, however, is limited because many approved plans have not all been fully[[Page 5675]]implemented. USDA expects more ***data*** will be available as the 2021 season begins and States and Tribes implement their programs.[GRAPHIC] [TIFF OMITTED] TR19JA21.038 AMS has issued guidance on approved methods for disposal of noncompliant hemp material, including plowing under, mulching or composting, disking, bush mowing or chopping, deep burial, and burning. AMS requires disposal of noncompliant hemp using one of these methods. Discussion with state departments of ***agriculture*** and producers led AMS to estimate an average of 15 minutes per acre required to dispose of noncompliant material. This 15-minute estimate is an average across all disposal methods. According to the May 2019 Occupational Employment ***Statistics*** Survey of the Bureau of Labor and ***Statistics***, the mean hourly wage of a compliance officer is $35. Assuming 39 percent of total compensation accounts for benefits, then total compensation of a compliance officer is $57 per hour. This is described in the Paperwork Reduction Act (PRA) section of this[[Page 5676]]rule. Applying the total hourly salary of a compliance officer to the disposal time per acre of hemp results in a per acre cost of $14.25 for disposal of noncompliant hemp acreage. The PRA section details the burdens of reporting and recordkeeping and their associated costs. Table 9 shows the calculations of the reporting and recordkeeping costs to producers that will be imposed by this rule. All assumptions in this table have been previously introduced. The PRA section describes how each estimate of time was calculated per required form. [GRAPHIC] [TIFF OMITTED] TR19JA21.039 In order to obtain a producer license, AMS requires that each producer, or key participant of a business entity, submit to a background check, or criminal history report, at least every three years. A key participant is a person with a direct or indirect financial interest in the hemp-producing entity, including a chief executive officer, a chief operating officer, and a chief financial officer. The cost of a criminal history report conducted by the Federal Bureau of Investigation (FBI) is $18 per record. For the purposes of this analysis, AMS assumes each producer license to represent three key participants. The total annual cost of a background check for three key participants every three years at minimum is $18 per producer. The producer net benefits of this rule to society are shown in Table 10. Subtracted from producer sales due to the rule are the opportunity costs of the land on which hemp is currently grown; sampling and testing costs; disposal of noncompliant acreage; reporting and recordkeeping burdens; and, annual background checks. The producer net benefits of this rule to society range from $49 million in 2020 to $357 million in 2025. Table 10--Producer Net Benefits to Society [Millions]-------------------------------------------------------------------------------------------------------------------------------------------------------- 2020 2021 2022 2023 2024 2025--------------------------------------------------------------------------------------------------------------------------------------------------------Grower sales due to rule................................ $75.51 $133.34 $200.38 $276.78 $326.88 $499.46Opportunity cost........................................ (20.05) (35.40) (53.20) (73.48) (86.78) (132.59)Sampling & testing...................................... (3.20) (3.89) (4.30) (4.56) (4.67) (4.91)Disposal of noncompliant material....................... (0.30) (0.36) (0.40) (0.42) (0.43) (0.46)Reporting & recordkeeping............................... (2.56) (2.82) (3.10) (3.41) (3.75) (4.12)Background checks....................................... (0.36) (0.40) (0.44) (0.48) (0.53) (0.58) ----------------------------------------------------------------------------------------------- Net benefits........................................ 49.05 90.47 138.95 194.43 230.72 356.80--------------------------------------------------------------------------------------------------------------------------------------------------------[[Page 5677]]States, Indian Tribes, and USDA States and Indian Tribes have the authority to establish fee structures to fund their hemp programs. As of the writing of this analysis, about half of the states with plans approved by USDA reported their programs as being full funded through user-fees. To estimate the cost of administering a hemp program, AMS calculated an average of the total fees charged to producers by these states, which reported as fully user-fee funded, to use as a proxy for the per producer cost of hemp program administration. The fees used to calculate this average included those with such designations as application fee, site registration fee, licensing fee, and others. The average did not include fees associated with sampling and testing as these were calculated separately in Table 7. AMS estimates an average cost per producer of hemp program administration of $800 annually. AMS has no reason to believe that Indian Tribes or USDA will be any more or any less efficient than states in program administration. AMS believes, therefore, that this figure is a suitable proxy for the cost of program administration to states, Indian Tribes, and USDA per producer who cultivates hemp as a result of this rule. As discussed in the ``Baseline Definition'' section, 17 states opted to participate in the new hemp programs authorized by the 2018 Farm Bill in time for the 2020 growing season. These states represented 20 percent of both planted acreage nationwide and the number of producers nationwide. By applying this percentage to the total number of producers in each year, as shown in Table 2, AMS estimates the number of producers that will cultivate hemp due to this rule. The product of the number of producers due to this rule and the $800 per grower proxy for administration costs results in program administration costs to States, Indian Tribes, and USDA of $3 million in 2020 to $5 million in 2025. This rule places a reporting and recordkeeping burden on states and Indian Tribes as detailed in the PRA section of this rule. The total time required per state or tribe for reporting and recordkeeping is 25.25 hours annually. AMS assumes constant the number of states and Indian Tribes that will operate their own hemp programs at 100 in total from 2020 through 2025. In total, the time required of 100 states and Indian Tribes for 25.25 hours of reporting and recordkeeping is 2,525 hours. Applying the hourly salary of a compliance officer of $57 to this total results in an annual cost to all states and Indian Tribes of reporting and recordkeeping of $143,919, or $1,439 per state or tribe. The total administration costs to states, Indian Tribes, and USDA are calculated in Table 11. They include the costs to all three entities of program administration, and the costs of reporting and recordkeeping to states and Indian Tribes. Total administration costs to states, Indian Tribes, and USDA range from $3 million in 2020 to $5 million in 2025. Table 11--Total Costs to States, Indian Tribes, and USDA [Millions]-------------------------------------------------------------------------------------------------------------------------------------------------------- 2020 2021 2022 2023 2024 2025--------------------------------------------------------------------------------------------------------------------------------------------------------Program administration.................................. $(3.20) $(3.52) $(3.87) $(4.26) $(4.69) $(5.15)Reporting & recordkeeping............................... (0.14) (0.14) (0.14) (0.14) (0.14) (0.14) ----------------------------------------------------------------------------------------------- Total costs......................................... (3.34) (3.66) (4.02) (4.40) (4.83) (5.30)--------------------------------------------------------------------------------------------------------------------------------------------------------Laboratories This rule also places a reporting and recordkeeping burden on laboratories as they will be required to report on the results of samples tested for THC content to the entities administering the hemp programs. The PRA section of this rule estimates an annual reporting and recordkeeping requirement for laboratories of 0.58 hours per sampled and tested lot. As calculated in Table 7, the total number of lots to be sampled and tested in each year is 5,659 in 2020; 6,886 in 2021; 7,606 in 2022; 8,069 in 2023; 8,272 in 2024; and, 8,688 in 2025. Multiplying the total number of lots to be sampled and tested in each year by the annual reporting and recordkeeping requirement of 0.58 hours per sampled and tested lot and by the hourly salary of a compliance officer of $57 results in the total annual costs to laboratories as shown in Table 12. Table 12--Total Costs to Laboratories [Millions]-------------------------------------------------------------------------------------------------------------------------------------------------------- 2020 2021 2022 2023 2024 2025--------------------------------------------------------------------------------------------------------------------------------------------------------Reporting & recordkeeping......................... $(0.19) $(0.23) $(0.25) $(0.27) $0.27) $(0.29)--------------------------------------------------------------------------------------------------------------------------------------------------------Total Net Benefit Producers, states, Indian Tribes, and USDA, and laboratories are the entities most likely to be impacted by this rule. For this reason, the net benefits or costs of this rule to these entities have been evaluated in this analysis. The total net benefits to society as a whole and their present values by year are shown in Table 13. The rule has a positive net benefit in every year, ranging from $46 million in 2020 to $351 million in 2025. Table 13--Total Net Benefits to Society [Millions]-------------------------------------------------------------------------------------------------------------------------------------------------------- Entity 2020 2021 2022 2023 2024 2025--------------------------------------------------------------------------------------------------------------------------------------------------------Producers............................................... $49.05 $90.47 $138.95 $194.43 $230.72 $356.80States, Tribes & USDA................................... (3.34) (3.66) (4.02) (4.40) (4.83) (5.30)[[Page 5678]] Laboratories............................................ (0.19) (0.23) (0.25) (0.27) (0.27) (0.29) ----------------------------------------------------------------------------------------------- Total............................................... 45.52 86.58 134.68 189.76 225.61 351.21-------------------------------------------------------------------------------------------------------------------------------------------------------- Present values of net benefits annualized at the given discount rates--------------------------------------------------------------------------------------------------------------------------------------------------------Discount rates 2020 2021 2022 2023 2024 2024--------------------------------------------------------------------------------------------------------------------------------------------------------3%...................................................... $45.52 $84.06 $126.95 $173.66 $200.45 $302.967%...................................................... 45.52 80.92 117.63 154.90 172.12 250.41--------------------------------------------------------------------------------------------------------------------------------------------------------Alternatives In developing this final rule, AMS considered several alternatives to the policies that were adopted. The first of these was related to methodologies for sampling. The methodologies considered include sampling and testing of all lots, as mandated in the IFR, sampling and testing based on risk, and sampling and testing based on performance. The latter of these was the sampling methodology that was chosen for the final rule as it results in the lowest total cost to producers. Performance-based sampling also grants flexibility to States and Indian Tribes in the development of sampling methodologies. In the IFR, AMS required sampling of every hemp lot, regardless of intended use; however, AMS has determined that compliance to this method would too greatly burden producers as well as program administrators, whose responsibility it would be to enforce it. AMS also considered requiring risk-based sampling, which would mandate minimum portions of sampling of lots by intended use. The portions of lots to be sampled by intended use that were considered were 50 percent of lots for cannabinoids, 10 percent of lots for fiber, and 10 percent of lots for grain. AMS currently lacks sufficient ***data*** to successfully carry out a risk-based sampling methodology that would be applicable to the varying growing regions nationwide; therefore, the risk-based sampling methodology was not chosen for this final rule. An analysis of these sampling methodologies is illustrated in Table 14.[GRAPHIC] [TIFF OMITTED] TR19JA21.040[[Page 5679]] Secondly, AMS considered retaining at 0.5 percent the limit for total THC content that would result in a negligent violation, as required in the IFR. Based on comments, however, AMS has determined this requirement to too greatly burden producers as factors beyond the control of the producer, such as seed genetics, weather and climate, may cause an increase in total THC-levels. By increasing the negligent violation threshold to 1.0 percent, AMS diminishes the risk to producers of incurring a negligent violation, which results in time and cost savings to producers and to program-administering entities. Finally, AMS considered mandating a post-sample harvest window of 15 days, as required in the IFR. Based on comments and in consideration of the time required to complete sampling and testing activities, AMS has determined that requiring a 15-day post-sample harvest window would place undue strain on resources. AMS believes that the extension of the post-sample harvest window to 30 days will provide producers with a beneficial flexibility to adjust to unforeseen weather events and will accommodate complicated harvest processes.Regulatory Flexibility Analysis Pursuant to the requirements set forth in the Regulatory Flexibility Act (5 U.S.C 601-612), AMS has considered the economic impact of this action on small entities. AMS prepared an initial regulatory flexibility act analysis presented with the interim final rule, and has now prepared this Final Regulatory Flexibility Act Analysis. AMS has determined that this rule will have a significant economic impact on a substantial number of small businesses because many small businesses will not be able to participate in the hemp market without this rule.Need for Regulation The rule is necessary to facilitate the domestic cultivation of hemp for sale into the market for hemp products by creating a set of minimum standards to ensure that hemp being produced under this program meets all statutory requirements. The rule establishes minimum requirements for States and Indian Tribes to obtain program approval and, for producers operating under the Federal program to obtain a license and meet operating requirements under that license. Without these provisions, it would not be possible to grow hemp legally. Both the declassification of hemp, and the prohibition on interference with interstate transportation apply to hemp that is grown under an approved State or Tribal plan, or under a Federal license. As a result, this regulation facilitates provisions of the 2018 Farm Bill that would otherwise be self-implementing.Overview of the Action The 2018 Farm Bill granted regulatory authority of domestic hemp production to the State departments of ***agriculture***, Tribal governments, and USDA. States and Indian Tribes wishing to operate their own programs must submit to USDA plans that include provisions for maintaining information regarding the land on which hemp is produced, for testing the levels of THC, for disposal of plants that do not meet necessary requirements, and for procedures to ensure compliance with the requirements of the new part, including background checks of all key participants. State and Tribal Plans must be approved by USDA. This rule outlines requirements by which the USDA would approve plans submitted by States and Tribal governments for oversight of hemp production. The 2018 Farm Bill also directs USDA to develop a plan for use by hemp producers in States or Indian Tribes where no State or Tribal Plan has been approved and that do not prohibit the cultivation of hemp. These actions will promote consistency in regulations governing the legal production of hemp across the country.Potentially Affected Small Entities The Small Business Administration (SBA) defines, in 13 CFR part 121, small ***agricultural*** producers as those having annual receipts of no more than $1 million. Unfortunately, very little ***data*** exists on hemp grower sales receipts. To conduct this analysis, however, AMS estimated prices per acre by intended use of hemp to find the acreage equivalent of $1 million per intended use. AMS encountered ***data*** limitations due to the lack of reporting by States and Tribes that have not started implementing the 2018 Farm Bill provisions and the extension of the 2014 Farm Bill provisions which do not require reporting from States. To this end, AMS utilized ***data*** on acreage by intended use from the Kentucky Department of ***Agriculture*** and the Montana Department of ***Agriculture***. Together, Kentucky and Montana make up a large amount of domestic acreage and represent diversity in hemp planted by intended use. For the purpose of this analysis, therefore, AMS assumes that the combined planted acreage by intended use in Kentucky and Montana adequately represent the planted acreage by intended use across the United States. For yield estimates, AMS compared the hemp enterprise budgets published by seven different academic institutions that represent the growing conditions across the country. Aside from these seven, AMS is unaware of any other hemp enterprise budgets published by an academic institution. AMS sourced 2019 and 2020 prices from the Jacobsen to estimate per-pound prices for cannabinoids, fiber, and grain of $3.90, $0.09, and $0.53, respectively. The price for cannabinoids assumes 6 percent CBD content at $0.65 per CBD percentage per pound. Using these prices and yield estimates, AMS calculated a price per acre for each intended use of hemp, as shown in Table 15. From the estimates of price per acre by intended use, AMS calculated the equivalent of $1 million in acres of hemp product per intended use. Of the 922 unique producers in the combined ***data*** from the Kentucky and Montana Departments of ***Agriculture***, 97 percent reported acreage no greater than the amounts necessary to reach $1 million, based on the estimated prices per acre. Assuming that these ***data*** are representative of the U.S as a whole, then 97 percent of domestic producers of hemp would meet the SBA size standard of a small business of annual receipts of no greater than $1 million.[[Page 5680]][GRAPHIC] [TIFF OMITTED] TR19JA21.041Alternatives Considered To Minimize Impacts of the Rule In developing this final rule, due to comments received and experiences from the 2020 season, AMS considered several alternatives to the policies that were adopted. The first of these was related to methodologies for sampling. The methodologies considered include sampling and testing of all lots, as mandated in the IFR, sampling and testing based on risk, and sampling and testing based on performance. The latter of these was the sampling methodology that was chosen for the final rule as it results in the lowest total cost to producers. Performance-based sampling also grants flexibility to States and Indian Tribes in the development of sampling methodologies. Some States currently have considered performance-based sampling under the 2014 Farm Bill. However, this information is not available and will need to be evaluated and approved by USDA as part of State and Tribal plans before it can be implemented under the 2018 Farm Bill program if States and Tribes decide to utilize this option. In the IFR, AMS required sampling of every hemp lot, regardless of intended use; however, AMS has determined that compliance to this method would too greatly burden producers as well as program administrators, whose responsibility it would be to enforce it. AMS also considered requiring risk-based sampling, which would mandate minimum portions of sampling of lots by intended use. The portions of lots to be sampled by intended use that were considered were 50 percent of lots for cannabinoids, 10 percent of lots for fiber, and 10 percent of lots for grain. AMS currently lacks sufficient ***data*** to successfully carry out a risk-based sampling methodology that would be applicable to the varying growing regions nationwide; therefore, the risk-based sampling methodology was not chosen for this final rule. Secondly, AMS considered retaining at 0.5 percent the limit for total THC content that would result in a negligent violation, as required in the IFR. Based on comments, however, AMS has determined this requirement to too greatly burden producers as factors beyond the control of the producer, such as seed genetics, weather and climate, may cause an increase in total THC-levels. By increasing the negligent violation threshold to 1.0 percent, AMS diminishes the risk to producers of incurring a negligent violation, which results in time and cost savings to producers and to program-administering entities. Finally, AMS considered mandating a post-sample harvest window of 15 days, as required in the IFR. Based on comments and in consideration of the time required to complete sampling and testing activities, AMS has determined that requiring a 15-day post-sample harvest window would place undue strain on resources. AMS believes that the extension of the post-sample harvest window to 30 days will provide producers with a beneficial flexibility to adjust to unforeseen weather events and will accommodate complicated harvest processes. Pursuant to the Congressional Review Act (5 U.S.C 801 et seq.), the Office of Information and Regulatory Affairs designated this rule as ``major,'' as defined by 5 U.S.C 804(2).List of Subjects in 7 CFR Part 990 Acceptable hemp THC level, ***Agricultural*** commodities, Cannabis, Corrective action plan, Delta-9 tetrahydrocannabinol, Drugs, Dry weight basis, Hemp, Liquid chromatography, Laboratories, Marijuana.0For the reasons stated in the preamble, AMS revises 7 CFR part 990 to read as follows:[[Page 5681]]PART 990--DOMESTIC HEMP PRODUCTION PROGRAMSubpart A--DefinitionsSec.990.1 Meaning of terms.Subpart B--State and Tribal Hemp Production Plans990.2 State and Tribal plans; General authority.990.3 State and Tribal plans; Plan requirements.990.4 USDA approval of State and Tribal plans.990.5 Audit of State or Tribal plan compliance.990.6 Violations of State and Tribal plans.990.7 Establishing records with USDA Farm Service Agency.990.8 Production under Federal law.Subpart C--USDA Hemp Production Plan990.20 USDA requirements for the production of hemp.990.21 USDA hemp producer license.990.22 USDA hemp producer license approval.990.23 Reporting hemp crop acreage with USDA Farm Service Agency.990.24 Responsibility of a USDA licensee prior to harvest.990.25 Standards of performance for detecting total delta-9 tetrahydrocannabinol (THC) concentration levels.990.26 Responsibility of a USDA producer after laboratory testing is performed.990.27 Non-compliant cannabis plants.990.28 Compliance.990.29 Violations.990.30 USDA producers; License suspension.990.31 USDA licensees; Revocation.990.32 Recordkeeping requirements.Subpart D--Appeals990.40 General adverse action appeal process.990.41 Appeals under the USDA hemp production plan.990.42 Appeals under a State or Tribal hemp production plan.Subpart E--Administrative Provisions990.60 Agents.990.61 Severability.990.62 [Reserved]990.63 Interstate transportation of hemp.Subpart F--Reporting Requirements990.70 State and Tribal hemp reporting requirements.990.71 USDA plan reporting requirements. Authority: 7 U.S.C 1639o note, 1639p, 1639q, 1639r.Subpart A--DefinitionsSec. 990.1 Meaning of terms. Words used in this subpart in the singular form shall be deemed to impart the plural, and vice versa, as the case may demand. For the purposes of provisions and regulations of this part, unless the context otherwise requires, the following terms shall be construed, respectively, to mean: Acceptable hemp THC level. When a laboratory tests a sample, it must report the total delta-9 tetrahydrocannabinol content concentration level on a dry weight basis and the measurement of uncertainty. The acceptable hemp THC level for the purpose of compliance with the requirements of State or Tribal hemp plans or the USDA hemp plan is when the application of the measurement of uncertainty to the reported total delta-9 tetrahydrocannabinol content concentration level on a dry weight basis produces a distribution or range that includes 0.3 percent or less. For example, if the reported total delta-9 tetrahydrocannabinol content concentration level on a dry weight basis is 0.35 percent and the measurement of uncertainty is0.06 percent, the measured total delta-9 tetrahydrocannabinol content concentration level on a dry weight basis for this sample ranges from 0.29 percent to 0.41 percent. Because 0.3 percent is within the distribution or range, the sample is within the acceptable hemp THC level for the purpose of plan compliance. This definition of ``acceptable hemp THC level'' affects neither the statutory definition of hemp, 7 U.S.C 1639o(1), in the 2018 Farm Bill nor the definition of ``marihuana,'' 21 U.S.C 802(16), in the CSA. Act. ***Agricultural*** Marketing Act of 1946. ***Agricultural*** Marketing Service or AMS. The ***Agricultural*** Marketing Service of the U.S Department of ***Agriculture***. Applicant. (1) A State or Indian Tribe that has submitted a State or Tribal hemp production plan to USDA for approval under this part; or (2) A producer in a State or territory of an Indian Tribe that is not subject to a State or Tribal hemp production plan and who has submitted an application to USDA for a license under the USDA hemp production plan under this part. Audit. An official inspection of an individual's or organization's accounts and paperwork or documentation by an independent body. An audit also refers to a compliance audit of States and Indian Tribes with approved hemp production plans by USDA to determine compliance with their approved plan, the regulations in this part, and the Act. For this part, audit relates to documentation related to authorities under the 2018 Farm Bill to produce hemp. Cannabis. A genus of flowering plants in the family Cannabaceae of which Cannabis sativa is a species, and Cannabis indica and Cannabis ruderalis are subspecies thereof. Cannabis refers to any form of the plant in which the total delta-9 tetrahydrocannabinol concentration on a dry weight basis has not yet been determined. Controlled Substances Act (CSA). The Controlled Substances Act as codified in 21 U.S.C 801 et seq. Conviction. Means any plea of guilty or nolo contendere, or any finding of guilt, except when the finding of guilt is subsequently overturned on appeal, pardoned, or expunged. For purposes of this part, a conviction is expunged when the conviction is removed from the individual's criminal history record and there are no legal disabilities or restrictions associated with the expunged conviction, other than the fact that the conviction may be used for sentencing purposes for subsequent convictions. In addition, where an individual is allowed to withdraw an original plea of guilty or nolo contendere and enter a plea of not guilty and the case is subsequently dismissed, the individual is no longer considered to have a conviction for purposes of this part. Corrective action plan. A plan proposed by a licensed hemp producer and approved by the governing entity for correcting a negligent violation or non-compliance with the applicable State, Tribal, or USDA hemp production plan, its terms, the applicable law(s), and/or this part. Also, a plan proposed by a State or Tribal government for correcting violations or non-compliances with USDA-approved State or Tribal hemp programs. Criminal history report. The Federal Bureau of Investigation's Identity History Summary. Culpable mental state greater than negligence. To act intentionally, knowingly, willfully, or recklessly. Decarboxylated. The completion of the chemical reaction that converts THC-acid (THCA) into delta-9 THC, the intoxicating component of cannabis. The decarboxylated value is also calculated using a molecular mass conversion ratio that sums delta-9 THC and eighty-seven and seven tenths (87.7) percent of THC-acid ((delta-9 THC) + (0.877 \* THCA)). Decarboxylation. The removal or elimination of carboxyl group from a molecule or organic compound. Disposal. An activity that transitions the non-compliant product into a non-retrievable or non-ingestible form. Such activities include plowing, tilling, or disking plant material into the soil; mulching, composting, chopping, or bush mowing plant material into green[[Page 5682]]manure; burning plant material; burying plant material into the earth and covering with soil. Delta-9 tetrahydrocannabinol or THC. Delta-9 THC is the primary psychoactive component of cannabis. For the purposes of this part, delta-9 THC and THC are interchangeable. Drug Enforcement Administration or DEA. The United States Drug Enforcement Administration. Dry weight basis. The ratio of the amount of moisture in a sample to the amount of dry solid in a sample. A basis for expressing the percentage of a chemical in a substance after removing the moisture from the substance. Percentage of THC on a dry weight basis means the percentage of THC, by weight, in a cannabis item (plant, extract, or other derivative), after excluding moisture from the item. Entity. A corporation, joint stock company, association, limited partnership, limited liability partnership, limited liability company, irrevocable trust, estate, charitable organization, or other similar organization, including any such organization participating in the hemp production as a partner in a general partnership, a participant in a joint venture, or a participant in a similar organization. Farm Service Agency or FSA. An agency of the United States Department of ***Agriculture***. Gas chromatography or GC. A type of chromatography in analytical chemistry used to separate, identify, and quantify each component in a mixture. GC relies on heat for separating and analyzing compounds that can be vaporized without decomposition. Geospatial location. A location designated through a global system of navigational satellites used to determine the precise ground position of a place or object. Handle. To harvest or store hemp plants or hemp plant parts prior to the delivery of such plants or plant parts for further processing. ``Handle'' also includes the disposal of cannabis plants that are not hemp for purposes of chemical analysis and disposal of such plants. Hemp. The plant species Cannabis sativa L. and any part of that plant, including the seeds thereof and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a total delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis. Immature plants. A cannabis plant that is not flowering. Indian Tribe or Tribe. As defined in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C 5304). Information sharing system. The database that allows USDA to share information ***collected*** under State, Tribal, and USDA plans with Federal, State, Tribal, and local law enforcement. Key participants. A sole proprietor, a partner in partnership, or a person with executive managerial control in a corporation. A person with executive managerial control includes persons such as a chief executive officer, chief operating officer, and chief financial officer. This definition does not include non-executive managers such as farm, field, or shift managers. This definition also does not include a member of the leadership of a Tribal government who is acting in their capacity as a Tribal leader except when that member exercises executive managerial control over hemp production. Law enforcement agency. Any Federal, State, Tribal, or local law enforcement agency. Liquid chromatography or LC. A type of chromatography technique in analytical chemistry used to separate, identify, and quantify each component in a mixture. LC relies on pumps to pass a pressurized liquid solvent containing the sample mixture through a column filled with a solid absorbent material to separate and analyze compounds. Lot. A contiguous area in a field, greenhouse, or indoor growing structure containing the same variety or strain of cannabis throughout the area. The term lot also means the terms ``farm,'' ``tract,'' ``field,'' and ``subfield'' as these are terms used by FSA in 7 CFR 718.2 to define lot. Marijuana. Or ``marihuana'', as defined in the CSA, means all parts of the plant Cannabis sativa L., whether growing or not; the seeds thereof; the resin extracted from any part of such plant; and every compound, manufacture, salt, derivative, mixture, or preparation of such plant, its seeds or resin. The term ``marihuana'' does not include hemp, as defined in section 297A of the ***Agricultural*** Marketing Act of 1946, and does not include the mature stalks of such plant, fiber produced from such stalks, oil or cake made from the seeds of such plant, any other compound, manufacture, salt, derivative, mixture, or preparation of such mature stalks (except the resin extracted therefrom), fiber, oil, or cake, or the sterilized seed of such plant which is incapable of germination (7 U.S.C 1639o). ``Marihuana'' means all cannabis that tests as having a THC concentration level of higher than 0.3 percent on a dry weight basis. Measurement of Uncertainty (MU). The parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the particular quantity subject to measurement. Negligence. Failure to exercise the level of care that a reasonably prudent person would exercise in complying with the regulations set forth under this part. Phytocannabinoid. Cannabinoid chemical compounds found in the cannabis plant, two of which are delta-9 tetrahydrocannabinol (delta-9 THC) and cannabidiol (CBD). Plan. A set of criteria or regulations under which a State or Tribal government, or USDA, monitors and regulates the production of hemp. Post-decarboxylation. In the context of testing methodologies for THC concentration levels in hemp, means a value determined after the process of decarboxylation that determines the potential total delta-9 tetrahydrocannabinol content derived from the sum of the THC and THCA content and reported on a dry weight basis. The post-decarboxylation value of THC can be calculated by using a chromatograph technique using heat, gas chromatography, through which THCA is converted from its acid form to its neutral form, THC. Thus, this test calculates the total potential THC in a given sample. The post-decarboxylation value of THC can also be calculated by using a liquid chromatograph technique, which keeps the THCA intact. This technique requires the use of the following conversion: [Total THC = (0.877 x THCA) + THC] which calculates the potential total THC in a given sample. See the definition for decarboxylation. Produce. To grow hemp plants for market, or for cultivation for market, in the United States. Producer. A producer as defined in 7 CFR 718.2 specifically of hemp. Remediation. Remediation refers to the process of rendering non-compliant cannabis, compliant. Remediation can occur by removing and destroying flower material, while retaining stalk, stems, leaf material, and seeds. Remediation can also occur by shredding the entire plant into a biomass like material, then re-testing the shredded biomass material for compliance. Reverse distributor. A person who is registered with the DEA in accordance with 21 CFR 1317.15 to dispose of[[Page 5683]]marijuana under the Controlled Substances Act. Secretary. The Secretary of ***Agriculture*** of the United States Department of ***Agriculture***. State. Any one of the fifty States of the United States of America, the District of Columbia, the Commonwealth of Puerto Rico, and any other territory or possession of the United States. State department of ***agriculture***. The agency, commission, or department of a State government responsible for ***agriculture*** in the State. Territory of the Indian Tribe. (1) All land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, including rights-of-way running through the reservation; (2) All dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a State; (3) All Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same; and (4) Any lands title to which is either held in trust by the United States for the benefit of any Indian Tribe or individual or held by any Indian Tribe or individual subject to restriction by the United States against alienation and over which an Indian Tribe exercises jurisdiction. Total THC. Total THC is the value determined after the process of decarboxylation, or the application of a conversion factor if the testing methodology does not include decarboxylation, that expresses the potential total delta-9 tetrahydrocannabinol content derived from the sum of the THC and THCA content and reported on a dry weight basis. This post-decarboxylation value of THC can be calculated by using a chromatograph technique using heat, such as gas chromatography, through which THCA is converted from its acid form to its neutral form, THC. Thus, this test calculates the total potential THC in a given sample. The total THC can also be calculated by using a liquid chromatograph technique, which keeps the THCA intact. This technique requires the use of the following conversion: [Total THC = (0.877 x THCA) + THC] which calculates the potential total THC in a given sample. Tribal government. The governing body of an Indian Tribe. USDA licensee. A person, partnership, or corporation licensed under the USDA planto grow hemp under the terms established in this part and who produces hemp.Subpart B--State and Tribal Hemp Production PlansSec. 990.2 State and Tribal plans; General authority. States or Indian Tribes desiring to have primary regulatory authority over the production of hemp in the State or territory of the Indian Tribe shall submit to the Secretary for approval, through the State department of ***agriculture*** (in consultation with the Governor and chief law enforcement officer of the State) or the Tribal government, as applicable, a plan under which the State or Indian Tribe monitors and regulates that production.Sec. 990.3 State and Tribal plans; Plan requirements. (a) General requirements. A State or Tribal plan submitted to the Secretary for approval must include the practice and procedures described in this paragraph (a). (1) A State or Tribal plan must include a practice to ***collect***, maintain, and report to the Secretary relevant, real-time information for each producer licensed or authorized to produce hemp under the State or Tribal plan regarding: (i) Contact information as described in Sec. 990.70(a)(1); (ii) A legal description of the land on which the producer will produce hemp in the State or territory of the Indian Tribe including, to the extent practicable, its geospatial location; and (iii) The status and number of the producer's license or authorization in a format prescribed by USDA. (2) A State or Tribal plan must include a procedure for accurate and effective sampling of hemp that includes the requirements in this paragraph (a)(2). (i) Samples from cannabis plants must be ***collected*** within 30 days prior to the anticipated harvest, for total delta-9 tetrahydrocannabinol concentration level testing. Samples must be ***collected*** by a sampling agent. Producers may not ***collect*** samples from their own growing facilities. (ii) Samples shall be obtained from the flowering tops of plants when flowering tops are present, and shall be approximately five to eight inches in length from the ``main stem'' (that includes the leaves and flowers), ``terminal bud'' (that occurs at the end of a stem), or ``central cola'' (cut stem that could develop into a bud) of the flowering top of the plant. (iii) The method used for sampling must be sufficient at a confidence level of 95 percent that no more than one percent of the plants in each lot would exceed the acceptable hemp THC level and ensure that a representative sample is ***collected*** that represents a homogeneous composition of the lot. Alternatively, States and Tribes may adopt a performance-based method that meets the requirements in paragraphs (a)(2)(iii)(A) and (B) of this section. (A) The alternative method must be part of the State or Tribe's hemp plan and is subject to USDA approval. (B) The alternative method must have the potential to ensure, at a confidence level of 95 percent, that the cannabisplant species Cannabis sativa L. that will be subject to the alternative method will not test above the acceptable hemp THC level. The alternative method may consider one or more of the following factors: (1) Seed certification process or process that identifies varieties that have consistently demonstrated to result in compliant hemp plants in that State or territory of the Indian Tribe; (2) Whether the producer is conducting research on hemp; (3) Whether a producer has consistently produced compliant hemp plants over an extended period of time; and (4) Factors similar to those in this paragraph (a)(2)(iii)(B). (iv) During a scheduled sample ***collection***, the producer or an authorized representative of the producer shall be present at the growing site if possible. (v) Sampling agents shall be provided with complete and unrestricted access during business hours to all hemp and other cannabis plants (whether growing or harvested), to areas where hemp is grown and stored, and to all land, buildings, and other structures used for the cultivation, handling, and storage of all hemp and other cannabis plants, and all locations listed in the producer license. (vi) A producer shall not harvest the cannabis crop prior to samples being taken. (vii) Sampling agents must be trained using USDA, State, or Tribal training procedures. States and Indian Tribes must maintain information, available to producers, about trained sampling agents. (3) A State or Tribal plan must include a procedure for testing that is able to accurately identify whether the sample contains a total delta-9 tetrahydrocannabinol content concentration level that exceeds the acceptable hemp THC level. The procedure must include a validated testing methodology that uses post-[[Page 5684]]decarboxylation or other similarly reliable methods. The testing methodology must consider the potential conversion of THCA in hemp into THC and the test result must report the total available THC derived from the sum of the THC and THCA content. Testing methodologies meeting the requirements of this paragraph (a)(3) include, but are not limited to, gas or liquid chromatography with detection. The total THC concentration level shall be determined and reported on a dry weight basis. (i) Any test of a representative sample resulting in higher than the acceptable hemp THC level shall be conclusive evidence that the lot represented by the sample is not in compliance with this part and shall be disposed of or remediated in accordance with Sec. 990.27 (ii) Samples of hemp plant material from one lot shall not be commingled with hemp plant material from other lots. (iii) Laboratories conducting analytical testing for purposes of detecting the concentration levels of Total THC shall meet the following requirements: (A) Laboratory quality assurance must ensure the validity and reliability of test results; (B) Analytical method selection, validation, and verification must ensure that the testing method used is appropriate (fit for purpose), and that the laboratory can successfully perform the testing; (C) The demonstration of testing validity must ensure consistent, accurate analytical performance; (D) Method performance specifications must ensure analytical tests are sufficiently sensitive for the purposes of the detectability requirements of this part; and (E) Effective disposal procedures for non-compliant samples that do not meet the requirements of this part. (F) Measurement of uncertainty (MU) must be estimated and reported with test results. Laboratories shall use appropriate, validated methods and procedures for all testing activities and evaluate measurement of uncertainty. (G) Sample preparation of pre- or post-harvest samples shall require grinding of sample to ensure homogeneity of plant material prior to testing. Sample preparation may follow a procedure described by USDA. (H) After December 31, 2022, States and Indian Tribes shall require that only laboratories registered with the DEA may conduct testing under this section. (4) A State or Indian Tribe shall require testing laboratories to comply with USDA reporting requirements in subpart F of this part. Laboratories shall only submit test results used to determine compliance with this part. Test results from informal testing conducted throughout the growing season shall not be reported to USDA. (5) A State or Tribal plan must include a procedure to comply with the enforcement procedures in Sec. 990.6 (6) A State or Tribal plan must include a procedure for the disposal or remediation of cannabis plants if the sample representing that plant tests above the acceptable hemp THC level. (i) The disposal must be conducted either by using a DEA-registered reverse distributor or law enforcement; or on site at the farm or hemp production facility. (ii) The State or Tribal plan must include procedures to verify the disposal or remediation of the cannabis plant. This may come in the form of in-person verification by State or Tribal representatives, or alternative requirements that direct growers to provide pictures, videos, or other proof that disposal or remediation occurred successfully. Disposal and remediation means are described at AMS's website. (iii) If a producer elects to perform remediation activities, an additional sampling and testing of the post-remediated crop must occur to determine THC concentration levels. (7) A State or Tribal plan must include a procedure for conducting annual inspections of, at a minimum, a random group of producers to verify that hemp is not produced in violation of this part. (8) A State or Tribal plan must include a procedure for submitting the report described in Sec. 990.70 to the Secretary by the first of each month. If the first of the month falls on a weekend or holiday, the report is due by the first business day following the due date. All such information must be submitted to the USDA in a format that is compatible with USDA's information sharing system. (9) The State or Tribal government must certify that the State or Indian Tribe has the resources and personnel to carry out the practices and procedures described in paragraphs (a)(1) through (9) of this section. (10) The State or Tribal plan must include a procedure to ***collect*** and share information with USDA to support the information sharing requirements in 7 U.S.C 1639q(d). The State or Tribal government is responsible for reporting the information identified in paragraphs (a)(10)(i) through (iii) of this section with AMS. The State or Tribal hemp production plan must include the following: (i) A requirement that producers report their hemp crop acreage to the FSA, consistent with the requirement in Sec. 990.7 (ii) Assignment of a license or authorization identifier for each producer in a format prescribed by USDA. (iii) A requirement that producers report the total acreage of hemp planted, harvested, and, if applicable, disposed or remediated. The State or Tribal government shall ***collect*** this information and report it to AMS. (b) Relation to State and Tribal law. A State or Tribal plan may include any other practice or procedure established by a State or Indian Tribe, as applicable; Provided, That the practice or procedure is consistent with this part and Subtitle G of the Act. (1) No preemption. Nothing in this part preempts or limits any law of a State or Indian Tribe that: (i) Regulates the production of hemp; and (ii) Is more stringent than this part or Subtitle G of the Act. (2) References in plans. A State or Tribal plan may include a reference to a law of the State or Indian Tribe regulating the production of hemp, to the extent that the law is consistent with this part.Sec. 990.4 USDA approval of State and Tribal plans. (a) General authority. No later than 60 calendar days after the receipt of a State or Tribal plan for a State or Tribal territory in which production of hemp is legal, the Secretary shall: (1) Approve the State or Tribal plan only if the State or Tribal plan complies with this part; or (2) Disapprove the State or Tribal plan if the plan does not comply with this part. USDA shall provide the State or Tribe with written notification of the disapproval and the cause for the disapproval. (b) Amended plans. A State or Tribal government, as applicable, must submit to the Secretary an amended plan if: (1) The Secretary disapproves a State or Tribal plan and the State or Indian Tribe wishes to have primary regulatory authority over hemp production within its State or territory of the Indian Tribe; or (2) The State or Indian Tribe makes substantive revisions to its plan or its laws which alter the way the plan meets the requirements of this part. If this occurs, the State or Tribal government must re-submit the revised plan for USDA approval. Such re-submissions should be provided to USDA within 60 days from the date that the State or[[Page 5685]]Tribal laws and regulations are effective. Producers shall continue to comply with the requirements of the existing plan while such modifications are under consideration by USDA. If State or Tribal government laws or regulations in effect under the USDA-approved plan change but the State or Tribal government does not submit a revised plan within 60 days from the effective date of the new law or regulation, the existing plan is revoked. (3) USDA approval of State or Tribal government plan shall remain in effect unless an amended plan must be submitted to USDA because of a substantive revision to a State's or Tribe's plan, a relevant change in State or Tribal laws or regulations, or approval of the plan is revoked by USDA. (4) Upon USDA approval of a Tribal plan, an Indian Tribe may exercise jurisdiction and therefore primary regulatory authority over all production of hemp in its Territory regardless of the extent of its inherent regulatory authority. (c) Technical assistance. The Secretary may provide technical assistance to help a State or Indian Tribe develop or amend a plan. This may include the review of draft plans or other informal consultation as necessary. (d) Approved State or Tribal plans. If the Secretary approves a State or Tribal plan, the Secretary shall notify the State or Indian Tribe by letter or email. (1) In addition to the approval letter, the State or Indian Tribe shall receive their plan approval certificate either as an attachment or via website link. (2) The USDA shall post information regarding approved plans on its website. (3) USDA approval of State or Tribal government plans shall remain in effect unless: (i) The State or Tribal government's laws and regulations in effect under the USDA-approved plan change, thus requiring such plan to be revised and re-submitted for USDA approval. (ii) A State or Tribal plan must be amended in order to comply with future amendments to Subtitle G the Act and this part. (e) Producer rights upon revocation of State or Tribal plan. If USDA revokes approval of a State or Tribal plan due to noncompliance as defined in paragraph (b)(2) of this section and Sec. 990.5, producers licensed or authorized to produce hemp under the revoked State or Tribal plan may continue to produce for the remainder of the calendar year in which the revocation became effective. Producers operating in a State or Tribal territory with a revoked plan would have to apply to USDA for a license to continue producing.Sec. 990.5 Audit of State or Tribal plan compliance. The Secretary may conduct an audit to determine a State or Indian Tribe's compliance with their approved plan. (a) Frequency of audits. Compliance audits may be scheduled, no more frequently than every three years, based on available resources. Audits may include an onsite-visit, a desk-audit, or both. The USDA may adjust the frequency of audits if deemed appropriate based on program performance, compliance issues, or other relevant factors identified and provided to the State or Tribal governments by USDA. (b) Scope of audit review. The audit may include, but is not limited to, a review of the following: (1) The resources and personnel employed to administer and oversee its approved plan; (2) The process for licensing and systematic compliance review of hemp producers; (3) Sampling methods and laboratory testing requirements and components; (4) Disposal and/or remediation of non-compliant hemp plants or hemp plant material practices, to ensure that correct reporting to the USDA has occurred; (5) Results of and methodology used for the annual inspections of producers; and (6) Information ***collection*** procedures and information accuracy (i.e , geospatial location, contact information reported to the USDA, legal description of land). (c) Audit reports. (1) Audit reports will be issued to the State or Tribal government no later than 60 days after the audit concludes. If the audit reveals that the State or Tribal government is not in compliance with its USDA approved plan, USDA will advise the State or Indian Tribe of non-compliances and the corrective measures that must be completed to come into compliance with the Act and regulations in this part. The USDA will require the State or Indian Tribe to develop a corrective action plan, which must be reviewed and approved by the USDA. The corrective action plan must include a reasonable date by which the State or Indian Tribe will correct make corrections. USDA will approve or deny the corrective action plan within 60 days of its receipt. USDA will conduct a second audit to determine if the State or Indian Tribe is in compliance with the corrective action plan and has corrected the non-compliances. (2) If the USDA determines that the State or Indian Tribe is not in compliance after the second audit, the USDA may revoke its approval of the State or Tribal plan for one year or until the State or Indian Tribe becomes compliant whichever occurs later. USDA will not approve a State or Indian Tribe's plan until the State or Indian Tribe demonstrates upon inspection that it is in compliance with all regulations in this part.Sec. 990.6 Violations of State and Tribal plans. (a) Producer violations. Producer violations of USDA-approved State and Tribal hemp production plans shall be subject to enforcement in accordance with the terms of this section. (b) Negligent violations. Each USDA-approved State or Tribal plan shall contain provisions relating to negligent producer violations as defined under this part. Producers shall not receive more than one negligent violation per growing season. Negligent violations shall include: (1) Failure to provide a legal description of land on which the producer produces hemp; (2) Failure to obtain a license or other required authorization from the State department of ***agriculture*** or Tribal government, as applicable; or (3) Production of cannabis with a total delta-9 tetrahydrocannabinol concentration exceeding the acceptable hemp THC level. Hemp producers do not commit a negligent violation under this paragraph (b)(3) if they make reasonable efforts to grow hemp and the cannabis (marijuana) does not have a total delta-9 tetrahydrocannabinol concentration of more than 1.0 percent on a dry weight basis. (c) Corrective action for negligent violations. Each USDA-approved State or Tribal plan shall provide for the correction of negligent violations. Each corrective action plan shall include, at a minimum, the following terms: (1) A reasonable date by which the producer shall correct the negligent violation. (2) A requirement that the producer periodically report to the State department of ***agriculture*** or Tribal government, as applicable, on its compliance with the State or Tribal plan and corrective action plan for a period of not less than the next 2 years from the date of the negligent violation. (3) A producer that negligently violates a State or Tribal plan approved under this part shall not as a result of that violation be subject to any criminal[[Page 5686]]enforcement action by the Federal, State, Tribal, or local government. (4) A producer that negligently violates a State or Tribal plan three times during a 5-year period shall be ineligible to produce hemp for a period of 5 years beginning on the date of the third violation. (5) The State or Indian Tribe shall conduct an inspection to determine if the corrective action plan has been implemented as submitted. (d) Culpable violations. Each USDA-approved State or Tribal plan shall contain provisions relating to producer violations made with a culpable mental state greater than negligence, including that: (1) If the State or Tribal government determines that a producer has violated the plan with a culpable mental state greater than negligence, the State or Tribal government, as applicable, shall immediately report the producer to: (i) The U.S Attorney General; and (ii) The chief law enforcement officer of the State or Indian Tribe, as applicable. (2) Paragraphs (b) and (c) of this section shall not apply to culpable violations. (e) Felonies. Each USDA-approved State or Tribal plan shall contain provisions relating to felonies. Such provisions shall state that: (1) A person with a State or Federal felony conviction relating to a controlled substance may not participate in the plan and may not produce hemp under the State or Tribal plan for 10 years from the date of the conviction. An exception applies to a person who was lawfully growing hemp under section 7606 of the ***Agricultural*** Act of 2014 (7 U.S.C 5940) before December 20, 2018, and whose conviction also occurred before that date. (2) The State or Tribal plan shall define who is participating in the plan or program and is subject to the felony conviction restriction for purposes of paragraph (e)(1) of this section. To determine whether a person is subject to the felony conviction restriction, the State or Tribe much obtain a criminal history report for that person. The State or Indian Tribe may require additional reports or checks as it deems necessary. (3) For each license or authorization that the State or Indian Tribe issues, its plan must identify at least one individual as participating in the plan and for whom it will obtain a criminal history report to determine eligibility under paragraph (e)(1) of this section. (f) False statement. Each USDA-approved State or Tribal plan shall state that any person who materially falsifies any information contained in an application to participate in such program shall be ineligible to participate in that program. (g) Appeals. For States and Indian Tribes who wish to appeal an adverse action, subpart D of this part will apply.Sec. 990.7 Establishing records with USDA Farm Service Agency. All producers licensed to produce hemp under an USDA-approved State or Tribal plan shall report hemp crop acreage to FSA and shall provide, at minimum, the following information: (a) Street address and, to the extent practicable, geospatial location for each lot or greenhouse where hemp will be produced. If an applicant operates in more than one location, or is producing under multiple licenses, production information shall be provided for each location. (b) Acreage dedicated to the production of hemp, or greenhouse or indoor square footage dedicated to the production of hemp. (c) License or authorization identifier in a format prescribed by USDA.Sec. 990.8 Production under Federal law. Nothing in this subpart prohibits the production of hemp in a State or the territory of an Indian Tribe for which a State or Tribal plan is not approved under this subpart if produced in accordance with subpart C of this part, and if the production of hemp is not otherwise prohibited by the State or Indian Tribe.Subpart C--USDA Hemp Production PlanSec. 990.20 USDA requirements for the production of hemp. (a) General hemp production requirements. The production of hemp in a State or territory of an Indian Tribe where there is no USDA approved State or Tribal plan must be conducted in accordance with this subpart, provided that the production of hemp is not prohibited by the State or territory of an Indian Tribe where production will occur. (b) Convicted felon ban. A person with a State or Federal felony conviction relating to a controlled substance is subject to a 10-year ineligibility restriction on participating in and producing hemp under the USDA plan from the date of the conviction. An exception applies to a person who was lawfully growing hemp under section 7606 of the ***Agricultural*** Act of 2014 (7 U.S.C 5940) before December 20, 2018, and whose conviction also occurred before that date. (c) Falsifying material information on application. Any person who materially falsifies any information contained in an application for a license under the USDA plan shall be ineligible to participate in the USDA plan.Sec. 990.21 USDA hemp producer license. (a) General application requirements--(1) Requirements and license application. Any person producing or intending to produce hemp must have a valid license prior to producing hemp. A valid license means the license is unexpired, unsuspended, and unrevoked. (2) Application dates. Applicants may submit an application for a license at any time. (3) Required information on application. The applicant shall provide the information requested on the application form, including: (i) Contact information. Full name, residential address, telephone number, and email address. If the applicant is a business entity, the full name of the business, the principal business location address, full name and title of the key participants, title, email address (if available), and employer identification number (EIN) of the business; and (ii) Criminal history report. A current criminal history report for an individual, or if the applicant is a business entity, all key participants, dated within 60 days of the application submission date. A license application will not be considered complete without all required criminal history reports. (4) Submission of completed application forms. Completed application forms shall be submitted to USDA. (5) Incomplete application procedures. Applications missing required information shall be returned to the applicant as incomplete. The applicant may resubmit a completed application. (6) License expiration. USDA-issued hemp producer licenses shall be valid until December 31 of the year three years after the year in which license was issued. (b) License renewals. USDA hemp producer licenses must be renewed prior to license expiration. Licenses are not automatically renewed. Applications for renewal shall be subject to the same terms, information ***collection*** requirements, and approval criteria as provided in this subpart for initial applications unless there has been an amendment to the regulations in this part or the law since approval of the initial or last application. (c) License modification. A license modification is required if there is any[[Page 5687]]change to the information submitted in the application including, but not limited to, sale of a business, the production of hemp in a new location, or a change in the key participants under a license. (d) Licensing for research. (1) Producers that produce hemp for research must obtain a USDA license. However, the hemp that is produced for research and does not enter the stream of commerce is not subject to the sampling requirements in Sec. Sec. 990.24 and 990.26; provided that the producer adopts and carries out a USDA approved alternative sampling method that has the potential to ensure, at a confidence level of 95 percent, that the cannabis plant species Cannabis sativa L. that will be subject to this alternative method will not test above the acceptable hemp THC level. (2) USDA licensees shall ensure the disposal of all non-compliant plants in accordance with Sec. 990.27 Only research institutions registered with DEA to handle marijuana can keep hemp that tests over the 0.3 acceptable hemp THC level until the end of the study. (3) USDA licensees shall comply with the reporting requirements in Sec. 990.71 including reporting disposal of non-compliant plants.Sec. 990.22 USDA hemp producer license approval. (a) A license shall not be issued unless: (1) The application submitted for USDA review and approval is complete and accurate. (2) The criminal history report(s) submitted with the license application confirms that all key participants to be covered by the license have not been convicted of a felony, under State or Federal law, relating to a controlled substance within the past ten (10) years unless the exception in Sec. 990.20(b) applies. (3) The applicant, if the applicant was previously or is currently licensed, submitted all reports required as a participant in the hemp production program by this part. (4) The application contains no materially false statements or misrepresentations and the applicant has not previously submitted an application with any materially false statements or misrepresentations. (5) The applicant's license is not currently suspended, if the applicant is currently licensed. (6) The applicant is not applying for a license as a stand-in for someone whose license has been suspended, revoked, or is otherwise ineligible to participate. (7) The State or territory of the Indian Tribe where the person produces or intends to produce hemp does not have a USDA-approved plan or has not submitted a plan to USDA for approval and is awaiting USDA's decision. (8) The State or territory of the Indian Tribe where the person produces or intends to produce hemp does not prohibit the production of hemp. (b) USDA shall provide written notification to applicants whether the application has been approved or denied. USDA shall provide written notification to applicants in a State or territory of an Indian Tribe that has submitted a plan to USDA and is awaiting USDA approval that their application is being returned. (1) If an application is approved, a license will be issued. (2) Licenses will be valid until December 31 of the year three after the year in which the license was issued. (3) Licenses may not be sold, assigned, transferred, pledged, or otherwise disposed of, alienated or encumbered. (4) If a license application is denied, the notification from USDA will explain the reason for denial. Applicants may appeal the denial in accordance with subpart D of this part. (c) If the applicant is producing in more than one State or territory of an Indian Tribe, the applicant may have more than one license to grow hemp. If the applicant has operations in a location covered under a State or Tribal plan, that operation must be licensed under the State or Tribal plan, not the USDA plan.Sec. 990.23 Reporting hemp crop acreage with USDA Farm Service Agency. All USDA licensees shall report hemp crop acreage to FSA within 30 days of hemp been planted and shall provide, at a minimum, the following information: (a) Street address and, to the extent practicable, geospatial location of the lot, greenhouse, building, or site where hemp will be produced. All locations where hemp is produced must be reported to FSA. (b) Acreage dedicated to the production of hemp, or greenhouse or indoor square footage dedicated to the production of hemp. (c) The hemp license number.Sec. 990.24 Responsibility of a USDA licensee prior to harvest. USDA licensees must: (a) No more than 30 days prior to the anticipated harvest of cannabis plants, have a sampling agent ***collect*** samples from the cannabis plant for total delta-9 tetrahydrocannabinol concentration level testing. (b) Have samples ***collected*** from the flowering tops of the plant by cutting the top five to eight inches from the ``main stem'' (that includes the leaves and flowers), ``terminal bud'' (that occurs at the end of a stem), ''or ``central cola'' (cut stem that could develop into a bud) of the flowering top of the plant. Sampling guidelines and training requirements for sampling agents are available from USDA. The method used for sampling must be sufficient at a confidence level of 95 percent that no more than one percent (1%) of the plants in the lot would exceed the acceptable hemp THC level. The method used for sampling must ensure that a representative sample is ***collected*** that represents a homogeneous composition of the lot. (c) Have an authorized representative of the USDA licensee present at the growing site during a scheduled sample ***collection***, if possible. (d) Ensure that sampling agents are provided with complete and unrestricted access during business hours to all hemp and other cannabis plants, (whether growing or harvested), all hemp production and storage areas, all land, buildings, and other structures used for the cultivation, handling, and storage of all hemp and other cannabis plants, and all locations listed in the producer license. (e) Not harvest the cannabis crop prior to samples being taken. (f) Use post-harvest samples only for remediated biomass.Sec. 990.25 Standards of performance for detecting total delta-9 tetrahydrocannabinol (THC) concentration levels. Analytical testing for purposes of determining total THC in cannabis plants shall meet the standards in this section. (a) Laboratory quality assurance must ensure the validity and reliability of test results. (b) Analytical method selection, validation, and verification must ensure that the testing method used is appropriate (fit for purpose), and that the laboratory can successfully perform the testing. (c) The demonstration of testing validity must ensure consistent, accurate analytical performance. (d) Method performance specifications must ensure analytical tests are sufficiently sensitive for the purposes of the detectability requirements of this part. (e) Laboratory must have an effective disposal procedure for non-compliant samples that do not meet the requirements of this part. (f) Measurement of uncertainty (MU) must be estimated and reported with[[Page 5688]]test results. Laboratories shall use appropriate, validated methods and procedures for all testing activities and evaluate measurement of uncertainty. (g) At a minimum, analytical testing of samples for total THC must use post-decarboxylation or other similarly reliable methods approved by the Secretary. The testing methodology must consider the potential conversion of THCA in hemp into THC and the test result must reflect the total available THC derived from the sum of the THC and THCA content. Testing methodologies meeting the requirements of this paragraph (g) include, but are not limited to, gas or liquid chromatography with detection. (1) The total THC shall be determined and reported on a dry weight basis. Additionally, measurement of uncertainty (MU) must be estimated and reported with test results. Laboratories shall use appropriate, validated methods and procedures for all testing activities and evaluate measurement of uncertainty. (2) Any sample test result exceeding the acceptable hemp THC level shall be conclusive evidence that the lot represented by the sample is not in compliance with this part. (3) After December 31, 2022, USDA licensees may only use laboratories registered with the DEA to conduct testing under this section.Sec. 990.26 Responsibility of a USDA producer after laboratory testing is performed. (a) The producer shall harvest the crop no later than thirty (30) days after the date of sample ***collection***. (b) If the producer fails to complete harvest within thirty (30) days of sample ***collection***, a second pre-harvest sample of the lot shall be required to be submitted for testing. (c) Harvested lots of hemp plants shall not be commingled with other harvested lots or other material. (d) Lots that meet the acceptable hemp THC level may enter the stream of commerce. (e) Lots that do not meet the acceptable hemp THC level are subject to Sec. 990.27 (f) Any producer may request additional pre-harvest testing if it is believed that the original total delta-9 tetrahydrocannabinol concentration level test results were in error. Additional testing may be conducted by the laboratory that conducted the initial test, or another laboratory.Sec. 990.27 Non-compliant cannabis plants. (a) Cannabis plants exceeding the acceptable hemp THC level constitute marijuana, a schedule I controlled substance under the Controlled Substances Act (CSA), 21 U.S.C 801 et seq., and producers must either use a DEA-registered reverse distributor or law enforcement to dispose of non-compliant plants or ensure the disposal of such cannabis plant on site at the farm or hemp production facility. (b) Producers must notify USDA of their intent to dispose of or remediate non-conforming plants and verify disposal or remediation by submitting required documentation. (c) If a producer elects to perform remediation activities, an additional sampling and testing of the post-remediated crop must occur to determine THC concentration levels.Sec. 990.28 Compliance. (a) Audits. USDA licensees may be audited by the USDA. The audit may include a review of records and documentation, and may include site visits to farms, fields, greenhouses, storage facilities, or other locations affiliated with the producer's hemp operation. The audit may include the current crop year, as well as any previous crop year(s). The audit may be performed remotely or in person. (b) Frequency of audit verifications. Audit verifications may be performed once every three (3) years unless otherwise determined by USDA. If the results of the audit find negligent violations, a corrective action plan may be established. (c) Assessment of producer's hemp operations for conformance. The producer's operational procedures, documentation, recordkeeping, and other practices may be verified during the audit verification. The auditor may also visit the production, cultivation, or storage areas for hemp listed on the producer's license. (1) Records and documentation. The auditor shall assess whether required reports, records, and documentation are properly maintained for accuracy and completeness. (2) [Reserved] (d) Audit reports. Audit reports will be issued to the producer no later than 60 days after the audit is concluded. If USDA determines through an audit that the producer is not compliant with the Act or this part, USDA shall require a corrective action plan. The corrective action plan must include a reasonable date by which the producer will correct the negligent violation. USDA will approve or deny the corrective action plan within 60 days of its receipt. Producers operating under a corrective action plan must also periodically report to USDA on their compliance with the plan for a period of not less than two calendar years following the violation. The producer's implementation of a corrective action plan may be reviewed by USDA during a future site visit or audit. If additional instances of noncompliance occur, USDA may revoke the producer's USDA license for one year or until the producer becomes compliant whichever occurs later.Sec. 990.29 Violations. Violations of this part shall be subject to enforcement in accordance with the terms of this section. (a) Negligent violations. Hemp producers are not subject to more than one negligent violation per calendar year. A hemp producer shall be subject to enforcement for negligently: (1) Failing to provide an accurate legal description of land where hemp is produced; (2) Producing hemp without a license; and (3) Producing cannabis exceeding the acceptable hemp THC level. Hemp producers do not commit a negligent violation under this paragraph (a) if they make reasonable efforts to grow hemp and the cannabis does not have a total THC concentration of more than 1.0 percent on a dry weight basis. (b) Corrective action for negligent violations. For each negligent violation, USDA will issue a Notice of Violation and require a corrective action plan from the producer. The producer shall comply with the corrective action plan to cure the negligent violation. Corrective action plans will be in place for a minimum of two (2) years from the date of their approval. Corrective action plans will, at a minimum, include: (1) The date by which the producer shall correct each negligent violation; (2) Steps that will be taken to correct each negligent violation; and (3) A description of the procedures that will demonstrate compliance must be submitted to USDA. (c) Negligent violations and criminal enforcement. A producer who negligently violates this part shall not, as a result of that violation, be subject to any criminal enforcement action by any Federal, State, Tribal, or local government. (d) Subsequent negligent violations. If a subsequent negligent violation occurs while a corrective action plan is in place, a new corrective action plan must be submitted with a heightened level of quality control, staff training, and quantifiable action measures. (e) Negligent violations and license revocation. A producer that negligently violates the license 3 times in a 5-year[[Page 5689]]period shall have their license revoked and be ineligible to produce hemp for a period of 5 years beginning on the date of the third violation. (f) Culpable mental state greater than negligence. If USDA determines that a licensee has violated the terms of the license or of this part with a culpable mental state greater than negligence: (1) USDA shall immediately report the licensee to: (i) The U.S Attorney General; and (ii) The chief law enforcement officer of the State or Indian territory, as applicable, where the production is located; and (2) Paragraphs (a) and (b) of this section shall not apply to culpable violations.Sec. 990.30 USDA producers; License suspension. (a) USDA may issue a notice of suspension to a producer if USDA or its representative receives some credible evidence establishing that a producer has: (1) Engaged in conduct violating a provision of this part; or (2) Failed to comply with a written order from the USDA-AMS Administrator related to negligence as defined in this part. (b) Any producer whose license has been suspended shall not handle or remove hemp or cannabis from the location where hemp or cannabis was located at the time when USDA issued its notice of suspension, without prior written authorization from USDA. (c) Any person whose license has been suspended shall not produce hemp during the period of suspension. (d) A producer whose license has been suspended may appeal that decision in accordance with subpart D of this part. (e) A producer whose license has been suspended and not restored on appeal may have their license restored after a waiting period of one year from the date of the suspension. If the license was issued more than three years prior to the date of restoration, the producer shall submit a new application and criminal history report to USDA. (f) A producer whose license has been suspended may be required to provide, and operate under, a corrective action plan to fully restore their license.Sec. 990.31 USDA licensees; Revocation. USDA shall immediately revoke the license of a USDA licensee if such licensee: (a) Pleads guilty to, or is convicted of, any felony related to a controlled substance; or (b) Made any materially false statement with regard to this part to USDA or its representatives with a culpable mental state greater than negligence; or (c) Is found to be growing cannabis exceeding the acceptable hemp THC level with a culpable mental state greater than negligence or negligently violated this part three times in five years.Sec. 990.32 Recordkeeping requirements. (a) USDA licensees shall maintain records of all hemp plants acquired, produced, handled, disposed of, or remediated as will substantiate the required reports. (b) All records and reports shall be maintained for at least three years. (c) All records shall be made available for inspection by USDA inspectors, auditors, or their representatives during reasonable business hours. The following records must be made available: (1) Records regarding acquisition of hemp plants; (2) Records regarding production and handling of hemp plants; (3) Records regarding storage of hemp plants; and (4) Records regarding disposal and remediation of all cannabis plants that do not meet the definition of hemp. (d) USDA inspectors, auditors, or their representatives shall have access to any premises where hemp plants may be held during reasonable business hours. (e) All reports and records required to be submitted to USDA as part of participation in the program in this part which include confidential ***data*** or business information, including but not limited to information constituting a trade secret or disclosing a trade position, financial condition, or business operations of the particular licensee or their customers, shall be received by, and at all times kept in the custody and control of, one or more employees of USDA or their representatives. Confidential ***data*** or business information may be shared with applicable Federal, State, Tribal, or local law enforcement or their designee in compliance with the Act.Subpart D--AppealsSec. 990.40 General adverse action appeal process. (a) Persons who believe they are adversely affected by the denial of a license application under the USDA hemp production program may appeal such decision to the AMS Administrator. (b) Persons who believe they are adversely affected by the denial of a license renewal under the USDA hemp production program may appeal such decision to the AMS Administrator. (c) Persons who believe they are adversely affected by the revocation or suspension of a USDA hemp production license may appeal such decision to the AMS Administrator. (d) States and Indian Tribes that believe they are adversely affected by the denial of a proposed State or Tribal hemp plan may appeal such decision to the AMS Administrator.Sec. 990.41 Appeals under the USDA hemp production plan. (a) Appealing a denied USDA-plan license application. A license applicant may appeal the denial of a license application. (1) If the AMS Administrator grants an applicant's appeal of a licensing denial, the applicant will be issued a USDA hemp production license. (2) If the AMS Administrator denies an appeal, the applicant's license application will be denied. The applicant may request a formal adjudicatory proceeding within 30 days to review the decision. Such proceeding shall be conducted pursuant to the U.S Department of ***Agriculture***'s Rules of Practice Governing Adjudicatory Proceedings, 7 CFR part 1, subpart H. (b) Appealing a denied USDA-plan license renewal. A producer may appeal the denial of a license renewal. (1) If the AMS Administrator grants a producer's appeal of a licensing renewal denial, the applicant's USDA hemp production license will be renewed. (2) If the AMS Administrator denies the appeal, the applicant's license will not be renewed. The denied producer may request a formal adjudicatory proceeding within 30 days to review the decision. Such proceeding shall be conducted pursuant to the U.S Department of ***Agriculture***'s Rules of Practice Governing Formal Adjudicatory Proceedings, 7 CFR part 1, subpart H. (c) Appealing a USDA-plan license termination or suspension. A USDA hemp plan producer may appeal the revocation or suspension of a license. (1) If the AMS Administrator grants the appeal of a license termination or suspension, the producer will retain their license. (2) If the AMS Administrator denies the appeal, the producer's license will be terminated or suspended. The producer may request a formal adjudicatory proceeding within 30 days to review the decision. Such proceeding shall be conducted pursuant to the U.S Department of ***Agriculture***'s Rules of Practice Governing Formal Adjudicatory Proceedings, 7 CFR part 1, subpart H.[[Page 5690]] (d) Filing period. The appeal of a denied license application, denied license renewal, suspension, or revocation must be filed within the time-period provided in the letter of notification or within 30 business days from receipt of the notification, whichever occurs later. The appeal will be considered ``filed'' on the date received by the AMS Administrator. The decision to deny an appeal of a license application or renewal, or suspend or terminate a license, is final unless a formal adjudicatory proceeding is requested within 30 days to review the decision. Such proceeding shall be conducted pursuant to the U.S Department of ***Agriculture***'s Rules of Practice Governing Adjudicatory Proceedings, 7 CFR part 1, subpart H. (e) Where to file. Appeals to the Administrator must be filed in the manner as determined by AMS. (f) What to include. All appeals must include a copy of the adverse decision and a statement of the appellant's reasons supporting why the decision was not proper or made in accordance with applicable program regulations in this part, policies, or procedures.Sec. 990.42 Appeals under a State or Tribal hemp production plan. (a) Appealing a State or Tribal hemp production plan application. A State or Indian Tribe may appeal the denial of a proposed State or Tribal hemp production plan by the USDA to the AMS Administrator. (1) If the AMS Administrator grants a State or Indian Tribe's appeal of a denied hemp plan application, the proposed State or Tribal hemp production plan shall be established as proposed. (2) If the AMS Administrator denies an appeal, the proposed State or Tribal hemp production plan shall not be approved. Prospective producers located in the State or territory of the Indian Tribe may apply for hemp licenses under the terms of the USDA plan. The State or Indian Tribe may request a formal adjudicatory proceeding be initiated within 30 days to review the decision. Such proceeding shall be conducted pursuant to the U.S Department of ***Agriculture***'s Rules of Practice Governing Adjudicatory Proceedings, 7 CFR part 1, subpart H. (b) Appealing the suspension or termination of a State or Tribal hemp production plan. A State or Tribe may appeal the revocation by USDA of an approved State or Tribal hemp production plan. (1) If the AMS Administrator grants a State or Indian Tribe's appeal of a State or Tribal hemp production plan suspension or revocation, the associated hemp production plan will remain in place and effective. (2) If the AMS Administrator denies an appeal, the State or Tribal hemp production plan will be suspended or revoked as applicable. Producers located in that State or territory of the Indian Tribe may continue to produce hemp under their State or Tribal license until the end the calendar year in which the State or Tribal plan's disapproval was effective or when the State or Tribal license expires, whichever is earlier. Producers may apply for a USDA license under subpart C of this part unless hemp production is otherwise prohibited by the State or Indian Tribe. The State or Indian Tribe may request a formal adjudicatory proceeding be initiated to review the decision. Such proceeding shall be conducted pursuant to the U.S Department of ***Agriculture***'s Rules of Practice Governing Formal Adjudicatory Proceedings, 7 CFR part 1, subpart H. (c) Filing period. The appeal of a State or Tribal hemp production plan suspension or revocation must be filed within the time-period provided in the letter of notification or within 30 business days from receipt of the notification, whichever occurs later. The appeal will be considered ``filed'' on the date received by the AMS Administrator. The decision to deny a State or Tribal plan application or suspend or revoke approval of a plan, is final unless the decision is appealed in a timely manner. (d) Where to file. Appeals to the Administrator must be filed in the manner as determined by AMS. (e) What to include in appeal. All appeals must include a copy of the adverse decision and a statement of the appellant's reasons supporting why the decision was not proper or made in accordance with applicable program regulations in this part, policies, or procedures.Subpart E--Administrative ProvisionsSec. 990.60 Agents. As provided under 7 CFR part 2, the Secretary may name any officer or employee of the United States or name any agency or division in the United States Department of ***Agriculture***, to act as their agent or representative in connection with any of the provisions of this part.Sec. 990.61 Severability. If any provision of this part is declared invalid or the applicability thereof to any person or circumstances is held invalid, the validity of the remainder of this part or the applicability thereof to other persons or circumstances shall not be affected thereby.Sec. 990.62 [Reserved]Sec. 990.63 Interstate transportation of hemp. No State or Indian Tribe may prohibit the transportation or shipment of hemp lawfully produced under a State or Tribal plan approved under subpart B of this part, under a license issued under subpart C of this part, or under 7 U.S.C 5940 through the State or territory of the Indian Tribe, as applicable.Subpart F--Reporting RequirementsSec. 990.70 State and Tribal hemp reporting requirements. (a) State and Tribal hemp producer report. Each State and Indian Tribe with a plan approved under this part shall submit to USDA, by the first of each month, a report providing the contact information and the status of the license or other authorization issued for each producer covered under the applicable State and Tribal plans. If the first of the month falls on a weekend or holiday, the report is due by the first business day following the due date. The report shall be submitted using a digital format compatible with USDA's information sharing systems, whenever possible. The report shall contain the information described in this paragraph (a). (1)(i) For each new producer who is an individual and is licensed or authorized under the State or Tribal plan, the report shall include the full name of the individual, license or authorization identifier, Employee Identification Number (``EIN'') of the business entity, business address, telephone number, and email address (if available). (ii) For each new producer that is an entity and is licensed or authorized under the State or Tribal plan, the report shall include full name of the entity, the principal business location address, license or authorization identifier, and the full name, title, and email address (if available) of each employee for whom the entity is required to submit a criminal history report. (iii) For each producer that was included in a previous report and whose reported information has changed, the report shall include the previously reported information and the new information. (2) The status of each producer's license or authorization. (3) The period covered by the report. (4) Indication that there were no changes during the current reporting cycle, if applicable.[[Page 5691]] (b) State and Tribal hemp disposal or remediation report. If a producer has produced cannabis exceeding the acceptable hemp THC level, the cannabis must be disposed of or remediated. States and Tribes with plans approved under this part shall submit to USDA, by the first of each month, a report notifying USDA of any occurrence of non-conforming plants or plant material and providing a disposal or remediation record of those plants and materials. This report would include information regarding name and contact information for each producer subject to a disposal or remediation during the reporting period, and date disposal or remediation was completed. If the first of the month fall on a weekend or holiday, reports are due by the first business day following the due date. The report shall contain the information described in this paragraph (b). (1) Name and address of the producer. (2) Producer license or authorization identifier. (3) Location information, such as lot number, location type, and geospatial location or other location descriptor for the production area subject to disposal or remediation. (4) Disposal or remediation completion date. (5) Total acreage. (c) Annual report. Each State or Indian Tribe with a plan approved under this part shall submit an annual report to USDA. The report form shall be submitted by December 15 of each year and contain the information described in this paragraph (c). (1) Total planted acreage. (2) Total harvested acreage. (3) Total acreage disposed and remediated. (d) Test results report. Each producer must ensure that the laboratory that conducts the test of the sample(s) from its lots reports the test results to USDA. Informal testing conducted throughout the growing season for purposes of monitoring THC concentration do not need to be reported to USDA. The test results report shall contain: (1) Producer's license or authorization identifier. (2) Name of producer. (3) Business address of producer. (4) Lot identification number for the sample. (5) Name of laboratory and, no later than December 31, 2022, the DEA registration number of laboratory for testing. (6) Date of test and report. (7) Identification of a pre-harvest or post-harvest retest. (8) Test result.Sec. 990.71 USDA plan reporting requirements. (a) USDA licensing application. USDA will accept applications on a rolling basis. Licenses will be valid until December 31 of the year three years after the license is issued. The license application will be used for both new and renewal applicants. The application shall include: (1) Contact information. (i) For an applicant who is an individual, the application shall include full name of the individual, Employee Identification Number (``EIN'') of the business entity, business address, telephone number, and email address (if available). (ii) For an applicant that is an entity, the application shall include full name of the entity, the principal business location address, and the full name, title, and email address (if available) of each key participant of the entity. (2) Criminal history report. As part of a complete application, each applicant shall provide a current Federal Bureau of Investigation's Identity History Summary. If the applicant is a business entity, a criminal history report shall be provided for each key participant. (i) The applicant shall ensure the criminal history report accompanies the application. (ii) The criminal history report must be dated within 60 days of submission of the application submittal. (3) Consent to comply with program requirements. All applicants submitting a completed license application, in doing so, consent to comply with the requirements of this part. (b) USDA licensee disposal and remediation form. USDA licensee conducts a disposal or remediation activity, that licensee must report the activity on the appropriate form to USDA no later than 30 days after the date of completion of disposal or remediation activity. The report shall contain the information described in this paragraph (b). (1) Name and address of the producer. (2) The USDA licensee's USDA license number. (3) Geospatial location, or other valid land descriptor, for the production area subject to disposal or remediation. (4) Date of completion of disposal or remediation. (5) Signature of the USDA licensee or authorized representative. (c) USDA licensee annual report. Each USDA licensee shall submit an annual report to USDA. The report form shall be submitted by December 15 of each year and contain the information described in this paragraph (c). (1) USDA licensee 's license number. (2) USDA licensee 's name. (3) USDA licensee's address. (4) Lot, location type, geospatial location, total planted acreage, total acreage disposed and remediated, and total harvested acreage. (d) Test results report. Each USDA licensee must ensure that the laboratory that conducts the test of the sample(s) from its lots reports the test results for all samples tested to USDA. Informal testing conducted throughout the growing season for purposes of monitoring THC concentration do not need to be reported to USDA. The test results report shall contain the information described in this paragraph (d) for each sample tested. (1) USDA licensee 's license number. (2) Name of the USDA licensee. (3) Business address of the USDA licensee. (4) Lot identification number for the sample. (5) Name of testing laboratory. (6) Date of test and report. (7) Identification of a pre-harvest or post-harvest retest. (8) Test result.Bruce Summers,Administrator, ***Agricultural*** Marketing Service.[FR Doc. 2021-00967 Filed 1-15-21; 8:45 am]BILLING CODE P

**Load-Date:** January 20, 2021

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[***Council of the European Union: COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A Union of Equality: Gender Equality Strategy 2020-2025 PDF document ST 6678 2020 INIT09-03-2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YD8-5JY1-JDG9-Y4T3-00000-00&context=1516831)

Impact News Service

March 10, 2020 Tuesday

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**Length:** 9845 words

**Body**

Brussels: Council of the European Union has issued the following document:

6678/20 PL/nnLIFE.4 ENCouncil of theEuropean UnionBrussels, 9 March 2020(OR. en)6678/20SOC 137EMPL 115GENDER 18ANTIDISCRIM 12COVER NOTEFrom: Secretary-General of the European Commission,signed by Mr Jordi AYET PUIGARNAU, Directordate of receipt: 5 March 2020To: Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council ofthe European UnionNo. Cion doc.: COM(2020) 152 finalSubject: COMMUNICATION FROM THE COMMISSION TO THE EUROPEANPARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC ANDSOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS AUnion of Equality: Gender Equality Strategy 2020-2025Delegations will find attached document COM(2020) 152 final.Encl.: COM(2020) 152 finalEN ENEUROPEANCOMMISSIONBrussels, 5.3.2020COM(2020) 152 finalCOMMUNICATION FROM THE COMMISSION TO THE EUROPEANPARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIALCOMMITTEE AND THE COMMITTEE OF THE REGIONSA Union of Equality: Gender Equality Strategy 2020-20251TOWARDS A GENDER-EQUAL EUROPE“In all its activities, the Union shall aim to eliminate inequalities, and to promote equality, between men and women.”Article 8 of the Treaty on the Functioning of the European Union“We should not be shy about being proud of where we are or ambitious about where we want to go.”- President Ursula von der Leyen Political GuidelinesThe promotion of equality between women and men is a task for the Union, in all its activities, required by the Treaties. Gender equality is a core value of the EU, a fundamental right1 and key principle of the European Pillar of Social Rights2. It is a reflection of who we are. It is also an essential condition for an innovative, competitive and thriving European economy. In business, politics and society as a whole, we can only reach our full potential if we use all of our talent and diversity. Gender equality brings more jobs and higher productivity3 – a potential which needs to be realised as we embrace the green and digital transitions and face up to our demographic challenges.The European Union is a global leader in gender equality: 14 of the top 20 countries worldwide on gender equality are EU Member States4. Thanks to robust equal treatment legislation and jurisprudence5, efforts to mainstream the gender6 perspective into different policy areas, and laws to address particular inequalities, the EU has made significant progress in gender equality in the last decades.1 See Articles 2 and 3(3) TEU, Articles 8, 10, 19 and 157 TFEU and Articles 21 and 23 of the EU Charter of Fundamental Rights.2 [*https://ec.europa.eu/commission/sites/beta-political/files/social-summit-european-pillar-social-rights-booklet\_en.pdf*](https://ec.europa.eu/commission/sites/beta-political/files/social-summit-european-pillar-social-rights-booklet_en.pdf) 3 By 2050, improving gender equality would lead to an increase in the EU’s GDP per capita by 6.1% to 9.6%, which amounts to €1.95 to €3.15 trillion:   [*https://eige.europa.eu/gender-mainstreaming/policy-areas/economic-and-financial-affairs/economic-benefits-gender-equality.4*](https://eige.europa.eu/gender-mainstreaming/policy-areas/economic-and-financial-affairs/economic-benefits-gender-equality.4) As regards the implementation of the Sustainable Development Goal 5 on gender equality, according to the 2019 EM2030 SDG Gender Index:   [*https://****data****.em2030.org/em2030-sdg-gender-index/.5*](https://data.em2030.org/em2030-sdg-gender-index/.5) The EU has adopted six Directives covering equality between women and men in the workplace, in self-employment, in access to goods and services, in social security, in pregnancy and maternity and on family-related leave and flexible working arrangements for parents and carers. Together they have progressively set a legal standard across Europe ensuring a broad protection from discrimination. Numerous cases brought to the European Court of Justice have further strengthened the principle of equality and delivered justice for victims of discrimination.6 ‘Gender’ shall mean the socially constructed roles, behaviours, activities and attributes that a given society considers appropriate for women and men, see Article 3(c) of the Council of Europe Convention on preventing and combating violence against women and domestic violence.2However, no Member State has achieved full gender equality and progress is slow. Member States on average scored 67.4 out of 100 in the EU Gender Equality Index 20197, a score which has improved by just 5.4 points since 2005.Unfortunately progress with regard to gender equality is neither inevitable nor irreversible. We therefore need to give a new impetus to gender equality. While the gender gap in education is being closed, gender gaps in employment, pay, care, power and pensions persist. Too many people still violate the principle of gender equality through sexist hate speech and by blocking action against gender-based violence and gender stereotypes. Gender-based violence and harassment continue at alarming levels. The #MeToo movement has demonstrated the extent of sexism and abuse that women and girls continue to face. At the same time, it has empowered women across the globe to now come forward with their experiences and bring cases to court.This Gender Equality Strategy frames the European Commission’s work on gender equality and sets out the policy objectives and key actions for the 2020-2025 period8. It aims at achieving a gender equal Europe where gender-based violence, sex discrimination and structural inequality between women and men are a thing of the past. A Europe where women and men, girls and boys, in all their diversity9, are equal. Where they are free to pursue their chosen path in life, where they have equal opportunities to thrive, and where they can equally participate in and lead our European society.The implementation of this strategy will be based on the dual approach of targeted measures to achieve gender equality, combined with strengthened gender mainstreaming. The Commission will enhance gender mainstreaming by systematically including a gender perspective in all stages of policy design in all EU policy areas, internal and external. The strategy will be implemented using intersectionality10 – the combination of gender with other personal characteristics or identities, and how these intersections contribute to unique experiences of discrimination – as a cross-cutting principle.In this year of 2020, which marks the 25th anniversary of the adoption of the Beijing Declaration and Platform for Action11 – the first universal commitment and action plan to advance on equality between women and men – this strategy is the EU’s contribution to shaping a better world for women and men, girls and boys. It delivers on the gender equality Sustainable Development Goal (SDG 5), gender equality as a cross-cutting priority7 See European Institute for Gender Equality (EIGE):   [*https://eige.europa.eu/gender-equality-index/2019.8*](https://eige.europa.eu/gender-equality-index/2019.8) Following the Commission's 2016-2019 strategic engagement for gender equality.9 The expression ‘in all their diversity’ is used in this strategy to express that, where women or men are mentioned, these are a heterogeneous categories including in relation to their sex, gender identity, gender expression or sex characteristics. It affirms the commitment to leave no one behind and achieve a gender equal Europe for everyone, regardless of their sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation.10 EIGE defines ‘intersectionality’ as an “analytical tool for studying, understanding and responding to the ways in which sex and gender intersect with other personal characteristics/identities, and how these intersections contribute to unique experiences of discrimination” (See:   [*https://eige.europa.eu/thesaurus/terms/1263*](https://eige.europa.eu/thesaurus/terms/1263)). According to Article 10 TFEU, when “defining and implementing its policies and activities, the Union shall aim to combat discrimination based on sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation”.11   [*https://beijing20.unwomen.org/en/about.3of*](https://beijing20.unwomen.org/en/about.3of) all SDGs12, and on the EU’s commitment to the UN Convention on the Rights of Persons with Disabilities.1. Being free from violence and stereotypesEveryone should be safe in their homes, in their close relationships, in their workplaces, in public spaces, and online. Women and men, girls and boys, in all their diversity, should be free to express their ideas and emotions, and pursue their chosen educational and professional paths without the constraints of stereotypical gender norms.Ending gender-based violenceGender-based violence – or violence that is directed against a woman because she is a woman or that affects women disproportionately13 – remains one of our societies’ biggest challenges and is deeply rooted in gender inequality14. Gender-based violence, in all its forms, remains under-reported and overlooked, both inside and outside the EU. The EU will do all it can to prevent and combat gender-based violence, support and protect victims of such crimes, and hold perpetrators accountable for their abusive behaviour.The Council of Europe Convention on preventing and combating violence against women and domestic violence – the ‘Istanbul Convention’ – is the benchmark for international standards in this field. The EU signed the Convention in 2017, and concluding the EU’s accession is a key priority for the Commission. To accelerate the conclusion of the EU’s accession, the European Parliament requested in 2019 an opinion from the European Court of Justice on this issue15.Should the EU’s accession to the Istanbul Convention remain blocked, the Commission intends to propose in 2021 measures, within the limits of EU competence, to achieve the same objectives as the Istanbul Convention.The Commission intends in particular to present an initiative with a view to extending the areas of crime where harmonisation is possible to specific forms of gender-based violence in accordance with Article 83(1) TFEU, the so-called Eurocrimes.To the extent that they are already apprehended by the existing Eurocrimes within the meaning of Article 83(1) TFEU, the Commission will propose additional measures to prevent and combat specific forms of gender-based violence, including sexual harassment, abuse of women and female genital mutilation (FGM).12   [*https://ec.europa.eu/europeaid/policies/sustainable-development-goals\_en.13*](https://ec.europa.eu/europeaid/policies/sustainable-development-goals_en.13) Article 3(d) of the Istanbul Convention.14 European Union Agency for Fundamental Rights (FRA), ‘Violence against women: an EU-wide survey’, 2014 – see infographics.15 Request for an opinion submitted by the European Parliament pursuant to Article 218(11) TFEU (Opinion 1/19).4Female genital mutilation16, forced abortion and forced sterilisation, early and forced marriage, so-called ‘honour-related violence’ and other harmful practices against women and girls are forms of gender-based violence and serious violations of women’s and children’s rights within the EU and around the world. In addition to possible legislation, the EU will table a Recommendation on the prevention of harmful practices, including the need for effective pre-emptive measures and acknowledging the importance of education. The recommendation will also address the strengthening of public services, prevention and support measures, capacity-building of professionals and victim-centred access to justice.The Commission will also present a Victims’ Rights Strategy in 2020, which will address the specific needs of victims of gender-based violence, including domestic violence, building on the Victims’ Rights Directive17.Women who have a health problem or disability are more likely to experience various forms of violence.18 The Commission will develop and finance measures19 to tackle abuse, violence as well as forced sterilisation and forced abortion, such as capacity-building of professionals and awareness-raising campaigns on rights and access to justice.Effective prevention of violence is key. It involves educating boys and girls from an early age about gender equality and supporting the development of non-violent relationships. It also requires a multi-disciplinary approach among professionals and services including the criminal justice system, victim support services, perpetrator programmes and social and health services. Addressing violence against women and ideologies undermining women’s rights could also contribute to the prevention of radicalisation leading to violent extremism and terrorism. The Commission will launch an EU network on the prevention of gender-based violence and domestic violence, bringing together Member States and stakeholders to exchange good practice, and will provide funding for training, capacity-building and support services. Violence prevention focusing on men, boys and masculinities20 will be of central importance.To address violence and harassment in work contexts, the Commission will continue to encourage Member States to ratify the International Labour Organisation (ILO)16 Figures in the infographic are from recent studies by the End FGM European Network, see:   [*https://www.endfgm.eu/female-genital-mutilation/fgm-in-europe.17*](https://www.endfgm.eu/female-genital-mutilation/fgm-in-europe.17) Directive 2012/29/EU establishing minimum standards on the rights, support and protection of victims of crime.18 For instance, 34% of women with a health problem or disability have experienced physical or sexual partner violence, compared with 19% of women who do not have a health problem or disability. FRA, ‘Violence against women: an EU-wide survey’, 2014.19 To implement the UN Committee on the Rights of Persons with Disabilities recommendations for the EU, in particular concerning Articles 6 (Women with disabilities) and 16 (Freedom from exploitation, violence and abuse).20 According to EIGE, ‘masculinities’ refers to the “different notions of what it means to be a man, including patterns of conduct linked to men’s place in a given set of gender roles and relations”, see:   [*https://eige.europa.eu/thesaurus/terms/1285.5Convention*](https://eige.europa.eu/thesaurus/terms/1285.5Convention) on combating violence and harassment in the world of work21, implement the existing EU rules22 on protecting workers from sexual harassment, and raise people’s awareness of them. As an employer, the Commission will adopt a new comprehensive legal framework with a set of both preventive and reactive measures against harassment in the workplace.Online violence targeting women has become pervasive with specific, vicious consequences; this is unacceptable. It is a barrier to women’s participation in public life. Bullying, harassment and abuse on social media have far-reaching effects on women's and girls’ daily lives. The Commission will propose the Digital Services Act23 to clarify online platforms’ responsibilities with regard to user-disseminated content. The Digital Services Act will clarify what measures are expected from platforms in addressing illegal activities online, while protecting fundamental rights. Users also need to be able to counter other types of harmful and abusive content, which is not always considered illegal but can have devastating effects. To protect women’s safety online, the Commission will facilitate the development of a new framework for cooperation between internet platforms24.Women and girls form the vast majority of victims of trafficking in human beings, both in and outside the EU, and are mostly trafficked for the purposes of sexual exploitation25. The EU addresses trafficking in human beings comprehensively through coordination in all relevant areas26. Countering impunity of users, exploiters and profit-makers is a priority. The concerns of women and girls affected by trafficking have to be at the centre of policy development. As part of the Security Union, the Commission will present a new EU strategy on the eradication of trafficking in human beings and an EU strategy on a more effective fight against child sexual abuse.The EU needs comprehensive, updated and comparable ***data*** for policies on combating gender-based violence to be effective. To get a complete picture of gender-based violence, ***data*** should be disaggregated by relevant intersectional aspects and indicators such as age, disability status, migrant status and rural-urban residence. An EU-wide survey, coordinated by ***Eurostat***, will provide ***data*** on the prevalence and dynamics of violence against women and other forms of interpersonal violence, with results presented in 2023.Challenging gender stereotypesGender stereotypes are a root cause of gender inequality and affect all areas of society27. Stereotypical expectations based on fixed norms for women and men, girls and boys, limit their aspirations, choices and freedom, and therefore need to be dismantled. Gender stereotypes strongly contribute to the gender pay gap. They are often combined with other21 ILO, Violence and Harassment Convention (No. 190) and Recommendation (No. 206).22 Directive 2006/54/EC on the implementation of the principle of equal opportunities and equal treatment of men and women in matters of employment and occupation (recast).23   [*https://ec.europa.eu/digital-single-market/en/new-eu-rules-e-commerce.24*](https://ec.europa.eu/digital-single-market/en/new-eu-rules-e-commerce.24) Based on cooperation under the EU Internet Forum, which led to the adoption of the EU Code of Conduct on countering illegal hate speech online.25 Trafficking in human beings is recognised as violence against women and girls, in line with Article 6 of the UN Convention on the Elimination of All Forms of Discrimination against Women (CEDAW).26 Emanating from the Anti-Trafficking Directive 2011/36/EU on preventing and combating trafficking in human beings and protecting its victims.27 Special Eurobarometer 465, June 2017 – see infographics.6stereotypes such as those based on race or ethnic origin, religion or belief, disability, age or sexual orientation, and this can reinforce stereotypes’ negative impacts.Artificial Intelligence (AI) has become an area of strategic importance and a key driver of economic progress, hence women have to be part of its development as researchers, programmers and users. While AI can bring solutions to many societal challenges, it risks intensifying gender inequalities. Algorithms and related machine-learning, if not transparent and robust enough, risk repeating, amplifying or contributing to gender biases that programmers may not be aware of or that are the result of specific ***data*** selection. The new Commission White Paper on AI sets out the European approach grounded in EU values and fundamental rights, including non-discrimination and gender equality28. The next framework programme for research and innovation, Horizon Europe29, will also provide insights and solutions on addressing potential gender biases in AI, as well as on debunking gender stereotypes in all social, economic and cultural domains, supporting the development of unbiased evidence-based policies.The media and the cultural sectors have considerable say in shaping people’s beliefs, values and perception of reality, and are thus further key channels for changing attitudes and challenging stereotypes30. The Commission will continue supporting projects promoting gender equality under Creative Europe31, including under Music Moves Europe, and will present a gender equality strategy in the audio-visual industry as part of the next MEDIA sub-programme32, including financial support, structured dialogue, mentoring and training for women film-makers, producers and screenwriters.The Commission will launch an EU-wide communication campaign combatting gender stereotypes. It will tackle all spheres of life with an intersectional approach and a focus on youth engagement, in collaboration with the Member States.28 European Commission, White paper on Artificial Intelligence - A European approach to excellence and trust, COM(2020) 65 final:   [*https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020\_en.pdf*](https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf) 29   [*https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme\_en.30*](https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme_en.30) See, for example, 'Gender equality in the media sector', a study carried out for the FEMM Committee on women’s rights and gender equality, European Parliament, 2018.31   [*https://ec.europa.eu/programmes/creative-europe/node\_en.32*](https://ec.europa.eu/programmes/creative-europe/node_en.32)   [*https://ec.europa.eu/digital-single-market/en/media-sub-programme-creative-europe.7In*](https://ec.europa.eu/digital-single-market/en/media-sub-programme-creative-europe.7In) addition to the Commission actions listed above, the Commission calls:- on the Council to:• conclude the EU’s accession to the Istanbul Convention and ensure swift EU ratification.- on the Member States to:• ratify and implement the Istanbul Convention;• ratify and implement the ILO Convention to combat violence and harassment in the world of work;• implement the Victims’ Rights Directive, the Child Sexual Abuse Directive33 and other relevant EU law protecting victims of gender-based violence34;• systematically ***collect*** and report ***data*** on gender-based violence; and• support civil society and public services in preventing and combating gender-based violence and gender stereotyping, including with the help of EU funding available under the “citizens, equality, rights and values” programme (2021-2027).2. Thriving in a gender-equal economyA prosperous and social Europe depends on us all. Women and men in all their diversity should have equal opportunities to thrive and be economically independent, be paid equally for their work of equal value, have equal access to finance and receive fair pensions. Women and men should equally share caring and financial responsibilities.Closing gender gaps in the labour marketIncreasing women’s participation in the labour market has a strong, positive impact on the economy, notably in the context of a shrinking workforce and skills shortages. It also empowers women to shape their own lives, play a role in public life and be economically independent.Women’s employment rate in the EU is higher today than ever before35, yet many women still experience barriers to joining and remaining in the labour market36. Some women are structurally underrepresented in the labour market37, often resulting from the intersection of gender with additional conditions of vulnerability or marginalisation such as belonging to an ethnic or religious minority38 or having a migrant background.33 Directive 2011/93/EU on combating the sexual abuse and sexual exploitation of children and child pornography.34 In particular, Directive 2011/36/EU on preventing and combating trafficking in human beings and protecting its victims, Directive 2011/99/EU on the European Protection Order, Regulation (EU) No. 606/2013 on mutual recognition of protection measures in civil matters and Council Directive 2004/80/EC relating to compensation to crime victims.35 ***Eurostat***, 2019,   [*https://ec.europa.eu/****eurostat****/web/products-datasets/product?code=sdg\_05\_30*](https://ec.europa.eu/eurostat/web/products-datasets/product?code=sdg_05_30) and   [*https://appsso.****eurostat****.ec.europa.eu/nui/show.do?dataset=lfsi\_emp\_a&lang=en*](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsi_emp_a&lang=en) – see infographic.36   [*https://ec.europa.eu/****eurostat****/****statistics****-explained/pdfscache/35409.pdf*](https://ec.europa.eu/eurostat/statistics-explained/pdfscache/35409.pdf) and also FRA, ‘Roma Women in nine EU Member States’, 2019 – see infographic.37 ***Eurostat***, ‘Labour Forced Survey’, calculations done based on lfsa\_eegan2 – see infographic.38 See, for example, ENAR, ‘Racism and discrimination in Employment in Europe 2013-2017’, 2017.8Improving the work-life balance of workers is one of the ways of addressing the gender gaps in the labour market. Both parents need to feel responsible and entitled when it comes to family care. The Work-Life-Balance Directive39 introduces minimum standards for family leave and flexible working arrangements for workers, and promotes equal sharing of caring responsibilities between parents. The Commission will ensure that Member States correctly transpose40 and implement this directive to enable men and women to equally thrive both personally and professionally, and calls upon the Member States to go beyond these minimum standards in reviewing their policies. They should also ensure quality solutions, for instance for childcare, that also reach less populated areas in Europe. Within its own administration, the Commission will promote and monitor an equal use of flexible working arrangements by all employees41.Gender equality challenges in the Member States, in particular their labour market, social inclusion and education dimensions, will continue to be monitored through the European Semester42. Through the Social Scoreboard, the European Semester also monitors these dimensions of the European Pillar of Social Rights43. As of the 2019-2020 Semester cycle, the Semester country reports contribute to the monitoring of the SDGs, including on gender equality (SDG 5), and the way in which economic and employment policies can help deliver on them.The structural reform support programme can support Member States in mainstreaming gender in public administration, state budgeting and financial management. In addition, it can contribute to national structural reforms in Member States to close the gender employment gap and to address the higher proportion of women in poverty, particularly in older age.Social and economic policies, taxation and social protection systems should not perpetuate structural gender inequalities based on traditional gender roles in the realms of work and39 Directive (EU) 2019/1158 on work-life balance for parents and carers.40 The Work-Life Balance Directive shall be transposed by Member States by 2 August 2022 (and by 2 August 2024 as regards payment of the last two weeks of the minimum of two months of parental leave).41 For existing measures, see European Commission, ‘Diversity and Gender Equality Report 2019’ (internal document).42   [*https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester\_en.43*](https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester_en.43) Principle 2 of the Pillar is about gender equality, while several other principles address gender-related challenges, including the principles on equal opportunities (principle 3), work-life balance (principle 9), childcare and support to children (principle 11), old age income and pensions (principle 15) and long-term care (principle 18).9private life. The Commission will develop guidance for Member States on how national tax and benefits systems can impact financial incentives or disincentives for second earners.Empowering women in the labour market also means giving them the possibility to thrive as investors and entrepreneurs44. The EU cohesion policy supports women’s entrepreneurship, their (re)integration into the labour market and gender equality in specific, traditionally male, sectors. Targeted measures promoting the participation of women in innovation will be developed under the Horizon Europe European Innovation Council, including a pilot to promote women-led start-ups and innovative small and medium-sized enterprises in 202045. The Commission will also promote the presence of women in decision-making positions in private equity and venture capital funds and support funds investing with gender diversified portfolios through the InvestEU programme to mobilise private and public investment in Europe for more sustainable, inclusive and innovative growth.Achieving equal participation across different sectors of the economyWhile there are more women university graduates in Europe than men graduates, women remain underrepresented in higher paid professions46. More women than men work in low-paid jobs and sectors, and in lower positions47. Discriminatory social norms and stereotypes about women’s and men’s skills, and the undervaluation of women’s work are some of the contributing factors.44 International Finance Corporation, ‘Moving toward gender balance in private equity and venture capital’, 2019; Biegel, S., Hunt, S. M., Kuhlman, S., ‘Project Sage 2.0 Tracking venture capital with a gender lens’, 2019; and Atomico, ‘State of European Tech 2019 Report’,   [*https://2019.stateofeuropeantech.com/chapter/state-european-tech-2019/article/executive-summary*](https://2019.stateofeuropeantech.com/chapter/state-european-tech-2019/article/executive-summary) – see infographics.45   [*https://ec.europa.eu/research/eic/index.cfm*](https://ec.europa.eu/research/eic/index.cfm) 46 PISA report 2019,   [*http://www.oecd.org/pisa/PISA%202018%20Insights%20and%20Interpretations%20FINAL%20PDF.pdf;*](http://www.oecd.org/pisa/PISA%202018%20Insights%20and%20Interpretations%20FINAL%20PDF.pdf;) European Commission, ‘Women in the Digital Age – Final Report’, 2018; and World Economic Forum Global ‘Gender Gap Report 2020’ – see infographics.47 ***Eurostat***, ‘A decomposition of the unadjusted gender pay gap using Structure of Earnings Survey ***data***’, Statistical working paper, 2018.10The digital transition is of utmost importance in this context. With rapid transformation and digitisation of the economy and the labour market, today 90% of jobs require basic digital skills48. Women only represent 17% of people in ICT49 studies and careers in the EU50 and only 36% of STEM51 graduates52, despite the fact that girls outperform boys in digital literacy53. This gap and this paradox will be addressed in the updated Digital Education Action Plan and through the implementation of the Ministerial declaration of commitment on ‘Women in Digital’54. The ‘Women in Digital’ scoreboard will be used more systematically.The Updated Skills Agenda for Europe will help address horizontal segregation, stereotyping and gender gaps in education and training. The Commission proposal for a Council recommendation on vocational education and training will support improving gender balance in traditionally male or female-dominated professions and address gender stereotypes. The reinforced Youth Guarantee will also specifically address women that are not in education, employment or training to ensure equal opportunities.In the Commission’s forthcoming communication on the European Education Area, gender equality will be put forward as one of the key elements. The renewed strategic framework for gender equality in sport will promote women’s and girls’ participation in sport and physical activity and gender balance in leadership positions within sport organisations.Addressing the gender pay and pension gapThe principle of equal pay for equal work or work of equal value has been enshrined in the Treaties since 1957 and translated into EU law. It ensures that there are legal remedies in case of discrimination. Yet, women still earn on average less than men55. Accumulated lifetime gender employment and pay gaps result in an even wider pension gap and consequently older women are more at risk of poverty than men.Eliminating the gender pay gap requires addressing all of its root causes, including women’s lower participation in the labour market, invisible and unpaid work, their higher use48 European Commission, ‘ICT for Work: Digital Skills in the Workplace’, 2017.49 Information and Communications Technology.50   [*https://ec.europa.eu/****eurostat****/web/products-****eurostat****-news/-/EDN-20180425-1.51*](https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20180425-1.51) Science, Technology, Engineering and Mathematics.52   [*https://op.europa.eu/en/publication-detail/-/publication/9540ffa1-4478-11e9-a8ed-01aa75ed71a1/language-en.53*](https://op.europa.eu/en/publication-detail/-/publication/9540ffa1-4478-11e9-a8ed-01aa75ed71a1/language-en.53) 2018 International Computer and Information Literacy Study (ICILS).54   [*https://ec.europa.eu/digital-single-market/en/news/eu-countries-commit-boost-participation-women-digital.55*](https://ec.europa.eu/digital-single-market/en/news/eu-countries-commit-boost-participation-women-digital.55) ***Eurostat***, 2018 at   [*https://ec.europa.eu/****eurostat****/databrowser/product/view/SDG\_05\_20?lang=en;*](https://ec.europa.eu/eurostat/databrowser/product/view/SDG_05_20?lang=en;)   [*https://appsso.****eurostat****.ec.europa.eu/nui/show.do?dataset=ilc\_pnp13&lang=en*](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ilc_pnp13&lang=en) and   [*https://appsso.****eurostat****.ec.europa.eu/nui/show.do?dataset=ilc\_pnp14&lang=en*](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ilc_pnp14&lang=en) – see infographics.11of part-time work56 and career breaks, as well as vertical and horizontal segregation based on gender stereotypes and discrimination.When information about pay levels is available it is easier to detect gaps and discrimination. Because of a lack of transparency, many women do not know or cannot prove that they are being underpaid. The Commission will table binding measures on pay transparency by the end of 2020.Such an initiative will strengthen the rights of employees to get more information about pay levels, while it may add an administrative burden for employers. To find the right balance for such EU action, it is of utmost importance to consult and listen to social partners and national administrations. The Commission undertook a thorough evaluation of the existing framework on equal pay for equal work or work of equal value57. Together with the adoption of this strategy, the Commission is launching a wide-ranging and inclusive consultation process58 with the public, the Member States and the social partners. More broadly, the Commission will re-launch the discussion with the social partners on how to improve gender equality in the world of work, including within their structures, and encourage them to intensify efforts in addressing the gender employment and pay gaps.Reduced earnings, higher concentration in part-time work and career gaps linked to women’s caring responsibilities contribute substantially to the gender pension gap. In the 2021 edition of the Pension Adequacy Report, the Commission, together with the Council’s Social Protection Committee, will assess how risks and resources are shared in pension systems between women and men. To protect pension rights and encourage equal sharing of care responsibilities between women and men, the Commission will explore with Member States and stakeholders the provision of pension credits for care-related career breaks in occupational pension schemes, as recommended by the High-level group on pensions59.Closing the gender care gapThriving at work while managing caring responsibilities at home is a challenge, especially for women. Women often align their decision to work, and how to work, with their caring responsibilities and with whether and how these duties are shared with a partner. This is a particular challenge for single parents, most of whom are women60, and for people living in remote rural areas for whom support solutions are often lacking. Women also carry a disproportionate burden of unpaid work, which constitutes a significant share of economic activity61.56 One of the reasons is the fact that on average women spend fewer hours in paid work than men: whereas only 8% of men in the EU work in part-time, almost a third of women across the EU (31%) does so - see ***Eurostat***, 2018,   [*https://ec.europa.eu/****eurostat****/web/products-****eurostat****-news/-/DDN-20190621-1.57*](https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190621-1.57) Evaluation of the relevant provision in Directive 2006/54/EC implementing the Treaty principle on ‘equal pay for equal work or work of equal value’, SWD(2020)50; Report on the implementation of the EU Action Plan 2017-2019 on tackling the gender pay gap, COM(2020)101.58 To be launched together with this strategy.59 Final report of the High-level group of experts on pensions, December 2019,   [*https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3589.60*](https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3589.60) Maldonado, L. C., & Nieuwenhuis, R., ‘Family policies and single parent poverty in 18 OECD countries, 1978–2008’. Community, Work & Family, 18(4): 395–415.61   [*https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms\_713376.pdf*](https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_713376.pdf) 12An equal sharing of care responsibilities at home is crucial, as is the availability of childcare, social care and household services, in particular for single parents62. Insufficient access to quality and affordable formal care services is one of the key drivers of gender inequality in the labour market63. Investing in care services is therefore important to support women’s participation in paid work and their professional development. It also has potential for job creation for both women and men.The Barcelona targets64 for the provision of early childhood education and care arrangements for children are mostly met, but some Member States are significantly lagging behind. The Commission will therefore propose to revise the Barcelona targets to ensure further upwards convergence among Member States of early childhood education and care. Moreover, the Commission’s proposal for a Child Guarantee in 2021 will focus on the most significant barriers preventing children from accessing the necessary services for their wellbeing and personal development, in order to break the poverty cycle and reduce inequalities.The Commission will continue supporting Member States’ work on improving the availability and affordability of quality care services for children and other dependents through investments from the European Social Fund Plus, the European Regional Development Fund, the InvestEU programme and the European ***Agricultural*** Fund for Rural Development.At the end of 2020, the Commission will launch the consultation process for a Green Paper on Ageing with a focus on long-term care, pensions and active ageing.In addition to the Commission actions listed above, the Commission calls on Member States to:• transpose the Work-Life Balance Directive and properly implement EU gender equality and labour law65;• follow up on the Council conclusions of June 2019 “Closing the Gender Pay Gap: Key Policies and Measures”;• ensure adequate investments in early childhood education, care services and long-term care services including from available EU funding; and• implement the Ministerial declaration of commitment on “Women in Digital”.62 Eurofound, ‘Striking a balance: Reconciling work and life in the EU’, 2018 – see infographics.63 Hoffmann, F., & Rodrigues, R., ‘Informal carers: who takes care of them?’, Policy brief, April 2010, European Centre for Social Welfare Policy and Research, Vienna – see infographics.64   [*https://ec.europa.eu/info/sites/info/files/bcn\_objectives-report2018\_web\_en.pdf*](https://ec.europa.eu/info/sites/info/files/bcn_objectives-report2018_web_en.pdf) 65 This includes the recast Directive on gender equality in employment and occupation, the Directives on gender equality in self-employment, in access to goods and services, in social security, in pregnancy and maternity, the Directive on part-time work, the Directive on transparent and predictable working conditions, the Recommendation on access to social protection, and the Recommendation on equality bodies.133. Leading equally throughout societyCompanies, communities and countries should be led by both women and men, in all their diversity. Whether you are a woman or a man should not influence the career you pursue.Achieving gender balance in decision-making and politicsThere are still far too few women in leading positions. Be it in politics or government agencies, at the highest courts or on companies’ boards. This is the case even if gender parity exists at the lower levels. If top positions are held exclusively by men for a long time, this shapes the recruitment pattern for successors, sometimes only due to unconscious bias.Having both women and men represented is crucial for successful leadership. Inclusive and diverse leadership is needed to solve the complex challenges that decision-makers face today. More inclusion and more diversity is essential to bring forward new ideas and innovative approaches that better serve a dynamic and flourishing EU society. Allowing citizens from all backgrounds to meaningfully participate in society is a necessary pre-condition for a well-functioning democracy and leads to more effective policy-making66.A broad range of talents and skills contributes to better decision-making and corporate governance, and drives economic growth.67 Despite some progress in recent years, women’s under-representation in decision-making positions in Europe's businesses and industry persists.68To help break the glass ceiling, the Commission will push for the adoption of the 2012 proposal for a Directive on improving the gender balance on corporate boards69 which set the aim of a minimum of 40% of non-executive members of the under-represented sex on company boards70.In parallel, the Commission will facilitate the exchange of good practices addressing gender balance in executive boards and managerial positions, bringing in the examples of national or regional projects run by governments, civil society or the private sector. The EU Platform of66 EIGE Gender ***Statistics*** Database, National parliaments: Single/lower house, 2019 – see infographic.67 ILO, ‘The business case for change’, 2019; McKinsey, ‘Women Matter report’, 2017; Catalyst, ‘Why Diversity and Inclusion Matter’, 2018; Rohini Anand, ‘Gender-Balanced Teams Linked to Better Business Performance: A Sodexo Study’, 2016.68 EIGE, Gender ***Statistics*** Database, Women and men in decision-making, 2019 – see infographic.69 COM(2012)614 final.70 Positive results are shown in several countries that have introduced relevant legislative measures, including France, Italy, Belgium, Germany, and more recently Austria and Portugal. See   [*https://eige.europa.eu/publications/gender-equality-index-2019-report/more-gender-equality-corporate-boards-only-few-member-states.14Diversity*](https://eige.europa.eu/publications/gender-equality-index-2019-report/more-gender-equality-corporate-boards-only-few-member-states.14Diversity) Charters71 will serve as a platform for exchange. The Commission will continue to cooperate with EU-wide projects, such as the European Gender Diversity Index72.Equal opportunity in participation is essential for representative democracy at all levels – European, national, regional and local. The Commission will promote the participation of women as voters and candidates in the 2024 European Parliament elections, in collaboration with the European Parliament, national parliaments, Member States and civil society, including through funding and promoting best practices. European political parties asking for EU funding are encouraged to be transparent about the gender balance of their political party members73.EU institutions and bodies should not be exempt from ensuring gender balance in leadership positions. The Commission will lead by example. Thanks to the strong call of President von der Leyen to achieve gender parity in the College of Commissioners, it has the highest number to date of women Commissioners. The Commission aims to reach gender balance of 50% at all levels of its management by the end of 202474. Supporting measures will include quantitative targets for female appointments and leadership development programmes75. The Commission will also increase efforts towards reaching a larger share of female managers in EU agencies76, and will ensure gender balanced representation among speakers and panellists in the conferences it organises.The Commission will support Member States in developing and implementing more effective strategies to increase the number of women in decision-making positions including through the Mutual Learning Programme in Gender Equality77. The Commission will also disseminate ***data*** and analysis of trends on the representation of women and men in decision-making positions in cooperation with the European Institute for Gender Equality (EIGE).71   [*https://ec.europa.eu/info/policies/justice-and-fundamental-rights/combatting-discrimination/tackling-discrimination/diversity-management/eu-platform-diversity-charters\_en.72*](https://ec.europa.eu/info/policies/justice-and-fundamental-rights/combatting-discrimination/tackling-discrimination/diversity-management/eu-platform-diversity-charters_en.72) Relevant projects include European Women on Boards:   [*https://europeanwomenonboards.eu/.73*](https://europeanwomenonboards.eu/.73) Regulation 2018/673 amending Regulation (EU, Euratom) No 1141/2014 on the statute and funding of European political parties and European political foundations, recital 6.74 In 2019, 41% of managers in the Commission were women (up from 30% in 2014). This included 37% of senior managers (up from 27%) and 42% of middle managers (up from 31%).75 For existing measures: European Commission, ‘Diversity and Gender Equality Report 2019’, Brussels, 6 November 2019.76 More than 3 out of 4 EU agencies are currently headed by men.77   [*https://ec.europa.eu/info/policies/justice-and-fundamental-rights/gender-equality/who-we-work-gender-equality/mutual-learning-programme-gender-equality\_en.15In*](https://ec.europa.eu/info/policies/justice-and-fundamental-rights/gender-equality/who-we-work-gender-equality/mutual-learning-programme-gender-equality_en.15In) addition to the Commission actions listed above, the Commission calls:- on the European Parliament and the Council to:• adopt the proposal for a Directive on improving the gender balance on corporate boards; and• adopt measures to improve gender balance at all levels of their management and in leadership positions.- on the Member States to:• transpose and implement the Directive on improving the gender balance on corporate boards, once adopted; and• develop and implement strategies to increase the number of women in decision-making positions in politics and policy-making.4. Gender mainstreaming and an intersectional perspective in EU policiesThe core challenges affecting the EU today – including the green and digital transitions and demographic change – all have a gender dimension. The inclusion of a gender perspective in all EU policies and processes is essential to reach the goal of gender equality.Gender mainstreaming ensures that policies and programmes maximise the potential of all – women and men, girls and boys, in all their diversity. The aim is to redistribute power, influence and resources in a fair and gender-equal way, tackling inequality, promoting fairness, and creating opportunity.The Commission will integrate a gender perspective in all major Commission initiatives during the current mandate, facilitated by the appointment of the first Commissioner for Equality, as a stand-alone portfolio, and by creating a Task Force for Equality78 composed of representatives of all Commission services and of the European External Action Service. The Task Force will ensure the implementation of equality mainstreaming, including gender equality, at operational and technical level.As an example, upcoming policies under the European Green Deal, such as the Building Renovation Wave or the EU Strategy on Climate Adaptation, can impact women differently to men79. As regards climate change, the role of young women in particular has been remarkable in leading the push for change. Women and men are not equally affected by green policies tackling climate change (there are less possibilities for women as climate refugees), or the clean transition (there are more women in energy poverty), emission-free transport (more women use public transport). Addressing the gender dimension can therefore have a key role in leveraging the full potential of these policies.Another example is that of digitisation, which will fundamentally change our lives and that of our children. In this transition, it is crucial that women help to build that future and that78 The Task Force will facilitate the mainstreaming of equality relating to six grounds of discrimination: sex, race or ethnic origin, religion or belief, disability, age and sexual orientation.79 In both cases, specific attention towards elderly people (in terms of future-proof renovations or, for climate adaptation policies, measures during heat waves to improve hydration) will, for example, have a positive impact on women in particular as they form the majority of the elderly population.16many more girls than currently acquire IT skills to be able to play a role in shaping the digital world of tomorrow.In health, women and men experience gender-specific health risks. A gender dimension will be integrated into the EU Beating Cancer Plan to be launched in 2020. Regular exchanges of good practices between Member States and stakeholders on the gender aspects of health will be facilitated, including on sexual and reproductive health and rights.The EU Drugs Agenda 2021-2025 will be adopted in 2020, and will address gender-specific challenges faced by women and girls in substance abuse.The intersectionality of gender with other grounds of discrimination will be addressed across EU policies. Women are a heterogeneous group and may face intersectional discrimination based on several personal characteristics. For instance, a migrant woman with a disability may face discrimination on three or more grounds. EU law, policies and their implementation should therefore respond to the specific needs and circumstances of women and girls in different groups. The forthcoming Action Plan on Integration and Inclusion and the EU strategic frameworks on disability, LGBTI+, Roma inclusion and children’s rights will be linked to this strategy and to each other. Moreover, the intersectional perspective will always inform gender equality policies.5. Funding actions to make progress in gender equality in the EUThe Commission’s proposals for the Multi-Annual Financial Framework (MFF) ensure the integration of a gender dimension throughout the financial framework, and more specifically in various EU funding and budgetary guarantee instruments, in particular the European Social Fund Plus, the European Regional Development Fund, Creative Europe, the European Maritime and Fisheries Fund, the Cohesion Fund and the InvestEU Programme. Funding will support actions to promote women’s labour market participation and work-life balance, invest in care facilities, support female entrepreneurship, combat gender segregation in certain professions and address the imbalanced representation of girls and boys in some sectors of education and training.The proposed Common Provisions Regulation80 includes specific “enabling conditions”, requiring a Member State to have in place a national gender equality strategic framework as a precondition to make use of the funds when investing in improving gender balance in the labour market, work-life balance or childcare infrastructure. Another horizontal ‘enabling condition’ on effective implementation of the Charter of Fundamental Rights includes gender equality as one of its key principles and applies to all the investments under this regulation.Dedicated funding for projects benefiting civil society organisations and public institutions that implement specific actions, including preventing and combating gender-based violence, will be available through the Citizens, Equality, Rights and Values Programme. Particular attention needs to be paid to women and girls in the asylum and migration area. Through the Asylum and Migration Fund, the Commission will encourage Member States to target actions that support the specific needs of women in the asylum procedure, as well as actions that support the integration of women in the new society. Furthermore, the fund will enable80 COM/2018/375 final.17the stepping up of protection of vulnerable groups, including women victims of gender-based violence in asylum and migration contexts.In the field of research and innovation, the Commission will introduce new measures to strengthen gender equality in Horizon Europe, such as the possibility to require a gender equality plan from applicants and an initiative to increase the number of women-led technology start-ups. Funding for gender and intersectional research will also be made available.There will also be funding opportunities to increase women’s entrepreneurship knowledge and participation in decision-making and to invest in basic services’ development in rural areas under the Common ***Agricultural*** Policy. In view of empowering women, a new call dedicated to women in the “blue economy”81 is planned as part of the next European Maritime and Fisheries Fund for 2021-2027.An Inclusion and Diversity Strategy for the future Erasmus+ programme will provide guidance on how the programme can help address gender inequalities in all education and training, youth and sport sectors.The Commission’s guidance on socially responsible public procurement will fight discrimination and promote gender equality in public tenders.In line with repeated calls by several Member States and the European Parliament82, the Commission will look at the gender impact of its activities and at how to measure expenditure related to gender equality at programme level in the 2021-2027 MFF. The outcome of the recently launched audit by the European Court of Auditors on gender mainstreaming in the EU budget to promote equality will contribute to this process. This will improve gender mainstreaming in the Commission’s budget process, further increasing the contribution made by policy design and resource allocation to gender equality objectives.6. Addressing gender equality and women’s empowerment across the worldGender inequality is a global problem. Gender equality and women’s empowerment is a core objective of EU external action. It is important that the EU’s internal and external actions in this field are coherent and mutually reinforce each other. The EU promotes gender equality and women’s empowerment in its international partnerships, political and human rights dialogues with third countries, EU trade policy as well as in the EU’s neighbourhood and enlargement policies, including in the context of accession negotiations and the Stabilisation and Association Process. Moreover, gender-related actions are included in the EU’s actions in fragile, conflict and emergency situations.The action plan on gender equality and women’s empowerment in external relations (2016-2020) (GAPII)83 focuses on ending violence against women and girls, promoting women’s economic and social empowerment and ensuring the fulfilment of their human,81   [*https://ec.europa.eu/jrc/en/news/how-big-eus-blue-economy-eu-report-potential-coasts-and-oceans-provide-sustainable-economic-growth.82*](https://ec.europa.eu/jrc/en/news/how-big-eus-blue-economy-eu-report-potential-coasts-and-oceans-provide-sustainable-economic-growth.82)   [*http://www.europarl.europa.eu/meetdocs/2014\_2019/plmrep/COMMITTEES/FEMM/DV/2018/09-03/20180828DraftResolutionGenderBudgetingintheEUBudget-thewayforward\_EN.pdf*](http://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/FEMM/DV/2018/09-03/20180828DraftResolutionGenderBudgetingintheEUBudget-thewayforward_EN.pdf) 83   [*https://europa.eu/capacity4dev/articles/eu-gender-action-plan-ii-how-eu-delegations-contribute-gender-equality-worldwide.18political*](https://europa.eu/capacity4dev/articles/eu-gender-action-plan-ii-how-eu-delegations-contribute-gender-equality-worldwide.18political) and civil rights. Building on the achievements and lessons learned, GAP III will be launched in 2020, with a comprehensive approach, and will be coherent with the priorities of this strategy through integrating all its relevant elements into the EU’s external action.The EU will continue supporting women’s human rights, its defenders, sexual and reproductive health and rights, and efforts to curb sexual and gender-based violence throughout the world, including in fragile, conflict and emergency situations. The EU initiated the Spotlight Initiative, a joint EU-UN global programme with an overall EU allocation of EUR 500 million to eliminate all forms of violence against women and girls. The EU is launching a campaign #WithHer in 2020, designed to challenge harmful gender norms and stereotypes, which perpetuate violence against women worldwide. The EU will adopt the EU Action Plan on Human Rights and Democracy (2020-2024) in 2020. The EU will also continue to implement the EU Strategic Approach and Action Plan on Women, Peace and Security 2019-202484.The Commission will continue to actively promote gender equality through its trade policy, including through its active engagement on the issue in the World Trade Organisation. It will continue to gather gender-disaggregated ***data***, to ensure that trade-related aspects of gender are adequately addressed in trade agreements and to consider gender impact in trade initiatives.In partner countries, the EU will make use of the External Investment Plan to promote women’s entrepreneurship and labour market participation. For instance, the Women’s Financial Inclusion Facility alone aims to leverage EUR 100 million for women’s access to finance. The EU Strategy with Africa in 2020 will also focus on gender equality and women’s empowerment.In the EU’s external policies, gender mainstreaming is used in the budget process through the commitment of ensuring that 85% of all new programmes contribute to gender equality and women’s empowerment85.84 The EU Strategic Approach to Women, Peace and Security (WPS) is annexed to the Foreign Affairs Council Conclusions on WPS adopted on 10 December 2018, (Council document 15086/18),   [*https://www.consilium.europa.eu/media/37412/st15086-en18.pdf*](https://www.consilium.europa.eu/media/37412/st15086-en18.pdf), and the EU Action Plan on Women, Peace and Security (WPS) 2019-2024, of 4 July 2019 EEAS(2019) 747,   [*https://www.consilium.europa.eu/register/en/content/out?&typ=ENTRY&i=ADV&DOC\_ID=ST-11031-2019-INIT.85*](https://www.consilium.europa.eu/register/en/content/out?&typ=ENTRY&i=ADV&DOC_ID=ST-11031-2019-INIT.85) The measurement is done according to the OECD Gender Equality Policy Marker. Specifically for humanitarian aid, the Commission applies its own humanitarian Gender-Age marker.19WORKING TOGETHER FOR A GENDER-EQUAL EUROPEAchieving gender equality in the European Union is a joint responsibility. It requires teaming up and action by all EU institutions, Member States and EU agencies, in partnership with civil society and women’s organisations, social partners and the private sector.The European Parliament86 and the Council87 have shown their commitment to gender equality in several resolutions and conclusions calling on the Commission to adopt a European Gender Equality Strategy and strengthen gender mainstreaming in all policy areas.Working together, the EU institutions and Member States need to deepen their engagement with civil society, including women’s movements and organisations, international organisations, and governments, to progress on gender equality and continue being global leaders.The Commission calls on the European Parliament and the Council to take forward their work on the existing and forthcoming Commission proposals in a timely manner. Member States should use all the tools at their disposal, in particular the possibilities offered for EU financial support and ensure the improvement in gender equality.The key actions presented in this strategy will be regularly updated and supplemented. Their implementation will be monitored, and progress will be reported on an annual basis. These reports will serve as an annual political stock-taking of progress made. In addition to examples of good practice in the Member States, the annual reports will also include relevant ***data***, including from ***Eurostat*** and Eurofound, as well as indicators for measuring progress, building on EIGE’s annual EU Gender Equality Index. EIGE will also provide ***data*** and research to feed into the evidence-based policy-making of EU institutions and Member States.Working together, we can make real progress by 2025 in achieving a Europe where women and men, girls and boys, in all their diversity, are equal – where they are free to pursue their chosen path in life and reach their full potential, where they have equal opportunities to thrive, and where they can equally participate in and lead our European society.86 Recent resolutions of the European Parliament on gender equality include: European Parliament resolution 2019/2870(RSP) of 30 January 2020 on the gender pay gap; European Parliament resolution 2019/2855(RSP) of 28 November 2019 on the EU’s accession to the Istanbul Convention and other measures to combat gender-based violence; European Parliament resolution 2016/2249(INI) of 14 March 2017 on equality between women and men in the European Union in 2014-2015.87 Recent Council Conclusions on gender equality include: Council Conclusions of 10 December 2019 on gender equal economies in the EU: The way forward – taking stock of 25 years of implementation of the Beijing Platform for Action; Council Conclusions of 24 October 2019 on The Economy of Wellbeing; Council Conclusions of 13 June 2019 on Closing the Gender Pay Gap: Key Policies and Measures.

**Load-Date:** March 11, 2020

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[***Association Between Fasting Blood Glucose and All-Cause Mortality in a Rural Chinese Population: 15-Year Follow-Up Cohort Study***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P311-F0C0-33FS-00000-00&context=1516831)

Diabetes Therapy

September 2020

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**Section:** Pg. 2691-2701; Vol. 11; No. 11; ISSN: 1869-6953,1869-6961

**Length:** 4114 words

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**Body**

Key Summary Points

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| This is a large cohort with a population of 17,902 and a long-term (from 2003 to 2018) follow-up. |
| The study found a relatively safe range of fasting blood glucose (FBG) levels in this rural Chinese population. |
| A significant U-shaped relationship between FBG levels and risk of all-cause mortality was found in this rural Chinese population. |
| The American Diabetes Association (ADA) changed the definition of impaired fasting glucose (IFG) from an FBG range of 6.1?6.9 mmol/l to 5.6?6.9 mmol/l, which may not be suitable for this rural Chinese population. |

Digital Features

This article is published with digital features to facilitate understanding of the article. To view digital features for this article go to [*https://doi.org/10.6084/m9.figshare.12932966*](https://doi.org/10.6084/m9.figshare.12932966)

Introduction

The total number of deaths worldwide has been increasing for decades; in 1950, there were 43.7 million deaths in the world, while by 2017, that number had increased to 55.9 million []. According to the National Bureau of ***Statistics***, China's death rate in 2014 was 7.16% and in 2017 was 7.11% []. However, with the increase in total population and the gradual acceleration of aging of the population, the number of deaths in China continues to increase, and the burden of death will likely be greatly aggravated.

With the improvement of people’s living standards, diabetes has gradually become one of the most important public health challenges in the twenty-first century. For the past few decades, the global prevalence of diabetes has increased; according to the International Diabetes Federation (IDF) 2019 report, an estimated 463 million people worldwide have diabetes, and by 2045 the number will be 700 million [, ]. Many epidemiologic studies have confirmed diabetes mellitus (DM) as a recognized risk factor for all-cause mortality [, ]. An article reported that the number of global deaths due to diabetes in 2000 was estimated at 2.9 million, accounting for 5.2% of all deaths []. Additionally, of all countries, China has the largest number of people suffering from diabetes [].

In 1997, the American Diabetes Association (ADA) introduced the concept of impaired fasting glucose (IFG), a type of pre-diabetes defined by a patient’s FBG range []. Many studies have found that IFG is associated with increased all-cause mortality [–]. In 2003, to better identify the individual risks of future DM and reduce its disease burden, the ADA changed the definition of IFG from an FBG range of 6.1–6.9 mmol/l to 5.6–6.9 mmol/l []. However, this change has caused much controversy, with some studies suggesting that the new IFG definition is related to increased all-cause mortality [, ], while other studies showed no such association [, , ]. Determining the appropriate cut-points for fasting blood glucose and finding a relatively “safe range” of fasting blood glucose to minimize mortality will help inform the public and clinical actions to prevent deaths caused by hyperglycemia or hypoglycemia. Our study combined the two standards of IFG defined by the ADA; FBG was analyzed as a categorical variable (< 5.6, 5.6 – < 6.1, and ≥ 6.1 mmol/l).

The purpose of our study was to investigate the relationship between fasting blood glucose levels and all-cause mortality in a Chinese rural population and to identify a relatively ‘safe range’ for fasting blood glucose levels. Our study is based on a rural Chinese population of low socioeconomic status. The results of the study may provide evidence for rural areas or low-***nutrient*** populations in China.

Methods

Participants

The study participants were all part of an original cohort of a previously conducted study on osteoporosis, who were enrolled in 2003 in Anqing, Anhui Province, in Eastern China. Anqing is located in the southwest of Anhui Province, with a current population of 6.1 million, 90% of which are rural residents. The livelihoods of most are based on ***agriculture***, and their economic level is relatively backward []. All participates were from a family of at least three siblings. Exclusion criteria included chronic infections, renal failure, history of type 1 diabetes mellitus, rickets or other metabolic bone diseases, chronic glucocorticoid use, and thyrotoxicosis. Premenopausal women who were uncertain of their pregnancy status at the time of enrollment were also excluded. All participants provided written informed consent and underwent a questionnaire survey at baseline, administered by professionally trained investigators, that included information on demographic ***data***, lifestyle, and medical history. As part of the baseline study, blood pressure measurements and blood samples were obtained (as detailed below). The ***data*** supporting the findings of this study will be available from the corresponding author (Xiping Xu) on request.

The study was approved by the ethics committee of Anhui Medical University (the committee’s reference number is 1005 2003-8-11). All procedures followed ethical standards. Written informed consent was obtained from each participant. The research was performed in accordance with the Helsinki Declaration of 1964 and its later amendments and applicable local laws and regulations.

***Data*** were obtained at baseline in 2003, and follow-up visits were conducted in 2014, in 2017, and at the study’s conclusion in 2018. The study had a high percentage of follow-up as this rural population remained stable and homogeneous with respect to ethnicity, environmental factors, lifestyle, and dietary habits. The homogeneity and stability of the population are reflected in the fact that this is a population in rural Anqing. Most of them are Han farmers, and their diet, work, and rest are probably consistent. After excluding 335 participants who were missing fasting blood glucose ***data*** and family number at baseline, a total of 17,902 participants were included in this analysis (Fig. ). During the follow-up period, a total of 1053 (5.9%) deaths occurred.

Flow chart of the participants in the current study

Ascertainment of All-Cause Mortality

The study outcome was all-cause mortality. ***Data*** on all-cause mortality were obtained by telephone or through face-to-face interviews with household members.

Laboratory Assessment

At baseline, fasting blood samples were ***collected*** and stored in aliquots at − 80 °C. Serum lipids and fasting blood glucose were measured enzymatically with a Cobas Integra Roche analyzer (Roche, Indianapolis, IN).

Glucose Status Classification

Type 2 diabetes mellitus was defined as either a fasting blood glucose concentration ≥ 7.0 mmol/l (126 mg/dl) or a physician’s previous diagnosis of diabetes (other than during pregnancy), based on the American Diabetes Association criterion. In participants who did not have a previous diagnosis of DM, the baseline fasting blood glucose concentrations were divided into the following categories: < 5.6, ≥ 5.6 and < 6.1, and ≥ 6.1 mmol/l (< 100, ≥ 100 and < 110, and ≥ 110 mg/dl).

Statistical Analyses

Means (SD) or medians (25th percentile–75th percentile) and proportions were calculated for population characteristics by sex. Multivariable analyses were performed using generalized estimating equations (GEEs) to evaluate odds ratios (OR) and 95% confidence intervals (CIs) of all-cause mortality risk. GEEs were used to account for autocorrelations among multiple family members. In the multivariate model, we adjusted for age, sex, body mass index (BMI), smoking status, drinking status, systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol (TC), triglycerides (TG), and high-density lipoprotein cholesterol (HDL-C). In the stratified analysis, lipids were divided into two groups by clinical cut-point, and interactions were tested through GEE. A two-tailed P < 0.05 was considered to be statistically significant in all analyses. Subjects were stratified by sex, age (< 50 vs. ≥ 50 years), BMI (< 24 vs. ≥ 24 kg/m2), smoking and drinking status (never vs. ever), TG (< 1.7 vs. ≥ 1.7 mmol/l), TC (< 5.2 vs. ≥ 5.2 mmol/l), HDL-C (< 1.04 vs. ≥ 1.04 mmol/l), SBP (< 140 vs. ≥ 140 mmHg), and DBP (< 90 vs. ≥ 90 mmHg) in additional exploratory analyses. EmpowerStats ([*https://www.empowerstats.com*](https://www.empowerstats.com)) and R software, version 3.5.1 ([*https://www.R-project.org/*](https://www.R-project.org/)), were used for all statistical analyses.

Results

Study Participants and Baseline Characteristics

Baseline characteristics of the participants according to sex are summarized in Table . Male participants were older and had higher blood pressure and HDL-C levels, while female participants tended to be younger and heavier with higher total cholesterol and triglyceride levels. Fasting blood glucose in the female population was significantly higher than in the male population. Within fasting blood glucose strata, age, blood pressure, BMI, TC, TG, and HDL levels were significantly higher as fasting blood glucose levels increased (Supplemental Table 1).

Baseline characteristics of the study participants by sexa

| **Variables** | **Stratified by sex** | | | ***P* value** |
| --- | --- | --- | --- | --- |
| **Total** | **Males** | **Females** |
| *N* | 17,902 | 9054 | 8848 |  |
| Age (years) | 45.9 (7.6) | 46.9 (7.7) | 44.9 (7.4) | < 0.001 |
| SBP, mmHg | 121.1 (18.9) | 121.7 (18.5) | 120.5 (19.2) | < 0.001 |
| DBP, mmHg | 77.6 (11.6) | 78.6 (11.9) | 76.6 (11.3) | < 0.001 |
| BMI, kg/m2 | 21.7 (2.9) | 21.3 (2.5) | 22.1 (3.1) | < 0.001 |
| Laboratory results |  |  |  |  |
| Fasting glucose, mmol/l | 5.5 (1.0) | 5.4 (1.0) | 5.5 (0.9) | 0.007 |
| Total cholesterol, mmol/l | 4.4 (0.8) | 4.4 (0.8) | 4.4 (0.9) | < 0.001 |
| Triglycerides, mmol/l | 1.3 (0.9) | 1.2 (1.0) | 1.4 (0.9) | < 0.001 |
| HDL cholesterol, mmol/l | 1.4 (0.4) | 1.4 (0.4) | 1.4 (0.3) | < 0.001 |
| Smoking status, *n* (%) |  |  |  | < 0.001 |
| Never | 10,440 (58.6) | 1919 (21.3) | 8521 (96.6) |  |
| Former | 786 (4.4) | 763 (8.5) | 23 (0.3) |  |
| Current | 6603 (37.0) | 6328 (70.2) | 275 (3.1) |  |
| Drinking status, *n* (%) |  |  |  | < 0.001 |
| Never | 13,574 (76.2) | 4982 (55.3) | 8592 (97.5) |  |
| Former | 252 (1.4) | 226 (2.5) | 26 (0.3) |  |
| Current | 3999 (22.4) | 3803 (42.2) | 196 (2.2) |  |

BMI body mass index, SBP systolic blood pressure, DBP diastolic blood pressure, HDL high-density lipoprotein

aFor continuous variables, values are presented as mean (SD). For categorical variables, values are presented as n (%)

Association between Fasting Blood Glucose and All-Cause Mortality

As shown in Fig. , as fasting blood glucose levels increase, the smooth curves show that after adjustment for major covariates, the risk of all-cause mortality first decreases and then increases, showing a significant U-shaped relationship between fasting blood glucose levels and risk of all-cause mortality, with a nadir at around 5.6–6.1 mmol/l. Consistent with the smooth curves, compared with the reference group (FBG of 5.6 – < 6.1 mmol/l), the odds ratios (ORs) and 95% confidence intervals (CIs) for all-cause mortality for group 1 of the fasting blood glucose categories of < 4.75, 4.75 – < 5.6, 6.1 – < 7.0, and ≥ 7.0 mmol/l or DM were 1.31 (1.02–1.69), 1.35 (1.14–1.60), 1.34 (1.06–1.70), and 2.00 (1.45–2.76), respectively. A similar pattern was observed for group 2 when we combined the categories of fasting blood glucose into < 5.6 and ≥ 6.1. Compared with the reference group (FBG of 5.6 – < 6.1 mmol/l), the risk of death among individuals with fasting blood glucose levels < 5.6 mmol/l significantly increased by 34% (OR 1.34; 95% CI 1.13–1.59), while the risk of death among individuals with fasting blood glucose ≥ 6.1 mmol/l or participants who had a self-reported history of diabetes significantly increased by 49% (OR 1.49; 95% CI 1.20–1.85) (Table ). Additionally, there was a similar pattern when fasting blood glucose was divided into six equal groups (Supplemental Table 2).

Association between baseline fasting glucose and risk of all-cause mortality. Model adjusted for age, sex, systolic blood pressure, diastolic blood pressure, body mass index, total cholesterol, triglycerides, HDL cholesterol, and smoking and drinking status

Association between fasting glucose and all-cause mortality

| **Fasting glucose, mmol/l** | ***N*** | **Case (%)** | **Crude model** | **Adjusted modela** | ***P* value** |
| --- | --- | --- | --- | --- | --- |
| **OR (95%CI)** | **OR (95%CI)** |
| Group 1b |  |  |  |  |  |
| < 4.75 | 1987 | 110 (5.5) | 1.11 (0.87?1.42) | 1.31 (1.02?1.69) | 0.035 |
| 4.75? < 5.6 | 10,093 | 590 (5.9) | 1.17 (0.99?1.40) | 1.35 (1.14?1.60) | < 0.001 |
| 5.6 ? < 6.1 | 3545 | 178 (5.0) | Ref. | Ref. |  |
| 6.1? < 7.0 | 1765 | 120 (6.8) | 1.38 (1.09?1.75) | 1.34 (1.06?1.70) | 0.016 |
| ? 7.0 or DM | 512 | 55 (10.7) | 2.28 (1.66?3.13) | 2.00 (1.45?2.76) | < 0.001 |
| Group 2b |  |  |  |  |  |
| < 5.6 | 12,080 | 700 (5.8) | 1.16 (0.98?1.38) | 1.34 (1.13?1.59) | < 0.001 |
| 5.6 ? < 6.1 | 3545 | 178 (5.0) | Ref. | Ref. |  |
| ? 6.1 or DM | 2277 | 175 (7.7) | 1.57 (1.27?1.95) | 1.49 (1.20?1.85) | < 0.001 |

aAdjusted for age, sex, systolic blood pressure, diastolic blood pressure, body mass index, total cholesterol, triglycerides, HDL cholesterol, and smoking and drinking status

bGroup 1: the fasting blood glucose categories of < 4.75, 4.75 – < 5.6, 5.6 – < 6.1, 6.1– < 7.0, and ≥ 7.0 mmol/l or DM; group 2: the fasting blood glucose categories of < 5.6, 5.6 – < 6.1, and ≥ 6.1 mmol/l or DM

Stratified Analyses on Fasting Blood Glucose and All-Cause Mortality

We further performed stratified analyses to assess the effects of FBG on all-cause mortality in various subgroups (Table ). None of the following variables, including age, sex, BMI, SBP, DBP, smoking status, drinking status, triglycerides, total cholesterol, and high-density lipoprotein cholesterol, significantly modified the association between fasting blood glucose and all-cause mortality. Compared with the reference group (FBG of 5.6 – < 6.1 mmol/l), the risk of all-cause mortality in the fasting blood glucose categories of < 5.6 mmol/l or ≥ 6.1 mmol/l increased across all stratifications by risk factors, showing a stable U-shaped relationship between fasting blood glucose levels and all-cause mortality.

Association among all-cause mortality and fasting glucose, stratified by risk factors

|  | **FPG < 5.6 mmol/l** | | **FPG 5.6?6.1 mmol/l** | | **FPG ? 6.1 mmol/l or DM** | | ***P* for interaction** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Events (%)** | **OR (95%CI)** | **Events (%)** | **OR (95%CI)** | **Events (%)** | **OR (95%CI)** |
| Sex |  |  |  |  |  |  | 0.88 |
| Female | 209 (3.6) | 1.42 (1.05?1.92) | 54 (3.0) | Ref. | 60 (5.0) | 1.45 (1.00?2.11) |  |
| Male | 491 (7.9) | 1.31 (1.06?1.61) | 124 (7.1) | Ref. | 115 (10.7) | 1.52 (1.16?1.99) |  |
| Age (years) |  |  |  |  |  |  | 0.19 |
| < 50 | 329 (3.8) | 1.61 (1.21?2.15) | 56 (2.5) | Ref. | 58 (4.3) | 1.72 (1.18?2.49) |  |
| ? 50 | 371 (10.9) | 1.15 (0.93?1.43) | 122 (9.3) | Ref. | 117 (12.6) | 1.38 (1.05?1.81) |  |
| Smoking status |  |  |  |  |  | 0.74 |  |
| Never | 258 (3.7) | 1.29 (1.00?1.67) | 77 (3.6) | Ref. | 77 (5.5) | 1.38 (0.99?1.91) |  |
| Former | 58 (11.5) | 1.45 (0.80?2.63) | 18 (10.0) | Ref. | 11 (10.8) | 1.09 (0.49?2.42) |  |
| Current | 381 (8.2) | 1.39 (1.09?1.77) | 82 (6.8) | Ref. | 85 (11.3) | 1.68 (1.23?2.30) |  |
| Drinking status |  |  |  |  |  | 0.85 |  |
| Never | 465 (5.1) | 1.41 (1.14?1.74) | 113 (4.2) | Ref. | 117 (6.8) | 1.50 (1.15?1.96) |  |
| Former | 33 (20.9) | 1.50 (0.71?3.15) | 11 (17.5) | Ref. | 7 (22.6) | 1.39 (0.47?4.10) |  |
| Current | 198 (7.3) | 1.17 (0.85?1.60) | 53 (6.8) | Ref. | 50 (9.9) | 1.46 (0.97?2.18) |  |
| Systolic blood pressure, mmHg |  |  |  |  | 0.33 |  |  |
| < 140 | 551 (5.2) | 1.33 (1.10?1.62) | 128 (4.4) | Ref. | 104 (6.1) | 1.34 (1.03?1.75) |  |
| ? 140 | 148 (9.6) | 1.26 (0.89?1.78) | 49 (8.1) | Ref. | 70 (12.6) | 1.73 (1.16?2.59) |  |
| Diastolic blood pressure, mmHg |  |  |  |  | 0.62 |  |  |
| < 90 | 562 (5.3) | 1.30 (1.08?1.58) | 136 (4.6) | Ref. | 123 (6.7) | 1.42 (1.10?1.83) |  |
| ? 90 | 137 (9.0) | 1.39 (0.96?2.02) | 42 (7.1) | Ref. | 51 (12.0) | 1.79 (1.14?2.81) |  |
| Total cholesterol, mmol/l |  |  |  |  | 0.99 |  |  |
| < 5.2 | 593 (5.7) | 1.33 (1.10?1.61) | 144 (4.9) | Ref. | 139 (7.6) | 1.51 (1.19?1.93) |  |
| ? 5.2 | 107 (6.1) | 1.35 (0.89?2.07) | 34 (5.5) | Ref. | 36 (7.9) | 1.40 (0.84?2.33) |  |
| Triglycerides, mmol/l |  |  |  |  | 0.56 |  |  |
| < 1.7 | 599 (5.9) | 1.41 (1.17?1.70) | 141 (4.8) | Ref. | 134 (7.8) | 1.52 (1.19?1.94) |  |
| ? 1.7 | 101 (5.3) | 1.12 (0.75?1.67) | 37 (5.9) | Ref. | 41 (7.5) | 1.36 (0.85?2.18) |  |
| High density lipoprotein, mmol/l |  |  |  |  | 0.32 |  |  |
| < 1.04 | 125 (6.1) | 1.88 (1.11?3.18) | 17 (3.8) | Ref. | 24 (7.8) | 1.81 (0.93?3.51) |  |
| ? 1.04 | 575 (5.7) | 1.26 (1.05?1.52) | 161 (5.2) | Ref. | 151 (7.7) | 1.45 (1.15?1.83) |  |
| Body mass index, kg/m2 |  |  |  |  | 0.83 |  |  |
| < 24 | 609 (6.1) | 1.33 (1.10?1.59) | 152 (5.4) | Ref. | 144 (8.2) | 1.48 (1.17?1.88) |  |
| ? 24 | 90 (4.3) | 1.41 (0.91?2.33) | 25 (3.5) | Ref. | 29 (5.7) | 1.57 (0.90?2.75) |  |

Adjusted, if not stratified, for age, sex, systolic blood pressure, diastolic blood pressure, body mass index, total cholesterol, triglycerides, HDL cholesterol, and smoking and drinking status

Discussion

In our study, FBG was analyzed categorically (< 5.6, 5.6 – < 6.1, ≥ 6.1 mmol/l). This study showed a significant U-shaped relationship between fasting blood glucose levels and risk of all-cause mortality in the study population. After adjustment for possible confounding factors, it was found that the risk of all-cause mortality was lowest when fasting blood glucose was in the level of 5.6 – < 6.1 mmol/l, suggesting that a ‘safe range’ for fasting blood glucose concentrations exists between 5.6 and < 6.1 mmol/l. Compared with the reference group (FBG of 5.6 – < 6.1 mmol/l), the risk of death significantly increased in the groups with fasting blood glucose < 5.6 mmol/l or equal to or above 6.1 mmol/l.

The worldwide prevalence of diabetes has been increasing for decades; diabetes can lead to serious health problems and even death [–]. Both hypoglycemia and hyperglycemia are significantly associated with adverse outcomes []. However, controversy regarding the association between fasting blood glucose and all-cause mortality still exists. A prospective study of a Korean population found a J-shaped association between fasting blood glucose levels and all-cause mortality, with a nadir at around 80–94 mg/dl (4.4–5.2 mmol/l) in both men and women; both low and high fasting blood glucose concentrations were associated with a higher risk of mortality []. Wändell et al. also found a similar J-shaped curve relationship between fasting glucose levels and all-cause mortality []. However, a study including a stratified sample of participants (n = 17,287) from the Women's Health Initiative (WHI) showed that a fasting blood glucose level > 100 mg/ml increased the risk for cardiovascular disease and all-cause mortality. The study found no significant association with low fasting glucose (HR 0.97; 95% CI 0.79–1.20) [].

Yanhong Li et al. found a U-shaped relationship between early blood glucose concentrations and PICU mortality. When the blood glucose concentration is 110–140 mg/dl (6.1–7.8 mmol/l), the risk of all-cause mortality is the lowest []. The People's Republic of China-USA (PRC-USA) collaborative study also found a significant U-shaped relationship between fasting blood glucose levels and all-cause mortality, and the result of the study showed that both low (< 80 mg/dl) and high (≥ 126 mg/dl) fasting blood glucose levels were significantly associated with increased risk of all-cause and cardiovascular disease mortality in the Chinese general population[].

Our results showed that fasting blood glucose levels in this population had a significant U-shaped relationship with mortality risk and that this relationship was not affected by other risk factors; both higher and lower fasting blood glucose levels were significantly associated with increased risk of all-cause mortality, which is consistent with the results of some studies [–, ]. The mechanism for the association between high fasting blood glucose levels and risk of all-cause mortality is very clear; high fasting blood glucose causes complications such as CVD and chronic kidney disease, both of which increase the risk of death []. While the mechanism for the relationship between low fasting blood glucose and risk of all-cause mortality is not that clear, studies have shown that hypoglycemia may be associated with low energy consumption, resulting in poor health and increased bodily susceptibility to diseases, thus increasing the risk of death []. Additionally, other studies have suggested that the relationship between low levels of fasting blood glucose and all-cause mortality risk may be explained by brain damage during hypoglycemia []. Our study is based on a rural Chinese population, of low socioeconomic status. It may be that inadequate intake of ***nutrients*** in this population leads to an increased risk of death from malnutrition. This study provides a relatively safe fasting blood glucose range (5.6 – < 6.1 mmol/l) for the regional population in rural China, but this relatively safe fasting blood glucose range is higher than in previous studies, probably because our population generally has a low BMI, which may be caused by malnutrition. Therefore, more trials are needed to verify the results.

However, there are still several limitations to this study. First, we did not have information on specific causes of mortality. In addition, recall bias could exist. Because we conducted household or telephone interviews at follow-up visits, we failed to ***collect*** the time of death in time, resulting in the inability to use the Cox model to better predict the correlation between blood glucose and all-cause mortality. Second, we did not obtain information on patient medication usage for diabetes and/or a time variable to better predict the association between fasting blood glucose and all-cause mortality. Third, during the follow-up, we did not have complete fasting blood glucose measurements for each participant. Therefore, we could not assess the association between mean fasting blood glucose and all-cause mortality risk during follow-up. Finally, although this cohort study was designed to explore the association between fasting blood glucose and all-cause mortality, all study participants were from rural areas in Anhui Province; therefore, the findings of this study cannot be extended to a wider population.

Conclusion

This study showed a significant U-shaped relationship between fasting blood glucose levels and risk of all-cause mortality in a rural Chinese population. Both low and high fasting blood glucose concentrations were associated with higher mortality in this study population. When fasting blood glucose was at the level of 5.6 – < 6.1 mmol/l, the risk of mortality was lowest, and when blood glucose was < 5.6 mmol/l or ≥ 6.1 mmol/l, the risk of death increased significantly. Controlled fasting blood glucose levels within the 5.6 – < 6.1 mmol/l range appear to be relatively safe.

**Acknowledgements**

We thank the investigators and participants in the osteoporosis cohort study, the parent study, who made this report possible.

**Funding**

The study was supported by funding from the following: the National Key Research and Development Program (2016YFE0205400, 2018ZX09739010, 2018ZX09301034003), the Science and Technology Planning Project of Guangzhou, China (201707020010), the Science, Technology, and Innovation Committee of Shenzhen (GJHS20170314114526143, JSGG20180703155802047), the Economic, Trade and Information Commission of Shenzhen Municipality (20170505161556110, 20170505160926390, 201705051617070), the National Natural Science Foundation of China (81730019, 81973133, 81960074, 81500233), Jiangxi Outstanding Person Foundation (20192BCBL23024), and the Major Projects of the Science and Technology Department, Jiangxi (20171BAB205008). The journal’s Rapid Service Fee was paid by the authors. Xiping Xu, the PI of the osteoporosis cohort study, has full access to all of the ***data*** in the study and takes responsibility for the integrity of the ***data*** and the accuracy of the ***data*** analysis.

**Authorship**

All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

**Disclosures**

Xiping Xu reports grants from the National Key Research and Development Program (2016YFE0205400, 2018ZX09739010, 2018ZX09301034003), the Science and Technology Planning Project of Guangzhou, China (201707020010), the Science, Technology and Innovation Committee of Shenzhen (GJHS20170314114526143, JSGG20180703155802047), and the Economic, Trade and Information Commission of Shenzhen Municipality (20170505161556110, 20170505160926390, 201705051617070). Xianhui Qin reports grants from the National Natural Science Foundation of China (81730019, 81973133). Xiao Huang reports grants from the National Natural Science Foundation of China (81960074, 81500233), the Jiangxi Outstanding Person Foundation (20192BCBL23024), and Major Projects of the Science and Technology Department, Jiangxi (20171BAB205008). Nannan Cheng, Yue Zhang, Jie Yang, Jingyi Li, Lijing Ye, Ziyi Zhou, Zhuo Wang, Lishun Liu, Yun Song, Zhibo Yang, Guiping She, Xue Bai, Xiaoshu Cheng, Genfu Tang, Binyan Wang, Pierre Zalloua, and Fangrong Yan have nothing to disclose.

**Compliance with Ethics Guidelines**

The study was approved by the ethics committee of Anhui Medical University (The committee’s reference number is 1005 2003–8-11). All procedures followed ethical standards. Written informed consent was obtained from each participant. The research was performed in accordance with the Helsinki Declaration of 1964 and its later amendments and applicable local laws and regulations.

***Data* Availability**

***Data*** described in the manuscript, code book, and analytic code will be made available from the corresponding authors on request, after the request has been submitted and formally reviewed and approved by the Ethics Committee of the Institute of Biomedicine, Anhui Medical University, Hefei, China.

**Load-Date:** May 4, 2023

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[***The association of fluoride in drinking water with serum calcium, vitamin D and parathyroid hormone in pregnant women and newborn infants***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2C1-JCWX-C1N9-00000-00&context=1516831)

European Journal of Clinical Nutrition

August 2020

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**Section:** Pg. 151-159; Vol. 75; No. 1; ISSN: 0954-3007,1476-5640

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**Body**

Introduction

Fluorine is the most electronegative element and has a strong tendency to acquire negative charges in solutions, forming fluorides. If fluoride is consumed optimally through drinking water and other sources, it is beneficial for the teeth and bones, but excessive exposure may lead to many adverse effects, such as tooth decay, osteoporosis and kidney, bone, nerve and muscle damage [–]. According to the American Academy of Pediatrics, daily intake should be 0.05–0.07 mg/kg body weight for optimal dental health benefits [].

When the quantity of fluoride in drinking water and other sources increases, the concentration in maternal plasma, foetal plasma and foetal deciduous tooth enamel also increases []. After consumption, ~90% of fluoride is absorbed from the gastrointestinal tract, and the remaining 10% is excreted in faeces. In humans, 99% of the fluoride is deposited in bones and teeth, and the remaining 1% is found in soft tissues []. The free passage of fluoride to the foetus through the placenta has been disputed by researchers. Although the mechanisms of maternal–foetal transmission of fluoride are poorly understood, many studies have proven that fluoride can readily pass across the placenta and ultimately increase fluoride levels in foetal tissue. Many articles pertaining to the advantages and adverse effects of fluoride on pregnant women and foetuses have been published [, ].

Vitamin D is a steroid hormone that plays a significant role in maintaining normal calcium and phosphorous levels in the blood. It improves bone health status by enhancing mineralisation through the absorption of calcium and the secretion of parathyroid hormone []. Worldwide, vitamin D deficiency is a pandemic, but in most populations this deficiency is underdiagnosed and undertreated. Vitamin D deficiency is seen in all age groups irrespective of gender, race and location []. Sufficient 25(OH)D levels are important for pregnant women to sustain vitamin D levels for themselves and their foetuses. Deficient 25(OH)D levels among mothers may be associated with some adverse outcomes in neonates, such as impaired bone development, insulin-dependent diabetes, impaired immune system function, multiple sclerosis cancer, asthma and atrophy, but the results obtained from previous studies were inconsistent [].

Serum calcium plays diverse roles in maintaining homoeostasis, muscle contraction, cellular function, nerve conduction and cellular membrane stability. Serum calcium levels depend on parathyroid hormone (PTH), vitamin D and calcitonin secretion in the body []. Low calcium levels in pregnant women were associated with hypertensive disorders, particularly preeclampsia. During pregnancy, calcium and vitamin D metabolism undergo many adaptations. PTH is a very essential hormone in calcium homoeostasis. Maternal PTH is positively associated with birth weight and foetal upper arm and calf circumference. Parathyroid hormone regulates foeto-placental mineral homoeostasis and skeletal development and stimulates placental calcium transfer [].

Since 1948, studies have shown a relationship between fluoride and calcium []. To date, many works have confirmed that fluoride could modify calcium homoeostasis in the human population and that calcium also plays a significant role in the cellular alterations induced by fluoride []. Long-term consumption of fluoridated drinking water increases fluoride plasma levels, which are related to a decrease in calcium transport across the renal tubule endoplasmic reticulum and plasma membrane, as well as to a reduction in the amount of calcium pump proteins in isolated kidney membranes []. In the present study, it was hypothesised that varying levels of fluoride present in drinking water are associated with serum calcium, vitamin D and PTH levels in pregnant women and newborn infants. Hence, the study was conducted to investigate the relationship of varying fluoride concentrations in drinking water with calcium and vitamin D levels in pregnant women and newborn infants.

Methodology

In the present study, two groups were established based on the fluoride concentration in drinking water. One group, in which the fluoride concentration in drinking water was <1 ppm, was considered low/optimum, and the other group was considered a high fluoride group, in which the fluoride concentration was ≥1 ppm as per the Indian Bureau of Standards []. In each group, 90 pregnant women were recruited from the hospital during delivery. The study sample consisted of pregnant women recruited from JSS Hospital, Mysore, during a prenatal visit approximately one month before their due date. Only primiparous mothers who were healthy, non-smokers, aged between 18 and 45 years were included. Uneventful, singleton foetuses and full-term pregnancies were included. Women with a history of renal stones or hypercalcaemia or any serious pregnancy complications at the time of enrolment were excluded from the study. All subjects gave written informed consent in accordance with the Declaration of Helsinki. Before the beginning of the study, the protocol was approved by the institutional ethics committee at JSS Dental College and Hospital.

Sample size

The sample size was calculated using a 95% confidence interval and 80% power assuming a mean difference of 0.5 mg calcium in the optimum/low and high levels of fluoride in drinking water with a standard deviation of 1.16. The sample size obtained was 85 for each group. To overcome the loss to follow-up and due to any other reasons, the sample size was increased to 90 for each group. Therefore, the total sample size for the present study was 180 (hypothesis testing for two means equal variance- N master sample size calculation software).

At the time of recruitment, the participants were given a validated questionnaire regarding their medical history, sunshine exposure duration, lifestyle factors and supplement use. The questionnaire included a food frequency questionnaire (FFQ) to calculate the intake of vitamin D and calcium []. Before using the questionnaire was validated, and a final version was used for the study. The questionnaire was ***collected*** from the participants before labour and checked by one of the researchers. Records on pregnancy follow-ups and the birth report, including infant length, weight, and head circumference, were assessed by research staff using the standardised WHO protocol. The duration of the pregnancy was recorded.

Fluoride analysis

Study participants were asked to obtain water samples that they consumed during the course of the pregnancy. The serum and urine fluoride levels of the pregnant women were assessed prior to delivery. Cord blood fluoride levels were assessed post delivery. The fluoride levels were measured according to the American Public Health Association (APHA) guidelines with a standardised instrument. To sensitise the 9609BNWP fluoride electrode, a 10 ppm standard fluoride solution and 0.5 ml of total ionic strength adjustment buffer (TISAB III) were used. The electrode was dipped in the solution for 20 min prior to calibration every day.

Laboratory measurements

First, blood samples ***collected*** from a pregnant woman for a routine investigation before delivery were used to assess fluoride, vitamin D, PTH, and calcium levels. Then, after delivery, the same parameters were assessed again in the cord blood samples. After blood sample ***collection***, the samples were immediately placed in tubes and submitted to the hospital’s clinical analysis laboratory, where they were centrifuged and then transported under refrigeration. 25(OH)D and PTH were analysed in a fully automated immunoassay system Roche-Coba e601. Calcium was analysed using a fully automated chemistry analyser (Toshiba TBA120 FR). All the samples were stored at −20 °C.

***Data*** management and statistical analysis

SPSS-23 version was used for the statistical analysis. For descriptive analysis, the mean, standard deviation, frequency and percentages were calculated. For inferential ***statistics***, if the ***data*** followed a normal distribution comparison of two independent groups, an unpaired ‘t’ test was used. For skewed distribution ***data***, a nonparametric Mann–Whitney test was used to compare two independent groups. To test the normality of the ***data***, the Kolmogorov–Smirnov test and Shapiro-Wilk test were used. For the comparison of frequencies and percentages, the Pearson chi-square test was used. To find the association between the groups, Spearman’s correlation test was used.

To identify one-to-one associations between drinking water fluoride levels and serum calcium, vitamin D and parathyroid hormone levels, simple linear regression was used. In the model, drinking water fluoride level was considered an independent variable, and vitamin D, parathyroid hormone and serum calcium were entered as dependent variables. To control for the confounders of socioeconomic status, maternal education and sunlight exposure duration, multivariate linear regression was performed. From the multivariate regression analysis model, an equation was used to predict the parameters vitamin D, parathyroid hormone and serum calcium with each ppm increase in fluoride in drinking water. P < 0.05 was used for statistical significance.

Results

The mean age of the low/optimum group was 23.88 (3.57), and that of the high fluoride group was 24.13 (3.85); the age difference between the groups was not significant. Apart from age, the following variables were also considered: socioeconomic status, maternal education, calcium and vitamin D supplement usage, calcium and vitamin D dietary intake, gestation length, sunlight exposure, birth weight and newborn length. Among these, socioeconomic status, maternal education and sunlight exposure showed statistically significant differences between the two groups. The mean (SD) fluoride concentrations in drinking water in the low/optimum group was 0.50 (0.28) and that in the high fluoride group was 2.65 (1.29). The fluoride concentrations found in urine, pregnant mother’s blood and cord blood were 0.20, 0.014 and 0.0110 ppm in the low/optimum group and 1.91, 0.15 and 0.10 ppm, respectively, in the high fluoride group. The comparison of the mean fluoride concentrations in water, urine, pregnant mother’s blood and cord blood among the two groups was found to be statistically highly significant (p < 0.001) (Table ).

Descriptive characteristics.

| **Variables** | **Low/optimum** | **High** | ***p* value** |
| --- | --- | --- | --- |
| Age (years) Socioeconomic status | 23.88 (3.57) | 24.13 (3.85) | 0.645 NS |
| *n* (%) | *n* (%) |  |  |
| Class I?13 (14.4) | Class I?3 (3.3) |  |  |
| Class II?26 (28.9) | Class II?18 (20.0) | 0.000 HS |  |
| Class III?31 (34.4) | Class III?23 (25.6) |  |  |
| Class IV?15 (16.7) | Class IV?27 (30.0) |  |  |
| Class V?5 (5.6) | Class V?19 (21.1) |  |  |
| Education | Illiterate?4 (4.4) | Illiterate?10 (11.1) | 0.000 HS |
| Primary (1 to 4)?10 (11.1) | Primary (1 to 4)?23 (25.6) |  |  |
| Middle (5 to 7)?16 (17.8) | Middle (5 to 7)?26 (28.9) |  |  |
| High school and PUC?32 (35.6) | High school and PUC?23 (25.6) |  |  |
| Degree and Diploma?28 (31.1) | Degree and Diploma?8 (8.9) |  |  |
| Calcium and vitamin D supplements | Yes?89 (98.9) | Yes?85 (94.4) | 0.211 NS |
| No?1 (1.1) | No?(5.6) |  |  |
| Sunlight exposure (hours/month) | 42.00 (17.84) | 58.50 (34.95) | 0.000HS |
| Gestation length (weeks) | 38.31 (1.13) | 38.47 (0.97) | 0.321 NS |
| Gender | Male?47 (52.2)Female?43 (47.8) | Male?44 (48.9)Female?46 (51.1) | 0.766 NS |
| Birth weight (kg) | 2.69 (0.57) | 2.60 (0.56) | 0.274 NS |
| Birth length (cm) | 49.24 (1.38) | 49.14 (1.37) | 0.599 NS |
| Dietary intake of calcium mg/d | 895.41 (213.70) | 836.10 (233.24) | 0.077 NS |
| Drinking water fluoride level ppm | 0.50 (0.28) | 2.65 (1.29) | 0.001 HS |
| Urine fluoride ppm | 0.20 (0.24) | 1.92 (1.19) | 0.001 HS |
| Pregnant mothers blood fluoride ppm | 0.014 (0.014) | 0.153 (0.113) | 0.001 HS |
| Cord blood fluoride ppm | 0.011 (0.011) | 0.11 (0.10) | 0.001 HS |

Table depicts the mean values and categories of 25(OH)D, PTH and calcium levels in pregnant mothers’ blood and cord blood. In maternal blood, the mean values of 25(OH)D and PTH were significantly different between the low/optimum and high fluoride groups, whereas in cord blood, 25(OH)D and serum calcium showed significant differences both in mean values and categorisation. All the values are presented in Table .

Biochemical characteristics.

| **Variables** | **Low/optimum** | **High** | ***p* value** |
| --- | --- | --- | --- |
| Mean (SD) |  |  |  |
| Vitamin D |  |  |  |
| ?Maternal blood | 12.31 (7.87) | 9.11 (6.39) | 0.001 HS |
| ?Cord blood | 10.96 (7.5) | 7.9 (5.62) | 0.001HS |
| Parathyroid hormone (PTH) |  |  |  |
| ?Maternal blood | 19.47 (10.73) | 12.29 (8.75) | 0.000 HS |
| ?Cord blood | 10.63 (15.16) | 9.69 (14.38) | 0.523 NS |
| Calcium |  |  |  |
| ?Maternal blood | 7.42 (1.45) | 7.25 (1.53) | 0.812 NS |
| ?Cord blood | 7.69 (2.10) | 7.11 (1.69) | 0.020 S |
| Frequency (%) |  |  |  |
| Vitamin D |  |  |  |
| Maternal blood <10 ng/ml (Deficient) | 40 (44.4) | 55 (61.1) |  |
| ?10?32 ng/ml (Insufficient) | 49 (54.4) | 34 (37.8) | 0.079 NS |
| ?>32 ng/ml (Adequate) | 1 (1.1) | 1 (1.1) |  |
| Cord blood |  |  |  |
| ?<10 ng/ml (Deficient) | 45 (50.0) | 65 (72.2) |  |
| ?10?32 ng/ml (Insufficient) | 42 (46.7) | 24 (26.7) | 0.008 HS |
| ?>32 ng/ml (Adequate) | 3 (3.3) | 1 (1.1) |  |
| Parathyroid Hormone (PTH) |  |  |  |
| Maternal blood |  |  |  |
| ?<10 pg/Ml (Hypo) | 17 (18.9) | 43 (47.8) |  |
| ?10?55 pg/Ml (Normal) | 72 (80.0) | 47 (52.2) | 0.000 HS |
| ?>55 pg/Ml (Hyper) | 1 (1.1) | 0 (0) |  |
| Cord blood |  |  |  |
| ?<10 pg/Ml (Hypo) | 72 (80.0) | 74 (82.2) |  |
| ?10?55 pg/Ml (Normal) | 16 (17.8) | 14 (15.6) | 0.923 NS |
| ?>55 pg/Ml (Hyper) | 2 (2.2) | 2 (2.2) |  |
| Calcium |  |  |  |
| Maternal blood |  |  |  |
| ?<8.6 mg/dl (Hypo) | 74 (82.2) | 81 (90) |  |
| ?8.6?10 mg/dl (Normal) | 14 (15.6) | 9 (10) | 0.182 NS |
| ?>10 mg/dl (Hyper) | 2 (2.2) | 0 (0) |  |
| Cord blood |  |  |  |
| ?<8.6 mg/dl (Hypo) | 54 (60.0) | 73 (81.1) |  |
| ?8.6?10 mg/dl (Normal) | 31 (34.4) | 15 (16.7) | 0.008 HS |
| ?>10 mg/dl (Hyper) | 5 (5.6) | 2 (2.2) |  |

Table explains the strength of the association between the fluoride present in drinking water, urine, maternal blood and cord blood. The fluoride concentration in drinking water was positively associated with urine, maternal blood, and cord blood (r = 0.897, 0.897 and 0.768) and negatively associated with 25(OH)D, PTH and calcium levels (r = −0.289, −0.279, −0.385 and −0.175). All indexes were significantly associated, except parathyroid hormone in cord blood and calcium in maternal blood.

Spearmans correlation between vitamin D, parathyroid hormone (PTH) and calcium in maternal serum and cord blood and fluoride present in drinking water, urine, maternal serum and cord blood.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Fluoridewater | Fluoride urine | Fluoride blood | Fluoride cord blood | Vitamin-D Blood | Vitamin-D cord blood | Parathyroid hormone Blood | Parathyroid hormone Cord blood | Calcium blood | Calcium cord blood |
| Spearman?s rho |  |  |  |  |  |  |  |  |  |  |  |
| ?Fluoride Water | Correlation coefficient | 1.000 |  |  |  |  |  |  |  |  |  |
|  | Sig. (two-tailed) | . |  |  |  |  |  |  |  |  |  |
|  | *N* | 180 |  |  |  |  |  |  |  |  |  |
| ?Fluoride Urine | Correlation coefficient | 0.897 (\*\*) | 1.000 |  |  |  |  |  |  |  |  |
|  | Sig. (two-tailed) | 0.000 | . |  |  |  |  |  |  |  |  |
|  | *N* | 180 | 180 |  |  |  |  |  |  |  |  |
| ?Fluoride Blood | Correlation coefficient | 0.897 (\*\*) | 0.834 (\*\*) | 1.000 |  |  |  |  |  |  |  |
|  | Sig. (two-tailed) | 0.000 | 0.000 | . |  |  |  |  |  |  |  |
|  | *N* | 180 | 180 | 180 |  |  |  |  |  |  |  |
| ?Fluoride Cordblood | Correlation coefficient | 0.768 (\*\*) | 0.734 (\*\*) | 0.901 (\*\*) | 1.000 |  |  |  |  |  |  |
|  | Sig. (two-tailed) | 0.000 | 0.000 | 0.000 | . |  |  |  |  |  |  |
|  | *N* | 180 | 180 | 180 | 180 |  |  |  |  |  |  |
| ?Vitamin-D Blood | Correlation coefficient | ?0.289 (\*\*) | ?0.302 (\*\*) | ?0.260 (\*\*) | ?0.200 (\*\*) | 1.000 |  |  |  |  |  |
|  | Sig. (two-tailed) | 0.000 | 0.000 | 0.000 | 0.007 | . |  |  |  |  |  |
|  | *N* | 180 | 180 | 180 | 180 | 180 |  |  |  |  |  |
| ?Vitamin-D Cordblood | Correlation coefficient | ?0.279 (\*\*) | ?0.283 (\*\*) | ?0.268 (\*\*) | ?0.239 (\*\*) | 0.737 (\*\*) | 1.000 |  |  |  |  |
|  | Sig. (two-tailed) | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | . |  |  |  |  |
|  | *N* | 180 | 180 | 180 | 180 | 180 | 180 |  |  |  |  |
| ?Parathyroid hormone Blood | Correlation coefficient | ?0.385 (\*\*) | ?0.365 (\*\*) | ?0.362 (\*\*) | ?0.304 (\*\*) | 0.273 (\*\*) | 0.238 (\*\*) | 1.000 |  |  |  |
|  | Sig. (two-tailed) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | . |  |  |  |
|  | *N* | 180 | 180 | 180 | 180 | 180 | 180 | 180 |  |  |  |
| ?Parathyroid hormone Cordblood | Correlation coefficient | 0.044 | 0.027 | 0.052 | 0.048 | ?0.087 | ?0.066 | 0.120 | 1.000 |  |  |
|  | Sig. (two-tailed) | 0.556 | 0.720 | 0.491 | 0.521 | 0.244 | 0.382 | 0.108 | . |  |  |
|  | *N* | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 |  |  |
| ?Calcium Blood | Correlation coefficient | ?0.030 | ?0.007 | ?0.131 | ?0.193 (\*\*) | 0.211 (\*\*) | 0.081 | 0.170 (\*) | ?0.121 | 1.000 |  |
|  | Sig. (two-tailed) | 0.688 | 0.926 | 0.079 | 0.009 | 0.004 | 0.282 | 0.023 | 0.106 | . |  |
|  | *N* | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 |  |
| ?Calcium Cord blood | Correlation coefficient | ?0.175 (\*) | ?0.134 | ?0.285 (\*\*) | ?0.306 (\*\*) | 0.054 | 0.077 | 0.119 | ?0.053 | 0.540 (\*\*) | 1.000 |
|  | Sig. (two-tailed) | 0.019 | 0.073 | 0.000 | 0.000 | 0.474 | 0.305 | 0.113 | 0.478 | 0.000 | . |
|  | *N* | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 |

\*\*Correlation is significant at the 0.01 level (two-tailed).

\*Correlation is significant at the 0.05 level (two-tailed).

Simple linear regression analysis and multivariate regression analysis adjusted with covariates are presented in Table . Vitamin D was significantly associated with drinking water fluoride in maternal and cord blood in both the univariate (β = −1.041 and −0.918, p = 0.006 and 0.009) and multivariate regression (β = −0.943 and −0.847, p = 0.019 and 0.023) analyses. Parathyroid hormone was significantly associated with maternal serum (β = −1.731, p = 0.002) and serum calcium in cord blood (β = −0.212, p = 0.044) with drinking water fluoride.

Simple and multivariate regression analysis table.

| **Parameters** | **Constant** | ***?*** | **SE** | ***p* value** |
| --- | --- | --- | --- | --- |
| Vitamin D |  |  |  |  |
| ?Maternal serum |  |  |  |  |
| ??\* | 12.351 | ?1.041 | 0.376 | 0.006 |
| 13.950 | ?0.943 | 0.398 | 0.019 |  |
| ??# |  |  |  |  |
| ?Cord blood |  |  |  |  |
| ??\* | 10.881 | ?0.918 | 0.349 | 0.009 |
| ??# | 12.149 | ?0.847 | 0.370 | 0.023 |
| Parathyroid hormone |  |  |  |  |
| ?Maternal serum |  |  |  |  |
| ??\* | 19.203 | ?2.108 | 0.522 | 0.001 |
| ??# | 28.147 | ?1.731 | 0.538 | 0.002 |
| Serum calcium |  |  |  |  |
| ?Cord blood |  |  |  |  |
| ??\* | 7.706 | ?0.197 | 0.100 | 0.049 |
| ??# | 6.256 | ?0.212 | 0.104 | 0.044 |

\*= simple linear regression analysis without adjusting any variables. Drinking water fluoride considered as independent variable and parameters vitamin D, parathyroid hormone and serum calcium, were considered as dependent variable.

#= multivariate linear regression analysis adjusting socioeconomic status, maternal education and duration of sunlight exposure.

Discussion

The present study was designed to estimate the fluoride concentration in the drinking water, urine, blood before delivery and cord blood after delivery of pregnant mothers. Another objective of the present study was to investigate the association of the serum calcium, vitamin D, and parathormone levels of pregnant mothers just before delivery with the same parameters in the cord blood after delivery. To the best of our knowledge, this is the first study to evaluate the association of fluoride with the abovementioned parameters in groups of pregnant women exposed to both low/optimum levels and high levels of fluoride in the drinking water.

The study conducted by Grinaldo et al. showed that risk factors associated with human fluoride exposure were mainly through drinking water []. In the present study, the low/optimum level group of pregnant women mainly used river water (surface water), and the high fluoride group used tap water. In addition, this study shows that as the fluoride concentration increases in drinking water, an increase in fluoride levels is observed in pregnant mothers’ blood and urine. This result is in accordance with previous studies by Iftekhar Ahmed et al., LizetJarquin-Yanez et al. and Christine till et al. [–].

Very few studies have been performed to associate fluoride levels in the urine and serum of pregnant mothers just before delivery with those in cord blood. According to the present study, the placenta does not provide a complete barrier to the passage of fluoride to the foetus (cord blood). As the fluoride concentration increased in the drinking water, the fluoride levels in the mothers’ serum and cord blood also increased. In high fluoride areas, there are chances of increased fluoride exposure to the foetus, which in turn may cause potential negative effects on foetal development. The results were consistent with previous studies by Opydo-Szymaczek and Borysewicz, Ahmed et al. [, ]. The acceptable (recommended) concentration of fluoride is 1 mg/l in urine and 0.15 ppm in serum. In the present study, both urine and serum fluoride concentrations among the pregnant women in the high fluoride group were higher than the recommended values [].

The majority of studies have shown that vitamin D deficiency is highly prevalent among pregnant women and the general population. Previous studies have reported that 61 to 93.3% of pregnant women have vitamin D deficiency/insufficiency in different parts of India [–]. In the present study, vitamin D deficiency (VDD < 10 ng/ml) was found in 61.1% of pregnant mother blood samples and 72.2% of cord blood samples in the high fluoride group compared to 44.4% and 50%, respectively, in low/optimum fluoride group. Vitamin D deficiency in pregnant mother blood and cord blood samples was found to be more common among the high fluoride group than the low/optimum fluoride group.

The major source of vitamin D for humans is diet and exposure of the skin to sunlight []. In the present study, the high fluoride group consisted of pregnant women with low socioeconomic status who had more sunlight exposure than the women in the low/optimum group, as they had to work in ***agricultural*** fields. The low/optimum group consisted of an urban population who had lower sunlight exposure, and pollution also decreased the synthesis of vitamin D. Both groups were on the same dosage of calcium and vitamin D supplements for the same period of time. However, the results were contrary to expectation. Even with exposure to more sunlight and less pollution, the high fluoride group had significantly more pregnant women with vitamin D deficiency than did the low/optimum group.

Regarding supplementation, the pregnant women in both the high and low/optimum fluoride groups regularly took calcium and vitamin D tablets. In addition, in India, the antenatal care programme provides free supplements containing calcium and vitamin D to pregnant women.

Even though supplements were provided to all the pregnant women, those who drank drinking water with high fluoride levels exhibited significantly low levels of vitamin D, which could be due to many reasons. As previously stated, the calcium concentration may regulate vitamin D in healthy adults and in pregnant women. Previous studies have stated that fluoride ingested in high concentrations forms insoluble complexes with calcium, which can markedly decrease gastrointestinal fluoride absorption, causing hypocalcaemia []. Another study stated that an increase in fluoride plasma levels causes a reduction in calcium transport across the renal tubule endoplasmic reticulum (ER) and plasma membrane and a reduction in calcium pump proteins in isolated kidney membranes []. In addition, fluoride may act in many ways at the molecular level, such as vitamin D-binding proteins, epimers, calcium homoeostasis, etc [].

The effect of fluoride on vitamin D may be direct or indirect. Much molecular research is required to determine the exact mechanism underlying the reduction of vitamin D in maternal blood. Another alarming issue from the present study is that vitamin D levels in pregnant mothers’ blood and in cord blood were positively correlated. A vitamin D deficiency in the mothers’ blood will be carried to the foetus, and a 20% decrease was observed in the cord blood. Long-term studies need to be conducted to investigate risks among infants and pre-primary school children whose mothers consumed drinking water with high fluoride levels while pregnant.

In the present study, the PTH concentration in pregnant mothers’ blood was significantly different between the high and low/optimum groups. The high fluoride group showed lower levels of PTH in pregnant mothers’ blood than the low/optimum fluoride group. Fluoride ions alone or in combination with aluminium (Al3+) have been shown to enhance the activity of guanine nucleotide-binding proteins (G proteins) in cell membrane preparations from a variety of cell types and in intact hepatic cells. Previous studies have shown that G proteins have a role in the regulation of PTH secretion and intracellular second messengers that modulate PTH secretion. The studies also explained the possible role of intracellular second messengers and G proteins during deficient PTH secretion [].

Unlike pregnant mothers’ blood, in cord blood, PTH levels anywhere not significantly different between the high and low/optimum fluoride groups of pregnant women. The mean cord blood PTH levels were lower than the maternal blood PTH levels. This result may be due to the degradation of the perfused hormone during passage through the placenta [].

In cord blood, the proportion of hypocalcaemia among cord blood samples was significantly higher in the high fluoride group than in the low/optimum. The amount of calcium actively transferred to the foetus during the third trimester across the placenta when the collagen matrix is rapidly ossified. In neonates, ~30 g of calcium is present at birth []. The calcium content in foetal serum increases exponentially during gestation. The literature indicates that the calcium concentration in foetal blood is higher than that in maternal serum []. The increase in foetal serum calcium content occurs through an active transport mechanism. However, in the present study, the calcium concentration was lower in cord blood than in maternal serum in the high fluoride group. In the low/optimum group, the calcium concentration was higher in cord blood than in maternal serum. The exchange of ***nutrients*** and gases occurs through the syncytiotrophoblast layer of the placenta between the mother and foetus. The calcium concentration in the foetal blood is regulated by foetal parathyroid hormone and plasma concentration of 1,25(OH)2 or vitamin D3. Several studies have shown that vitamin D plays a key role in calcium transport through syncytial cells []. Vitamin D-dependent calcium binding protein is present in the placenta. In the present study, vitamin D was significantly lower in the high fluoride group than in the low/optimum fluoride group. The decreased levels of vitamin D might play a role in the control of this transport. The exact mechanism through which calcium transport through the placenta is blocked in the high fluoride group remains unclear.

Our study had some limitations. The present study was a cross-sectional design. Therefore, a cause–effect relationship could not be identified. The present study was conducted during the winter season. There is a lack of information regarding vitamin D and other element levels during other seasons. ***Data*** regarding exposure to sunlight and diet history were self-reported, and more chances of recall bias were possible.

Conclusion

The present study concludes that high fluoride levels in drinking water are negatively associated with calcium and the associated hormones vitamin D and parathyroid hormone. Government policies were undertaken to provide safe drinking water and strict follow-up of vitamin D, calcium and PTH and other elements during pregnancy. We can spread awareness regarding the effect of high fluoride on calcium and vitamin D in pregnant women and newborn infants.

**Funding**

This research was funded by Indian Council of Medical Research (ICMR), India.

**Notes**

Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***A global perspective on sustainable intensification research***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2M1-JCWX-C26B-00000-00&context=1516831)

Nature Sustainability

April 2020

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**Section:** Pg. 262-268; Vol. 3; No. 4; ISSN: 2398-9629

**Length:** 5748 words

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**Body**

Main

In the broadest sense, sustainable intensification (SI) seeks to increase crop and livestock yields and associated economic returns per unit time and land without negative impacts on soil and water resources or the integrity of associated non-***agricultural*** ecosystems. Success in implementing an SI approach is best quantified by metrics that measure system outputs (again, broad sense) in terms of: (1) yield; (2) input requirements to achieve that yield; (3) impact on soil quality defined as the capacity to support crop yields and input-use efficiencies; and (4) impact on natural resources and ecosystems affected by the production system. Hence, in addition to yield, SI must be evaluated by efficiency metrics such as yield per unit input of energy, water and ***nutrients*** rather than by the source or type of inputs (for example, organic or conventional, genetically modified organism (GMO) or non-GMO), and by impacts on a broad array of ecosystem services with particular concern for water quality and biodiversity.

The potential to achieve SI and the degree to which it is achieved can be considered from a local field or farm scale, to regional, national and global scales. At a local level, SI of small-scale subsistence farms might include judicious use of fertilizer and greater diversification with high-value vegetable crops, or addition of fishponds and livestock that utilize by-products from crop production and allow return of animal manures to help maintain soil fertility. On large-scale mechanized farms, intensification typically involves manipulating crop and soil management practices to eke out further efficiencies in capture of resources and conversion to yield. Examples include use of shorter-maturing crop varieties to allow production of an additional crop each year on the same field, improved ***nutrient*** management practices that better synchronize ***nutrient*** supply with crop demand during the growing season without excess or deficiency, conservation tillage that increases infiltration of rainfall and reduced runoff, and cover crops to recover fertilizer ***nutrients*** not taken up by the cash crop and to protect soil from erosion, to name a few. In all cases, the capacity of soil to provide water and ***nutrients*** to support crop growth must be maintained or enhanced to ensure sustainability in terms of soil quality.

The call for ‘sustainable intensification’ originally focused on the need to move beyond the seed, fertilizer and pesticide technologies that support modern, high-yield conventional ***agriculture***, towards more ‘restorative’ production systems that rely less on external inputs and more on leveraging internal resources and ecological processes to supply ***nutrients*** and control pests. Since then, justification for SI, and closely related ‘ecological intensification’, has expanded to address national and global concerns about ***agriculture***’s negative impact on environmental quality and natural resources on one hand, and need to achieve substantial increases in crop yields on existing farmland to avoid further loss of natural habitat on the other–. Of particular concern is conversion of rainforests, grassland savannahs and wetlands to crop production and the associated loss of biodiversity and soil carbon stocks, the latter contributing considerably to anthropogenic greenhouse gas (GHG) emissions. And while SI is necessary to address these challenges, it is not sufficient because success in conserving natural habitat also requires good governance, appropriate legal frameworks for land tenure, and international agreements to ensure that progress towards SI on existing farmland achieves desired environmental outcomes.

Evaluating the potential of existing ***agricultural*** systems to undergo SI at national and global scales provides insight about land, water and energy requirements to ensure adequate food supply while also addressing concerns about climate change and biodiversity. A global lens helps illuminate broad trends and drivers of future food supply and commodity prices in international markets, which in turn provides critical input to national research and development (R&D) priorities because most countries currently rely on imports to meet food demand. Effective priority setting at a national scale identifies the crops, cropping systems, regions and technologies most likely to advance SI given endowments of climate, soil and water resources.

Global food security on a razor’s edge

After years of relatively stable and declining prices for the world’s major staple food crops, the new millennium has brought considerably more turmoil in commodity markets. Since year 2000 there have been three episodes of abrupt spikes in prices of major staple grains compared to much greater price stability during the preceding two decades (Fig. ). In each case relatively small deficits in global food supply attributed to drought, heatwave, flooding, or a combination of these stresses in one or more countries caused international commodity prices to increase by 50% or more. Accompanying these price spikes were episodes of political unrest in countries dependent on imports,. Although export restrictions imposed by a few countries in response to production shortfalls and expanded biofuel mandates helped amplify these price spikes, in each case the triggering event was a grain production shortfall representing a relatively small share of global grain production.

Price trends of the major cereals from 1980–2018.

***Data*** source: World Bank international monthly price ***data***, under a Creative Commons License CC BY 4.0.

In addition to vicious price spikes, other evidence of a tenuous global food supply includes rapid increase in land used for crop production and abrupt slowing, and sometimes complete stagnation, in the rate of yield increase on existing farmland. For example, from 2002–2014, which includes the most recent available ***data***, expansion of harvested crop production area increased at the fastest rate in human history (Fig. ). The staple crops included in this analysis provide more than 75% of all calories in human diets, either directly consumed or as fed to livestock and fish for human consumption. Of these, maize, rice, wheat and soybean are the most widely grown and are responsible for about 70% of the increase in crop area since 2002, and most of the increase is due to conversion of natural ecosystems to farmland.

Trends in global harvested area of the major staple food crops and of the four most widely grown crops.

***Data*** for the major stable food crops are shown as red triangles and ***data*** for the four most widely grown crops (rice (R), wheat (W), maize (M) and soybean (S)) are shown as yellow triangles. Regression coefficients were obtained from piecewise, linear regressions updated from Grassini et al.. Staple crops include all major cereal, oil, sugar, pulse, sugar, fibre, tuber and root crops. Figure adapted with permission from ref. , Springer Nature Limited, under a Creative Commons License CC BY 3.0.

The fact that so much of this increase comes from production of just four crops attests to powerful demographic forces associated with economic development in the world’s most populous countries of Asia, Africa and South America. Rising incomes leads to greater consumption of livestock products and higher per capita grain consumption, much of which is used for livestock production. And these trends are not likely to change over the next 30 years as billions more join the ranks of the global middle class and can afford a more diverse dietary fare that includes meat and dairy. Hence the call for reducing meat consumption as a means to lower ***agriculture***’s contribution to climate change, is not relevant to those of low and modest incomes who currently eat very little meat, and who represent the vast majority of new mouths to feed at the global dinner table in 2050.

Although global average yields of major food crops are still increasing at linear rates, relative growth rates are decreasing due to the tyranny of linear increase, which gives declining relative rates as average yields rise (Fig. ), and slowing or plateauing yields in many of the world’s major breadbaskets (Fig. ). Examples of yield growth stagnation include wheat in northern Europe (accounting for 20% of global production) and rice in California (USA), while considerable slowing can be seen in yield trends of rice in China (accounting for 30% of global production). In each case, slowing yield growth occurs in countries with highest yields due to diminishing returns on investments in yield-enhancing inputs and technologies as average farm yields approach biophysical limits on yield potential determined by climate, soil and water supply. If yield growth follows current trajectories, projected food demand will not be met without large expansion of crop area, continuing or even accelerating the trends seen in Fig. .

Yield trends of major food crops.

a, Global yield trends of major food crops: maize, rice, wheat, and soybean. Inset shows relative yield gains, calculated as the ratio of linear rate of yield gain and trend-line yield in a given year. b, Yield trends in regions with slowing yield growth (rice in China) or yield plateaus (rice in California, USA, and wheat in northern Europe). Piecewise linear regression was used to obtain best fit to the ***data*** following Grassini et al..

Taken together, abrupt spikes in prices of major food crops associated with small temporary decreases in global production, and explosive expansion of crop production area are symptoms of a global food supply on a razor’s edge of sufficiency. Hence the urgency to achieve rapid SI of ***agriculture*** in general, and of staple food crop production in particular, in tandem with appropriate policies and institutions to support it.

Current global SI research portfolio

The most visible published science on SI, as quantified by citation activity on Google Scholar under the term ‘sustainable intensification’ ([*https://scholar.google.com/*](https://scholar.google.com/)), is centred on four main thrusts. The first calls for an expanded SI scope to include “adopting practices along the entire value chain of the global food system that meet rising needs for nutritious and healthy food through practices that build social–ecological resilience and enhance natural capital within the safe operating space of the Earth system”. Additional SI-relevant objectives have been proposed including animal welfare, viability of rural communities, sustainable development, adequate and equitable access to food, and food sovereignty,. These extensive views seek eradication of hunger and improved human nutrition, as well as environmental performance defined within concepts of safe operating space, multi-functional landscapes, performance goals of net zero GHG emissions, very low or zero expansion of ***agriculture*** into remaining natural ecosystems, zero loss of biodiversity, drastic reduction in excessive use of N and P, major improvement in water productivity, and safeguarding of environmental water flows and groundwater quality. Addressing these multiple SI dimensions requires research that robustly links environmental performance at the level of a single production field or farm, with aggregated impact from thousands of fields and farms on non-***agricultural*** ecosystems such as rivers, lakes, estuaries and coastal biomes. While general guidelines on planetary boundaries are suggested, specific thresholds for individual farms and cropping systems remain poorly defined. Also required is a capacity to link biophysical SI performance in terms of increased food production and environmental stewardship to social benefits such as improved human health, poverty reduction and integrity of rural communities.

A second thrust focuses on improving crops and cropping systems in low-income developing countries of Sub-Saharan Africa and Asia where current yield gaps are large. And while sustainable intensification is relevant to these regions, the scientific challenge is muted by the fact that existing production systems are very low yielding because they receive few inputs of fertilizers, improved seed and pest control measures, and thus have undergone very little intensification. In many cases the major constraint is soil degradation caused by inadequate ***nutrient*** inputs and little return of crop residues to maintain soil organic matter. Hence it is possible to achieve substantial progress towards SI with little danger of negative environmental impact through use of existing technologies such as judicious use of fertilizer and improved crop cultivars with greater resistances to drought and pests. Gaining widespread use of these inputs requires policies, markets and infrastructure that support adoption by smallholder farmers. At some point, however, gains from this approach reach a level at which more aggressive intensification is required to sustain yield gains, such as use of greater amounts of fertilizer inputs and proactive pest management tactics to control insect pests, weeds and diseases. At this point, the challenge of dealing with planetary boundaries comes into play, including more radical changes in the cropping systems themselves.

A third, and growing, body of SI literature calls for a shift to greater diversity of crops and cropping systems as a means to improve human nutrition through production of more nutritious crop species than the primary cereals, and because greater crop diversity can sometimes reduce risk, improve soil health and reduce need for fertilizer and pesticides,. While such work may be relevant for specific situations and local conditions, its global relevance can be questioned because it fails to recognize the reasons why the current human food supply relies so heavily on a small number of crops, and the fact that much of the developing world depends on grain imports to meet basic food needs. Indeed, our globalized food system is tuned to the inherent characteristics of the major cereal and oilseed crops because they are easily dried and stored for long periods of time, easily transported over long distances, and have low energy requirements for processing and cooking when used directly as human food (especially for maize, rice and wheat). Low energy requirements for processing and cooking represent an important quality-of-life benefit for low-income families who rely on daily ***collection*** of firewood for cooking fuel. In addition, these four major crops produce higher yields of calories, protein and oil per unit time, light, water and ***nutrient*** inputs than most other crop species. And as previously mentioned, rapid economic growth in the world’s most populous developing countries supports rising income, which in turn is highly correlated with per capita consumption of meat, dairy and fish. Rapid increase in demand for these foods cannot be met by traditional, small-scale livestock production systems, so large-scale livestock feeding operations fill the gap and require enormous amounts of feed grains and high-protein seed meal. While less intensive, lower yielding, more diverse production systems may offer local environmental benefits, there are trade-offs if widely adopted due to indirect effects of land clearing elsewhere to meet food demand in global markets,.

A fourth thrust includes work that seeks to establish metrics that measure progress towards SI at the field or farm level–. Most studies of this kind focus on metrics associated with input-use efficiencies for fertilizers, energy, and water due to lack of well-defined environmental performance thresholds. In addition to these yield and efficiency metrics, a recent study of maize systems in Malawi included risk of crop failure, probability of food sufficiency, and ratings of crop and soil management options by women, all of which are important considerations for smallholder farms in most countries of Sub-Saharan Africa.

No time to waste in research prioritization

The combined impact of slowing yield growth in the world’s major breadbaskets and rapid expansion of crop production area puts our global food system on an unsustainable path. Whereas only 13% of the increase in global production of soybean, maize, rice and wheat came from expansion of harvested area from 1980–2002, area expansion contributed most of the increase from 2002–2014 (Fig. ). These trends are clearly not consistent with SI goals and suggest an urgency in the quest to achieve SI at a scale that can have global impact. At issue is whether the current global R&D portfolio is up to the task and how to monitor progress. The answer depends on assumptions about the time frame, magnitude of food demand increase that is needed, and required improvements in environmental performance. The time frame in which solutions are needed has a large influence on research prioritization because the time required to develop new technologies and farming approaches differs depending on the type of research undertaken. We suggest a time frame consistent with the demographic transition to a global population growth rate approaching zero, which is projected to occur by mid-century, 30 years from now.

Contributions to global supply of major food crops from yield gain on existing crop land (green) or expansion of harvested crop production area (brown) in two periods.

Increases in production, area and yield are based on 3-year averages centred on initial and final years for each period. We assume yield levels of new crop area in a given period are the same as yields on existing crop land, which may overestimate contributions from crop area expansion. Mt, million metric tons. ***Data*** from ref. .

The magnitude of increase in food supply and the types of food that comprise human diets determine the crops and cropping systems that will be needed. The most likely scenario is a food demand increase that follows historical trajectories in income growth and diets, and the relationship between the two. Tilman et al. use a robust approach to estimate food demand under this ‘business as usual’ scenario, which represents a 1.55% annual rate of increase. This rate is well above current yield growth rates of about 1.0–1.2% for the major food crops (Fig. ). Assuming a more conservative 50% increase in food demand over the next 30 years from 2020 to 2050 means that yields of the major food crops must accelerate by about 30% from current levels to meet demand on existing farmland. The magnitude of acceleration, however, can be reduced through expanded use of cropping systems that produce more than one crop per year on the same field to give a substantial increase in total production without a yield increase per se,.

Given a 30-year time frame, ‘quantum leap’ innovations in genetic improvement and development of new crops and cropping systems are unlikely to have a large impact on SI over this period. For example, breakthroughs from genetic modifications to give large improvements in complex traits like photosynthesis, nitrogen-use efficiency and drought resistance require decades of work underpinned by large commitments of financial resources and success is highly uncertain. Recent examples of large investments by the private sector in a transgenic solution to drought resistance documents the high risk inherent to this approach. And while transgenic crops will play an important role to improve crop disease and insect resistances and nutritional quality, genetic engineering will not likely produce quantum-leap technologies for increasing complex traits like yield potential, nitrogen-use efficiency and drought resistance because these traits are controlled by a large number of genes with trade-off penalties associated with only optimizing a few of them. Fine-tuned manipulation of multiple genes that control intricate biochemical and physiological processes is currently beyond capabilities of genetic engineering. Similarly, development of new crops and cropping systems that achieve widespread adoption at a globally relevant scale is a long-term proposition. Indeed, there have been no globally important new crops or cropping systems developed in the past 40 years since the introduction of double-crop rice and rice–wheat cropping systems made possible by the early maturity ‘miracle’ rice and wheat cultivars that initiated the green revolution in the 1960s, or introduction of soybean to the Brazilian Cerrados in the 1970s.

Although quantum leaps are unlikely, we can expect continued incremental yield gains from genetic improvements in resistance to abiotic and biotic stresses and fine-tuning crop maturities to fit changing climate using brute-force breeding programs guided by precision phenotyping, genomics and genetic prediction methodologies linked to robust crop simulation models. Likewise, further intensification through production of more than one crop per year on the same field to give substantially higher total annual yield is made possible by adoption of shorter-maturing cultivars and mechanized tillage and harvesting operations in systems that are currently labour intensive, which includes most low-income developing countries. Longer growing seasons from warmer temperatures under climate change and high-speed precision planters promise considerable expansion of double-cropping in large-scale mechanized systems where rainfall or irrigation provides sufficient water supply for an additional crop. In cool temperate climates, earlier sowing dates permitted by warming temperatures give incrementally higher yields due to longer growing seasons coupled with the use of crop cultivars with later maturity,. ‘Orphan’ crops such as cassava, sweet potato, sorghum, millet, and some grain legumes with large yield potential and efficient use of water and ***nutrients*** may have potential for contributing to SI at national and global scales if there is demand for such crops in the marketplace and processing, storage and shipping technologies are available to minimize waste and spoilage.

In addition to an acceleration in total food production on existing farmland, a large reduction in negative environmental impacts is also needed. The most appropriate research agenda to address this challenge depends in large part on the types of negative environmental externalities addressed and the magnitude of reduction required. Here we propose a 50% target for improvements in water, nitrogen, and energy-use efficiencies coupled with a similar magnitude of reduction in soil erosion and GHG emissions. Although negative impacts from ***agriculture*** ultimately must fall below critical environmental thresholds based on robust water quality, emissions and biodiversity standards yet to be determined, the proposed 50% reduction provides a reasonable initial target for research prioritization purposes. It is notable, for example, that a 50% decrease is consistent with estimates of the N load reduction required to address the hypoxia problem in the Gulf of Mexico due to N losses from ***agriculture*** in the US Mississippi River watershed. Promising component technologies to improve environmental performance include smart fertilizers that provide adequate ***nutrient*** supply with minimal environmental losses, cover crops that recover ***nutrients*** at risk of loss and improve soil quality, robotic pest control that replaces chemical biocides, strategically placed buffer strips and biofilters that remove pollutants from runoff, and continued increases in adoption of conservation tillage that maintains soil coverage and reduces erosion.

Although SI goals are relevant across spatial scales and cropping systems, the means are not. Hence effective R&D prioritization requires identification of specific systems, crops and geographies with greatest potential to contribute to SI goals. A scenario that requires a 50% increase in food supply by 2050 reduces the degrees of freedom in terms of crops and cropping systems to be considered because establishing new crops and cropping systems is not likely to occur at scale within the next 30 years. Hence, we would argue that major emphasis should be placed on SI of the crops currently in greatest demand and which are responsible for most of the global expansion in crop production area. On the other hand, a survey of food security researchers suggests it might be possible to reduce food demand increase through decreased consumption of livestock products in high-income countries, reduced food losses and waste along the food chain from farm to consumer, and reduced use of human-edible foods for biofuel production. Under a scenario in which food demand increase to 2050 is halved, from 50% to only 25%, the current annual rate of gain in crop yields of 1–1.2%, as shown in the insert of Fig. , is roughly adequate to meet 2050 demand without a large expansion of crop production area. Likewise, this slower food demand growth scenario allows greater degrees of freedom in the types of crops and cropping systems to meet that demand.

Once priority crops and cropping systems have been identified, selection of regions with greatest potential for contributing to SI becomes an issue. Yield gap analysis that quantifies the difference between current average farm yields and yield potential provides insight about where greatest gains in yield are possible on existing cropland, and the reliability of those yields due to variability in weather. Yield gap assessments intended to inform research prioritization require adequate spatial resolution and agronomic relevance, which in turn depend on a robust ‘bottom-up’ spatial aggregation approach and location-specific ***data*** on soils, climate and cropping systems–. Assessments based on ‘top-down’, gridded spatial frameworks without location-specific agronomic detail are not reliable for research prioritization purposes at regional or national scales.

Gaps in the global research portfolio

There is a strong scientific consensus on three points. First, that meeting food demand for approximately 10 billion by mid-century in a sustainable fashion is one of humanity’s greatest challenges. Climate change further augments the magnitude of this challenge. Second, that SI is the path to meeting that challenge because it minimizes the pressure for further conversion of natural ecosystems to farmland. Third, that yield, the nutritional value of that yield, and environmental performance metrics are the yardsticks by which SI is measured rather than by the farming approaches or types of inputs used to achieve them. Given this remarkable degree of agreement, the lack of vigorous discussion about scope and focus of national and global SI research portfolios is peculiar, especially because we are well behind the curve in terms of achieving production increases on existing farmland and reducing negative environmental impacts. As a means to promote this dialogue, we have attempted to characterize the major foci of the current global SI research portfolio and the factors with greatest influence on research prioritization. Here we attempt to identify gaps in that portfolio that need filling.

Effective research prioritization is like betting on horses at the racetrack to increase chances of selecting winners. Largest bets are made on horses with best odds of winning, and smaller bets on horses with poorer odds, where the ‘odds’ represent a composite rating determined by cost of performing the research, probability of success, time frame to produce technologies ready for widespread adoption by farmers, and the scale of potential impact. The ‘odds’ are also tempered by assumptions about magnitude of expected food demand increase and environmental standards. Because several of these composite rating factors are somewhat subjective and rely to a large extent on expert opinion, it is wise to spread out investments on more than a single horse with highest odds.

As we see it, the most likely scenario is that the global food system in 2050 becomes increasingly globalized and trade-dependent due to the demographic weight of urbanization, which is expected to rise from 55% of global population today to nearly 70% by 2050. Therefore we see the ‘business as usual’ scenario as the odds-on favourite by a large margin, which means greatest emphasis on: (1) accelerating SI of current major crops and cropping systems in the world’s most important breadbaskets; (2) regions with large upside potential due to endowments of favourable climate and good soils that support high and stable yields as can now be identified by yield gap analysis,; and (3) expansion of irrigated ***agriculture*** in regions with sufficient renewable water supply to support it, such as some regions of Sub-Saharan Africa, and South America.

Although there is considerable investment in component technologies to support SI of current major crops and cropping systems, especially in the private sector, there is little research on putting the components together in viable production systems, and in quantifying SI potential in terms of both production and environmental performance in farmers’ fields rather than small manicured research plots. Such systems-level research would include assessing environmental impacts at landscape and watershed scales, which represents a critical missing link in the current global portfolio. Also missing are robust metrics to monitor environmental performance that simplify on the far side of complexity. The nitrogen balance metric, which represents the difference between nitrogen inputs and removal from a production field or farm, is an example of such a metric. Water productivity, quantified by the amount of grain produced per unit of water supply, is another,. Robust and parsimonious metrics for monitoring biodiversity and soil health, and the scale at which to measure them, remain elusive.

New agronomic research methods are needed to accelerate innovation in identification of best management practices for a given crop, soil and climate combination. Traditional replicated field experiments using standard statistical designs are not up to the task because they have trouble evaluating more than two or three factors at once. In contrast, farmers must fine-tune and optimize 10–20 crop and soil management factors to achieve yields that approach yield potential, and the manner in which one factor is implemented influences the outcome from each of the other factors. Here the term ‘management factors’ is used in the broad sense to include crop rotation, cover crops, tillage method, seed treatments, sowing dates, plant population, weed control measures, fertilizer application rates, timing, placement and formulation for all essential ***nutrients***, use of manure or compost, insect and disease control measures, and in irrigated systems—irrigation method, amounts and timing. Moreover, management options and optimal combinations of practices change rapidly as new technologies come to market. Farmer-reported ***data*** on management practices used in their fields and associated Global Positioning System (GPS) coordinates make it possible to deal with this complexity by classifying each production field into a cohort group with sufficient similarity in soil type and climate that a given management practice, or combination of practices, would be expected to perform similarly across all fields in that category. Use of straightforward ***statistics*** can then identify the combination of practices that perform best across a given cohort group of fields, which overcomes the constraints of traditional agronomic research because each farmer’s field represents an ‘experiment’. For example, optimal management practices can be identified by the practices used in fields that achieve highest yields for a given climate and soil cohort group (for example, the top 10% highest-yielding fields), and the statistical power of identifying these combinations is greatly increased because cohort groups often contain many thousands of fields,. Farmer concerns about privacy and not sharing in the value obtained from their ***data*** could be overcome by establishing farmer-controlled ‘***data*** cooperatives’ whereby those who contribute ***data*** receive an annual report benchmarking performance of each of their fields versus all other fields in the same soil and climate cohort group, as well as the suite of management practices used in fields that achieve highest yields, input-use efficiencies, and associated environmental performance metrics.

Although achieving SI to ensure global food security by 2050 is a massive scientific challenge, it is not beyond reach if there are well-prioritized national and global R&D agendas with a ruthless focus on the dual objectives of achieving large increases in yields on existing farmland coupled with substantial improvement in environmental performance that adequately protects natural resources, environmental services and minimizes GHG emissions. A 50% yield increase on existing farmland in tandem with a 50% decrease in negative environmental externalities provide useful initial targets for establishing national SI research portfolios. The required science must come from a wide array of disciplines including basic and applied sciences that extend well beyond traditional ***agricultural*** sciences to embrace computer and computational sciences (including ‘big ***data***’ analytics), landscape ecology, and molecular biology to name a few. But achieving the required degree of SI in national and global food production systems is only one piece of the food security challenge; it must be complemented by social, political and economic conditions that ensure access, affordability and adequate nutrition for all. While R&D on the biophysical attributes of SI is necessary, it is not sufficient because there is critical need for appropriate policies, institutions and trade agreements to ensure that successful SI in terms of production and environmental goals leads to land sparing for nature and an affordable and nutritious food supply for all,,. Regardless of scope and scale, one thing is clear: without SI in the strict sense of increasing crop yields on existing farmland while substantially reducing negative environmental impacts, it will be difficult to achieve a food-secure world without considerable loss of biodiversity and accelerated climate change. Hence the importance of adequate investment and effective R&D prioritization to reach the required degree of SI in food production systems that contribute most to human food supply.

**Notes**

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**Load-Date:** May 3, 2023

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[***Quantifying flight aptitude variation in wild Anopheles gambiae in order to identify long-distance migrants***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H841-F129-P1WR-00000-00&context=1516831)

Malaria Journal

July 2020

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**Section:** Vol. 19; No. 1; ISSN: 1475-2875

**Length:** 7013 words

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**Body**

Background

The long-distance migration (LDM) of insects [–] has provided primarily drawbacks to the economy, human ***agriculture***, and health []. For example, LDM has had impacts on food security [, –], public health [–], and even the transfer of ***nutrients*** by migrating insects [–]. Here, migration is defined as the persistent movement of individuals not driven by immediate cues for food, reproduction, or shelter, and which has a probability to land the migrator in a new environment suitable for survival/breeding [, , ]. The primary focus of this work is with the Sahelian Zone of West Africa, where mass seasonal migrations of pest insects, such as grasshoppers and pyrrhocorid bugs, into- and back out of the Sahel in Mali and Niger have been described [–]. These migrations follow cyclical shifts in wind direction as the Inter-Tropical Convergence Zone (ITCZ) moves north during March–August, then south during September–February, with the migrants taking advantage of ephemeral, but seasonally available, dependable habitats. However, because it is easier to notice immigration into areas depleted of conspecific populations, many other cases of insect migration have likely been discounted.

Anecdotal evidence has suggested that mosquitoes could also engage in long-range wind-assisted dispersals [–]. The prevailing view has been that such movements are accidental in most disease vector species and thus are of negligible epidemiological significance [, ]. However, a recent aerial sampling study showed that in the Sahel, many species of mosquitoes, including Anopheles coluzzii, Anopheles gambiae sensu stricto (s.s.), and several secondary malaria vectors, regularly engage in seasonal flights 40–290 m above ground []. Because of the large number of migrants, most of which were gravid females, and the large distances they were able to cover, the likely epidemiological significance of these migrations are inescapable.

As a previously unrecognized behaviour in malaria mosquitoes, windborne long-distance migration raises many questions. These include: What fraction of the population migrate (i.e. are they partial migrators)? Are migrants more common in some species and under certain conditions, and if so, what might these be? What are the physiological and molecular mechanisms involved in preparing for and undertaking the journey? Addressing such questions using aerial sampling would be challenging for many insect species because they would be intercepted at a frequency of less than one per sampling night [].

Tethered-flight mills have been used extensively to characterize short- and long-distance flyers in many insect species []. These include cotton strainers (Dysdercus fasciatus, Pyrrhocoridae) [], corn leafhoppers (Dalbulus maidis, Cicadellidae) [], the brown marmorated stinkbug (Halyomorpha halys, Pentatomidae) [], and Buprestid beetles [], facilitating investigations to address questions such as those mentioned previously. However, despite their intuitive appeal, flight mill results have also been reported to be at odds with expectations in species with well-established migration [–]. Thus, the approach has its merits and drawbacks [, , ] and predicting when it would be useful is not always clear. Additionally, while flight mills might be well suited for laboratory studies, they can be challenging in field experiments. Here, a novel assay was developed to measure the flight of tethered mosquitoes under field conditions using a fixed tether (non-rotary) and sound recordings to monitor flight. As previously done with flight mills, flight aptitude measures, such as total time in flight during the assay, may help distinguish persistent flight. Persistent flight, in turn, is presumably enhanced in migrants which fly considerably longer distances (= duration) than ‘appetitive’ flyers. Therefore, the aim was to estimate the fraction of strong flyers (presumed migrants) among wild mosquitoes, representing different species during different seasons. Based on population dynamics results [–], we initially predicted a high fraction of migrants during the early and late rainy season, along with a lower fraction of migrants in An. coluzzii (present in the Sahel during the dry season) compared to An. gambiae s.s. and Anopheles arabiensis (which are absent during the dry season).

Recent aerial sampling ***data*** [], which more directly reflect flight activity prompted reformulation of the predictions. Instead of predicting migrants to peak in An. gambiae and An. arabiensis in the early wet and dry seasons species, the predictions now included: (a) migration would be seen across the three species, peaking in the mid and late wet season, and (b) gravid females will exhibit greater flight than unfed mosquitoes. Finally, a morphological investigation was added to assess whether putative migrants (based on flight ***data***) exhibited a different wing morphology (i.e., size or shape), aiming to identify external features which can help in quantifying of potential migrators in a population.

Methods

Study area

Tethered-flight assays were conducted in the Sahelian village of Thierola (−7.2147 E, 13.6586 N) from August 21, 2015 until November 21, 2015 and from March 28 until September 27, 2016. During the dry season, due to a scarcity of mosquitoes in the Thierola area, assays were conducted in the rice-cultivation town of Kangaré (Selingue commune, −8.198 E, 11.644 N, 250 km SSW of Thierola) between December 24, 2015 and February 12, 2016.

In total, 114 assay-nights were conducted in the field throughout the course of 13 months during the rainy season (June–October) and during the dry season (November–May).

In both villages, flight assays were conducted indoors, within local houses that were selected for experimentation. Windows in the experimental rooms enabled limited natural light without measurable wind or air currents. In Thierola, the mean nightly (21:00 to 5:00 h) temperature throughout the rainy season was 24.5 °C (range: 20.2–32.4 °C), with a mean RH of 88.6% (range: 31–100%). During the dry season, the mean nightly temperature was 23.4 °C (range: 10.9–35.6 °C) with a mean RH of 27.3% (range: 5.0–100%). In Kangaré, the mean nightly temperature between December and February was 26.2 °C (range: 24.5–27.7 °C) with a mean RH of 29.3% (range: 20.9–63.1%).

Mosquitoes

Wild An. gambiae sensu lato (s.l.) were ***collected*** within the village, both indoors and outdoors, on the morning of a flight assay (between 07:00 and10:00 h). They were ***collected*** using aspirators and kept indoors in 1-gallon plastic cages covered with a dampened cloth. Mosquitoes were then provided water on cotton balls for hydration until 16:00 h. Before each flight assay, active mosquitoes (reacting with flight to tapping on the cage) were selected by gonotrophic stage (gravid or unfed), which was assessed by visual examination of the abdomen.

Following morphological identification [], only An. gambiae s.l. were included in the flight assays. Subsequent species identification was performed by species-specific PCR and PCR–RFLP using legs as a template []. Thirteen individuals not identified by this assay were excluded.

Wing measurements

Wing length (WL) and wing width were measured as described elsewhere []. Wings were spread under a coverslip with glycerol and photographed at ×25 magnification using a microscope (Olympus DM-4500B) coupled with digital camera (MC170 HD, Leica Microsystems, Wetzlar, Germany). For each wing, 14 specific landmarks (Fig. , i.e., vein intersections) were mapped using the tps-DIG32 2.15 software package []. Wing length was measured between points 1 and 10 (Fig. ) and wing width was calculated as the average value of the height of the three triangles formed between the landmarks (Fig. ): 1-2-13 (proximal triangle), 2-5-11 (medial triangle), and 2-12-14 (distal triangle). For damaged wings (n = 265), wing length was predicted using a regression analysis based on distances between landmarks 1 and 7 for wings with a damaged tip or based on distances between landmarks 4 and 10 for wings with a damaged base. Regression models showed that these predictors accounted for > 95% of the variation in wing length based on intact wings.

Wing of Anopheles gambiae s.l. (×25 magnification); Landmarks (14) denoted by numbers. Black dot-dash line represents the wing length between landmarks 1–10. Wing width was the average value of the height of three triangles formed between landmarks: 1-2-13 (proximal triangle, black), 2-5-11 (distal triangle, red), and 2-12-14 (medial triangle, blue). Scale bar = 1 mm

Tethered flight assay

Individual mosquitoes were gently aspirated from their cages and transferred into a 1.6 mL microcentrifuge tube with the bottom removed and replaced with muslin netting. These tubes were then inserted into a 50 mL Falcon tube containing a cotton ball with 2–3 drops of diethyl ether (Cat. No. 673811, Sigma-Aldrich, St. Louis, MO) at the bottom. Mosquitoes were anesthetized by exposure to the ether-vapor rich environment for 3–4 s, then swiftly placed, wings down, under a dissection stereo-microscope (Zeiss Stemi 2000-C. Carl Zeiss Microscopy, Germany). Entomological pins (Morpho No.3. Ento Sphinx, Czech Republic), with the sharp ends clipped off, were then bent twice at 90° to result in a square bracket shape. The tip-end of the pin was lightly dipped in glue (Elmer’s, Glue-All E1322, Atlanta, GA) and gently pressed on to the ventral side of the posterior abdomen (covering the posterior half of the abdomen). Meanwhile, the other end was threaded through the base of a disposable 10 μl pipette tip with the nozzle cone (dispensing end) clipped off (Fig. a). Tether pins were cut to size and bent, enabling all the mosquito legs to remain suspended in the air throughout the assay. This, in turn, prevented tarsal contact and flight cessation. Tethered mosquitoes were allowed 2 h to fully recuperate from the anesthesia before the flight assay, during which time their fore legs were allowed to rest on a folded piece of paper (‘leg-rest’). This ‘leg-rest’ provided tarsal contact and prevented flight before the assay (Fig. b).

Tethered female Anopheles gambiae s.l.a Entomological pin attached to ventral side of posterior abdomen of the mosquito (a; right), allowing unobstructed flight (a; left). Bottom part of pin inserted into clipped 10 µl pipet tip as a base. b Tethered mosquitoes in recuperation time before assay start, fore legs resting on folded paper for tarsal contact preventing flight. c Tether flight hive of 18 flight tubes housed inside soft (mattress) foam for surrounding sound muffling and external cue reduction. Each flight tube microphone connects to an individual sound recorder. ci Tethered female inside flight tube (polystyrene prototype, not used in the experiment); tethered mosquito construct attached on to double-sided foam tape with microphone (black) in backdrop. Photos by: RF (a and ci) and ASY (b and c)

At the end of the recuperation time, tethered mosquitoes were inserted into individual flight tubes (50 mL Falcon®, Corning, NY, USA) housed within a polyurethane foam hive (foam mattress) for soundproofing and environmental cue reduction (Fig. c). Tether constructs (mosquito, pin and base; Fig. a) were secured onto a small piece of double-coated urethane foam tape (Cat. No. 4026. 3 M®, St. Paul, MN) to fasten them at 1 cm inward of the flight tube edge. Each flight tube housed a small microphone (ME-15, Olympus America Inc., Center Valley, PA, USA) attached to a portable voice recorder (VN-5200PC, Olympus America Inc., Center Valley, PA, USA) (Fig. c and ci) to record flight sound.

Flight sound extraction

Tethered mosquitoes were recorded over a 10-h period starting at 21:00 h; sound recordings were then downloaded and read using Audacity 2.1.2 open-source software []. Flight bouts (episodes of flight) were identified visually in spectrogram view (Additional file : Fig. S1a) and uncertain flights were confirmed by listening to the flight sound recordings. For each flight bout, start time and duration were manually logged into a Microsoft Excel® spreadsheet. Since the shortest time frames measured by the software were 1-s long, all flight bouts shorter than 1 s were inserted into the database as 1 s long bouts. In total, 216 individual mosquito recordings from 47 different assay-nights were extracted manually. Subsequently, Raven Pro 1.5 Interactive Sound Analysis Software [] was used to detect and extract flight bouts from the sound files. This software, by utilizing a Band Limited Energy Detector (BLED), estimates the background noise of a signal and uses this information to find sections of the signal exceeding a user-specified signal-to-noise ratio (SNR) threshold in a specific frequency band during a specified time []. BLED outputs were verified audibly or visually in spectrogram view to rule out false positive flight bouts (Additional file : Fig. S1b).

All 8-h long sound files (approximately 140 megabytes each) were split into four sections before analysis in Raven Pro 1.5. This allowed for modification of the sound detector (BLED) and thus adjustments for changing background noises throughout the night (e.g., filtering out background noise produced by passing vehicles, electricity generators, crickets, farm animals, rain, etc.), as well as to ensured sufficient computer processor memory for the BLED runs. Although the Raven Pro software detectors picked up flight bout durations as short as 0.01 s, flight bouts separated by rest periods < 1.45 s (Audacity counted values above 1.5 s as 2 s long) (12% of samples) were pooled as continuous flight bouts to ensure consistency with the manual extraction method (see above). The resulting flight duration values were essentially identical to the original values in total, mean, and longest flight, while also consistent with the manual ***data*** with respect to flight bouts.

Flight bout records produced by Raven Pro were exported as text files (.txt), which were then read into a singular sound database (including manual flight extraction files) using R-Studio (The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request).

***Data*** processing and analysis

The ***data*** was trimmed to the interval of 21:00 h to 05:00 h, in an effort to avoid shorter recordings due to battery failure on some of the nights. However, flight bouts beginning before 05:00 h and continuing after this time were included in full.

To characterize flight aptitude of individual mosquitoes, their total-flight duration between 21:00 h and 05:00 h (sum of all flight bouts per mosquito), longest flight-bout duration, and the total number of flight bouts per mosquito were computed. Assuming that long-distance flyers would exhibit much higher values in at least one of these flight measures, when compared to the majority of the population, median-based robust ***statistics*** were used; a method often used to detect outliers based on the distance of a value in units of the median absolute deviation (MAD). Unlike the mean and the standard deviation, the median and MAD are not sensitive to extreme outliers; as a result, they are considered “robust” and better represent the population without being excessively skewed by extreme values. For these reasons, they are often used to detect outliers [–]. Following conventional guidelines, the threshold for outlier detection was set as follows: Values > 3.5 MAD units from the median were considered as “High Flight Activity” (HFA) and values < 3.5 MAD units from the median were considered as “Low Flight Activity” (LFA), or short-range flight. Unless a population is observed to be “on the move”, as are migratory swarms of locusts [] or monarch butterflies [], it was assumed that the fraction of individuals expressing migratory behaviour at any given moment was small [–, , ]. This assumption is based on previous Mark-Release-Recapture (MRR) studies, which suggested that a sizeable proportion of the population remain near the area where they were marked; moreover, these studies suggest that the duration of the migratory phase lasts only a few days and is typically shorter than the non-migratory phase, which can last several weeks or months [, ]. These findings underscore the reasons behind identifying mosquitoes with extremely high flight aptitude values as putative long-distance migrants.

Results

A total of 707 individual mosquito recordings (including the manual extractions) from 114 assays were included in the analysis (Table ). Individual flights lasting longer than 10 min were recorded in 46 mosquitoes, while flights exceeding 30 min were recorded in 12 mosquitoes. Total flight ranged 1–16,107 s with a mean total of 1257.2 s.

Mosquito samples by season, gonotrophic state and species, for which flight ***data*** was ***collected*** and analysed

| **Seasons** | **Gonotrophic stage** | ***An. coluzzii*** | ***An. arabiensis*** | ***An. gambiae*** | **Total** |
| --- | --- | --- | --- | --- | --- |
| Dec?Feb | Gravid | 62 | 0 | 2 | 64 |
| Unfed | 2 | 0 | 0 | 2 |  |
| Mar?Apr | Gravid | 31 | 0 | 0 | 31 |
| Unfed | 0 | 0 | 0 | 0 |  |
| Jul | Gravid | 75 | 0 | 3 | 78 |
| Unfed | 0 | 0 | 0 | 0 |  |
| Aug?Sep | Gravid | 125 | 10 | 62 | 197 |
|  | Unfed | 30 | 1 | 8 | 39 |
| Oct?Nov | Gravid | 114 | 95 | 76 | 285 |
| Unfed | 5 | 5 | 1 | 11 |  |
| Total |  | 444 | 111 | 152 | 707 |

Nightly flight activity and identification of putative long-distance flyers (LDMs)

To determine if flight activity was concentrated in certain parts of the night, we examined three indices, namely (1) number of hourly flight bouts, (2) longest flight bout, and (3) total hourly flight (across species, season and gonotrophic state) (Fig. ). To consider possible differences in nightly activity between appetitive and strong flyers, we evaluated both the median and 90th percentile of each flight aptitude index.

Nocturnal flight activity. Hourly flight bouts and total hourly flight across all 707 mosquitoes, (across species, season, and gonotrophic state). Hourly flight activity (flight aptitude) through the night showing the median (left column) and the 90th  %il (right column), representing trends of most mosquitoes and higher flight activity mosquitoes respectively. The 95% confidence interval of each hour (based on bootstrapping) not shown in full to emphasize the nightly trend

Overall, there were no significant peaks of activity identified in the hourly flight ***data***. Variation, as measured by hourly 95% confidence intervals, was also found to be non-indicative of clear modality. Although there was a mild modality, suggesting elevated total flight and flight bouts between 11:00 and 02:00 h (but not in longest flight), this modality was not found to be statistically supported by the 95% CI which overlapped widely. It was concluded that the flight activity was spread homogenously throughout the assay time and used the full length/duration (21:00–05:00 h) to measure flight aptitude.

Identification of putative migrants

Considering all recorded mosquito flights (n = 707 mosquitoes), the asymmetric distributions of each flight aptitude index revealed a long right tail. This observed distribution corresponds to existing literature, with frequency distributions of laboratory-measured bouts of flight [, ] showing a majority of individuals making short flights and a only few making long ones (Fig. ).

Flight aptitude index distributions: longest flight (a), total flight (b), and flight bouts (c). Flights were divided into two classes (x-axis; MAD units): LFAs; below 3.5 (left of vertical red line), and HFAs; above 3.5 (right of vertical red line) based on guidelines for outlier detection (see “Methods” section). The ***data*** are based on 707 wild female mosquitoes representing three species, both unfed and gravid females. Y-axis denotes the frequency in percent of the sample

Following previous flight behaviour studies [–, , ], the mosquitoes at the far-right tail of the distribution were suspected to represent long-distance flyers, or HFA individuals, in our study. Subsequently, differences in the proportion of HFAs among species, seasons, and gonotrophic state were evaluated.

For the most part, flight aptitude indices were significantly correlated with each other; however, correlation coefficients (Spearman) were negative (r = −0.43) between the longest flight bout and the number of flight bouts and moderately positive (r = 0.32–0.52) between total flight and other indices (Additional file : Fig. S2). The relatively low correlation coefficients indicate that each flight index conveys unique information—the negative correlation suggests that flight bouts describes “restlessness” unlike “flight persistence” that is captured by the longest flight bout and especially total flight. Therefore, all three indices were compared to determine which were more important/informative predictors of migrants.

Variation of flight aptitude by season

Seasonal variation in flight aptitude was tested on gravid An. coluzzii, as this was the only species (and gonotrophic state) found across seasons. Significant differences were most pronounced when looking at longest flight bout (P < 0.002, overall Monte-Carlo Exact test), but were also detected when examining total flight (P < 0.005, overall Monte-Carlo Exact test) (Fig. a and b, respectively). With regards to the longest flight bout index, the highest fraction of HFA was discovered in the late wet season (Oct–Nov; 39.5%), followed by the mid-wet season (Aug–Sep; 29%), early wet season (Jul; 19%), early dry season (Dec–Feb; 22%), and finally, the lowest fraction being in the late dry season (Apr; 10%, P < 0.005, 2-tailed test, Fig. a). A similar trend, albeit with smaller differences, was detected when looking at total flight, with only a single significant difference between late wet season and late dry season (P < 0.04, Fig. b). Flight bouts did not follow this pattern and showed no significant difference in the overall test (Fig. c).

Variation of flight aptitude indices by season; longest flight (a), total flight (b), and flight bouts (c). Variation in Anopheles coluzzii flight aptitude between seasons; The x-axis depicts the different parts of the year (‘seasons’); Dec–Feb and Apr represent the dry season. Jul, Aug–Sep and Oct–Nov represent the wet season. Y-axis values are percent frequencies of the HFA populations, with n above each bar. Seasonal flight aptitude comparison was carried out on gravid An. coluzzii females, the only species which had samples across seasons

Variation of FA between species

Variations in flight aptitude between species were tested on gravid females between Oct and Nov when all species were represented. Considering total flight, An. coluzzii exhibited a significantly higher fraction of HFAs (25%) than An. arabiensis (8%), with An. gambiae displaying intermediate values (17%) (Overall Monte Carlo Exact Test χ2 = 10.0, P < 0.015) (Fig. b). Contrasting tests between species showed a significant difference between An. coluzzii and An. arabiensis (Wald χ2 = 8.7, P < 0.004). Although not statistically significant, similar trends were revealed in both longest flight and flight bout indices (Fig. a and c).

Variation of flight aptitude between species (gravid females in Oct–Nov, when sample sizes were sufficient); longest flight (a), total flight (b), and flight bouts (c). Values are percent frequencies of the flyer populations, with n above each bar. Overall test is a contingency table exact test using Monte Carlo with 10,000 replicates (P-values pertain to 2-sided tests). Specific comparisons are shown were tested using contrasts in logistic regression if overall test was significant

Variation in flight aptitude between gonotrophic stages

The effect of gonotrophic stages on flight aptitude was tested after pooling the species, as well as with stratification by species (CMH test) in August–September, when the number of unfed females was suitable for such a test. These tests revealed that a significantly higher rate of HFAs among gravid females (11.2% vs. 0%, P < 0.013 Overall Monte Carlo Exact Test) was detected in flight bouts (pooled; P < 0.024, 1-tailed Fisher Exact test, and when stratified (CMH = P < 0.049, 2-tailed test) (Fig. c). However, while there were no significant differences detected when looking at the longest- and total flight indices, a consistent trend of higher HFA among gravid females was observed (Fig. a and b, respectively).

Variation in flight aptitude between gonotrophic stages; longest flight (a), total flight (b), and flight bouts (c). Overall test is a contingency table exact test using Monte Carlo simulations with 10,000 replicates. This Gonotrophic state comparison was done when on pooled species in Aug–Sep, when sample size was suitable for comparison. Prior CMH test showed that the effect was significant across species (not shown) and no heterogeneity between species was detected

Wing morphology and flight aptitude

Among the three species, significant differences in flight activity were found in An. coluzzii with regard to longest flight duration (Fig. a and d) and total flight (Fig. b and e), showing both longer (Fig. a and b) and wider wings (Fig. d and e) in HFAs (red) (Overall ANOVA; P < 0.02).

Box-whisker plot of wing length (top), and width (bottom) across species (x-axis, abbreviated species names: arab. = An. arabiensis, coluz. = An. coluzzii., gamb. = An. gambiae s.s.) in longest flight (a and d), total flight (b and c) and flight bouts (panels c and f) for LFAs (blue) and HFAs (red). Mean marked as ○ (for LFAs) or + (for HFAs). Horizontal line within box represents the median. Box bottom and top are 25th and 75th percentile, respectively, whiskers extend up to 1.5 time the inter-quartile range and outliers (‘o’ or ‘+’) represent observations that extend beyond the whiskers. Significantly larger mean and median wing dimensions in HFAs vs. LFAs indicated by asterisks on the left and right of the arrow (showing direction of increase; LFA or HFA), respectively. One tailed significance levels of P < 0.05 and P < 0.01 measured by ANOVA (left of arrow) or Median score tests (right of arrow); shown as ‘\*’ and ‘\*\*’ respectively

Allometry of wings to detect wing shape variation within HFA’s

In gravid An. coluzzii during the wet season, total-flight HFAs had wider wings when compared to LFAs, after adjusting for wing length (P < 0.035, 1-tail test) (Fig. ). No significant interaction was found between wing length and HFAs, indicating that the shape effect was monotonic with wing length. A similar trend was observed in An. arabiensis, but no significant difference in intercepts was detected, possibly due to smaller sample size.

Wing allometry in HFAs (red) and LFAs (blue) for total flight across species (the lines shown were computed based on separate linear regression models for flyer type of each species). In gravid Anopheles coluzzii during the wet season, total-flight HFAs had wider wings than LFAs after adjusting for wing length (P < 0.035, 1-tail test)

Consistent with previous studies [, ], An. coluzzii also displayed longer wings in the early dry season (December–February), when compared to other months in the year (Additional file : Fig. S3). This increase in length was isometric—in other words, it was accompanied by a proportional increase in wing width during this time (i.e. no change in wing shape).

Discussion

Recent studies on windborne migration of African malaria vectors raise new questions about this previously unrecognized behaviour, including questions regarding the fraction of windborne migrants in the population, as well as how this fraction might change across species, seasons, or ecological zones, among other factors. Identification of migrants in field experiments could help address such questions. In this study, wild mosquitoes were subjected to a novel, field-adapted tethered-flight assay, in order to separate them into mosquitoes with high flight activity (HFA) or low flight activity (LFA), employing flight aptitude indices reflecting flight persistence (i.e., longest flight duration, and total flight) and restlessness (i.e., flight bouts). Albeit not without exceptions, based on previous flight-mill studies, HFA is likely to be more common in long-distance migrants than LFA [, , , ]. Accordingly, we evaluated variation in HFA mosquitoes, as putative migrants in Sahelian populations of An. coluzzii, An. gambiae s.s., and An. arabiensis, over various seasons and gonotrophic states. Although differences between groups were moderate, consistent with our predictions, we found elevated HFA mosquitoes in the wet season and among gravid females. However, predictions regarding species variation during the wet season were less certain. Based on Dao et al. [], migrants were initially predicted only in An. gambiae s.s. and An. arabiensis; however, based on the aerial sampling of Huestis et al. [], the presence of HFAs across all three species was predicted, with higher HFAs in An. coluzzii, followed by An. gambiae s.s. Consistent with Huestis et al. [], results showed the highest proportion of HFA in An. coluzzii, with the lowest being in in An. arabiensis. Moreover, during the wet-season, An. coluzzii HFAs exhibited larger wings than conspecific LFAs.

Additional analysis indicated that wings of wet-season, An. coluzzii HFAs exhibited allometric change. Overall, these results agree with recent literature, which has found the dominance of gravid An. coluzzii flying during the wet season at altitudes of 40–290 m above ground [].

Although an ultimate ‘comprehensive flight index,’ as well as cutoff values to distinguish between long-distance migrants and appetitive flyers are yet to be found, ad hoc indices and values have been successfully used, e.g., [, , ]. This study followed flight-mill based studies seeking to identify long-distance migrant insects that often relied on (1) total flight; (2) longest flight; and (3) the number of flight bouts [, –]. In this study’s findings, the low absolute value of the correlation coefficient between the longest flight bout and flight bouts (r = −0.43, Additional file : Fig. S3, bottom-right panel) highlights both high degree of independence of these indices and a degree of distinction between exhibiting flight persistence vs. restlessness. Only 10.5% of HFA mosquitoes based on longest flight were classified as such by flight bouts (unlike longest and total flight sharing 90.3% of HFAs), reaffirming that these modalities of flights are distinct. Overall, out of six comparisons (Additional file : Table S1), HFA mosquito comparisons based on total flight revealed significant differences in five tests, whereas the same comparisons based on longest flight and flight bouts revealed significant differences in three tests and one test, respectively. This suggests that persistence of flight is a more relevant modality for long-distance migration, similar to most other studies []. Notably, the variable longest flight bout showed consistent trends with total flight in five (of six) comparisons, whereas the variable flight bouts showed consistent trends in only two comparisons (Additional file : Table S1).

Flight aptitude variation over seasons, species and gonotrophic states

Previous work in the Sahel has shown that An. coluzzii populations build up rapidly after the first rains (i.e. May–June), and decline towards the late wet season (i.e., October), presumably entering aestivation []. In contrast, both An. gambiae s.s. and An. arabiensis populations absent during the dry season build up around 6 weeks after the emergence of An. coluzzii, quickly vanishing with the drying-up of surface water. The population dynamics of both An. gambiae s.s. and An. arabiensis suggest immigration (using reliable wind systems) from southerly sources, where breeding sites are perennial. Based on these findings, minimal HFAs in An. coluzzii but elevated HFAs in both An. gambiae s.s. and An. arabiensis, were predicted to occur mostly during the wet season. Additionally, because long-distance migration in most insect species occurs before reproduction [, , , ], elevated HFAs in non-blood-fed females were expected, compared to gravid females. Unlike freshly blood-fed females which are burdened by the largest weight due to high water content of the bloodmeal, gravid females’ weight is intermediate and closer to the weight of the unfed female than to her weight when fully engorged []. Combined with the additional energy reserves that the bloodmeal offers, gravid females may be well suited to embark on long flights [, ]. There may be additional benefits to additional mass dependent on the flight modality while propelled by the wind such as gliding, soaring, which additional studies may uncover []. Finally, adding nutritional analysis with future tethered flight assays may shed light on the energetic content before and after the flight and possibly the allocation of nutritional reserves between reproduction and flight.

Overall, the results agree with the predictions based on the aerial sampling results, specifically regarding (1) elevated HFA during the wet season; (2) elevated HFAs among gravid mosquitoes; and (3) the presence of HFAs among all species, with highest flight aptitude in An. coluzzii and lowest flight aptitude in An. arabiensis. However, uncertainty remains, due to partial consistencies concerning the different flight aptitude indices, as well as coarse discrimination as a result of low statistical power among groups (Additional file : Table S1). For example, this uncertainty is reflected in the statistically non-significant differences in An. coluzzii between the early dry season (December–February) and the late dry season (March–April, Fig. ), as well as the statistically non-significant difference between An. gambiae s.s. and the other two species (Fig. ).

Wing morphometry and flight aptitude

Morphological differences between wings of HFAs and LFAs can provide strong evidence in support of migrators classification while on the ground and reveal distinct developmental program(s) for long-distance migrants. The findings show that during the wet season, An. coluzzii HFAs had a larger wing area, attributable to an increase in both wing width and length, when compared with the LFAs. These results were not confounded by variation in body size between seasons as the analysis was confined to the wet season, when no seasonal change in wing length was detected (Additional file : Fig. S3, in agreement with previous results [, ]). The larger wings of HFAs may reflect isometric increases in all aspects of body size; alternatively, it may indicate an allometric change (e.g., an increase in wing area independent of body size). This is difficult to resolve with wild, mostly gravid mosquitoes due to the fact that variations in dry weight may confound bloodmeal size (and number) with body size. However, the allometric increase in wing width (over that expected by wing length) of An. coluzzii HFAs during the wet season further supports the validity of the classification and suggests that migrants undergo a distinct developmental plan prior to adult eclosion/emergence.

Interpretation of flight behaviour

The prediction of higher flight activity during the wet season may sound counter-intuitive at first but fits with other empirical results and with theoretical expectations; No evidence to-date has shown high altitude flight in the early wet seasons (May–June). Huestis et al. [] have shown that An. coluzzii and An. gambiae s.s. were ***collected*** in altitude from late July through November, similarly to flight aptitude results presented here. As discussed in Huestis et al. [] the migration during the mid-wet season (July–September) probably follows the changing resources generated by the patchwork of precipitation that falls along the ITCZ as it sweeps through the Sahel northwards and then southwards. Unlike the early part of the season, in the later part of the wet season, i.e. October–November, the increase in elevated flight activity may represent individuals embarking on southerly, return flights before the dry season onset. Accordingly, results presented, both from altitude and the ground, support migration ‘within the Sahel’ and possibly emigration from the Sahel in October–November, when winds carrying insect southwards are more common. Additionally, these results indicate a similar capacity of these species for long-distance migration. The absence of evidence for high altitude migration during May–June may be due to the fact that during this period long-distance flight is suppressed, as conditions in Thierola are optimal, (i.e., minimal crowding, predation, competition) until local density increases (in late July when the ITCZ may well be some distance away), forming new optimal resources elsewhere. According to this hypothesis, elevated emigration will be detected in populations south of Thierola, maybe even south of Bamako, where the ITCZ (and the rains) arrives a month or so earlier.

In some species windborne migration appears to be a mandatory phase of the young adult [], however, based on the low fraction of HFA (based on total flight), the members of the An. gambiae complex are considered here as an example of ‘partial migrators’ [, ], in which the majority of individuals in the population do not engage in long-distance migration, even during times when migration peaks. Moreover, after arrival, immigrants will exhibit LFA; therefore, these results may identify only emigrants prior to their journey. Since the migratory phase may last only 1–3 days, we would expect to have only 1–2 days, at most, to capture a migrant before they embark on their journey. Thus, a large sample size is required to represent migrants among the more numerous ‘appetitive flyers’, which adds noise to the ***data*** and limits the statistical power of detecting differences or trends.

To date, no information is available concerning mosquito flight behaviour at high altitudes. Even if tethered flight assays accurately identify long-distance migrants, the flight ***data*** generated in the assay is unlikely to mirror free flight behaviour of mosquitoes at altitude. For example, the total flight duration may greatly underestimate actual flight in altitude—simulations based on aerial sampling ***data*** [] suggests night-long migratory flights in some cases. Likewise, flight-mill results may fail to exhibit flight patterns matching expectations based on migration due to technical, as well as biological reasons [, , , ]. Fair examples might include a lack of lift generation and a lack of tarsal contact, both of which may lead to unrealistically extended flight. On the other hand, the lack of sensory cues from either air movement, temperature and humidity gradients, or apparent ground movement, may curtail flights. In the present study, the flight aptitude assay relied on fixed-tethered mosquitoes placed in 50 mL Falcon tubes to partially isolate them from surrounding environmental cues. As a result, they may express intrinsically driven flight, as previously suggested in studies regarding locusts and moths [, ]. Finally, flight assays for migrant identification will be more informative when additional information is gathered on each mosquito to assess agreement with other aspects of the migration syndrome, pertaining to optimal locomotor drive in young, pre-reproductive adults, with metabolism switching between flight characteristics and ovary development [, , , , , ]. Examples of additional information might include combining ***data*** on nutritional reserves (typically elevated before migration) necessary to fuel extended flight, responses to host or oviposition site cues (typically inhibited prior and during migration) [], levels of cuticular hydrocarbons (presumably elevated prior to migration to enhance desiccation tolerance) [], and transcriptome analyses along with morphometrical analyses of size/shape of wings, thorax, and spiracles.

Conclusions

A new field-focused flight assay was developed and tested in order to identify long-distance migrators (LDM) among the An. gambiae s.l.

A year-long experiment of flight aptitude of wild An. gambiae s.l. females from the Sahel revealed that flight activity exhibited a skewed distribution, with 10-29.7% identified as putative LDMs.

Similar to findings by Huestis et al. [], the flight aptitude results revealed a higher fraction of High Flight Activity (HFA) during the wet season compared with the dry, higher HFA in An. coluzzii compared with An. arabiensis, and a higher fraction of HFA in gravid females compared with unfed females. Additionally, evidence that An. coluzzii HFAs exhibit changes in wing size and shape was found, supporting that changes in the larval habitat (e.g., crowding) induce a specific developmental pattern yielding the HFA adult.

Altogether, these results provide partial support for the utility of flight aptitude assays in identifying LDMs. Further studies should include a) optimization of the method to identify LDMs by integration of this assay with other assays that measure the “migratory syndrome” such as lipid deposits, withholding of blood-feeding, withholding of oviposition, and using the improved method for comparing geographically distinct populations for the fraction of LDMs.

**Acknowledgements**

We thank the people of the villages of Thierola and Selingue in Mali for their support of the field work. We wish to thank Drs. Don R. Reynolds, Jason W. Chapman and Christopher M. Jones for valuable discussions and comments on previous versions of this manuscript. We thank Drs. Manu Prakash, Felix Hol, Haripriya V. Narayanan and Deepak Krishnamurthy for valuable discussions on flight mechanics. We also wish to thank Samuel Moretz, André Laughinghouse, Kevin Lee, and Anish Prasanna for providing logistical support. Thanks to Dr. Xavier Martini for providing a flight mill for testing, and to Cedric Kouam and Joshua Woo for their valuable help with manuscript improvements. Finally, we thank the anonymous reviewers who provided valuable suggestions contributing to improving this paper. This study was supported by the Division of Intramural Research, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda MD.

**Notes**

Supplementary informationSupplementary information accompanies this paper at [*https://doi.org/10.1186/s12936-020-03333-2.Publisher's*](https://doi.org/10.1186/s12936-020-03333-2.Publisher's) NoteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

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May 9, 2020 Saturday

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**Length:** 11421 words

**Body**

Brussels: Council of the European Union has issued the following document:

7853/20 SV/slECOMP 1A ENCouncil of theEuropean UnionBrussels, 8 May 2020(OR. en)7853/20ECOFIN 283UEM 110COWEB 54ELARG 35COVER NOTEFrom: General Secretariat of the CouncilTo: DelegationsSubject: Draft Joint Conclusions of the Economic and Financial Dialogue betweenthe EU and the Western Balkans and TurkeyIn view of the Economic and Financial Dialogue between the EU and the Western Balkans andTurkey of 19 May 2020, delegations will find attached the Draft Joint Conclusions of the Economicand Financial Dialogue between the EU and the Western Balkans and Turkey, which were endorsedby the members of the EFC and representatives of Albania, Bosnia and Herzegovina,the Republic of North Macedonia, Kosovo\*, Montenegro, Serbia and Turkey on 4 May 2020.\* This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 andthe ICJ Opinion on the Kosovo declaration of independence.7853/20 SV/sl 1ECOMP 1A ENJOINT CONCLUSIONS OF THE ECONOMIC AND FINANCIAL DIALOGUE BETWEEN THE EU AND THE WESTERN BALKANS AND TURKEYThe Economic and Financial Dialogue between the EU and the Western Balkans and Turkey, Brussels, 19 May 2020Representatives of the EU Member States, the Western Balkans and Turkey, the European Commission and the European Central Bank, as well as representatives of the central banks of the Western Balkans and Turkey1 met for their annual economic policy dialogue2. The dialogue aims at preparing the Western Balkans and Turkey for the future participation in the European Semester.The outbreak of the Covid-19 pandemic confronts EU Member States, the Western Balkans and Turkey with similar unprecedented major public health, economic and social challenges. Participants agreed that it is crucial to maintain the economic policy dialogue in these exceptional circumstances in view of a commonly coordinated response to the crisis. Participants acknowledged the strong solidarity between the EU and the Western Balkans and Turkey they have been demonstrating by providing medical and financial assistance to fight the Covid-19 pandemic and contributing to address its socio-economic impact in the region. Participants welcomed the measures adopted by the Western Balkans and Turkey to limit the spread of the Covid-19 virus. They also acknowledged that the adoption of temporary emergency measures should be done in a transparent manner and should not undermine the principles of rule of law, democracy and fundamental rights. Participants fully supported the Western Balkans and Turkey in their decisions to allow automatic fiscal stabilisers to accommodate crisis-induced economic fall-outs in 2020. They also considered appropriate to take additional discretionary measures to cushion the negative impact on growth and employment in the short-term. Looking ahead beyond the short-term impact of the crisis, participants agreed that the economic policy dialogue should continue to play a central role for policy coordination in view of the medium-term recovery after the crisis. The macro-fiscal scenarios and part of the structural analysis presented in the Economic Reform Programmes have been strongly impacted by the Covid-19 crisis fallout. Therefore, participants concluded that this year’s policy guidance will focus on measures providing an immediate fiscal, economic and social policy response to mitigate the impact of the pandemic as well as on the transition from these short-term to more structural measures to foster the medium-term recovery. In order to build up economies’ resilience in the longer term, these measures should duly take into account the digital transformation and the green transition, in line with international commitments. It is important to duly integrate gender equality perspective in all the measures taken to foster employment, social protection and health care. Strong ownership will be key to achieve the successful implementation of the jointly agreed policy guidance.Overall, Participants underlined their commitment to this surveillance process and encouraged the Western Balkans and Turkey to foster strong recovery via further improvement of their macroeconomic, budgetary and structural policies in a medium-term perspective. The dialogue will continue in 2021, including on the implementation of these conclusions.1 Montenegro, Serbia, the Republic of North Macedonia, Albania and Turkey are candidate countries for EU accession.2 The conclusions of this dialogue are without prejudice to EU Member States´ positions on the status of Kosovo.7853/20 SV/sl 2ECOMP 1A ENTurkeyTurkey submitted its Economic Reform Programme 2020-2022 on 10 February 2020. The policy guidance set out in the conclusions of the Economic and Financial Dialogue of May 2019 has been implemented to a limited extent.The economy recovered faster than expected from the recession triggered by the 2018 sharp depreciation of the lira thanks to a strong policy stimulus and favourable external financing conditions. However, the growth momentum was interrupted abruptly by the Covid-19 pandemic, which stifled global economic activity and rendered the ERP’s macroeconomic and fiscal scenarios obsolete. As other major emerging market economies, the Turkish economy is affected by the global slowdown due to its high integration in global value chains and, additionally, because of its dependence on tourism and transport – two of the most heavily affected sectors. In this context, preserving the recent significant improvement in the external balance, which is key to sustaining macroeconomic stability, has become challenging, especially in the short run, notwithstanding accommodative policies by major world economies, low oil prices and a competitive exchange rate.Despite a limited policy space, the authorities took timely and targeted measures to cushion the impact of the pandemic on the local economy and employment. Although delaying plans to improve general government balance, fiscal measures could be expanded beyond the operation of automatic fiscal stabilisers to further enhance direct transfers to the most vulnerable groups and increase active labour market policies. A post-crisis fiscal strategy should be developed as well and, once the temporary shock dissipates and the economy has stabilised, fiscal policy should be geared towards winding down one-off and temporary measures and improving the structural balance, while simultaneously boosting productive expenditure. Improving fiscal transparency and governance would be an important step towards enhancing policy credibility.The easing cycle of monetary policy that started in July 2019 brought the ex-post real policy rate further into negative territory, while leaving the ex-ante real policy rate slightly positive up to April 2020, yet much below that of other large emerging and developed economies. Elevated global uncertainty, trade and geopolitical tensions, as well as concerns about central bank independence weighed on the local currency. The central bank has taken a wide set of liquidity measures in response to the coronavirus pandemic. As inflation and inflation expectations remain above the target, monetary policy space to further ease financing conditions seems relatively limited.Regarding financial stability, subdued economic activity, coupled with declining but high inflation and a weaker lira, has put some pressure on the debt repayment capacity of corporates, and to a lesser extent of households, resulting in a deterioration of the banking sector’s asset quality. Overall, non-performing loan ratios still remain relatively low in international comparison; however they are likely to increase amid the coronavirus pandemic as in many other countries. In this context, measures introduced earlier by the government, especially with respect to improvements in the financial restructuring legislation, are welcome but could be broadened. Overall, the banking sector appears to have sound buffers, with capitalisation well above internationally accepted minimum standards. Profitability has declined, relatively more in state-owned banks, which have led the broad-based credit recovery. The build-up of indirect credit risk stemming from the high share of corporate forex lending and external debt denominated in forex has slowed in 2019, thanks to macro-prudential measures and heightened awareness of foreign exchange risks, but given the high accumulated levels of forex debt this remains a key vulnerability.7853/20 SV/sl 3ECOMP 1A ENStructural weaknesses have been exacerbated by the Covid-19 pandemic, highlighting the strong need for structural reforms. Effective and well-coordinated structural reforms will contribute to mitigating the impact of the pandemic and accelerate the post-crisis economic recovery. The government’s policy response will be critical to shape the economy in the post crisis context. The recovery would also benefit from further efforts to tackle corruption, improve the rule of law, enhance transparency and strengthen institutions and social dialogue.As regards specific structural reforms, the main challenges posed by Covid-19 are linked to strengthening the public health sector, preserving employment and improving social protection, and improving the regulatory and institutional environment affecting businesses and providing support to the private sector. The pandemic is putting the health system under stress, and highlights the importance of covering the whole population by health insurance. In a situation of already increased unemployment levels over 2019, the pandemic is putting jobs at further risk, including in the informal sector. Social assistance and unemployment benefit schemes are further stretched due to the pandemic and are limited in providing coverage and adequate benefits to those in need.. Businesses, in particular SMEs, self-employed and small family enterprises are considerably affected by the pandemic and are in need of further urgent support, such as liquidity and further easing the regulatory and tax burdens. The effectiveness of support measures depends on good governance, coordination and inclusiveness, taking into consideration the large informal sector.Participants take note that Turkey improved compliance with respect to annual national accounts by sending population ***data*** and in balance of payments, sending quarterly international investment positions series. Turkey has also made progress in other statistical areas such as Europe 2020 indicators, annual international trade in services ***statistics***, foreign direct investment, research and development which is fully compliant and harmonised indices of consumer prices. Turkey should give priority to the transmission of excessive deficit procedure notifications, government finance ***statistics*** and further improve annual and quarterly national accounts, by also improving ***agricultural*** ***statistics*** that serves as a ***data*** source for national accounts.In light of this assessment, Participants hereby invite Turkey to:1. Increase in a transparent manner fiscal transfers to households and companies with the view to limiting the fall-out in employment. Increase growth-enhancing capital expenditure above budget plans in 2020 and in the medium term. To reinforce the medium-term sustainability of public finances, prepare an exit strategy to lower the use of one-off and temporary measures over the medium term,.2. Conduct spending reviews and implement performance budgeting as planned, in order to create space for more productive expenditure and to increase budgetary transparency and accountability. Publish the regular audited reports of the Sovereign Wealth Fund. Take preparatory steps towards publishing higher-than-annual frequency ***data*** by sub-sector on general government budget execution.3. Implement an appropriate monetary policy stance at the central bank’s own discretion to contain inflation broadly in line with the target and anchor inflation expectations, increase trust in the local currency and boost investor confidence, in particular amid the global risk-off environment evoked by the Covid-19 pandemic. Closely monitor financial stability challenges arising as a result of the Covid-19 pandemic and take appropriate action if needed. Ensure the transparency of measures taken to provide liquidity for the banking sector and support the flow of credit to the private sector. Enhance confidence in the banking sector by conducting transparent asset quality reviews, and explore further measures to mitigate the likely build-up of new NPLs.7853/20 SV/sl 4ECOMP 1A EN4. With the aim to improving the business environment, further strengthen the rule of law and the regulatory environment and improve consultation mechanisms with business organisations and social partners on relevant new legislation. In order to mitigate the impact of the Covid-19 pandemic, target state aid and small and medium-sized enterprises support programmes in a transparent manner to sectors with strong potential for economic recovery. Implement additional measures helping viable businesses to avoid insolvency.5. Extend social protection coverage and provide incentives for businesses and employees in the informal economy sector to register and to facilitate their transfer to the formal economy. Revise the Action Plan for reducing the informal economy taking into account the specific situation of migrant workers and those under temporary protection as well as the impact of Covid-19 pandemic.6. Take measures to preserve jobs including through short-time work schemes and other employment flexibility schemes, step up VET training, reskilling and upskilling, and redesign and upscale targeted employment incentives, in particular for recently unemployed workers and young people. Ensure adequate income support and social assistance for the unemployed and those at risk of poverty and social exclusion.7853/20 SV/sl 5ECOMP 1A ENMontenegroMontenegro submitted its Economic Reform Programme 2020-2022 on 31 January 2020. The policy guidance set out in the conclusions of the Economic and Financial Dialogue of May 2019 has been partially implemented.The maturing of the investment cycle had a dampening effect on economic output in 2019. The economy grew by robust 3.6% y-o-y, albeit decelerating from the 5.1% expansion recorded a year before. GDP growth was driven by a record-breaking tourist season, boosting private consumption and exports of services. However, the economic performance is set to deteriorate in 2020 due to the negative effects of the coronavirus (COVID-19) outbreak. Montenegro’s economy is strongly dependent on tourism, a key source of foreign exchange, GDP growth, and fiscal revenues. However, tourism has been paralyzed with knock-on effects on other related sectors like retail sales, transport and catering.Despite a very constrained fiscal space and modest effect from automatic fiscal stabilisers, the authorities reacted rapidly, adopting a series of measures to limit the impact of the pandemic on growth and employment, such as increasing healthcare spending, deferring the payment of taxes and social contributions and providing a credit line to help companies to improve their liquidity. The fiscal costs of the policy response together with a deteriorating economy is likely to undermine temporarily the ERP’s plan for public debt reduction. Once the temporary shock dissipates, fiscal policy should be geared towards debt reduction based on earlier plans. Improving fiscal governance and transparency would be an important step towards enhancing long-term sustainability. Montenegro lacks an independent body to ensure not only the implementation of the fiscal rules but also their transparency. Moreover, the tax administration would require designing new tools to help improving fiscal performance.The resilience of the banking system has strengthened, also on the back of some consolidation in the sector. To safeguard the progress achieved in 2019, the central bank should closely monitor financial stability challenges that may arise as a result of the coronavirus pandemic and take appropriate action where needed. Efforts in this regard should be supported by additional investment in the central bank’s supervisory capacity, by duly operationalising the bank resolution framework as well as by pursuing measures to facilitate the resolution of existing and potential future non-performing debts. Equally, the central bank should diligently work towards completing the asset quality review, apply equal standards to all banks to assure its credibility, publish its findings in a transparent manner and promptly take any measures that its results may call for.Structural weaknesses have been exacerbated by the Covid-19 pandemic, highlighting the strong need for structural reforms. Effective and well-coordinated structural reforms will contribute to mitigating the impact of the pandemic and accelerate the post-crisis economic recovery. The government’s policy response will be critical to shape the economy in the post crisis context. The recovery would also benefit from further efforts to tackle corruption, improve the rule of law, enhance transperancy and strengthen institutions and social dialogue.7853/20 SV/sl 6ECOMP 1A ENAs regards specific structural reforms, the main challenges posed by Covid-19 are linked to strengthening the public health sector, preserving employment and improving social protection, enhancing the business environment and providing support to the private sector. The pandemic is putting the health system under stress, revealing persistent under-funding and weak capacities to cope with the crisis. Despite improvements in the labour market in the past few years, the pandemic is now putting jobs at risk, including in the informal sector. Underfunded, inadequate and insufficiently targeted social assistance and unemployment benefit schemes become further stretched. The crisis has also highlighted the need to review the social protection system with the aim of improving its coordination with employment activation and its capacity to reduce social exclusion and poverty. Businesses, in particular SMEs, self-employed and small family enterprises are considerably affected by the pandemic and are in need of urgent support, such as provision of liquidity and further easing the regulatory and tax burdens. The effectiveness of support measures depends on good governance, coordination and inclusiveness, taking into consideration the large informal sector.Participants take note that Montenegro made progress in several statistical areas, namely in balance of payments (with start of compilation of the international investment position), energy ***statistics***, harmonised indices of consumer prices, foreign direct investment and short-term business ***statistics***. However, serious gaps still remain in national accounts. Montenegro should also give priority to the transmission of excessive deficit procedure notifications and government finance ***statistics*** and aim for a full implementation of the European System of Accounts 2010.In light of this assessment, Participants hereby invite Montenegro to:1. Use fiscal policy to mitigate the crisis-induced impact on growth and employment. While allowing for due reinforcement of healthcare spending during the crisis, reinforce the medium-term sustainability of public finances by limiting overall spending on wages, also by taking concrete steps towards implementing the public administration optimisation plan. Establish a fully-fledged centralised public sector employment payroll system.2. To support economic recovery, make sound cost-benefit analysis an integral part of public investment management. Take steps towards the establishment of a fiscal council, following consultation of the related options paper with stakeholders, including the EU. Introduce the electronic fiscal invoice system (e-fiscalisation).3. Closely monitor financial stability challenges arising as a result of the coronavirus pandemic and take appropriate action if needed, while developing further the supervisory capacity of the central bank. Identify and prioritise the removal of obstacles for the swift and successful resolution of non-performing debts, particularly by improving legal, judicial and institutional procedures. Ensure the participation of all banks in the asset quality review on equal terms, transparently publish its findings and promptly take remedial action where needed.4. Ensure smooth and effective support to the private companies and their employees affected by the crisis, in particular micro, small and medium-sized enterprises and self-employed. Extend social protection coverage and provide incentives for businesses and employees in the informal economy sector to register and to facilitate their transfer to the formal economy. In order to ensure a swift recovery, focus on simplifying tax legislation and reducing the diversity of para-fiscal charges affecting businesses.5. Maintain continuous dialogue with social partners, business organisations and civil society on all decisions taken in response to the Covid-19 pandemic. Provide an active feedback from this dialogue to the public domain. Ensure close cooperation between central and local authorities on all crisis mitigation and economic recovery measures, including through joint and coordinated actions.7853/20 SV/sl 7ECOMP 1A EN6. Take measures to preserve employment including by ensuring short-time work schemes and flexible working arrangements, as well as through increased provision of active labour market policies to facilitate transition to work and support workers at risk of job loss. Ensure adequate income support and social assistance for the unemployed, and for those at risk of poverty and of social exclusion. Strengthen the healthcare system’s resilience and capacity to improve access and quality provision of health care services.7853/20 SV/sl 8ECOMP 1A ENThe Republic of SerbiaSerbia submitted its Economic Reform Programme 2020-2022 on 31 January 2020. The policy guidance set out in the conclusions of the Economic and Financial Dialogue of May 2019 has been partially implemented.Serbia maintained a robust pace of economic growth of 4.2% in 2019 due to strong domestic demand, in particular from investment. The ERP projected the economy to continue expanding steadily, supported by solid growth in private consumption, investment and exports. It also expected the public debt ratio to continue falling based on a broadly balanced budget. However, the growth momentum was interrupted abruptly by the Covid-19 pandemic, which stifled global economic activity and turned the ERP’s macroeconomic and fiscal scenarios obsolete. The Serbian economy is strongly exposed due to its relatively high trade openness and its reliance on FDI inflows to modernise productive capacities, especially in view of the particularly strong Covid-19 impact on its main trading partners. On the other hand, the relatively low share of tourism in gross value added may attenuate the impact as compared to some neighbouring countries.In addition to allowing a significant effect of automatic stabilisers mostly on the revenue side, the authorities took major discretionary fiscal and monetary measures to cushion the impact of the pandemic on the local economy and employment. The adopted fiscal measures, such as deferred tax payments, direct income support to employees in SMEs and laid off workers, increased healthcare spending, one-off payments to pensioners and all citizens and loan guarantees will increase the general government deficit and delay the reduction of government debt. To reinforce the medium-term sustainability of public finances, the overall spending on public wages should be contained while simultaneously increasing growth-enhancing capital expenditure. Improving fiscal governance would be essential to durably anchor fiscal policy after the crisis. Increasing transparency on fiscal risks and further restructuring of state-owned enterprises would also be important steps towards enhancing medium-term policy credibility.The National Bank of Serbia conducted monetary policy in 2019 in line with the inflation targeting regime. The key policy rate was cut to 2.25% through the year, and a further cut by 75 bps to 1.5% was implemented in March and April 2020 as a response to the coronavirus pandemic. Headline inflation hovered mostly within the lower part of the tolerance band in 2019.The banking sector remains well capitalised and liquid according to several metrics. The ratio of non-performing loans to total loans has declined considerably since 2015 and credit growth appears to have resumed for both corporates and households. The central bank adopted prudential measures to prevent a build-up of risks stemming from excessive lending at long maturities in the household sector. Continued vigilance is warranted, in particular in light of the financial stability challenges that may arise from the coronavirus pandemic. The measures introduced so far to foster the use of the local currency are welcome. While the dinarisation of bank deposits has been gradually increasing, enhancing lending dinarisation has proved more difficult, with foreign currency use overall remaining the highest in the region. A number of factors weigh on the ability to progress further, including the remaining, albeit decreasing, interest rate differentials between dinar and euro denominated lending and limited long-term funding sources in dinar for banks. The measures adopted by the central bank at the end of 2019 to improve the currency structure of lending to corporates and provide more favourable dinar financing for SMEs are appropriate steps in this regard.7853/20 SV/sl 9ECOMP 1A ENStructural weaknesses have been exacerbated by the Covid-19 pandemic, highlighting the strong need for additional structural reforms,. Effective and well-coordinated structural reforms will contribute to mitigating the impact of the pandemic and accelerate the post-crisis economic recovery. The government’s policy response will be critical to shape the economy in the post crisis context. The recovery would also benefit from further efforts to tackle corruption, improve the rule of law, enhance transparency and strengthen institutions and social dialogue.As regards specific structural reforms, the main challenges posed by Covid-19 are linked to strengthening the public health sector, preserving employment and improving social protection, enhancing business environment and providing support to the private sector. The pandemic is putting the health system under stress, revealing persistent under-funding and weak capacities to cope with the crisis. Despite improvements in the labour market in the past few years, the pandemic is now putting jobs at risk, including in the informal sector. The high tax wedge on low-wage earners acts as a disincentive to formal employment. Social assistance and unemployment benefit schemes, which are underfunded, are further stretched and do not provide sufficient coverage and adequate benefits. Businesses, in particular SMEs, self-employed and small family enterprises are considerably affected by the pandemic and are in need of urgent support, such as liquidity and further easing the regulatory and tax burdens. The effectiveness of support measures depends on good governance, coordination and inclusiveness, taking into consideration the large informal sector.Participants welcome that Serbia has increased its efforts in the area of national accounts and has completed the implementation of the benchmark revision of its GDP back ***data*** to eliminate the breaks in series. Serbia transmits the entire set of monthly MFI Interest Rate ***Statistics*** and has had a good level of compliance with regard to short-term business ***statistics*** and balance of payments. Further progress is expected regarding adherence to the excessive deficit procedure methodology and government finance ***statistics***. The missing ***data*** series in the area of annual and quarterly national accounts should also be addressed.In light of this assessment, Participants hereby invite Serbia to:1. Allow automatic fiscal stabilisers to accommodate crisis-induced economic fall-outs and further mitigate the impact on growth and employment by appropriate discretionary fiscal measures. To reinforce the medium-term sustainability of public finances, contain overall spending on wages as a percentage of GDP, while allowing for due reinforcement of healthcare spending during the crisis, also by taking concrete steps towards implementing an appropriately designed public sector wage system reform. Adopt a credible and binding system of fiscal rules underpinning fiscal sustainability. I2. To support economic recovery, further increase growth-enhancing capital spending as a share of GDP in 2020 and over the medium term. Increase the transparency of the fiscal impact of state-owned enterprises by reinforcing fiscal risk analysis and by publishing quarterly reports on SOEs’ financial performance. To reduce fiscal risks, improve the governance of state-owned enterprises including via further restructuring.3. Closely monitor financial stability challenges arising as a result of the coronavirus pandemic and take appropriate action if needed. Further implement the measures included in the 2018-2020 NPL strategy and related action plan, including those aimed at preventing the accumulation of new non-performing loans such as reforms of the bankruptcy frameworks. Enhance further the use of the local currency by fostering the development of secondary markets for government and corporate dinar securities, and support the use of hedging instruments.7853/20 SV/sl 10ECOMP 1A EN4. With a view of mitigating the economic consequences of Covid-19 pandemic and stimulating economic recovery, ensure effective, transparent and non-discriminatory support to businesses affected by the crisis, in particular micro, small and medium-sized enterprises and self-employed. Extend social protection coverage and provide incentives for businesses and employees in the informal economy sector to register and to facilitate their transfer to the formal economy. Include monitoring and evaluation of measures introduced and further improve the public consultation process by consulting businesses and social partners on the adoption and implementation of all new legislation concerning their operations.5. Ensure cross-sectoral coordination within the government and across public administration to effectively respond to Covid-19. Take measures to preserve employment including through short-time work schemes and ensure increased provision of effective active labour market policies to the unemployed. Provide adequate unemployment compensation schemes for laid off workers in order to mitigate the social impact of the economic downturn.6. Step up social transfers to ensure adequate income support for people at risk of poverty and social exclusion. Reduce the tax wedge considerably for low wage earners to ensure living wages and to incentivise the formalisation of employment. Ensure adequate and sustainable funding to strengthen the health care sector with an aim to improve access to quality public health care for all citizens.7853/20 SV/sl 11ECOMP 1A ENThe Republic of North MacedoniaNorth Macedonia submitted its Economic Reform Programme 2020-2022 on 03 February 2020. The policy guidance set out in the conclusions of the Economic and Financial Dialogue of May 2019 has been partially implemented.Economic growth strengthened in 2019, driven by firming domestic demand and supported by expansionary policies. Investment rebounded, while the external balance detracted from growth amid slowing export growth. The ERP expected the outlook to remain positive based on further strengthening household and investment spending, while it projected public debt to stabilise partly as a result of a gradually decreasing primary deficit. However, the growth momentum was interrupted abruptly by the Covid-19 pandemic, which stifled global economic activity and rendered the ERP’s macroeconomic and fiscal scenarios obsolete. North Macedonia’s economy is exposed to developments in the EU, its main trading partner, due to its high reliance on exports, in particular automobile supplies, for growth. Transport, tourism and trade are important sectors of the economy likely to be severely impacted by the pandemic. Moreover, although the current account deficit is moderate, the expected hit to remittances from abroad is likely to narrow external financing sources.The authorities should allow automatic fiscal stabilisers to accommodate potential major economic fall-outs from the coronavirus in the short term and take additional measures to soften its impact on growth and employment. Despite limited fiscal policy space, the authorities reacted in a swift and bold manner to assist those sectors most affected by liquidity shortages, by, inter alia, exempting companies from corporate tax advances, providing SMEs with interest-free loans, subsidising employer contributions, wage subsidies, allowances for vulnerable families in the informal economy, and establishing a tourism support fund and a solidarity COVID-19 fund. The fiscal costs of the policy response, together with a slowing economy are likely to delay temporarily the implementation of public debt reduction envisaged in the ERP. Once the temporary shock dissipates, fiscal policy should be geared towards re-building fiscal buffers and debt reduction with a view to enhancing long-term sustainability. Improving fiscal governance and transparency would be important supporting steps.In 2019, robust economic growth, subdued inflation and a sustained balance of payments surplus enabled the central bank to fulfil its primary goal of price stability with relative ease. Going forward, policies should be consistent with maintaining the exchange rate peg, using all available instruments within that framework to mitigate the economic fallout from the coronavirus pandemic. In this context, the central bank cut its main policy rate, provided additional liquidity, reintroduced the non-standard measure which allows for reducing the banks’ base for reserve requirements by the amount of newly approved and restructured loans to companies that will be most affected by the pandemic, eased conditions for the restructuring of loans, and allowed for additional regulatory flexibility.The soundness of the banking sector is underpinned by comfortable levels of capital, liquidity and profitability. However, the coronavirus pandemic may pose a challenge for financial stability, calling for a close monitoring of developments and, if warranted, the adoption of remedial measures at an early stage. In this regard, the swift establishment of the Financial Stability Committee with the aim to formalise the collaboration of all supervisory authorities appears crucial, with the legal clarification of the central bank’s macro-prudential mandate providing added benefit. Likewise, swift operationalisation of the resolution strategy for non-performing loans will prepare the banking sector for better dealing with the adverse consequences of economic contraction. To strengthen the resilience of the financial system in the longer term, the denarisation strategy should be further implemented to reduce risks from currency mismatches on the balance sheets of borrowers and banks.7853/20 SV/sl 12ECOMP 1A ENStructural weaknesses have been exacerbated by the Covid-19 pandemic, highlighting the strong need for continued structural reforms. Effective and well-coordinated structural reforms will contribute to mitigating the impact of pandemic and accelerate the post-crisis economic recovery. The government’s policy response will be critical to shape the economy in the post crisis context. The recovery would also benefit from further efforts to tackle corruption, improve the rule of law, enhance transparency and strengthen institutions and social dialogue.As regards specific structural reforms, the main challenges posed by Covid-19 are linked to strengthening the public health sector, preserving employment and improving social protection, enhancing the business environment and providing support to the private sector. The pandemic is putting the health system under stress, revealing persistent under-funding and weak capacities to cope with the crisis. Despite improvements in the labour market in the past few years, the pandemic is now putting jobs at risk, including in the informal sector. Social assistance and unemployment benefit schemes are further stretched due to the pandemic and are limited in providing coverage and adequate benefits to those in need. The crisis has also highlighted the need to continuously review the social protection system with the aim of improving its coordination with employment activation to improve its capacity to reduce social exclusion and poverty. Businesses, in particular SMEs, self-employed and small family enterprises are considerably affected by the pandemic and need urgent support, such as provision of liquidity, further easing of para-fiscal charges and of other regulatory and tax burdens. The effectiveness of support measures depends on good governance, coordination and inclusiveness, as well as the ability to take into consideration the large informal sector.Participants welcome that North Macedonia made progress concerning annual international trade in service ***statistics***, research and development, harmonised indices of consumer prices, and short-term business ***statistics***. Further progress is expected regarding adherence to the excessive deficit procedure methodology. Efforts on government finance ***statistics*** should be intensified and the ***data*** gaps in annual and quarterly national accounts should be addressed.In light of this assessment, Participants hereby invite the Republic of North Macedonia to:1. Use fiscal policy to mitigate the crisis-induced impact on growth and employment. Adopt the Tax System Reform Strategy 2020-2023 and improve revenue ***collection*** capacities in line with the strategy. Further improve the transparency of public finances by publishing regular fiscal reports on public enterprises and taking steps towards incorporating them in the general government ***statistics*** in line with the excessive deficit procedure methodology.2. To support the economic recovery, improve public investment management to mitigate technical obstacles to implementation of capital spending. Establish a comprehensive registry of state aid and review firm-level subsidies based on their cost-effectiveness. Take initial legal and operational steps to establish fiscal rules and a fiscal council with a view to strengthening fiscal sustainability in the medium term.3. Closely monitor financial stability challenges arising as a result of the coronavirus pandemic and take appropriate action if needed. Operationalise the reconstituted Financial Stability Committee and ensure the legal clarification of the central bank’s macro-prudential mandate. Work towards a further implementation of the denarisation and NPL resolution strategies, ensuring the effectiveness of the measures taken and making any adjustments deemed necessary.4. Ensure a whole-of-government approach and a cross-sectoral coordination across public administration to effectively respond to Covid-19. Maintain continuous dialogue with business organisations, social partners and civil society on all measures in response to the crisis. Take necessary actions to ensure easy access to digital public services for citizens and businesses.7853/20 SV/sl 13ECOMP 1A EN5. With a view to mitigate the economic consequences of Covid-19 pandemic and to stimulate economic recovery, establish an effective and transparent mechanism to support the businesses affected by the crisis, in particular micro, small and medium-sized enterprises and self-employed. Extend social protection coverage and provide incentives for businesses and employees in the informal economy sector to register and to facilitate their transfer to the formal economy. Create a register of para-fiscal charges to streamline their use and further decrease the administrative and regulatory burden of companies.6. Continue taking measures to preserve employment including by ensuring short-time work schemes and flexible working arrangements. Increase the capacity of and cooperation between the Employment Agency and Centres for Social Work to provide integrated services and measures for inclusion in the labour market including training upskilling and reskilling. Ensure adequate and sustainable funding to strengthen the health care sector with an aim to improve access to quality public health care for all citizens.7853/20 SV/sl 14ECOMP 1A ENThe Republic of AlbaniaAlbania submitted its Economic Reform Programme 2020-2022 on 31 January 2020. The policy guidance set out in the conclusions of the Economic and Financial Dialogue of May 2019 has been partially implemented.Following an economic slowdown in 2019, caused by weak electricity production amid low rainfall and aggravated by the November earthquake, Albania’s ERP projected economic growth to rebound in 2020-2022 driven by exceptionally high public investment for post-earthquake reconstruction and a recovery of exports, and later by private consumption. The earthquake-related rise in expenditure was set to temporarily increase the fiscal deficit and slow down the pace of reducing the high public debt. The outbreak of the Covid-19 pandemic renders the macroeconomic and fiscal projections of the ERP obsolete. Its intensive economic relations with the strongly hit Italy and the importance of the tourism sector for its economy, make Albania particularly vulnerable to the economic fallout from the pandemic. The limited capacity of the health sector adds to Albania’s vulnerability in this situation.The Albanian government swiftly imposed restrictions on mobility and social contacts to contain the pandemic and put in place measures to buffer their socio-economic impact. Despite limited policy space, the government announced as immediate support for businesses postponements of tax declarations and financial guarantees for wages in addition to financial support for the health sector, and for SMEs and households in need. The central bank reduced its policy rate, increased liquidity injections and introduced temporary provisions to allow for delays in loan repayments of viable businesses affected by the crisis. The implementation of these measures challenge the already stretched administrative capacity. Albania’s existing social protection system covers only a small part of the population, while the large informal sector might not benefit from state support. The likely loss of a whole tourism season this year dampens the expectations for a beginning recovery in the second half of the year. The economic and fiscal impact of the crisis is likely to overturn public debt reduction, which however should remain a medium-term priority in light of the high debt burden and the need to rebuild fiscal buffers.Monetary policy continued to be accommodative in 2019, with inflation still below the target. In response to the Covid-19 crisis, the central bank reduced its policy rate and released liquidity. The banking sector remained well capitalised and liquid, while the authorities made further progress in supervisory and regulatory convergence. Banking sector consolidation continued in 2019, with the number of active banks decreasing to twelve. Asset quality continued to improve on account of a further decline in non-performing loans (NPLs) facilitated by the ongoing implementation of measures foreseen in the NPL action plan, including amendments to the regulation on out-of-court restructuring and credit risk management. However, the level is the highest in the region and likely to increase again as a result of the economic fallout from the coronavirus pandemic. Against that background, it is essential that the remaining obstacles to NPL resolution are addressed as soon as possible, e.g resolving the legal deadlock around the private bailiffs and developing a credit scoring system. With currency substitution at high levels, indirect credit risk continues to pose a significant challenge to financial stability.Structural weaknesses have been exacerbated by the Covid-19 pandemic, highlighting the strong need for structural reforms. Effective and well-coordinated structural reforms will contribute to mitigating the impact of pandemic and accelerate the post-crisis economic recovery. The government’s policy response will be critical to shape the economy in the post crisis context. The recovery would also benefit from further efforts to tackle corruption and money laundering , improve the rule of law, enhance transparency and strengthen institutions and social dialogue.7853/20 SV/sl 15ECOMP 1A ENAs regards specific structural reforms, the main challenges posed by Covid-19 are linked to strengthening the public health sector, preserving employment and improving social protection, enhancing business environment and providing support to the private sector. The pandemic is putting the health system under stress, revealing persistent under-funding, low public health insurance coverage and weak capacities to cope with the crisis. Despite improvements in the labour market in the past few years, the pandemic is now putting jobs at risk, including in the informal sector. Income support to registered unemployed and to socially vulnerable groups is very limited. Only a very small share of registered unemployed are eligible to unemployment benefits, while the allowances under the social assistance scheme are low and very far from the at-risk-of-poverty threshold. The crisis has also highlighted the chronic lack of social care services. Businesses, in particular SMEs, self-employed and small family enterprises are considerably affected by the pandemic and are in need of urgent support, such as providing liquidity and further easing the regulatory and tax burdens. The effectiveness of support measures depends on good governance, coordination and inclusiveness, taking into consideration the large informal sector.Participants welcome that Albania made progress concerning annual national accounts, excessive deficit procedure notifications, annual government finance ***statistics***, energy ***statistics*** and short-term business ***statistics***. However, significant progress is still needed in the domains of the excessive deficit procedure and national accounts, including quarterly national accounts and government finance ***statistics***. Harmonised indices of consumer prices, balance of payments, research and development, and labour market ***statistics*** also need attention.In light of this assessment, Participants hereby invite Albania to:1. Keep the increase of fiscal deficit and public debt temporary while accommodating the fiscal costs of post-earthquake reconstruction and addressing the pandemic impact in a transparent and cost-effective manner. Set time-limits for tax-relief measures, while paying all VAT refunds in time. Adopt the medium-term revenue strategy, with a particular focus on reviewing tax expenditures.2. Publish on a regular basis a break-down of all arrears of public expenditure and prevent any increase of their stock above the level of end-2019. Assess and approve all investments, which involve public funds, through the same approval process, based on the same minimum quality and fiscal affordability criteria. Increase the institutional capacities for monitoring and containing fiscal risks stemming from public-private partnerships, concessions and state-owned enterprises.3. Closely monitor financial stability challenges arising as a result of the coronavirus pandemic and take appropriate action if needed. Resolve remaining legal impediments to NPL resolution in the realm of the government, especially the bailiff deadlock that lingers on collateral execution, also in order to mitigate a potential renewed build-up of NPLs as a consequence of the coronavirus pandemic. Develop the market for forex hedging instruments, taking into account international expert advice, in the context of strengthening the use of the national currency.4. With a view to mitigating the economic consequences of Covid-19 pandemic and stimulating economic recovery, establish an effective and transparent mechanism to support the businesses affected by the crisis, in particular small and medium-sized enterprises and self-employed. Extend social protection coverage and provide incentives for businesses and employees in the informal economy sector to register and to facilitate their transfer to the formal economy. Ensure transparency and predictability of measures, by consulting new legislation with businesses and social partners.7853/20 SV/sl 16ECOMP 1A EN5. Considering the big investments to be made for the post-earthquake reconstruction, speed up the adoption the secondary legislation for the laws on energy efficiency and energy performance of buildings and provide incentives for energy efficiency measures in the private sector and households. Increase access to healthcare and public health insurance coverage while reducing the share of out-of-pocket payments on total health expenditure.6. Take short-term measures to preserve employment including through short-time work schemes, and once the Covid-19 pandemic subsides, ensure an increased provision of active labour market policies, especially training, upskilling and reskilling. Improve the adequacy of social assistance benefits and set up an objective mechanism for their regular update, taking into account the ***data*** from the Survey of Income and Living Conditions. Take more effective steps to increase availability of social care services through enhancing ability of municipalities to identify needs for social services and to prepare social care plans.7853/20 SV/sl 17ECOMP 1A ENBosnia and HerzegovinaBosnia and Herzegovina submitted its Economic Reform Programme 2020-2022 on 31 January 2020. The policy guidance set out in the conclusions of the Economic and Financial Dialogue of May 2019 has been implemented to a limited extent.Economic activity slowed down during 2019 largely reflecting decelerating private consumption and investment growth and weaker external demand for commodities, partly compensated by increasing tourism revenues. Employment benefitted from active labour market measures, while increasing emigration created an upward pressure on nominal wages. However, thanks to low import prices, inflation had remained low. The outbreak of the Covid-19 pandemic is sharply exacerbating the already ongoing slowdown, in particular affecting transport and tourism as well as remittances, rendering the ERP’s macroeconomic and fiscal projections obsolete.In order to compensate for the negative effects of the Covid-19 crisis, the authorities of Bosnia and Herzegovina took measures to address the liquidity squeeze by allowing households and businesses to defer loan repayments and tax payments. Along with other measures to provide financial assistance to alleviate the economic impact of the crisis, this will inevitably lead to a temporary worsening of the fiscal position. However, the public debt ratio is currently still rather low (at around 30% of GDP) and interest costs are quite favourable, resulting from a high share of concessional financing. Once the temporary shock dissipates, efforts should be undertaken to accelerate the economic recovery and the country’s shock resilience by improving the quality of public finance by shifting public spending towards a more growth-supporting pattern and improving the targeting of social spending. Moreover, country-wide medium-term planning capacities as well and the quality of statistical ***data*** should be significantly improved.Monetary policy has continued to be anchored around the currency board arrangement, which enjoys the confidence of the general public and provides stability within the complex institutional environment.Regarding financial stability, the banking system as a whole exhibits robust capital and liquidity buffers, but the legal framework should be strengthened further. Authorities have adopted a set of legislative reforms, but a final law on deposit insurance is still pending, which is a crucial element of the bank resolution framework. Approving the complete legal package entailing the establishment of a comprehensive bank resolution framework would buttress the legal underpinnings of the financial system. Ensuring sufficient coordination among bodies entrusted with resolution is essential. Notwithstanding improvements in asset quality, non-performing loans are still sizeable, which impacts banks’ profitability and constitutes an obstacle for credit extension. The dynamic rise of general-purpose consumer loans poses a potential financial stability risk and warrants close monitoring. The coronavirus pandemic aggravates the situation, as both consumers and firms may be adversely affected by containment measures and a looming economic downturn.Structural weaknesses have been exacerbated by the Covid-19 pandemic, highlighting the strong need for structural reforms. Effective and well-coordinated structural reforms will contribute to mitigating the impact of pandemic and accelerate the post-crisis economic recovery. The government’s policy response will be critical to shape the economy in the post crisis context. The recovery would also benefit from further efforts to tackle corruption, improve the rule of law, enhance transparency and strengthen institutions and social dialogue.7853/20 SV/sl 18ECOMP 1A ENAs regards specific structural reforms, the main challenges posed by Covid-19 are linked to strengthening the public health sector, preserving employment and improving social protection, enhancing business environment and providing support to the private sector. The pandemic is putting the health system under stress, revealing lack of adequate and sustainable funding, issues with access and weak capacities to cope with the crisis. Despite some improvements in the labour market in the past few years, the pandemic is now putting jobs at risk, including in the informal sector. Social assistance and unemployment benefit schemes, which are underfunded, are further stretched and do not provide sufficient coverage and adequate benefits. In addition, a major part of non-contributory social benefits are grants to war veterans and only a small part is spent on disabled and on means-tested social assistance and family benefits. Businesses, in particular SMEs, self-employed and small family enterprises are considerably affected by the pandemic and are in need of urgent support, such us providing liquidity and further easing the regulatory and tax burdens. The effectiveness of support measures depends on good governance, coordination and inclusiveness, taking into consideration the large informal sector.Participants welcome that Bosnia and Herzegovina made visible progress concerning excessive deficit procedure notifications, balance of payments and the international investment position. Progress in other statistical areas such as regional accounts, foreign direct investment, labour market ***statistics*** and harmonised indices of consumer prices was, however, limited. While efforts should be pursued to improve the coverage and timeliness of all ***statistics***, priority should be given to national accounts and government finance ***statistics***, and putting in place adequate infrastructure for ***data*** transmissions to ***Eurostat*** and the ECB.In light of this assessment, Participants hereby invite Bosnia and Herzegovina to:1. Take the necessary fiscal measures to alleviate the economic shock of the COVID-crisis, in particular protecting the most vulnerable groups. In order to support the recovery, improve analytical, planning and coordination capacities to strengthen country-wide macroeconomic policy formulation and its implementation. Improve the provision of timely, exhaustive and country-wide ***statistics*** and its transmission to ***Eurostat*** and the ECB, in particular on national accounts, the labour market and government finance, in line with ***Eurostat*** recommendations.2. To accelerate the economic recovery, increase growth-enhancing public investment as a share of GDP, based on a comprehensive investment strategy. Improve the targeting of social transfers by increasing the share of means-tested benefits in total social spending.3. Closely monitor financial stability challenges arising as a result of the coronavirus pandemic and take appropriate action if needed, while addressing the remaining obstacles to NPL resolution and ensuring the proper coordination of supervisory activities. Strengthen the bank resolution framework by adopting the law on deposit insurance. Safeguard the integrity of the currency board arrangement and the independence of the central bank, while enhancing its analytical capacity by establishing macroeconomic projections.4. With a view to mitigating the economic consequences of Covid-19 pandemic and stimulating economic recovery, establish an effective, coordinated and transparent mechanism to support the businesses affected by the crisis, in particular small and medium-sized enterprises and self-employed. Extend social protection coverage and provide incentives for businesses and employees in the informal economy sector to register and to facilitate their transfer to the formal economy. With a view to a swift recovery after the Covid-19 crisis, simplify business registration, licensing and permit procedures country-wide.7853/20 SV/sl 19ECOMP 1A EN5. Ensure adequate and sustainable funding to strengthen the health care sector with an aim to improve access to quality public health care for all citizens. Identify scope for and implement centralised procurement of pharmaceuticals and medical equipment, especially for high-cost and high-volume medications. Adopt and implement a credible and relevant countrywide Public Finance Management strategic framework with a performance based monitoring and reporting system.6. Take measures to preserve employment including through short-time work schemes, strengthen without delay the capacity and human resources of employment offices to ensure more active support to registered jobseekers including an increased provision of active labour market policies, especially training, upskilling and reskilling. Complete in the whole country the discharge of public employment services from administrative duties related to health insurance for registered unemployed. Ensure increased coverage of unemployment and needs-based social benefits and in the medium term, map non-contributory social benefits in the whole country and rebalance the social assistance system from status-based to needs-based benefits while increasing their adequacy and coverage.7853/20 SV/sl 20ECOMP 1A ENKosovo\*Kosovo submitted its Economic Reform Programme 2020-2022 on 22 January 2020. The policy guidance set out in the conclusions of the Economic and Financial Dialogue of May 2019 has been implemented to a limited extent.Relatively robust economic growth continued in 2019, supported by private investment and consumption. Despite the failure to implement the reclassification of war veteran pension beneficiaries, which has led to cost overruns, the 2019 budget deficit was lower than planned, due to a large under-execution of capital spending. The ERP projected GDP growth to strengthen further in 2020-2022 to above the historical trend, on the back of a planned strong pick-up in public investment and continuously robust private consumption. The fiscal strategy was envisaged to be frontloaded with the 2020 budget deficit projected to reach the ceiling of 2% of GDP prescribed by the fiscal rule (which excludes certain investment categories from the deficit). The projected rise in expenditure was expected to be driven by a steep rise in capital spending, while the envisaged current spending only partially takes into account the potentially substantial impact of the law on salaries.The fallout from the coronavirus has made the ERP’s macroeconomic and fiscal projections obsolete. The key vulnerabilities stem from a potential fall of service exports to diaspora, foreign investment and remittances. In the context of coronavirus, the authorities of Kosovo have postponed the deadline of payments of tax (VAT, PIT, CIT, etc) liabilities and adopted the emergency package, while the central bank has postponed all credit payments. Fiscal measures aim to soften the impact on growth and employment, but without access to international credit markets, the fiscal space is rather limited. Beyond mitigating the economic shock in 2020, public spending should better support medium-term growth potential. Social spending should focus on poverty reduction and should not discourage work. Prioritisation, planning and coordination between policies are essential, while new initiatives should be properly evaluated and costed before adoption.The banking sector continues to be characterised by capitalisation and liquidity ratios that are well above the regulatory minima. Credit activity remained buoyant in 2019, spurred by lower interest rates, increased competition among banks, ample liquidity in the banking sector and improved quality of the credit portfolio. Micro-financial institutions have boosted their short-term lending to households, capturing a market segment not necessarily tapped by bank lending, at much higher borrowing costs. A thorough analysis of household indebtedness is hampered by the absence of a comprehensive measure that combines a single borrower’s debt to all bank and non-bank financial institutions. Non-performing loans continue to be low by peer standards, but significant scope remains for deepening financial intermediation. Lengthy court and contract enforcement procedures, high informality, the low degree of audited financial statements and corporate governance shortcomings constitute bottlenecks to SME lending. Progress has been limited in identifying factors hampering access to finance for SMEs in 2019. Going forward, the authorities should closely monitor challenges arising as a result of the coronavirus pandemic, and adopt pre-emptive measures if warranted. For this purpose it is essential that the central bank has adequate staffing capacity in the areas of financial stability and banking supervision. For temporary difficulties in SME’s access to finance arising from increased uncertainty related to the coronavirus, the authorities could consider expanding the capacity of the Kosovo Credit Guarantee Fund if necessary.\* This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.7853/20 SV/sl 21ECOMP 1A ENStructural weaknesses have been exacerbated by the Covid-19 pandemic, highlighting the strong need for structural reforms. Effective and well-coordinated structural reforms will contribute to mitigating the impact of pandemic and accelerate the post-crisis economic recovery. The authorities’ policy response will be critical to shape the economy in the post crisis context. The recovery would also benefit from further efforts to tackle corruption, improve the rule of law, enhance transparency and strengthen institutions and social dialogue.As regards specific structural reforms, the main challenges posed by Covid-19 are linked to strengthening the public health sector, preserving employment and improving social protection, enhancing business environment and providing support to the private sector. The pandemic is putting the health system under stress, revealing persistent under-funding, low public health insurance coverage and limited capacities to cope with the crisis. The pandemic is putting jobs at risk, including in the informal sector, in a situation of already very low employment levels, especially for women and young people. The capacity of the Employment Agency is also weak. Social assistance and unemployment benefit schemes, which are underfunded, are further stretched and do not provide sufficient coverage and adequate benefits. Moreover, social benefits are not sufficiently targeted at categories in need. Businesses, in particular SMEs, self-employed and small family enterprises are considerably affected by the pandemic and are in need of urgent support, such as liquidity and further easing the regulatory and tax burdens. The effectiveness of support measures will largely depend on transparency, good coordination and inclusiveness, taking into consideration the large informal sector.Participants take note that Kosovo has made progress regarding international trade in goods ***statistics***, foreign direct investment, balance of payments and the international investment position. However, ***data*** for several statistical domains such as the excessive deficit procedure, short-term business ***statistics*** and research and development are missing. Although small progress was made in 2019, further efforts should continue towards a complete set of annual and quarterly national accounts and government finance ***statistics***.￼In light of this assessment, Participants hereby invite Kosovo to:1. Create fiscal space and undertake well-targeted measures to address the socio-economic consequences of the crisis, including by containing spending on the public wage bill and on war veterans pensions through progress with the reclassification of beneficiaries. To reinforce the medium-term sustainability of public finances, improve tax revenue ***collection*** by reducing informality.2. To support economic recovery, improve the execution of capital spending by strengthening institutional capacities at central and local government levels for multiannual investment planning and investment project management. Improve the financial oversight and accountability of publicly owned enterprises. Prepare an options paper on the establishment of an independent body for fiscal oversight for further consultations with stakeholders, including the EU.3. Closely monitor financial stability challenges as a result of the coronavirus pandemic and take appropriate action if needed, while developing a more integrated framework for measuring household indebtedness. Undertake an in-depth analysis of the staffing and competence requirements in the central bank’s key policy areas, especially financial stability. Continue with the inflation expectations survey and publish the time series once more ***data*** points become available.7853/20 SV/sl 22ECOMP 1A EN4. With a view to mitigating the economic consequences of Covid-19 pandemic and stimulate economic recovery, establish an effective and transparent mechanism to support the private sector and employees affected by the crisis, in particular micro, small and medium-sized enterprises and self-employed. Extend social protection coverage and provide incentives for businesses and employees in the informal economy sector to register and to facilitate their transfer to the formal economy. In order to ensure a swift recovery, further implement relevant business environment measures, in particular the simplification, merging and abolishment of licences and permits.5. Strengthen the health sector in order to provide adequate and accessible primary health services for all citizens. In the short term, ensure increased coverage of unemployment benefits and needs-based social benefits for the groups most affected by the Covid-19 crisis. In the medium term, review social assistance schemes, in particular the category-based pensions, to ensure that they are targeted at groups most in need and focused on poverty reduction.6. With a view to minimising the impact of Covid-19, take measures to preserve employment including through short-time work schemes and upgrade the capacity of the Employment Agency to ensure an increased provision of active labour market measures. With the aim of increasing the integration of youth in the labour market, conduct a feasibility study for a Youth Guarantee scheme.

**Load-Date:** May 11, 2020

**End of Document**



[***Adjusting GDP for ecological deficit: the Index of Debt to the Future (IDF)***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:673K-JYX1-JCWX-C4SS-00000-00&context=1516831)

SN Business & Economics

February 2021

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**Section:** Vol. 1; No. 3; ISSN: 2662-9399

**Length:** 6872 words

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**Body**

Introduction

It is now generally accepted that the Gross Domestic Product (GDP) is not a perfect measure of economic welfare. Some writers go as far as saying that it is not even a good measure of economic welfare (Bleys and Whitby ). The main criticisms put forward against GDP are four. First, it is stated that increasing GDP does not increase welfare or happiness after a certain level, e.g., 7,000$ per capita (Easterlin ; Layard ; Max-Neef ). This may be true for each individual and it is in agreement with utility theory, but it is not necessarily true for countries as a whole if GDP growth favours those individuals with lower income levels. Second, there is production taking place which is not included in the measured GDP as, for example, housework, unpaid voluntary work, and unregistered transactions. Third, some of the included transactions are not really contributing to welfare as, for example, spending on gas burned in a traffic jam, funeral expenses, or wages of a divorce lawyer.

This criticism is partly correct. The transaction for gas burnt in a traffic jam not only is not related to welfare but rather to the opposite, namely the uncomfortable situation of the driver. However, the other two examples fall in the category of what (Nordhaus and Tobin ) call instrumental expenditures and there is no reason to exclude them from the measurement of GDP. In such cases, it is useful to make the distinction between intended and unintended transactions. Intended transactions create some utility, otherwise they would not take place, and they should be included in the measurement of GDP. This is the reason that defence expenditure should be included in the GDP of countries that are involved in a war or are facing the danger of a war. Fourth, the estimates of GDP ignore the depletion of natural resources and the damage to the environment incurred by the production of GDP, as well as the potential for continued (sustained) growth (Stiglitz, Fitoussi, and Durand ).

In spite of the above criticisms, all countries continue to estimate GDP and use it for various purposes instead of the other proposed measures of economic welfare (e.g., ISEW, GPI, see below). The reasons are many. The estimation of GDP is now a routine with which governmental agencies are very familiar. GDP is clearly defined as a measure based on market transactions and therefore dubious imputations are avoided. It allows easy comparisons between years and also between countries. It clearly describes business fluctuations. Last, but not least, as Strunz and Schindler () have recently argued, there exist firmly established political interests that raise barriers to a change from GDP to other measures.

Literature review: measuring economic activity

The deficiencies of the GDP as a measure of economic welfare, and particularly the neglect of resource depletion and the environmental problems, gave rise to the development of several other measures of economic welfare. The best known alternatives to GDP are the Index of Sustainable Economic Welfare (ISEW) (Daly, Cobb, and Cobb ) and the Genuine Progress Indicator (GPI) (Cobb, Halstead, and Rowe 1995). These alternative measures of welfare are gaining popularity and are used in studies in many countries at a national as well as a regional level (for example, (Menegaki, Marques, and Fuinhas ; Bleys and Whitby ; Kalimeris et al. ). However, ISEW and GPI are not free of problems. In addition to those analysed by Neumayer , ; Ziegler ; Beça and Santos , two weaknesses seem to be present in the way ISEW and GPI are calculated.

First, the consumption item is adjusted for income inequality and poverty level. This adjustment leads to a very considerable reduction of consumption expenditure. For example, if the consumption expenditure is 100, the Gini coefficient 0.4 and the poverty index 0.3, the consumption expenditure included in ISEW and GPI is only 42. This might make sense if there was evidence or a convincing theoretical argument that individual utilities derived from consumption are positively or negatively affected by income inequality or/and the poverty level. It does not seem that there is such evidence or argument. This is also suggested by Adam Smith’s and Hume’s limited generosity argument. Society’s aversion to inequality may be real, but each individual’s utility from consumption is not necessarily affected by it (see e.g., Mathews and Schwartz ). Of course, inequality and poverty are undesirable in general and a real problem for politicians who have to deal with it, but discounting the welfare from consumption in the way done by ISEW seems unwarranted and rather extreme. It is interesting to note that Nordhaus and Tobin () do not adjust consumption expenditures for inequality in their estimate of the Measure of Economic Welfare (MEW). The other problem with the estimation of ISEW is the exclusion of public expenditures on defence. There are many countries where defence spending is essential to their territorial integrity and to the feeling of safety citizens must have. Also, it is arbitrary to assume that people living in peaceful countries with peaceful neighbours do not derive some utility from feeling safe because of defence expenditures. The same is true for private defence spending. This category of spending is intended and reveals the consumer’s preferences and as such it should not be excluded for any measure of welfare.

Another way of measuring aggregate production while taking account of the environmental impact of production is that suggested by the Environmentally Sustainable National Income (eSNI) suggested by Roefie Hueting, which is defined as “the maximal attainable production by which vital environmental functions remain available for future generations, based on the technology available at the time. Thus, the eSNI provides information about the distance between the current and sustainable situation” (Hueting ).

There are, further, some indices that attempt to disassociate the level of well-being or happiness from the available material wealth. In this vein, the Happy Planet Index uses subjective judgments together with life expectancy, inequality of incomes, and ecological footprint to produce an index of happiness. Another index of measuring well-being is the National Accounts of Well-being which uses information of subjective judgments about satisfying life, vitality, self-esteem, optimism, etc. The results of these indices, as valuable as they may be for other purposes, are not directly connected to economic welfare and therefore seem to fall outside the area of our present interest.

Finally, there is the ambitious and apparently expensive project of the United Nations () for a System of Environmental Economic Accounts (SEEA). This can be seen to be the continuation and expansion of work on indicators of sustainable development which has started since 1994 (United Nations ). What the UN intends to create is a national accounting standard “that integrates economic and environmental ***data*** to provide a more comprehensive and multipurpose view of the relationships between the economy and the environment and the stocks and changes in stocks of environmental assets as they bring benefits to humanity”. In other words, it is aimed that environmental ***statistics*** will be incorporated in the traditional model of national accounting, and that this will enable researchers and policy makers to better assess the effects of economic activity on nature.

In a nutshell, what is practically suggested by the SEEA is the deduction of the value of the environmental resources used in production. That is, the value added of an economic activity should be adjusted for the depletion of environmental resources. Putting aside the practical problem of the cost of ***data*** ***collection***, one can see four major issues with the UN augmented accounting standard. First, valuing environmental resources (wood, land, energy, fish stocks, etc.) at their market prices when markets contain inefficiencies can be methodologically unsound and may lead to underestimation of the value of the environmental resources. Secondly, as there is a macroeconomic model which informs the ***collection*** of national accounts ***data***, one would expect that there would be a model which informs the ***collection*** of ***data*** related to the depleted resources; a description of such a model seems to be missing. Third, it is not clear that the externalities of production and consumption are fully taken into account. For example, ***agricultural*** runoff (which may include excessive ***nutrients*** such as nitrogen, and/or pollutants such as antibiotics, POPs, heavy metals, etc.) affects the health of the land and seas. According to the SEEA, fish catches are valued according to their market value. But, if fish populations decline due to eutrophication or pollution created by this runoff, the market price of all fish (free and cultivated) will probably go up, while at the same time pollutant (e.g., mercury) concentration in fish increases. Therefore, the (increased) market value of fishes will not reflect the subsequent burden to public health (and of course not to the non-human parts of the ecosystem, e.g., the uncaught fishes and other marine life). In this respect, the SEEA seems to use a quite narrow lens in capturing humanity’s effect on the environment. Fourth, although international waters are part of the global ecosystem, pollution in these waters is not relevant for national accounts as long as there is no recorded economic activity there, which can lead to underestimation of the effects. Therefore, for the time being, the environmentally-adjusted GDP according to the SEEA cannot yet be seen as fully reflecting the part of economic activity that is realized at the expense of the environment and the generations to come. Furthermore the results are not readily available for all countries and many years.

Despite these shortcomings, the SEEA represents a huge and much needed effort to incorporate environmental issues into macroeconomic accounting. It is a massive project which is under constant improvement, and all the above shortcomings are aimed to be taken into account. Despite current limitations, it seems that the SEEA project delivers a much needed message: that the measured GDP should take into account sustainability issues. Of course, it seems that it can serve as a system of ***collective*** benchmarking, allowing comparisons among countries, localities, sectors etc. Most countries are at various stages of adoption and implementation of the SEEA standard. Sixty seven countries were involved in some kind of implementation in 2017 and this figure is expected to reach 100 by the end of 2020 (United Nations n.d.). However, an index of sustainable welfare based on SEEA is neither reading available, nor simple, nor cheap to calculate.

Research approach: adjusting GDP for debts to the future

Following from the above discussion, it could be argued that the Index of Sustainable Economic Welfare and the Genuine Progress Indicator may be better estimates of economic welfare than GDP in some respects, but they are inferior in others. Thus, instead of abandoning GDP as an estimate of welfare, a simple way for adjusting GDP for the negative ecological impact caused by the production of GDP is suggested here. This can be done by combining two widely used measures – the GDP and the ecological footprint – into a new index: the Index of Debt to the Future (IDF). The IDF can then be used to depreciate GDP to the level that could be produced without causing ecological deficit.

What follows is an overview of the discussion on planetary boundaries as a justification for the choice of the ecological footprint (instead of e.g., the carbon footprint) that is adopted in this paper. It is then explained how the concept of ecological footprint can be used to derive the IDF-adjusted GDP. Then the IDF-adjusted GDP is compared with the GDP level calculated with the ISEW and GPI methods. Of course, despite its advantages, the ecological footprint does not reflect every dimension of human impact on the planet and could not be considered as the best metric. Rather, the method illustrated below can serve as a showcase for the use of several available estimates of human impact on the planet. Eventually the results of all these estimates could create a dashboard of information on the sustainability part of economic activity.

The ecological footprint is a satisfactory measure of demand on earth’s resources

The notion of ecological impact describes the effects of human activity on nature. Attempts to define and quantify this impact seem to have started in the 1970s. Ehrlich and Holdren’s () work initiated an increasing conversation on the economic, technological, and population determinants of this impact, which is broadly described with an equation known as “the IPAT equation” (an equation showing that the Impact is a function of Population, Affluence, and Technology). This equation can be considered as the “demand” for the services that nature can offer. On the other hand, the availability of nature (i.e., the “supply” side) may be equally important in understanding the relationship between humanity and nature. Recent work on critical processes of our planet which have come to be called “planetary boundaries” attempts to define and quantify the supply side in terms of the limits, posed by nature, that the human impact should have and, relatedly, to quantitatively define the safe operating space for humanity. Nine boundaries have been initially identified, with seven of them seeming to be adequately quantified: climate change, biosphere integrity (including biodiversity loss), biogeochemical cycles (mainly phosphorus and nitrogen), ocean acidification, land use, freshwater, and ozone depletion (Rockström et al. ; Steffen et al. ). More work is underway on new boundaries and the interactions between them (Halpern et al. ; Liu et al. ; Nash et al. ; Webb ). It is interesting to note that the existence of interactions incurs an additional negative effect on humanity: interactions of threats reduce the safe operating space of humanity within each boundary even more (Lade et al. ). This might suggest that humanity should strive to be within all limits, instead of focusing on a few.

The core idea of the conversation on planetary boundaries is that if humanity’s impact on nature is beyond those limits, human survival is at risk. After a certain amount of impacts, a tipping point may be reached; once reached it will be very costly or technically impossible to reverse the consequences and human life will be in danger. There seems to be consensus so far that humanity does not operate at a safe space now: four boundaries (biosphere integrity, biogeochemical flows, climate change, and land-system change) have been already crossed with the first two being critically violated (Steffen et al. ).

There also seems to be clear that some countries, especially developed ones, create a relatively larger part of the impacts, at least in per capita terms. In other words, per capita GDP seems to be a good predictor of impact, with richer countries exceeding their supposed allocated boundaries disproportionately more than other countries and creating disproportionately more of the global burden on nature (Cibulka and Giljum ; Fang et al. ; Kalimeris et al. ; Wiedmann et al. ).

From the above discussion it follows that the quantification of the boundaries actually quantifies the supply of planetary ecological resources and services. On the other hand, the idea of humanity’s demand on nature is incorporated into the concept of footprints. Generally speaking, a “footprint” is the impact of a decision making unit or a process on nature. A footprint can be calculated for a chosen unit of analysis: a person, a company, a product, a process, a city, a sector, a country, or the whole world. Numerous footprints have been created, each one focusing on a specific effect of economic activity on nature, see (Hoekstra and Wiedmann ) for an overview. Notwithstanding overlaps, all footprints can be seen to quantify the impact of human activity along the planetary boundaries, see (Vanham et al. ). Importantly, what almost all footprints share is that they can easily communicate the impact of economic activity to a wider audience.

The most widely known and used footprints are the ecological footprint, the carbon footprint, and the water footprint (Vanham et al. ). Among them, the only one that seems to clearly combine issues of demand and supply and covers a relatively wide array of impacts (land, water, carbon) is the ecological footprint (Borucke et al. ; Wackernagel et al. ). This footprint measures demand on nature as the land and sea surface that is needed to provide food and natural renewable materials (e.g., wood), settlement area, and carbon sequestration, as well as the supply, i.e., the land that is available for the provision of ecological services. This available land and sea surface is called biocapacity. It should be noted that the demand side measures only the materials that nature can regenerate; the extraction of nonrenewable materials such as oil or minerals is not taken into account. Therefore, the ecological footprint by definition underestimates the impact that economic activity has on nature.

In the ecological footprint analyses, the usual unit of analysis is the country and the world as a whole. The country footprints are measured for both the consumption side and the production side. This is informative, because trade between countries may allow for a lower consumption footprint but a higher production footprint, and vice versa. At a global scale, though, the production and consumption footprints are the same.

The comparison of demand (ecological footprint) and supply (biocapacity) produces a metric showing the ecological balance (deficit or surplus). Available ***data*** cover the period 1961–2016 for each country and the world (Global Footprint Network ). Ecological footprints of sectors have not been calculated yet; this work has started very recently. The main findings of the ecological footprint is that the whole planet and most countries are functioning in ecological deficit, which has first appeared in the 1970s and is steadily increasing. Most recent ***data*** show that the global deficit accounted for 69% of biocapacity in 2016. That year, global biocapacity was about 12.2 bn global hectares but humanity consumed more than 20. The ecological deficit was about 8.3 global hectares. This is an indication that the average person on the planet lives in an unsustainable way. It can thus be argued that the economic welfare created with the current mode of production and consumption is unsustainable. This deficit represents a burden that current production and consumption transfers to future years. It can be seen as an “ecological debt to the future”. Producing on an ecological deficit is made possible if we destroy natural capital (e.g., forests) or create “excess” pollution, i.e., pollution that nature cannot assimilate (as is the case with polluted water and/or increasing concentrations of greenhouse gases in the atmosphere).

Ecological footprint ***data*** can be easily combined with GDP ***data***

To summarize, both indices (GDP and ecological footprint) have their benefits, which seem to justify their wide use. However, a combined index of sustainable economic activity would be welcome. Therefore, based on the benefits of each measurement, combined with the need to create an indication of whether the economic activity of humanity is sustainable, a measure of sustainable economic welfare is suggested below. This measure has the benefit that is based on readily available ***data***: GDP, biocapacity, and ecological footprint.

The basic idea to derive this measure is that the production of GDP should not create ecological deficit. If it does, GDP has to be adjusted for the ecological deficit that it creates. This adjusted GDP can be called “Ecological Debt–Free GDP” (GDPEDF) and corresponds to what should have been produced without creating a burden to current and future generations; it indicates the level of zero-ecological-deficit production. Ideally, ecological footprint should equal biocapacity and thus GDP should equal GDPEDF. The latter (the GDPEDF) remains to be calculated.

The idea for the needed calculations to get GDPEDF is quite simple: the ratio of realized quantities (GDP and ecological footprint) should be equal to the ratio of available quantities (GDPEDF and biocapacity). In terms of demand and supply, the ratio of demanded quantities (of goods and ecological services) should equal the ratio of quantities supplied (of goods and biocapacity), that is:

The GDPEDF can then be calculated as follows:

Equation () shows that, in cases that the footprint is different from biocapacity, measured GDP should be adjusted to produce the GDPEDF. As the global economy produces an ecological deficit for almost 50 years, the following discussion will focus on the case of ecological deficit.

To interpret the above two equations, it would be useful to introduce the notion of “excess” GDP. As mentioned above, the ecological deficit can be seen to correspond to a portion of GDP that is produced in excess of what should ideally be produced so that no ecological deficit would be created. Therefore:

Combining (1) through (3), the Index of Debt to the Future can be constructed to equal the proportion of GDP that corresponds to the ecological deficit.

Using world ***data*** for the global biocapacity and ecological footprint for 2016, the world IDF for 2016 can be calculated as follows:

An alternative, more intuitive, derivation of IDF would be

which yields

The above IDF means that 40.5% of the gross world product produced is in excess of what would be produced in ecological balance; this excess GDP is achieved using “excess” (borrowed) resources that should be used in the future. The image above shows the analogies between the “excess” GDP and the ecological deficit.

image: The GDPEDF that is calculated with the IDF is analogous to biocapacity; the excess GDP is analogous to the ecological deficit.

Finally, a word of caution about the meaning of debt as used here. Usually, the debt of a country is used as a stock concept measuring the financial debts that have been accumulated in previous periods. In this paper, debt is a flow, namely the difference between biocapacity and ecological footprint of each period. Thus, it can be used along with GDP, which is also a flow.

Comparison of GDPEDF with other indices of sustainable welfare

The Index of Debt to the Future (IDF) suggested here attempts to correct the traditionally measured GDP by reducing it by the extent to which the production of goods causes ecological deficit. Obviously, the resulting Ecological Debt–Free GDP (GDPEDF) calculated with the use of the IDF does not contradict other indices of sustainable economic welfare as, for example, the ISEW and GPI. It simply suggests that the ecological deficit could be a factor in adjusting GDP as a source of welfare. The IDF is based on the idea that the satisfaction we derive from our present consumption level is less (or should be less) because we know that our consumption creates problems for the present and the future generations. Our situation is similar to that of the individual who consumes 100 euros every day knowing that every day he/she creates a debt of 40 euros to support their present consumption level, and this growing debt negatively affects the level of utility derived from future consumption. The irony of this situation is that the debt created by the present generation will be paid by the future generations in various unpleasant, evil, and even catastrophic ways (Ceballos, Ehrlich, and Dirzo ; Ripple et al. ; IPCC ).

The estimation of the GDPEDF uses GDP ***data*** as its base and therefore has all the advantages that GDP has as an index of economic activity. In this sense, it could be considered superior to ISEW and GPI because the connection between these indices and measured GDP, with which the general public is acquainted, might be difficult for most people to see. Furthermore, it could be argued that the ecological footprint and the ecological deficit are conceptually and graphically simpler concepts than the macroeconomics concepts used to create the ISEW and GPI, thus the former are easy to be understood by the general public, including younger ages. Given that massive changes are needed to humanity’s lifestyle to avert a climate catastrophe (IPCC ; Springmann et al. ; Wiedmann et al. ), the use of simple and cost-effective tools (such as the suggested IDF) to communicate the relevant ideas should be welcome.

Results: calculating the ecological debt-free GDP using the IDF

The Index of Debts to the Future can be very easily estimated for individual countries and for the world as a whole, since ***data*** for GDP, ecological footprint, and biocapacity are readily available. Table provides the estimated IDF for the entire world from 1995 to 2016. It also provides the adjusted (i.e., Environmental Debt–Free) gross world product (GWPEDF). It can be seen that while global biocapacity is increasing (mainly due to Technological change), this increase is not enough to counteract the increase in the ecological footprint (due to the increased Population and Affluence, i.e., incomes). This is a manifestation of the I = PAT equation at work. It can be seen that the IDF as a percentage of GDP steadily increases, although it seems to have plateaued during the last decade.

Global Biocapacity, Ecological Footprint, the IDF, and the actual and IDF-adjusted GDP 1971–2016

| **Year** | **Biocapacity (million global hectares)** | **Ecological Footprint (million global hectares)** | **IDF (as % of GDP)** | **GDP (bn USD in constant 2010 prices)** | **GDPEDF** |
| --- | --- | --- | --- | --- | --- |
| 1971 | 10,097 | 10,419 | 3.1% | 20,000 | 19,383 |
| 1972 | 10,052 | 10,693 | 6.0% | 21,145 | 19,877 |
| 1973 | 10,162 | 11,261 | 9.8% | 22,520 | 20,322 |
| 1974 | 10,112 | 11,154 | 9.3% | 22,969 | 20,824 |
| 1975 | 10,119 | 11,079 | 8.7% | 23,107 | 21,105 |
| 1976 | 10,206 | 11,638 | 12.3% | 24,325 | 21,332 |
| 1977 | 10,209 | 11,863 | 13.9% | 25,282 | 21,756 |
| 1978 | 10,363 | 12,193 | 15.0% | 26,267 | 22,323 |
| 1979 | 10,331 | 12,501 | 17.4% | 27,350 | 22,604 |
| 1980 | 10,333 | 12,277 | 15.8% | 27,871 | 23,458 |
| 1981 | 10,432 | 12,121 | 13.9% | 28,406 | 24,447 |
| 1982 | 10,541 | 12,084 | 12.8% | 28,529 | 24,886 |
| 1983 | 10,481 | 12,050 | 13.0% | 29,217 | 25,413 |
| 1984 | 10,667 | 12,561 | 15.1% | 30,533 | 25,931 |
| 1985 | 10,712 | 12,734 | 15.9% | 31,666 | 26,636 |
| 1986 | 10,758 | 12,978 | 17.1% | 32,742 | 27,140 |
| 1987 | 10,776 | 13,317 | 19.1% | 33,956 | 27,478 |
| 1988 | 10,710 | 13,607 | 21.3% | 35,525 | 27,961 |
| 1989 | 10,869 | 13,970 | 22.2% | 36,831 | 28,655 |
| 1990 | 11,027 | 14,190 | 22.3% | 37,905 | 29,456 |
| 1991 | 10,943 | 14,138 | 22.6% | 38,447 | 29,758 |
| 1992 | 11,123 | 14,246 | 21.9% | 39,126 | 30,551 |
| 1993 | 11,072 | 14,204 | 22.0% | 39,725 | 30,968 |
| 1994 | 11,155 | 14,406 | 22.6% | 40,917 | 31,683 |
| 1995 | 11,103 | 14,651 | 24.2% | 42,153 | 31,944 |
| 1996 | 11,285 | 15,013 | 24.8% | 43,582 | 32,759 |
| 1997 | 11,326 | 15,244 | 25.7% | 45,183 | 33,571 |
| 1998 | 11,401 | 15,316 | 25.6% | 46,338 | 34,494 |
| 1999 | 11,438 | 15,380 | 25.6% | 47,843 | 35,582 |
| 2000 | 11,425 | 15,715 | 27.3% | 49,941 | 36,307 |
| 2001 | 11,487 | 15,879 | 27.7% | 50,920 | 36,836 |
| 2002 | 11,469 | 16,033 | 28.5% | 52,031 | 37,218 |
| 2003 | 11,445 | 16,615 | 31.1% | 53,573 | 36,903 |
| 2004 | 11,696 | 17,523 | 33.3% | 55,934 | 37,334 |
| 2005 | 11,607 | 17,929 | 35.3% | 58,124 | 37,630 |
| 2006 | 11,636 | 18,403 | 36.8% | 60,670 | 38,362 |
| 2007 | 11,678 | 18,916 | 38.3% | 63,293 | 39,076 |
| 2008 | 11,862 | 19,157 | 38.1% | 64,466 | 39,918 |
| 2009 | 11,814 | 18,817 | 37.2% | 63,387 | 39,796 |
| 2010 | 11,834 | 19,770 | 40.1% | 66,113 | 39,576 |
| 2011 | 11,918 | 20,189 | 41.0% | 68,189 | 40,254 |
| 2012 | 11,879 | 20,117 | 41.0% | 69,906 | 41,278 |
| 2013 | 12,078 | 20,571 | 41.3% | 71,767 | 42,136 |
| 2014 | 12,159 | 20,612 | 41.0% | 73,811 | 43,542 |
| 2015 | 12,148 | 20,504 | 40.8% | 75,936 | 44,991 |
| 2016 | 12,169 | 20,509 | 40.7% | 77,904 | 46,226 |

Figure  shows the Gross World Product along with the GWPEDF. The top (dotted) line is the Gross World Product, as usually measured. The estimated IDF has been used to calculate the other two lines: The middle line shows the IDF–adjusted GWP. The vertical difference between the two is the “excess” GDP that corresponds to the ecological deficit and is shown by the lower (dashed) line.

Measured Gross World Product, Adjusted GWP, and “excess” GDP, 1961–2016. Note: Ecological Debt-Free GDP shown only since 1970, when the global economy started being in ecological deficit. The “excess” GDP (red dashed line) is the difference between the two

From the above discussion and figures it is evident that an ecologically sustainable standard of living is associated with rather drastically lower production and/or population levels compared to the current ones. Table has been compiled to illustrate this point. It provides the Ecological Debt–Free GDP for 2016 for some ecological debtor countries. The countries are ranked according to the relative size of their ecological debt. To showcase the lifestyle aspect of the impact, the ecological deficit in this table has been calculated using the footprint of consumption. In sum, Table shows that many countries consume in a way that the resources needed to support their consumption far exceeds their biocapacity. Of course, one could not easily proceed to conclusions about the effect of affluence on resource use, as each country’s consumption of resources is a function of both population size and lifestyle.

Biocapacity, Ecological footprint, IDF, conventionally measured GDP, and estimates for the Ecological Debt-Free GDP (GDPEDF) for selected countries, 2016

| **Country** | **Biocapacity (million global hectares)** | **Ecological Footprint (million global hectares)** | **IDF (as % of GDP)** | **GDP 2016 (bn USD)** | **GDPEDF (bn USD)** |
| --- | --- | --- | --- | --- | --- |
| Singapore | 0.33 | 33.06 | 99.0% | 308.6 | 3.07 |
| Barbados | 0.05 | 1.08 | 95.6% | 4.6 | 0.20 |
| Israel | 2.06 | 39.94 | 94.8% | 288.2 | 14.87 |
| Bahrain | 0.74 | 12.30 | 94.0% | 31.8 | 1.92 |
| United Arab Emirates | 5.22 | 82.68 | 93.7% | 384.2 | 24.27 |
| Saudi Arabia | 13.52 | 201.20 | 93.3% | 690.1 | 46.37 |
| Kuwait | 2.39 | 34.79 | 93.1% | 142.0 | 9.77 |
| Qatar | 2.57 | 37.03 | 93.1% | 170.7 | 11.86 |
| Cyprus | 0.32 | 4.39 | 92.7% | 25.2 | 1.85 |
| Jordan | 1.61 | 19.67 | 91.8% | 31.2 | 2.55 |
| Lebanon | 1.70 | 19.75 | 91.4% | 43.0 | 3.71 |
| Aruba | 0.06 | 0.68 | 91.3% | 2.8 | 0.24 |
| Luxembourg | 0.71 | 7.43 | 90.4% | 64.1 | 6.15 |
| Malta | 0.26 | 2.49 | 89.7% | 12.2 | 1.26 |
| Korea, Rep | 33.99 | 304.78 | 88.8% | 1,368.8 | 152.63 |
| Belgium | 8.92 | 70.94 | 87.4% | 520.6 | 65.45 |
| Japan | 74.31 | 573.94 | 87.1% | 6,019.9 | 779.44 |
| Netherlands | 13.99 | 81.98 | 82.9% | 898.0 | 153.24 |
| Trinidad and Tobago | 2.12 | 11.44 | 81.4% | 21.6 | 4.01 |
| Italy | 55.98 | 263.81 | 78.8% | 2,089.2 | 443.32 |
| Switzerland | 8.44 | 38.96 | 78.3% | 645.0 | 139.70 |
| United Kingdom | 71.65 | 287.37 | 75.1% | 2,788.5 | 695.24 |
| China | 1,373.63 | 5,195.89 | 73.6% | 9,523.8 | 2,517.78 |
| Germany | 132.53 | 396.52 | 66.6% | 3,784.7 | 1,265.02 |
| Spain | 63.69 | 187.28 | 66.0% | 1,461.9 | 497.16 |
| Greece | 17.42 | 47.73 | 63.5% | 244.3 | 89.15 |
| India | 566.12 | 1,547.65 | 63.4% | 2,484.4 | 908.78 |
| Philippines | 56.60 | 137.41 | 58.8% | 299.3 | 123.26 |
| United States | 1,174.98 | 2,611.07 | 55.0% | 16,972.3 | 7,637.54 |
| Mexico | 149.59 | 331.95 | 54.9% | 1,258.7 | 567.25 |
| Bangladesh | 66.26 | 137.25 | 51.7% | 167.8 | 81.00 |
| Austria | 25.38 | 52.54 | 51.7% | 421.6 | 203.69 |
| France | 153.97 | 288.00 | 46.5% | 2,811.8 | 1,503.23 |
| World | 12,169.28 | 20,508.91 | 40.7% | 77,904.1 | 46,225.64 |

GDP in constant 2010 US$. Source: World Bank, World Development Indicators

Ecological footprint of consumption and biocapacity figures from Global Footprint Network ()

Finally, it is interesting to compare the ratio of GDP to IDF–adjusted GDP (GDPEDF) with the ratio of GDP to ISEW for some countries. To this end, Table provides calculations for the GDP/ISEW ratio for some countries and the GDP/GDPEDF ratio for the same countries and years. The final lines contain the GWP/GDPEDF ratio for the world. Obviously, the ratios are not strictly comparable. The GDP/GDPEDF ratio is by definition equal to the number of planets (in terms of biocapacity) needed to sustain the realized economic activity; it shows how much bigger the realized GDP is compared to our estimate of sustainable GDP. It is interesting to observe that for all countries, big ones like USA and UK as well as small ones like Belgium and Netherlands, the gaps implied in the ratios GDP/GDPEDF are in all cases larger than those implied by the GDP/ISEW or GDP/GPI ratios. However, in the case of the world GDP (i.e., GWP), the ratio GWP/GDPEDF is smaller than the GDP/GDPEDF and GDP/ISEW ratios in all cases. For Australia the GDP/GDPEDF ratio is less than one, implying that biocapacity is greater than the ecological footprint, and therefore no adjustment is needed for the estimate of the Ecological Debt-Free GDP, as Australia is an ecological creditor country.

Ratios of GDP to various measures of adjusted GDP (ISEW, GPI, PINE, IDF, and GDPEDF), for some countries and years

| **Country** | **1985** | **1990** | **1995** | **2000** | **2002** | **2004** | **2006** | **2010** | **2014** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Belgium(1) |  |  |  |  |  |  |  |  |  |
| GDP/ISEW | 2.19 | 2.54 | 2.37 | 2.45 | ? | ? |  | ? | ? |
| GDP/GDPEDF(2) | 7.24 | 7.95 | 7.60 | 7.44 |  |  |  |  |  |
| Netherlands(1) |  |  |  |  |  |  |  |  |  |
| GDP/ISEW | ? | 1.74 | 1.73 | 1.99 | ? | 1.66 | ? | ? | ? |
| GDP/GDPEDF |  | 6.11 | 6.64 | 6.58 |  | 6.96 |  |  |  |
| USA(3) |  |  |  |  |  |  |  |  |  |
| GDP/ISEW | ? | 1.91 | 2.09 | 2.96 | ? | 2.43 | ? | ? | ? |
| GDP/GPI |  | 3.11 | 3.67 |  |  |  |  |  | 1.85 |
| GDP/GDPEDF |  | 2.36 | 2.49 | 2.63 |  | 2.71 |  |  | 2.33 |
| UK(4) |  |  |  |  |  |  |  |  |  |
| GDP/ISEW | ? | ? | ? | ? | 1.75 | ? | ? | ? | ? |
| GDP/GDPEDF |  |  |  |  | 4.53 |  |  |  |  |
| Australia(5) |  |  |  |  |  |  |  |  |  |
| GDP/GPI | ? | 1.33 | 1.42 | 1.59 | ? | ? | 1.72 | ? | ? |
| GDP/GDPEDF |  | 0.44 | 0.45 | 0.46 |  |  | 0.58 |  |  |
| Mexico(6) |  |  |  |  |  |  |  |  |  |
| GDP/PINE | ? | ? | ? | ? | ? | 1.26 | 1.26 | 1.28 | 1.26 |
| GDP/GDPEDF |  |  |  |  |  | 2.05 | 2.22 | 2.52 | 2.12 |
| World: GWP/GWPEDF(2) |  | 1.29 | 1.32 | 1.37 |  | 1.50 | 1.58 | 1.66 | 1.69 |

(1)Source of ISEW ***data*** for Belgium are from (Bleys ) and for Netherlands from (Bleys )

(2)The IDF used for the country GDP/GDPEDF ratios in the table are estimated using the ecological footprint of consumption

(3)USA: 1st line: Source of per capita GNP and ISEW ***data*** for 1990: Daly, Cobb and Cobb (). Figures for the USA except for 1990 are from (Talberth et al. , Table , Columns AB and AC). 2nd line: GDP/GPI ratio for 1990 and 1995 calculated with per capita figures in (Anielski and Rowe ). 2014 GPI ratio calculated with ***data*** from (J. Talberth and Weisdorf )

(4)The figures used for the UK are approximations based on the diagrams of Jackson and McBride ()

(5)Australia: Figures for Australia are from Lawn ()

(6)PINE = Spanish acronym for Ecologically Adjusted Net Domestic Product (Producto Interno Neto Ajustado Ambientalmente). Source: INEGI (2019)

Two conclusions can be drawn from the calculations of Table . First, even if one accepts ISEW as a measure of economic welfare, the ISEW cannot be seen as an index that corresponds to ecological balance, i.e. ecological deficit being equal to zero. This follows from the fact that the adjustment made to GDP by ISEW is less than that required for ecological equilibrium as shown by the adjustment made by the IDF that is suggested in this paper. For Belgium, for example, GDP is 100 and ISEW is 40 (100/2,5) but, according to the IDF it should be only 13 (100/7,6). If ecological balance is a condition for sustainability, the ISEW may be an index of economic welfare but it is not an index of sustainability. It is very likely that the same is true for GPI and for the environmentally-adjusted Net Domestic Product (NDP) (UN 2014). Second, the fact that the global ratio GWP/GWPEDF is much higher that the GDP/GDPEDF for the countries of Table , with the exception of Australia, indicates that the ecological deficit is unequally created by the various countries in the world.

Discussion

This paper has been strongly motivated, as many others, by an increasing wave of literature showcasing that humanity’s current trajectory is unsustainable. This literature includes the conversations on climate change (IPCC ; Ripple et al. ), on the need to sustainably provide healthy food for an increasing population through 2050 and beyond (Clark et al. ; Heleno, Ripple, and Traveset ; Springmann et al. ; ; Willett et al. ), on the collapse of biodiversity (Ceballos, Ehrlich, and Dirzo ; Crist, Mora, and Engelman ; Dasgupta ), to name but a few areas. Although many studies, including the Scientists’ Warning Series, aim to convey an urgency of action, the timeframe of policy documents and international organisations is usually from 2030 at the earliest to 2050, even to 2100. It is easy to feel complacent if one thinks there is still time to act. But is there?

During the course of writing this article, the COVID pandemic emerged; the pandemic shattered our ***collective*** certainties that the threats to humanity will unfold in the near or far future; the pandemic showed that the threat to our lives and way of living is closer in time and space than we thought, revealed the vulnerability of our current well-being, and diverted resources from existing problems to a new and pressing one. Nevertheless, the threat of new viruses was not unexpected (Benatar ) and seems to be nurtured by the same powers that nurture the crossing of planetary boundaries and overexploiting nature: an increasing population with an increasing per capita appetite for consumption (CDC ; UNEP and International Livestock Research Institute ). It is interesting to note that the pandemic reduced the ecological footprint by almost 10% for the period of January to August 22, 2020 (Global Footprint Network ), while the Gross World Product is expected to contract by 5.2% in 2020 compared to 2019 (World Bank ). Most people would agree that this footprint reduction is too small compared to the large reduction of welfare that came along for almost the whole population on Earth and especially for the poorest. Obviously, humanity needs to come up with other ways to reduce her impact on the environment; these should not threaten human welfare and, ideally, should increase it.

Almost every recent policy document or scientific article acknowledges the vast, massive, or otherwise dramatic behavioural changes that have to be achieved in the next few years, if humanity is to stand a chance of survival from climate change, from biodiversity loss, and from a cascading and interacting set of problems created by humanity’s economic activity. If we are to avert a climate catastrophe, we need the message of urgency to reach the general public, young and old, all those individuals whose power we do not have the luxury of ignoring or underestimating.

“Education, information, and community approaches, […], can accelerate the wide-scale behaviour changes consistent with adapting to and limiting global warming to 1.5°C.” (IPCC , emphasis added). In the IPCC document, the word “behaviour” and its variants (behavioural, behaviours, etc.) is used 284 times. The authors hope that the simple idea provided in this paper will help visualize and disseminate the message of urgency and facilitate the behavioural change that is so urgently needed. We also hope that the resources that will be freed will be enough to help towards tackling humanity’s other pressing problems: violence, inequality, poverty, discriminations of all sorts, and more.

Conclusions

Many criticisms have been raised against the use of GDP as a measure of economic welfare. Although these criticisms may be justified, GDP arguably seems to remain the best measure of economic activity and could not be easily abandoned. It could, however, be adjusted for the ecological deficit that the production of products and services creates. The Index of Debt to the Future (IDF) proposed in this paper adjusts the measured GDP by subtracting the part of GDP that creates the ecological deficit. That part of GDP is a measure of the debt of the present generation to the future generations. The IDF-adjusted GDP (GDPEDF), defined as the difference between GDP and the implied debt to the future, is the net economic magnitude which the present generation should consider as its own. The GDPEDF is a metric which is simple to grasp and communicate to a wider, non-scientific audience. In addition to its simplicity, the proposed Index of Debt to the Future has the advantage of being easy to calculate with minimal marginal cost. Further, the simple idea of “deflating” GDP with a measure of excess demand on natural resources could be easily combined with other footprints as well, to provide a fuller view of the current situation.

The use of the IDF on GDP ***data*** has revealed that for the world as a whole, and for several countries, big ones as well as small ones, the differences between GDP and GDPEDF, i.e. between the GDP found in the macroeconomic ***statistics*** of these countries and the IDF-adjusted GDP, are large. Also, the comparison between the IDF-adjusted GDP and those of ISEW and GPI indicates that the ISEW and GPI indices underestimate the needed adjustment. Nevertheless, and even though the ecological footprint itself underestimates the actual impact to the environment, it is still a better approximation of the “sustainable” GDP than ISEW and GPI.

Based on these findings, it is clear that the necessary adjustment to GDP is so large that governments and international organisations cannot ignore the debt that past and existing generations have accumulated on the shoulders of the future ones. Conversations about sustainability already tend to show concern that humanity has exceeded the limits of nature and that adequate policies should be urgently implemented; what is also highlighted in this context, is that massive changes of individual behaviour are needed alongside changes in technologies.

The derivation of actionable country-level policies and the mobilization of individuals to change their lifestyles is a difficult task, with various parameters. A most challenging task is to invent ways for impact reduction that do not reduce the standard of living and actually increase it, at least for some populations of the world. All these are beyond the scope of this paper. Of course, as time for impactful changes seems to be running up, a crucial step in this direction is to act fast, to avert irreversible damage. To this end, the authors believe that the IDF can act as a simple tool to communicate the urgent need for policies and behavioural changes to politicians, businesses, and the public alike.

**Acknowledgement**

Constructive comments from anonymous referees and the Editor are gratefully acknowledged. Errors remain with us.

**Load-Date:** May 3, 2023

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[***Sugar-sweetened beverages increases the risk of hypertension among children and adolescence: a systematic review and dose–response meta-analysis***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H821-F129-P1M4-00000-00&context=1516831)

Journal Translational Medicine

September 2020

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**Section:** Vol. 18; No. 1; ISSN: 1479-5876

**Length:** 6317 words

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**Body**

Background

The increasing prevalence of obesity and weight gain in pediatric population, as a major health problem, is associated with insulin resistance, hypertension, atherogenic dyslipidemia, and pro-inflammatory state []. Hypertension, as one of the major component of metabolic syndrome is also associated with obesity state and has an increasing prevalence in youth []. Hypertension in children and adolescents is defined as average systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) greater than 95th percentile for gender, age, and height on ≥ 3 occasions, while prehypertension is defined as average SBP or DBP levels that are greater than 90th percentile but less than 95th percentile []. Hypertension and elevated blood pressure among children is associated with cardiovascular risk factors and obesity as well. Although major final outcome of CVD such as death and cardiovascular disability do not occur in hypertensive children, they are encountered with increased risk of intermediate markers of target organ damage, such as left ventricular hypertrophy, retinal vascular changes, thickening of the carotid vessel wall, and even subtle cognitive changes []. It is widely recognized that blood pressure levels are influenced by genetic as well as by environmental factors [, ]. In this regard, more than 90 different genetic polymorphisms have been identified to be associated with high blood pressure []. For example, a recent study reported that polymorphism of aldosterone synthase gene is linked with the development of hypertension through increasing the aldosterone level and aldosterone/renin ratio []. On the other hand, among environmental parameters, obesity, smoking, alcohol consumption, diet, and physical inactivity likely play a major role in development of hypertension [].

The role of sugars in developing cardio-metabolic disorders and hypertension in children has been actively investigated. However, recently the role of sugar-sweetened beverages (SSBs) in developing hypertension particularly in children and adolescents is highlighted [–]. SSBs, as a liquid form of carbonated or noncarbonated energy beverages, are the principle source of added sugar in diets []. For instance, a cross-sectional study from China showed that SSBs provide 10–15% of total calorie intake of school students []. Another study in Taiwan indicated that adolescents are also one of the major groups who consume a high amount of SSBs []. The US Nutrition Examination Survey showed that approximately 64% of the pediatric and adolescents aged 2–19 years have daily SSB consumption contributing to 8.4% of the daily energy intake []. In Iran, the average SSBs intake among children and adolescents was 38.5 ± 75.0 g per day with the mean daily SSB intake of 98 ml in boys and 70 ml in girls [].

In Australia, the average amount of 217 mL of SSB per day is consumed by youth contributing to 5.5% of their total energy intake []. In Mexico, SSB intake as one of the main sources of added sugar intake contributes to 8.3% of the total energy intake among children and adolescents []. Therefore, SSBs contain excessive amounts of energy, in the form of simple sugar. All of these figures have exceeded the recommended intake of free sugars that has been proposed by the World Health Organization to be less than 5% of total energy intakes []. Increased sympathetic nervous system activity [], significant increase in blood pressure due to potential antinatriuresis effect of fructose affecting salt metabolism [] and increased serum uric acid due to fructose metabolism [–] are several suggested mechanisms of the association between SSBs intake and hypertension among children and adolescents. Although numerous studies confirmed the role of high SSBs consumption in developing hypertension in youth [, , –], there are several inconsistencies reporting no significant association between SSB intake and blood pressure [, , ]. Moreover, childhood and adolescence are critical periods for the acquisition of healthy behaviors; therefore, the study of several indices and their co-occurrence in this ages should be a priority. In the current systematic review and meta-analysis, we aimed to summarize the studies that evaluated the association between SSBs intake and blood pressure among children and adolescents in two-class and dose–response meta-analysis.

Materials and methods

The current study was conducted according to Preferred Reporting Items for Systematic Reviews and Meta‐Analyses (PRISMA) []. The completed checklist has been provided in the Additional file 1 (Additional file 1: Table S1); moreover, the abstract was written according to the 12-item PRISMA extension checklist [].

***Data*** sources

A systematic search using PubMed, Scopus, Embase and Cochrane electronic databases was performed to find the studies evaluated the association between sugar-sweetened beverages intake and hypertension up to 1 April 2020. No language and time restrictions were applied. Moreover, hand-searching from reference lists of all relevant papers, previous reviews and meta-analyses was performed to cover all relevant publications. Strategy search was created using a combination of the MeSH (Medical Subject Headings) terms from the PubMed database and free text words.

Search strategy

For the search purpose, we used MeSH (Medical Subject Heading) and non-MeSH keywords including the following: (“Child”[Mesh]) OR child[Title/Abstract]) OR childhood[Title/Abstract]) OR pediatric\*[Title/Abstract]) OR adolescen\*[Title/Abstract]) OR youth[Title/Abstract]) OR teenager[Title/Abstract]) OR children)) AND ((SSB[Title/Abstract]) OR Sugar-Sweetened Beverage\*[Title/Abstract])) AND ((((((((“Hypertension”[Mesh]) OR hypertension[Title/Abstract]) OR HTN[Title/Abstract]) OR blood pressure [Title/Abstract]) OR systolic blood pressure[Title/Abstract]) OR diastolic blood pressure [Title/Abstract]) OR SBP [Title/Abstract]) OR DBP[Title/Abstract]) (Additional file : Table S2). The reviewed literatures were inserted into the EndNote software (version X8, for Windows, Thomson Reuters, Philadelphia, PA, USA). For each electronic database, search strategy was adopted.

Study selection

In the current systematic review and meta-analysis, observational studies with the design of cross-sectional, case control or cohort evaluating the association between sugar-sweetened beverages (SSB) and hypertension (HTN), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were included. The studies were included if they were (a) observational studies (b) original research as publication type; (c) reported SSB (sodas/soft drinks, carbonated beverages, non-100% fruit juice drinks, syrup-based drinks, flavored water with sugar, sports and energy drinks, chocolate milk, yogurt drinks, lemonades, Coca-Cola, Sprite, orange juice, Nutrition Express, and Red Bull and sweetened teas) intake as exposure and HTN, SBP and DBP as outcome variable; and (d) studies conducted in children and adolescents (less than 19 years of age) (e) if they reported the mean ± standard deviation (SD) of SBP or DBP or the odds ratio (OR) of HTN in subjects of the highest versus lowest SSBs category. Since there is no official definition for SSBs, they were defined as any type of above- mentioned drinks. Initially, retrieved citations were merged, duplications were eliminated and the review process was facilitated. Accordingly, the titles and abstracts of all articles were evaluated independently by 2 reviewers (MAF, LN). Full-texts of relevant articles were retrieved if meeting the eligibility criteria, and then were re-evaluated. Any disagreements were discussed and resolved by consensus.

Risk of bias and quality assessment

The quality of cross-sectional studies was assessed by Agency for Healthcare Research and Quality (AHRQ) checklist []. There was no quality criteria for inclusion of the studies in the current meta-analysis. The items were scored “1” if the answer was “YES,” and “0” if the answer was “NO” or “UNCLEAR.” The final quality assessments scores were as follows: low quality = 0–3; moderate quality = 4–7; high quality ≥ 8. The details of the studies’ quality assessment are presented in Additional file : Table S3.

***Data*** ***collection*** and extraction

***Data*** were ***collected*** according to a standard ***data*** extraction form. The following information was extracted from each study: (1) authors name; (2) publication year; (3) country of study; (4) study design; (5) age range and/or mean; (6) participants’ gender; (7) number of case and controls; (8) dietary assessment tool; (9) setting; (10) type and quantity of SSB; (11) covariates used in adjustment; (12) outcome values.

***Data*** synthesis and analysis

Two class meta-analysis of the comparison of SBP and DBP between SSB categories

The comparison of SBP and DBP between highest versus lowest category of SSB was performed by measuring the unstandardized mean differences as the effect size calculated by pooled estimate of weighted mean difference (WMD) with 95% confidence interval (CI), and the fixed effects and random effects models according to level of heterogeneity. When the mean values were missed and median and range were provided, we used the method provided by Hozo et al. [] considering the median values as best estimate of mean for sample size more than 25 and calculating SD as follows: ). When SD of the mean difference was not available from the studies, we calculated it using the following formula: SD change = square root [(SD baseline 2 + SD final 2) − (2 × 0.8 × SD baseline × SD final)] [], SD = IQR/1.35 (symmetrical ***data*** distribution) and SD = SEM × sqrt (n), where n is number of participants, IQR is interquartile range and SEM is standard error of the mean. When the number of individuals in each category of SSB was not provided in the manuscript, we assumed that equal number of participants is enrolled in each group. When the odds of hypertension in SSB consumers versus non-consumers were provided, ORs and 95% CIs were used to estimate the combined effects. Subgroup analysis was also performed to identify possible sources of heterogeneity according to the study setting, SSB dose, and baseline values of SBP or DBP, design, health status, sample size, region, quality score of study, gender and study design. The dose of SSB intake was converted to gram of intake per day according to food ***agriculture*** organization (FAO) guidelines for converting units, denominators and expressions [].

Cochran’s Q test and I squared test was used to identify between-study heterogeneity; I2 ˂ 25%, no heterogeneity; I2 = 25-50%, moderate heterogeneity; I2 > 50% large heterogeneity []. The heterogeneity was considered significant if either the Q ***statistic*** had P value < 0.1 or I2 > 50%. Sensitivity analysis by exclusion of one study at a time was applied to test the influence of each individual study on overall pooled estimates and heterogeneity []. Begg’s funnel plots was assessed to evaluate the publication bias followed by the Egger’s regression asymmetry test and Begg’s adjusted rank correlation for formal statistical assessment of funnel plot asymmetry. The ***data*** were analyzed using STATA version 13 (STATA Corp, College Station, TX, USA), and P-values less than 0.05 were considered as statistically significant.

Dose–response meta-analysis of the association between SSB dose and change in SBP or DBP

For dose response meta-analysis, the eligible studies had been reported the mean (SD) of continuous variable (e.g. SBP, DBP) in at least three categories. The median point in each SSB category was also identified. If medians had not been reported in the manuscript, then approximate medians were estimated, using the midpoint of the lower and upper limits. If the highest study category was open-ended, its SSB dose was calculated by assuming that the interval was the same as the closest category. The lowest categories of SSB intake was considered as the reference dose for each study. Any potential non- linear associations of SSB intake were performed by fractional polynominal modelling (polynomials) to explore the non-linear potential effects of SSB dosage (g/d) and the study- specific parameter [].

Results

Flow of studies

Our search strategy identified 1661 potentially relevant articles. Thereafter 857 manuscripts were remained for full text screening after removing duplicates and exclusion according to the title and abstract reading. Totally, 671 manuscripts were excluded because of their irrelevant subject, inappropriate design, being reviews including meta-analysis or systematic reviews, conferences and seminars, not relevant age groups, not evaluating the association of studied parameters. A final number of 14 manuscripts were included in the current meta-analysis (Fig. ).

Flowchart of the literature search and study selection process

Study characteristics

The characteristics of included studies are presented in Table . A total of 14 studies with 93,873 participants were included in the current meta-analysis [–, , , , , , , , –]. The studies had been performed between 2009 and 2020. Totally, eleven studies reported higher SBP in higher SSB intake categories versus lower consumers [, , , , , , , , –]; similarly, DBP was higher among high SSB consumers compared with low consumers in six studies [, , , , , ]. Two studies reported no significant difference between SBP and DBP of different SSB categories [, ]. Four studies reported the odds of hypertension in higher SSB consumers compared with lower consumers [, , , ]. Different kinds of sugar-sweetened beverages were included in the self-reported SSB intake questionnaires form including: sugar sweetened sodas, carbonated beverages, caloric and sport drinks, lemonades, yogurt drinks, sweetened teas, non-100% fruit juices, cordials and other types. The age range was from 5 to 22 years old while most of the studies were performed in apparently healthy children and adolescents [–, , , , , , , , ] and one study was performed in children with T1DM [] and one in severe obesity []. The setting of the studies was community [, , , , ], school [, , , , , ], home [] and clinic [, ]. The study by Chan TF et al. [] that was conducted in two genders separately and the study by DeBoer EC et al. [] that was performed in two age groups (5–6 years and 11–12 years) were included as two separate studies. The geographical locations of the studies were Australia [], USA [, , ], Iran [], Norway [], China [, , , ], Brazil [], Taiwan [, ] and Malaysia []. Almost all of the studies were cross sectional [–, , , , , , –] and in three cohort studies the cross-sectional baseline ***data*** was used [, , ].

The characteristics of studies included in the meta-analysis

| **First author** | **Country** | **Journal/year** | **Disease status/setting** | **Design/gender** | **Num. (total-each category)** | **Age range (y)** | **Dietary assessment tool** | **SSB dose (mean/median g/d)** | **SSB type** | **Main Results** | **Adjustments** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ambrosini GL [] | Australia | Am J Clin Nut/2013 | Apparently healthy/community | Cohort/both | 1433/478 | 14, 17 | FFQ | 47.5 ± 37.1 | Carbonated + cordials or and non-100% fruit juice/ | SBP in higher tertiles of SSB intake was higher than lower tertile (P = 0.03). No difference in DBP was found. | Age, pubertal stage, physical fitness, dietary misreporting, maternal education, family income, BMI, healthy and Western dietary pattern scores. |
| Barstad LH [] | Norway | BMC Pediatrics/2018 | Severe obesity/clinic | Cross-sectional | 313/(62-70) | 12?18 | Self-administered FFQ | None to at least 4 glasses per week ( ? 1375) | Sugar-sweetened soda | SBP in higher intakes of SSB was higher than lower. | ? |
| Bortsov AV [] | USA | Acta Diabetologica/2011 | Youth with T1DM/clinic | Cross-sectional/both | 902/(304-600) | 10?22 | FFQ | 0-750 | Sugar-sweetened soda | No significant difference in SBP or DBP between three categories SSB intake | Age, sex, race/ethnicity, parental education, diabetes duration, skipping insulin, time watching TV, involvement in team sports, and total energy intake, BMI-z-score, saturated fat intake, total fiber intake |
| Bremer AA [] | USA | Arch Pediatr Adolesc Med/2009 | Apparently healthy/community | Cross-sectional/both | 2630/(876) | 12-19 | FFQ | Low (? 20th percentile) to high (? 80th percentile) of the sum of the number of SSB serving equivalents | Caloric soft drinks, colas, sugar-sweetened fruit drinks, or other SSBs | Significantly higher SBP values (P = 0.03) and no difference in DBP values between low and high SSB consumers | PA, age, sex, race,energy intake (in kilocalories) |
| Chan TF [] | Taiwan | ***Nutrients***/2014 | Apparently healthy/school | Cross-sectional/females | 2727/(242-196) | 12?16 | FFQ | Non to > 750 | Any type | No significant difference between SBP and DBP of different SSB categories | Age, gender, study area, PA, total calories, alcohol and smoking |
| Chan TF [] | Taiwan | ***Nutrients***/2014 | Apparently healthy/school | Cross-sectional/males | 2727/(406-120) | 12?16 | FFQ | Non to > 750 | Any type | Significantly higher SBP in higher intakes compared with lower intakes of SSB (P = 0.043). No difference in DBP was observed. | Age, gender, study area, PA, total calories, alcohol and smoking. |
| DeBoer EC [] | USA | Clinical Nutrition- ESPEN/2013 | Apparently healthy/home | Birth cohort/both | 9600 | 5?6 | FFQ | 0-750 | Chocolate milk, yogurt drinks, lemonades, juices and soft drinks | Significantly higher SBP in higher versus lower SSB tertiles | Sex, height and age, ethnicity, maternal SES, BMI, PA, screen time, gestational age, birth weight, maternal BMI and paternal BMI, pubertal stage |
| DeBoer EC [] | USA | Clinical Nutrition- ESPEN/2013 | Apparently healthy/home | Birth cohort/both | 2516/(794-905) | 11-12 | FFQ | 0-950 | Yogurt drinks, soft drinks, juices, lemonades, sport drinks and energy drinks | Significantly higher SBP in higher versus lower SSB tertiles | Sex, height and age, ethnicity, maternal SES, BMI, PA, screen time, gestational age, birth weight, maternal BMI and paternal BMI, pubertal stage |
| Gui ZH [] | China | ***Nutrients***/2017 | Apparently healthy/community | Cross-sectional/both | 53,151/(15 763- 17773) | 6-17 | FFQ | 0-500 | Coca-Cola, Sprite, orange juice, Nutrition Express, and Red Bull | Significantly higher SBP and DBP in higher versus lower SSB intakes (P < 0.001), no difference in odds of HTN in different SSB intakes. | Age, sex, and residence, maternal education, paternal education, family income, screen time, and PA, meat and fried food for overweight, obesity, and abdominal obesity; and meat, fried food, height, and BMI for blood pressure. |
| He B [] | China | J AtherosclThromb/2018 | Apparently healthy/school | Cross-sectional/both | 2032/(440-705) | 6?18 | FFQ | 0-120 | Carbonated drinks, juices, and sports and sweet tea beverages. | Significantly higher SBP and DBP in higher versus lower SSB intakes (P < 0.001). | Age, gender, physical activities, sleeping duration, sedentary behavior, and dietary information |
| Lin WT [] | Taiwan | Int J Obesity/2013 | Apparently healthy/School | Cross-sectional/both | 2727/(164-317) | 12-16 | FFQ | non-intake to ? 1000 ml/d | SSB, including soft drinks, fruit drinks and sweetened teas. | Significant increase in SBP (3.47 mmHg; P = 0.004) and no significant change in DBP (p = 0.514) in higher versus lower SSB consumers. | The study area, age, gender, PA, total calories, the intake of meat, seafood, fruit, fried food and a food with jelly/honey, as well as for alcohol drinking and cigarette smoking. |
| Loh DA [] | Malaysia | Pediatric Obes/2015 | Apparently healthy/School | Cross-sectional/both | 881/(293) | 13 | FFQ | 338.75 | Carbonate beverages | No significant difference in SBP and DBP between SSB tertiels. | ? |
| Mirmiran et al. [] | Iran | Nutr Metab/2015 | Apparently healthy/Community | Cohort/both | 424/(106) | 6?18 | FFQ | 132.7 | Sugar sweetened carbonated soft drinks (SSSDs) and fruit juice drinks (non-100% fruit juices) | Significantly higher SBP in highest versus lowest SSB category (P = 0.021). No difference in DBP between SSB quartiles (P = 0.52). Higher odds of HTN in highest versus lowest SSB category (2.90 (0.91?9.26); P = 0.043) | Age, sex, total energy intake, PA, family history of diabetes dietary fiber, tea and coffee, red and processed meat, fruit, and vegetable, BMI |
| Qin Z [] | China | J Hyper/2018 | Apparently healthy/School | Cross-sectional/both | 10091/(249-203) | Grade 4: 9.04 ± 0.38Grade 7: 12.03 ± 0.41 | FFQ | Consumers/non-consumers | Sprite and Coca-Cola | Higher odds of HTN in SSB consumers versus non-consumers [OR:1.40 (1.15,1.70)] | School, parental educational attainment, PA, dietintake of meat and snacks |
| Souza BSN [] | Brazil | J Hypert/2016 | Apparently healthy/school | Cross-sectional/both | 488/(419-25) | 9?16 | FFQ | 500 | Soft drinks, fruit drinks and sweetened teas | Significantly higher SBP and DBP in SSB consumers than non-consumers (P < 0.05) | Age, sex, BMI, PA, addition of salt to food at the table, and education of the head of the family |
| Zhu Z [] | China | Pediatric Obes/2020 | Apparently healthy/Community | Cross-sectional/both | 3958/(343-2582) | 6-17 | FFQ | 201.7 | Nonalcoholic beverages sweetened by sugar, excluding fresh juice. | Significantly higher SBP and DBP in high consumers versus low consumers (P < 0.001; P = 0.004) | Age, gender, energy intake, pubertal stage, daily sedentary time, maternal education, household income, |

SSB sugar sweetened beverages, SBP systolic blood pressure, DBP diastolic blood pressure, BMI body mass index, FFQ food frequency questionnaire, HTN hypertension, PA physical activity, T1DM type one diabetes mellitus

Findings from the two-class meta-analysis of the comparison of SBP and DBP between different SSB categories

The results of the comparison of SBP and DBP between highest versus lowest SSB consumption categories have been presented in Figs.  and . As presented, high SSB consumption was associated with 1.67 mmHg increase in SBP in children and adolescents (WMD: 1.67; CI 1.021–2.321; P < 0.001). While, the change in DBP was not significant (WMD: 0.313; CI −0.131, 0.757; P = 0.108). Odds of hypertension in highest versus lowest SSB consumers has been shown in Fig. . High SSB consumers were 1.36 times more likely to develop hypertension compared with low SSB consumers (OR: 1.365; CI 1.145–1.626; P = 0.001). A significant between study heterogeneity was observed for studies that had evaluated SBP (I2 = 99.8; P < 0.001) and for DBP (I2 = 99.4; P < 0.001). However, there was no heterogeneity for the studies that had evaluated the odds of hypertension (I2 = 0.0; P = 0.976). For finding the source of heterogeneity, we performed subgroup analysis and the results are shown in Additional file : . Tables S4 and S5. As shown in these tables, subgrouping according to setting, baseline value of SBP, health status, region, gender and study quality reduced the heterogeneity for studies that evaluated the SBP values. While for DBP, the SSB dosage, setting, region, sample size, baseline DBP values, study quality, gender and design reduced the heterogeneity. Moreover, Subgroup analyses showed that a higher SSB consumption lead to a higher SBP among children and adolescents with baseline SBP greater than 110 mmHg (WMD: 0.743; CI 1.330–4.157; P < 0.001). Additionally, SSB intake might increase SBP in the studies with a sample size > 2000 (WMD: 2.720; CI 2.581–2.859; P < 0.001), school based studies (WMD: 2.780; CI 2.727–2.832; P < 0.001). Higher SSB intake also resulted in greater increase in SBP among apparently healthy subjects (WMD: WMD: 1.848; CI 0.888–2.808; P < 0.001). Accordingly, the subgrouping revealed that the high SSB intake is associated with high DBP in school based studies (WMD: 1.76; CI 1.431–2.089; P < 0.001), studies with high baseline DBP values (WMD: 0.494; CI 0.001–0.987; P = 0.049), performed in apparently healthy children or adolescents (WMD: 0.476; CI 0.023– 0.929; P = 0.039), studies with sample size greater than 2000 (WMD: 0.957; CI 0.531–1.384; P < 0.001) and studies that performed in Asia (WMD: 0.542; CI 0.024–1.060; P = 0.04).

The forest plot showing the weighted mean difference (WMD) of the effect of SSBs intake on systolic blood pressure (SBP)

The forest plot showing the weighted mean difference (WMD) of the effect of SSBs intake on diastolic blood pressure (DBP)

The forest plot showing the odds ratio (OR) of the association between SSBs intake and hypertension (HTN)

Finding from the dose–response meta-analysis of the association between SSB dose and blood pressure

The details of dose–response meta-analysis are shown in Table  and the results for the SBP and DBP are presented in Figs.  and , respectively. According to the results of dose–response meta-analysis, no evidence of departure from linearity was observed for the association between dose of SSB with mean change in SBP (P-nonlinearity = 0.707) or DBP (P-nonlinearity = 0.180).

Details of non-linear association between SSB intake, SBP and DBP

| **SBP Mean difference** | **Coefficient** | **Standard error** | **T** | **P > |t|** | **95% Conf. Interval** |
| --- | --- | --- | --- | --- | --- |
| Dose\_1 | 0.168 | 0.3513 | 0.48 | 0.64 | ?0.605? 0.941 |
| Dose\_2 | 0.0635 | 0.164575 | 0.39 | 0.707 | ?0.298 0.425 |
| \_cons | 1.314 | 0.5642 | 2.33 | 0.040 | 0.072 2.556 |
| DBP Mean difference | Coefficient | Standard error | t | P > |t| | 95% Conf. Interval |
| Dose\_1 | ?6.987 | 7.066 | ?0.99 | 0.346 | ?22.73?8.757 |
| Dose\_2 | 47.35816 | 32.84361 | 1.44 | 0.180 | ?25.82 ?120.5 |
| \_cons | 63.28868 | 1.101714 | 57.45 | 0.000 | 60.833? 65.743 |

SSB sugar sweetened beverages, SBP systolic blood pressure, DBP diastolic blood pressure

Dose– response association between the SSBs dosage and mean difference in systolic blood pressure (SBP) with the study outcomes (Linear relation (solid line) and 95% CI (gray area) of mean difference in study outcomes by 1 g/d increment in SSB dosage

Dose– response association between the SSBs dosage and mean difference in diastolic blood pressure (DBP) with the study outcomes (Linear relation (solid line) and 95% CI (gray area) of mean difference in study outcomes by 1 g/d increment in SSB dosage

Publication bias

The funnel plots are presented in Additional file : Figure S1a, b, c. No evidence of publication bias was observed neither for the meta-analysis of the comparison of SBP or DBP in highest versus lowest SSB categories according to Begg’s and Egger’s meta-bias tests [SBP: Begg test (P = 0.547) and Egger test (P = 0.267); DBP: Begg test (P = 0.115) and Egger test (P = 0.592)], nor for the meta-analysis of the association of hypertension with SSB intake [e.g. Begg test (P = 0.327) and Egger test (P = 0.127)].

Discussion

According to our finding, high SSBs intake among children and adolescents was associated with higher SBP and odds of hypertension. Moreover, no evidence of departure from linearity was observed in the dose–response meta-analysis of change in SBP or DBP according to SSB dosage. A total of 14 studies with 93,873 participants were included in the current meta-analysis.

SSBs such as sugar sodas and juices are one of the main sources of excess sugar consumption containing 22 to 39 g of sugar per serving [, ]. The American Academy of Pediatrics (AAP) has recommended that young children refrain from intake of SSB because of its potential adverse effects on obesity and related disorders []. According to the last update of the clinical practice guideline which is issued by AAP, the prevalence of pediatric prehypertension and hypertension has increased to 14.8% and 16.3%, respectively []. In our work, high SSB intake was associated with increased systolic blood pressure and odds of hypertension; numerous trials also evaluated the effects of reduced SSB intake on blood pressure; in the study by Chen L et al. reduction in SSB intake of 1 serving/day over 18 months was associated with a 1.8 and 1.1 mmHg reduction in SBP and DBP, respectively []. Chiu S et al. also reported reduced systolic blood pressure after replacing sugar sweetened sodas with milk in young male adolescents []. Accumulating evidence has linked SSB consumption during childhood to unhealthy weight gain which itself associated with risk of health outcomes such as type 2 diabetes, metabolic syndrome, cardiovascular diseases and other obesity-related disorders in later life []. Therefore, intake of SSB should be limited in children and adolescents to reduce obesity-related chronic disease risk.

By using subgroup analyses, we could successfully identify possible sources of heterogeneity; such that the setting, region, gender and study quality were associated with a significant source of heterogeneity for SBP and SSB dosage, baseline DBP values, study quality, gender and design were possible source of heterogeneity across studies for DBP. Although the effect of high SSB intake on DBP was not significant, while subgrouping, the results were significant for the studies performed in apparently healthy and Asian populations, school setting, with high baseline DBP values and in large sample size studies. So, potential sources of bias were detected with the help of subgroup analyses. It seems that school is one of the best environments for children’s psychological, physical and social development []. Since children spend so much of their day predominantly in the school setting, the school food environment can contribute in reversing the trend towards childhood obesity []. Research has shown that children consume nearly 35–47% of their daily dietary intake and they are exposed to less healthful food and beverages such as SSBs and energy dense food (pizza, french fries, chips and candies) while at school []. It seems that improvement to the school food environment through decreasing availability of SSBs and less healthful nutritional practices can be considered as a strategy to reduce obesity and its-related complications in children and adolescents [].

Numerous school base studies have effective strategies combating against children health problems [–]. WHO recommends that reduction of SSB intake among children should be implemented initially in schools by developing rules about consuming soft drinks in schools, removing vending machines selling soft drinks from school premises, provision of safe drinking water fountains in schools and other locations where children gather and promoting healthy dietary behavior in classrooms []. Moreover, children with higher baseline DBP values showed higher association of SSB intake with DBP; this finding showed that possibly the adverse effect of high SSB intake increased by increase in baseline blood pressure. In our research, the association between mean difference in SBP or DBP with SSB dosage did not exert a non-linear association. Therefore, increase in SBP or DBP is not a dose-dependent event after SSB consumption; this finding was also similar to the previous meta-analysis performed by Xi B et al. reporting no evidence of dose–response association between higher SSB consumption and risk of hypertension among adults (P nonlinearity = 0.82) []. Among the subjective dietary assessment methods such as the 24-hour dietary recall, dietary record, dietary history and food frequency questionnaire (FFQ), FFQ has been widely used in large-scale epidemiological studies []. It seems that the role of FFQ as a self-reported ***data*** ***collection*** tool for estimating the serving sizes might be a source of bias, this is mostly because of the difference in the FFQs structure and items and also difference in the serving definition in numerous studies. Also, in different studies outcome of study was adjusted for wide heterogenic confounders that may have affected the accuracy of dose–response estimates []. In the present meta-analysis, we found that SSB consumption is associated with the elevated SBP and DBP among apparently healthy subjects. However, we should take into account that the most of studies had included healthy participants in their researches and only one study performed among diabetic subjects. Therefore, the observed results may not reflect the true relationship regarding the subjects’ health status. Since the previous studies have shown that SSB intake is positively associated with diabetes and other health outcome [], these ***data*** support the benefits of lower intake of SSBs.

Region was also another important factor affecting the SSB and DBP association. Our meta-analysis found that in the studies that performed in Asia there was a potent effect of high SSB intake on DBP, while this association was not significant for the studies that performed in USA/Oceania. Interestingly, this finding was also similar for SBP subgrouping. This finding is possibly due to this fact that most of the studies were form Asia and this high number of studies give greater power to Asian studies; also, in the previous report of global, regional, and national consumption of sugar-sweetened beverages in 187 countries, the SSB intake among Asian countries was lower than European and American countries and these findings were strongly dependent to age, country and sex of participants []; therefore, the role of these confounders in explaining the association between SSB intake and burden of disease should be considered. On the other hand, cultural differences among the lifestyle and socio-demographic factors play an important role in dietary intakes especially sugar; and it has been proposed as an explanation for the disparities in disease risk among ethnically diverse population [, ]. It seems that cultural factors by influencing on food preferences and choices may contribute to diet quality and subsequently health inequalities []. On the other hand, according to the latest ***data***, childhood obesity prevalence, which coincides with the highest prevalence of hypertension and other metabolic disorders, in Latin American is among the highest in the world []. However, only one study from Latin American countries was included in our meta-analysis and as a result, we missed information on the relationship between SSB intake and hypertension among children and adolescents in this geographical region.

Several potential mechanisms may describe how SSB consumption could results in increasing the risk of hypertension. Hyperuricemia which is induced by a higher fructose load from sugar-sweetened beverages may leads to acute endothelial dysfunction and chronic Na retention and consequently predisposes individuals to hypertension [, ]. In this regard, findings from a human study showed a significant increase in blood pressure after acute administration of fructose while this effect was not seen with glucose []. Therefore, it has been hypothesized that the fructose in SSBs is responsible for their association with elevated blood pressure. Heredity appears to play a major role in the development of metabolic abnormalities such as hypertension especially in childhood and reports have shown heritability of childhood hypertension is estimated at 50 percent []. However, from included studies in our meta-analysis, only one citation [] had included those who didn’t have a history of hypertension. On the other hand, none of included studies have adjusted for family history, thus our finding in the present meta-analysis should be interpreted with caution. Additionally, SSB consumption has been shown to be a part of an overall unhealthy dietary pattern and is correlated with unfavorable socioeconomic status []. There is limited research has directly compared the effect of SSB intake to other foods with regard to the risk of cardio-metabolic risk factors such as elevated blood pressure []. For example, Amini et al. reported western dietary pattern which contains high amount of SSB is associated with greater odds of having increased blood pressure []. Besides, the Dietary Approach to Stop Hypertension (DASH) which emphasizes on higher consumption of vegetables, fruits, nuts, legumes, fish, chicken, whole grains, low-fat dairy products, and lower consumption of SSBs and red meat, has been shown to be negatively associated with hypertension in adults and children [].

Recently accumulating evidence has linked the maternal diet during pregnancy and breastfeeding to food and tastes preferences of children []. The fetus experiences maternal diet tastes and smells through amniotic fluids during pregnancy and afterward by breast milk []. Thus, maternal intake in pregnancy could program taste preference of the child towards SSB and health care providers should pay particular attention to educating women in this area.

The association between high SSBs intake and higher odds of hypertension among children and adolescents was another main finding in the present research. A large number of studies have shown that blood pressure in childhood predicts the future hypertension in adulthood [, ]. Hence, early interventions are warranted.

Strength and limitations

The current systematic review and meta-analysis for the first time evaluated the dose–response association between sugar-sweetened beverage intake and hypertension in children and adolescents. Due to growing prevalence of hypertension in this population, this study has clinical and social implications regarding developing preventive strategies against high SSB consumption in children and adolescents. However, several limitations of the current meta-analysis should also be mentioned; first, using different kinds of FFQ for extraction of SSB intake is a matter of bias because this information is self-reported and has different structures and definitions between studies. Second, there were different kinds of SSBs in these studies and subgrouping according to SSB types were not possible. Moreover, different studies have reported the SSB intake with different units and these conversions might be a cause of error in estimating the accurate dosage of SSB consumption. Additionally, there were different adjustments for confounders in different studies that might affect the results.

Conclusion

The current meta-analysis, for the first time revealed that high SSBs consumption is associated with increased SBP and odds of hypertension among children and adolescents. Although further large prospective studies and well-designed intervention studies are recommended to confirm the observed relationships, the results of the present study support recommendations to decrease the consumption of SSB to prevent and control hypertension and its complications. Developing strategic programs to reduce SSBs consumption particularly in school settings is suggested to reduce the disease burden in this population.

**Acknowledgements**

None.

**Notes**

Supplementary informationSupplementary information accompanies this paper at [*https://doi.org/10.1186/s12967-020-02511-9.Publisher's*](https://doi.org/10.1186/s12967-020-02511-9.Publisher's) NoteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

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Business Monitor Online

October 23, 2020 Friday

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**Length:** 1921 words

**Highlight:** We forecast household spending in Hungary to return to growth in 2021, after the Covid-19 pandemic led to a contraction in consumer spending in 2020. In Hungary, improving economic growth in 2021 along with ongoing government stimulus measures will feed through into better employment figures, which will help support household disposable incomes. As such, we forecast that household spending in the country will grow by a real rate of 8.7% y-o-y over 2021, a significant improvement from the 1.7% y-o-y contraction in 2020.

**Body**

*Key View: We forecast household spending in Hungary to return to growth in 2021, after the Covid-19 pandemic led to a contraction in consumer spending in 2020. In Hungary, improving economic growth in 2021 along with ongoing government stimulus measures will feed through into better employment figures, which will help support household disposable incomes. As such, we forecast that household spending in the country will grow by a real rate of 5.6% y-o-y over 2021, a significant improvement from the 4.5% y-o-y contraction in 2020.***Outlook For 2021** Our forecast for household spending over 2021 factors in the impact of the Covid-19 pandemic on Hungary and the subsequent government stimulus measures on consumer spending. We forecast that real growth in household spending will bounce back over the year, growing by a real rate of 5.6% y-o-y. This is a significant improvement from the 4.5% y-o-y contraction we projected for household spending during 2020, though just below the 6.0% y-o-y growth we estimated for 2019 prior to the pandemic.

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| Real Household Spending To Recover Strongly In 2021 |
| Hungary - Total Household Spending, real % y-o-y (2014-2024) |
|  |
| *f = Fitch Solutions forecast. Source:* ***Eurostat****, Fitch Solutions* |

We predict that all of the main consumer spending categories will return to positive growth in 2021. Food and non-alcoholic drink spending were prioritised in household budgets in 2020 and so growth in spending in these categories, while still positive, will be slightly lower in 2021. We forecast food and non-alcoholic drinks spending will grow by 4.9% y-o-y in 2021, from the 9.5% y-o-y growth we estimate for 2020. Spending within other consumer categories is expected to record strong growth over 2021. However, this growth comes from a low base as non-essential consumer categories recorded significant contractions over 2020. The links and table below highlight our analysis of consumer spending in Hungary prior to, during and after the Covid-19 pandemic. *Hungary In Covid-19 Lockdown: Impact on Consumer SectorHungary Consumer Outlook: 2020 Covid-19 Impact Assessment*

**Hungary - Consumer Spending Category (HUF % Chg Y-O-Y)**

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| **Consumer Spending Category** | **2020 Pre-Covid-19** | **2020 Revision** | **2021 Forecast** |
| Food and non-alcoholic drinks spending | 6.5% | 9.5% | 4.9% |
| Clothing and footwear spending | 6.7% | -5.4% | 9.8% |
| Alcoholic drinks and tobacco spending | 7.5% | -6.7% | 12.0% |
| Furnishing and home spending | 6.1% | -3.3% | 7.6% |
| Recreation and culture spending | 6.7% | -6.6% | 11.1% |
| Restaurants and hotels spending | 8.2% | -5.6% | 10.8% |

e/f = Fitch Solutions forecast/estimate. Source: National ***statistics***, Fitch Solutions **Dynamic Of Consumer Spending In 2021** Our improved forecast outlook for consumer spending in Hungary in 2021 is in line with our Country Risk team's forecasts that the Hungarian economy will grow by a real rate of 4.6% y-o-y over 2021, a recovery on the 5.3% contraction experienced over 2020. We expect that Hungarians will gradually return to their pre-pandemic consumption patterns in H220 and H121, which will drive a recovery in private consumption. Due to employment protection schemes, Hungary's lockdown had a limited effect on its unemployment rate, which only rose from 3.4% in February to 4.8% in July. Wage growth, which had slowed to 7.8% y-o-y in April picked up again, coming in at 15.6% y-o-y in July, comparing favourably against a 2019 average of 11.4%. We believe that this was a one-off rebound and that wage growth settled around the low double-digits towards the end of 2020. Our full-year forecast for unemployment in both 2020 and 2021 is 5.0% and 4.3% respectively. So despite a hiccup in consumer confidence in August (retail sales fell 0.7% y-o-y in August, having risen 0.4% y-o-y in July, largely to a lacklustre tourism sector), relatively solid labour market fundamentals will likely underpin a gradual recovery in consumer confidence over H220 and into 2021. We note, however, that there is a risk of increased underemployment where people return to work but work fewer hours than pre-Covid-19 or take lower paying jobs. This will put downside pressure on disposable incomes over the short term. Inflation will be a risk for consumer spending over 2021 as a lack of demand pushed prices down over 2020 causing inflation to average 2.8%. With a recovery forecast for 2021, demand-side pressure will push prices back up over the year causing inflation to average of 3.1%.

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| Falling Unemployment To Aid Consumer Spending |
| Hungary - Unemployment Rate (2019-2021) |
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| *e/f = Fitch Solutions estimate/forecast. Source: Fitch Solutions, Hungarian Central Statistical Office* |

**Government Support Measures** The recovery of consumer spending in Hungary in 2021 will also be supported by the government stimulus measures enacted in 2020. At the time of writing (October 15 2020), the Hungarian government had announced several stimulus packages amounting to 18% of GDP (GDP in 2019 was roughly USD161bn). Most of these measures are tax holidays and loan guarantees, so do not contribute directly to government expenditure, which we estimate grew by 8.9% in 2020. Direct payments consisted of wage subsidies for workers put on shortened work hours, which ended in August; support for priority sectors, including tourism, health, food, ***agriculture***, construction, logistics, transport, film and entertainment industries; and a wage subsidy program for new hires, with the condition a company keeps a worker for at least nine months. Furthermore, around HUF245bn (0.6% of GDP) was reallocated to the healthcare sector. An extra week of pension is to be paid out every February during 2021-24. Additionally, interest-free loans to SMEs were made available from June 12.In the table below, we highlight several elements of these stimulus packages that will support households and their propensity to spend into 2021. Our Country Risk team sees risks to Hungary's outlook remaining tilted to the downside. With the economic outlook so uncertain, further stimulus from the Hungarian government remains possible. This would result in wide deficits and higher public debt ratio. Given that Prime Minister Viktor Orban can renew his emergency powers indefinitely, his administration could approve further stimulus virtually unopposed.

**Hungary Government Support Measures**

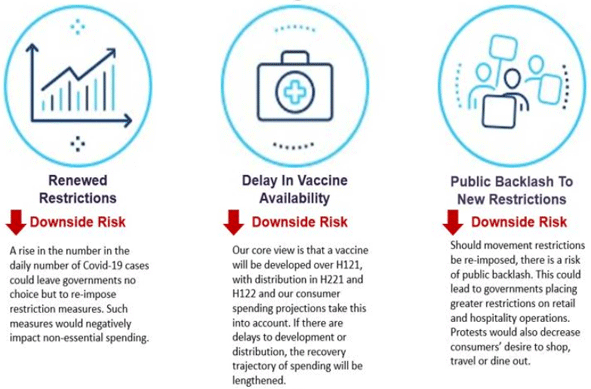
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| **Government Measure** | **Details** |
| Tax reductions | Employers' social contributions lifted in most affected sectors, healthcare contributions lowered in June 30, 80,000 SMEs (mainly in the services sector) exempt from small business tax, tourism development contributions temporarily cancelled, procedures for ***collecting*** tax arrears suspended during the state of emergency. |
| Wage subsidies | Wage subsidies for workers put on shortened work hours; support for priority sectors, including tourism, health, food, ***agriculture***, construction, logistics, transport, film and entertainment industries; wage subsidy program for new hires, with the condition a company keeps a worker for at least nine months. |
| Direct cash payouts | Around HUF245bn (0.6% of GDP) reallocated to the healthcare sector. |
| Cost of living support | An extra week of pension to be paid out every February during 2021-24. |
| Loan Repayment Moratoriums | Interest-free loans to SMEs will be available from June 12. 50% of the budget will be available for investments, 50% to finance liquidity and operations. The highest amount available is HUF150mn, while asset and liquidity financing loans are capped at HUF300mn. |
| Other | Government to purchase up to HUF150bn (0.3% of GDP) of bonds issued by banks in order to support lending during the crisis and to ensure financial stability. |

Source: National sources, Fitch Solutions **A Review Of 2020Our 2021 outlook for consumer spending in Malaysia is one of recovery after a very tough 2020.** Our 2021 outlook for consumer spending in Hungary is one of recovery after a very tough 2020. With the spread of the Covid-19 pandemic, the Hungarian government declared a state of emergency on March 11 (seven days after the first reported case in the country) and implemented containment measures that included travel and activity restrictions, and mandatory distance learning for schools and universities. On March 27, mandatory lockdown measures were imposed, except for essential business and activities (eg food shopping, healthcare). From May 4, the economy began reopening, and while the state of emergency was lifted by June 18, some of the emergency measures remain in place and the government can declare a health crisis for a period of up to six months (extendable indefinitely) without parliamentary authorisation. Social distance rules are expected to be heeded everywhere and policies and fines regarding wearing masks have recently got stricter. Hungary survived the first wave of the pandemic relatively unscathed. However, cases have been rising rapidly since the end of August, reaching about 10 times their peak level in April by mid-October. The authorities therefore reintroduced border restrictions in September, tightened the enforcement of mask wearing, and imposed an 23:00 curfew for bars and restaurants. The government has not ruled out further restrictions but appears reluctant to re-enter a lockdown as previously seen in order to maintain economic activity.

**List Of Remaining Restrictions**

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| **Restrictions** | **Details** |
| Schools and universities | From October 2020, schools and kindergartens can only be entered after the body temperature has been measured. Universities may be open provided that physical distancing is observed, but the rector has the ultimate right to decide. Visiting student residences is still prohibited. |
| International travel | Foreigners without a residence permit will be banned from entering Hungary, effective September 1. Travel for business purposes and military convoys are possible, and there will be a humanitarian corridor. Hungarians returning to the country will have to enter a 10-day quarantine, no matter which country they are coming from. Hungarians can leave quarantine only after two negative test results. |
| Social distancing | General rule is that physical distancing of one and a half meters is to be kept and face masks are mandatory when shopping, on public transport, in taxis, at public transport stations, waiting rooms and stops, and also in theaters, cinemas and shopping malls. |
| Entertainment hubs | Public areas, parks, shops, shopping malls, and markets are open. Restaurants, cafes, bars and hotels are open, but employees are expected to wear face masks. Catering and night spots must close at 23:00. Cultural institutions, such as libraries, museums, zoos, cinemas and theaters are open. |

Source: National sources, Fitch Solutions **Risk To Outlook** Our forecasts factor in risks that are highly likely to play out in the short term, such as the easing of government support. However, there are other risks to this outlook that if they do start to play out will lead to forecast revisions. The graph below highlights some of the most pertinent global risks to our 2021 Consumer Outlook which will also have an impact on Hungary. **Outlook For 2021 In Hungary Tilts To Downside Risks** Global Risks To Consumer Outlook *Source: Fitch Solutions Note: We continue to review and revise our forecasts in light of new* ***data****. Currently our forecasts are not factoring in a nationwide lockdown due to a second wave (restrictions could be implemented in virus hotspots within the country) and no effective vaccine being developed and administered to the public. Should either of these scenarios become more likely, we will adapt our forecasts accordingly.*



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HINA Digest

November 27, 2020 Friday

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**Length:** 9253 words

**Body**

Zagreb,Hrvatska27 November 2020 (Hina) - Croatia's Q3 GDP down 10% y-o-y ZAGREB, Nov 27 (Hina) -Croatia's economy contracted by 10%in the third quarter of this year compared to the same period last year,mostly due to the consequences of decreased consumption, but the contraction is lower thanthe record 15% fall in the second quarter. The State Bureau of ***Statistics*** (DZS) published its initial estimate on Friday showing that GDP fell by 10% in Q3 year on year. Thatis a little less than analysts had estimated. Seven analysts participating in a survey for Hina on average estimated a fall of 10.4% with their forecasts ranging from 9.5% to 11%. It was the second quarter in a row that GDP had fallen, which means that the economy has gone recession for the first time since 2014. The fall in GDP however was somewhat less than in Q2 when the economy contracted by a record 15.4% as a consequence of the lockdown in an effort to contain the coronavirus pandemic. The real GDP fall of 10% is the second biggestsince 1995 when quarterly estimates of GDP started being made, DZS said.

Personal consumption down 7.5% The economic downturn in the third quarter is mostly the consequence of weaker personal consumption, which is the major component of GDP. According to today's figures, household consumption sunk by 7.5% in the third quarter year on year. Gross fixed capital investments fellby 3% y-o-y. Exports of commoditiesand services contracted by 32.3% on the year, with commodity exports falling by 3% while exports of services plummeted by 45.3%. Imports of commodities and services also shrank, by 14.1%, with commodity imports decreasing by 9.9% and services by 33.3% on the year. The only item to increase in Q3 was government consumption, growingby 1.5% y-o-y. ***Data*** below EU average According to seasonally adjusted ***data***, GDP increased by 6.9% in Q3 compared to the preceding quarter while contracting by 10% on the year. The ***data*** is poorer than the European Union average. According to ***Eurostat***, the EU's Q3 GDP was up 11.6% quarter-on-quarter but down 4.3% on the year. FinMin says GDP contraction in Q3 as expected ZAGREB, Nov 27 (Hina) - Finance Minister Zdravko Maric said on Friday thatthe contraction of Croatia's Gross Domestic Product by10% was as expected, however, a decline in consumption was higher than expected, and on the other hand, a decline in investments was lower than expected. The minister said that the contraction of the export ofservicesof "only" 45% was a positive surprise. Earlier on Friday, theState Bureau of ***Statistics*** (DZS) published its initial estimate of economic growthshowing that GDP fell by 10% in Q3 year on year. That is lower than estimated by sevenanalysts, polledin a survey for Hina, whoon average estimated a fall of 10.4%, with their forecasts ranging from -9.5% to -11%. The 2020 Q3 contraction is lower than the record 15% fall in the second quarter. Croatia entered a recession for the first time since 2014. According to today's figures, household consumption sunk by 7.5% in the third quarter year on year. Gross fixed capital investments fell by 3% y-o-y. Maric said that the 3% fall in investments is "more or less good news". The minister highlighted the challenge of high dependence on imports and said that some changes must be made to reduce this dependence. Considering the statistical ***data*** for the first three quarters of 2020 and projections for the remaining quarter and taking into account a lockdown of a part of the economy in the coming weeks, Maric said that the government stuck to its projection of adownturn of 8%for the whole of 2020. The ***data*** show that in the first three quarters Croatia's economy contracted 8.4%. Maric said that theclosure of some businesses until 21 December could not be compared to the lockdown in Q2 2020. Asked by the press about compensatory measures for the businesses supposed to be closed in the coming weeks, Maric said that the measures to offset the consequences of the lockdown would be presented next week. The basic postulate of thosemeasures is not to encourage businessesnot to work, and grants are given to those who are prevented by the current circumstances from doingbusiness. Maric commented on the example of restaurants, explaining that they can prepare and deliver food although they cannot receive guests on their premises. Analysts forecast10% downturn in Q3 - analysts ZAGREB, Nov 27 (Hina) - The Croatian Bureau of ***Statistics*** (DZS) is due torelease its initial estimate of third-quarter Gross Domestic Product on Friday, and analysts expect a slower decline than the record 15% in the second quarter. Although the economy has somewhat recovered from the second-quarter downturn thanks to measures undertaken after the spring lockdown, analysts predict that GDP fell at a double-digit rate in the third quarter. Seven analysts polled by Hina expect a GDP decline of 10.4%on average, their projections ranging from 9.5% to 11%. It would be the second quarter in a row that the economy has declined on an annual level, which means that it has sunk into a recession. The record fall in the second quarter was the result of the coronavirus pandemic and restrictions imposed to curb the novel virus, which paralysed economic activity from the second half of March until the end of April. The decline was mainly the result of weak personal consumption, the largest GDP component. DZS ***data*** shows that retail sales dropped by 7.6% in the third quarter compared with the same period of 2019. Although the tourist season was somewhat better than expected at the outset of the corona crisis, tourist turnover fell sharply. According to DZS figures for the first nine months of the year, 6.6 million tourists stayed in commercial accommodation, down by 63% compared with the same period of last year, while the number of overnight stays fell by 54% to 39.7 million. GDP was also adversely affected by the second-quarter decline in industrial production of 1.3% as a result of weak domestic demand and a fall in exports. According to the DZS, Croatia exported about HRK 80 billion worth of goods in the year to September, a decrease of 4.8% compared with the same period of last year, while imports fell by 10.1% to HRK 126 billion. The second wave of the coronavirus outbreak is expected to result in an economic downturn in the fourth quarter as well. The analysts interviewed by Hina predict that the economic decline for the whole of 2020 would be 9.2% on average, their forecasts ranging between 8% and 10%. Three months ago they expected a downturn of 10.5%. The downturn this year could be sharper than during the financial crisis of 2009 when the economy sank by a record 7.4%. The government expects a GDP contraction of 8% for this year, the Croatian National Bank has forecast a decline of about 8%, and the European Commission expects that the Croatian economy will slide by 9.6% this year. While the GDP decline this year will probably be deeper than during the global financial recession of 2009, this recession is expected to be shorter. The previous recession dragged out over six years, while this time the economy is expected to rebound already next year. Employers say 2020 GDP fall to exceed gov't projection ZAGREB, Nov27(Hina) - The Croatian Employers Association (HUP) said on Friday thetourism season failed to make up for the big losses and that this year's downturn would exceed the government's 8% projection, while the Croatian Chamber of Commerce (HGK) said thesituation was bad but in line with global trends. They were commenting on the State Bureau of ***Statistics***' forecast that GDP in Q3 decreased 10% year on year.It was the second quarter in a row that GDP had fallen, which meansthe economy has gone into a recession for the first time since 2014.The fallwas smallerthan in Q2 when the economy contracted by a record 15.4% as a consequence of aCOVID-19 lockdown. HUP said that despite a major relaxation of COVID restrictions in Q3, Croatia was the EU member state with the largestGDP decrease annually and that in terms of recovery from Q2, it was in the bottom half of the ranking. In light ofthe new restrictions for businesses, the decrease in Q4 will most probably be even larger than in Q3, so this year'sreal GDP decrease could be close to 10%, as forecast by the European Commission, HUP said. It is encouraging, however, that some sectors, such as information and communications, ***agriculture***, construction and real estate, are registering growth, it added. In order to avert a completecollapsewhich would impact the entire society, including the public sector, it is necessary to find a way to maintain business in other sectors as well. Potential compensation measures are only temporary and additionally affect public finance, and only by keeping all sectors in business can we expect a recovery in 2021, HUP said. HGK: Bad year for Croatian economy The HGK said that thanks to the tourism season, Q3 was more importantthan other quarters as it generated 28% of the annual GDP and 40% of annual exports. A 10%annual GDP decrease shows that this is a bad year for the Croatian economy but in line with expectations and the effects of the pandemic as well as global and EU trends, it added. All EU member states are affected by the pandemic,decreases in domestic and foreign demand, and declines in consumption. According to ***Eurostat***, the savings rate in the EU in Q2 jumped to 23.9% from Q1, the highest quarterly level since the beginning of 2008, while the investment rate was the lowest and the consumption-per-capita fall the largest, the HGK said. Economic Sentiment Indicator falls markedly in Croatia, EU, euro zone in November ZAGREB, Nov27 (Hina) - TheEconomic Sentiment Indicator for Croatia's economy in November fell markedly, coupled withpronounced pessimism in the European Union and the euro area on the back of the second wave of the coronavirus pandemic that particularly affected the services and retail sectors. In November, Croatia's ESI stood at 85.8 points, down by 2.6 points compared to October when it was stable on the month, according to a report published by the European Commission on Friday. Sentiment deteriorated the most in the services sector, and the relevant indicator slid by 9.3 points. Sentiment also fell in the retail and construction sectors by 3.4 and 2.7 points respectively. The expectations of business people in the Croatian industry were subdued, and the indicator in this sector slipped by 1.4 points. A wave of pessimism in EU "In November 2020, the Economic Sentiment Indicator (ESI) fell markedly in the euro area (-3.5 points down to 87.6) and the EU (-3.6 points down to 86.6)," reads the report. "After the partial recovery of sentiment between May and September and the broad sideways movement in October, the drop is the first one since sentiment fell sharply in the first COVID-19 wave. The Employment Expectations Indicator (EEI) posted the second monthly decline in a row (down by 3.3 points in both regions to 86.6 in the euro area and 87.2 in the EU)." New record of 4,080 coronavirus cases in Croatia, 48 deaths ZAGREB, Nov 27 (Hina) - In the past 24 hours Croatia has registered a record number of 4,080 new coronavirus cases while 48 people have died, the national COVID response team reported on Friday. There are a total of 22,408 active cases in the country, including 2,240 in hospital treatment of whom, 266 are on ventilators. Since 25 February, when the first case was registered in Croatia, a total of 119,706 people have contracted the virus,1,600have died and95,698 have recovered, including 3,349 in the past 24 hours. There are currently 51,514 in self-isolation. A total of 724,820 tests have been conducted to date, with 11,091 taken in the past 24 hours. Decree being drawn up to reward medical staff, says minister Health Minister Vili Beros said on Friday the medical staff "on the front line of the fight against coronavirus" would soon be financially rewarded and that a decree was beingdrawn up to that effect. "The medical staff are our front line of the fight against coronavirus. We are aware oftheir importance and highly appreciate their hard work during the pandemic. We are actively thinking about rewarding them and we believe that we will soon be able to thank them in the form of financial support," he told Hina. Speaking for N1 television earlier, Beros said 1,160 medical staff were currently positive for the virus and that 1,121 were self-isolating. To date, 5,595 have recovered from this infection. "The question is for how much longer we will all have to work hard. Therefore the time has come to think about rewarding the medical staff. Some amendments are being defined so that the medical staff could be rewarded already in their salaries for December," he said. PM says measures are taken for sake of protection of health and lives ZAGREB, Nov 27 (Hina) - Prime Minister Andrej Plenkovic said in his address on Friday ahead of the enforcement of tighter restrictions that due to the global COVID-19 pandemic Croatia has been adjusting its social activities, economy and management of current affairs to protect the health and lives of its citizens. "The coronavirus pandemic has hit the whole world this year, and changed our way of life," the premier said, adding that this was why Croatia, just as other countries, has been modifying its social activities, economy and management of current affairs for the sake of the protection of the health and lives of its citizens. With the arrival of the autumn, the pandemic has become more intense in Europe and therefore we have ramped up the restrictions, he said in the televised address. "Our struggle against the coronavirus infection is based on the trust between citizens and the state." So far, the authorities have tried to preserve as normal way of life for citizens as possible, trying to avoid a total lockdown of the economy and imposition of a curfew which many European countries are currently applying, he said. Plenkovic recalled that the rise in weekly coronavirus numbers decelerated at the start of November, however, in the last seven days Croatia saw a 15-percent growth, and on Thursday the number of new infections with coronaviorus surpassed 4,000 for the first time. In this context, the new measures have been taken and the latest restrictions go into force as of Friday midnight, and Plenkovic underscored that the purpose of these anti-COVID measures is "to protect public health, save human lives and reduce the strain on the healthcare system." "For us to succeed in that, we must do our utmost to protect those who are at the highest risk of infection, and we must raise awareness of the danger stemming from the novel virus." To corroborate his claims, Plenkovic cited statistical ***data*** showing that one in 58 people diagnosed with COVID-19 would die and that one in nine hospitalised COVID-patents, unfortunately, pass away. He underscored that the new set of restrictions would be in force at least until 21 December, and they may be extended unless the current trend is reversed in the meantime. The latest measures include the lockdown of cafes, restaurants, fitness gyms, casinos, gaming machine facilities and betting outlets. All fairs and other commercial and tourism events for the promotion of products, wedding parties and similar events are banned. Bakeries can stay open until 10 pm and the sale of alcohol is prohibited between 10 pm and 6 am. There are restrictions limiting audiences to 25 persons. Only 40% of capacities in public transport may be used while transport providers need to identify available seats and both drivers and passengers are obliged to wear masks, properly at that. Government promises new support measures to businesses affected by latest restrictions The Prime Minister expressed regret at the adverse effect of those restrictions to many businesses and workers who have already felt the consequences of the economic downturn. "I can understand dissatisfaction of those who are forced to suspend their business activities due to the epidemiological situation. These restrictive measures concern an estimated 85,000 workers, that is 5.5% of all employed people in Croatia," Plenkovic said. He recalled the sets of measures which his cabinet has so far adopted to ease the situation for 107,000 businesses with over 630,000 employees. The government will adopt a new set of measures aimed at alleviating the situation in the enterprise sector, he said, explaining that the schemes will help them to overcome this challenging period The job-retention grant of 4,000 per worker per month will be in place, he added. Also additional funds for the so-called COVID loans will be made available. Personal responsibility, compliance with epidemic prevention measures amount to patriotism Plenkovic said that the legislation on the protection of the population against infectious diseases would be amended whereby breaking anti-COVID rules would be penalised. He admitted that the authorities reluctantly resorted to the introduction of penalties and fines, however "this tool is now necessary to protect a great majority of responsible citizens against irresponsible individuals." He appealed for the adherence to the epidemiological measures which can be efficient only if all of the citizens comply with them. In the current times, the responsible behaviour of each individual and compliance with all the measures including wearing masks, keeping a physical distance, hand washing, and airing of indoor premises, amounts to acts of patriotism, Plenkovic underscored. Croatia set to penalise breakingof anti-COVID rules ZAGREB, Nov 27 (Hina) - Interior Minister and thehead of the COVID response team, Davor Bozinovic, on Friday announced stepping up the control of the implementation of anti-CIVID measures that enter into force as of midnight, which includes penalties for not wearing masks. "Civil protection inspections, state inspectorate and police officers will be more visible than until now. Emphasis will be on premises and activities where more people are expected to gather, such as shopping malls," Bozinovic told a press conference. Task force to meet to discuss amendments to law on protecting the population's health Talks were held yesterday already and the next stage will be marked with stricter controls by the competent bodies. A task force is meeting today to discuss amendments to the law on protecting the population from infectious diseases and the main topic will be penalties for those who breach measures, he underlined. "All this time we have tried to avoid that and the majority of citizens have accepted the measures, however, due to a minority we will probably have to change the law," he added, saying that bill would be put on fast track in parliament. Asked how high the penalty for not wearing a maskwill be, he said that that is still to be discussed but that it will be heavy. With regard to the latest recommendations for churches, Bozinovic said that some bishops have cancelled the usualblessings of families in their home,which the minister welcomed asa good decision. Restrictions regarding transport and sports centres were adopted in an effort to shorten of the duration of the contact among peoplein closed premises. It would be ideal to just have family gathering but we cannot enter private homes to see if there are more than 10 people there, he said. We can only appeal to the people to avoid any unnecessary contact. Measures to be eased whenhospitalilsation numbersstart declining Assistant Health Minister Vera Katalinic Jankovic said that 74% of hospital capacities have been filled and 50% of ventilators are in use. Head of the public health institute Krunoslav Capak said that the latest measures would be eased if in the next month the number of hospitalised persons starts declining. "If the number of infections and hospitalised patients starts declining, we could discuss easing measures about 21 December," said Capak. Ove the past week there has been a 15% increase in the number of infections, the week before that increase was 7% and the week before that it was 4%. On the scale from the low to high incidence rate, Croatia currently ranks 24th amongEuropean countries in the incidence rate and only Slovenia, Austria and Luxembourg have higher rates. Opposition: If people will be fined, Croatia is in state of emergency ZAGREB, Nov27(Hina) - The opposition requested on Friday that the announced fining of citizens for violating COVID restrictions be regulated by law, saying that such a restriction of rights and freedoms must be voted in by a two-thirds parliamentary majority. "If citizens will be banned from doing things which in normal circumstances wouldn't be banned and if they will be fined for what is allowed in regular circumstances, then Croatia is evidently in a state of emergency. This means that laws which dramatically restrict civil rights and freedoms must be adopted by a two-thirds majority in parliament in line with Article 17 of the Constitution," Social Democratic Party president Pedja Grbin said about the possibility of fines for not wearing a mask or keeping a distance. If the ruling majority doesn'taccept that, he said,the SDP won't participate in the adoption of such a law "because we don't want to restrict our citizens' rights and freedoms in a way that is banned by the Constitution." Commenting on the latest COVID restrictions, Grbin said the government realised that previous ones were not effective and that in order for the new ones to be, "it's necessary to work on it together, in line with the Constitution." Skoro sees solution to crisis in new election Homeland Movement leader Miroslav Skoro said the mainquestion was whether the national COVID response team was the right authority to adopt decisions such as those made in other countries where, he added, the goal was to protect citizens and "not the man running the country and his HDZ" party. Skoro said he was against any fines and that things should have been set differently from the start. He said people were confused because the restrictions applied to them but not the ruling HDZ party. The solution to this crisis is in calling an election and changing the government, he added. Nikola Grmoja (Bridge) said all decisions which restricted human rights and freedoms should be adopted by parliament. He said he was not sure that fines would resolve the problemand that instead,it was necessary to explain to people why they should comply with COVID measures. Sandra Bencic of the Green-Left Bloc said all measures which restricted civil rights must be adopted in parliament by a two-thirds majority "because we are de facto in a state of emergency and for any penalties to be legal, they must be stipulated by law, clear and foreseeable." She said the government and the COVID response team were imposing restrictions without parliamentary procedure and that now they wanted to fine people without a law. That is against the Constitution and we will continue to fight it. This doesn't mean that violations should not be fined, but fines should be voted in parliament in order to be in line with the constitution, otherwise everyone whofiles a constitutional suitwill be right, said Bencic. SDP demands measures to help seniors cope with pandemic ZAGREB, Nov27(Hina) - The Social Democratic Party caucus on Friday gave the government an ultimatum to adopt an action plan for seniors, describing them as social prisoners ofthe current pandemic. Elderly and disabled persons should be helped to cope with the COVID restrictions more easily, while keeping their physical and mental health in the process, SDP MP Davorko Vidovic told the press. He said 16,000 citizens in care homes had become "prisoners" because of the ban on movement or contact with anyone. New social security measures have been introduced in 126 countries since the outbreak of the pandemic, but not in Croatia, where the ministry in charge treats vulnerable groups such as the elderly, the disabled, the homeless, migrants andthe unemployed in an unacceptably passive way, said Vidovic. "Croatia is the only country in Europe without a setof social protection measures in the pandemic. The state budget for next year doesn't envisage funds for vulnerable groups. Instead, the social protection budget has been cut by HRK 3 billion," he added. The SDP demands that the ministry in charge immediately form a multidisciplinary team and come up with a set of measures for socially vulnerable citizens, and that funds be found for their protection and the procurement of medicines and TVs. Due to fear and uncertainty, care home residents are subject to mental disease, stress, fear and loneliness, and their quality of life is markedly undermined, the SDP said. Aladrovic: Compensation measures for businesses to be presented early next week ZAGREB, Nov 27 (Hina) - Compensation measures for businesses affected by the new lockdown are expected to be discussed over the weekend andpresented to employer organisations early next weekand then to the public, Labour Minister Josip Aladrovic said after a meeting on Friday. The meeting involved ministers from economy-related departments and representatives of the Croatian Employers Association (HUP), the Croatian Chamber of Commerce (HGK), the Croatian Chamber of Trades and Crafts (HOK), the Voice of Entrepreneurs association and associations of bar andrestaurant owners. The associations are seeking compensation for losses to be incurred during the lockdown. "We have taken note of all the proposals and are taking a time out over the weekend to come up with concrete proposals," Aladrovic said. The job keeping measures in the form of between HRK 2,000 and 4,000 for workers' wages remain in force, but will cover more people, and additional funds will also be provided, he added. He said that Economy Minister Tomislav Coric and the SMEs agency HAMAG-BICRO had agreed an additional allocation of funds for "COVID loans" to help maintain short-term and medium-term liquidity. Aladrovic said that two models of compensation were presented at today's meeting, which had already been presented to the media, and that they would be examined in light of budget constraints. He added that he expected that some room would be found in the budget and that the government would be able to help the affected sectors. However, he said it was hard to believe that either model would be accepted in its entirety, buthe was confident that a consensus would be reached. Aladrovic said that all the participants in the meeting had shown understanding for the government's position, adding that measures would be defined over the next few days. "The measures adopted so far have been timely and adequate and will be so in the future. Any raising of tensions is neither necessary nor acceptable," Aladrovic said when asked by the press whether it wasn't strange that these measures were not already in place. Finance Minister Zdravko Maric said that dialogue would be much easier if it was known how long the coronavirus pandemic would last. He reiterated that the state budget must be strong and flexible enough to respond to all the challenges ahead. Maric said that the measures for businesses affected by the latest restrictions and their fiscal effect would be presented next week. He said that the latest measures would be in force until December 21 and were narrower in scope than the spring lockdown. The head of the national association of bar and restaurant owners, Marin Medak, said that everyone at the meeting had realised that the situation could not be resolved "with a snap of one's fingers" and that no agreement could be reached today. He expressed hope that agreement would be reached next week to the satisfaction of both the government and bar and restaurant owners. Two models of compensation Bar and restaurant owners on Thursday proposed two sets of measures to help them survive the new lockdown, saying that otherwise many of them would go bankrupt. The first model envisages long-term compensation by slashing VAT to 5% for three years and to 13% over alonger term, and providing job-retention aid until April 2021, i.e. HRK 4,000 per employee and writing off taxes and contributions until 1 May 2021. They also proposed compensation of €10 per square metre of their establishment, COVID loans to ensure liquidity for three years and a moratorium on loan payments for businesses which are not allowed to work. The second model envisages ensuring revenue for entrepreneurs in the amount of 50% of their turnover at the same time last year as a direct grant which would also be used for salaries, including a contribution write-off. This model also envisages exemption from all fixed liabilities for the duration of the lockdown, including rent and utilities. Exemption from parafiscal levies was also proposed. HUT welcomes government decisions for hotels and campsites ZAGREB, Nov 27 (Hina) - Ahead of a convention of the domestic tourist industry next week, the Croatian Tourism Association (HUT) has welcomed the decision by the government and the national coronavirus response team to allow hotels and campsites to continue operating, following the latest restrictions aimed at curbing the coronavirus outbreak. "Fully aware of the seriousness of the health situation, we welcome the decision by the government and the national coronavirus response team for the continuation of work of hotels and campsites. We believe that this is the result of adherence to measures and the highly professional behaviour of tourist workers during the past tourist season when we hosted more than a million guests a day, without any of the guests contracting the virus in commercial accommodation establishments," HUT director Veljko Ostojic told Hina. He said that the HUT also supported the announcement by the government of additional compensation measures for hospitality establishments that were ordered to shut down as part of the latest epidemiological measures. "In order to be ready for the next tourist season, and in anticipation of the vaccination of a considerable portion of the population of Croatia and the EU, we expect further support for job preservation until at least 1 April 2021," Ostojic said. Asked about hoteliers' expectations for December, he said that as far as the epidemiological situation in the hotels was concerned, they did not expect any difficulties considering the measures already in place and the expected volume of tourist turnover. Ostojic said that expectations for the post-pandemic period and the tourism development strategy would be discussed at the convention of hoteliers and campsite operators, which will be held online on 1 and 2 December. HGK waives fees for members whose business is affected by COVID ZAGREB, Nov 27 (Hina) - The Croatian Chamber of Commerce(HGK)said on Friday that it would suspend ***collecting*** membership fees from the companies whose business activities are restricted by the latest anti-COVID measures. The decision on the suspension of the fees concerns the period from 1 November to 31 December, the HGK said in a press release. Thus, the Chamber waives the membership fees for restaurants and bars, transport services, gyms, and businesses providing education and training courses in sports and entertainment. HGKhas proposed to the authorities to introduce a moratorium on enforcement actions conducted by the Tax Administration and moratoriums on the payment of loaninstallments to commercial banks. HTZ projects its revenues in amount of €38m in 2021 ZAGREB, Nov27 (Hina) -The Tourism Council of the Croatian National Tourist Board (HTZ)on Friday adopted the programme and financial plan for 2021, and therevenues fornext year are projected in the amount of 285 million kuna, the HTZ said in a press release after itsonline meeting. The HTZ is set to ramp up marketing and PR activities next year to offset a decline in the intensity of marketing activities at the level of local HTZ branches. The press release says that according to ***data*** ***collected*** by the e-Visitor system, over 54 million tourist nights have been registered year-to-date, which is half as in the corresponding period in 2019. The HTZis a national tourist organization founded with the aim of creating and promoting the identity and reputation of Croatian tourism domestically and internationally. Its activities "include both planning and implementing the promotional strategy, as well as proposing and implementing promotional activities that are of common interest to all entities in tourism, and raising the level of quality of the entire Croatian tourist offer," the HTZ says on its website. Big infrastructure works going as planned despite COVID, says minister ZAGREB, Nov27(Hina) - Big infrastructure works such as the Peljesac Bridge, the Istrian Y motorway and the Pan-Europeancorridor VC are proceeding without interruption despite the COVID-19 pandemic, Transport and Infrastructure Minister Oleg Butkovic said on Friday. After visiting works on the Halasica-Beli Manastir section of motorway A5, he said they were goingeven faster than planned and that the Osijek-Beli Manastir motorway was expected to be inaugurated by summer 2022. TheHRK 443 million contract on said section was signed in April. The project is being financed by the European and Croatian Banks for Reconstruction and Development, that is by the EBRD and HBOR. Asked when the motorway on corridor VC would reach the Hungarian border, Butkovic said by the end of 2023 orearly 2024 at the latest. He said HRK 750 million worth of reconstruction and construction works were under way on roads in Osijek-Baranja County, adding that they were a reflection of the Slavonia-Baranja-Srijem Project. Croatian Roads CEO Josip Skoric said HRK 260 million was being invested in state roads in said county. Nemetin landfill rehabilitation project completed ZAGREB, Nov27 (Hina) - The rehabilitation of the former landfill Nemetin near the eastern city of Osijek has been completed, and the HRK 38 million project has been covered mainly with funds from the EU Cohesion Fund. The cost coverage ratiowas 85% from the EU fund, while 10% of the costs was covered by the Croatian Environment Protection and Energy Efficiency Fund, and the remaining five percent by the City of Osijek. Deputy Mayor Boris Pilizota said in a press release that the local authorities are supposed to rehabilitate and close all landfills and after the Nemtin project, the next task is to rehabilitate the Saravas landfill, and 72 million kuna will be needed for that purpose. 53% of citizens shop in malls less frequently due to pandemic - survey ZAGREB, Nov27(Hina) - The COVID-19 pandemic has affected people's shopping habits, with 52.9% saying they go to shopping malls less frequently, according to the findings of a survey conducted by Ja Trgovac magazine and the Hendal market research agency. The survey was conducted in October, covering citizens older than 16, the magazine said in a press release on Friday. The findings show that 98.7% of Croats shop inmalls -34% several times a week and 30% several times a month. Thirteen percent visit shopping malls every day and 11% solely on weekends, 11% shop in malls on a monthly basis or less frequently, and 1.3% never. In malls, 69%of respondents mainly buy food and home essentials, 26.4% buy clothes and shoes, and 3.2% buy technical goods. Respondents very rarely go to hairdressing or beauty salons in shopping malls. 78% plan to buy Christmas gifts Respondents were asked if they planned tobuyChristmas gifts and how much they planned tospendon them. According to the findings, 78% plan to buy Christmas gifts, with 28% spending up to HRK 200,31% up to HRK 500, 13% upto HRK 1,000 and 6% more than that. They said that they would spend about the same amount as last Christmas. Parliament adopts amendments to Enforcement Act ZAGREB, Nov 27 (Hina) - The Croatian parliament on Friday adopted amendments to the Enforcement Act, reducing the costs of enforcement proceedings, introducing electronic communication and exempting Christmas and Easterbonuses,holiday grants and meal allowances from debt ***collection***. Under the amended law, evictions will not be carried out between November 1 and April 1, and the amount of loan principal for which debt ***collection*** cannot be initiated has been increased from HRK 20,000 to 40,000. The government adopted, albeit in slightly modified form,an amendment put forward by the opposition Social Democratic Party (SDP) under which it will be able to halt debt enforcement proceedings for up to six months in the circumstances of the COVID-19 epidemic. SDP leader Pedja Grbinsaid that the adoption of this amendment paved the way for a moratorium on debt enforcement proceedings, urging the government to do so already on Monday. Because of the coronavirus epidemic, many people are unable to meet their financial obligations, so it is only moral to reintroduce a six-month moratorium on debt enforcement proceedings and use that period for response measures and for the adoption of a new enforcement law, Grbin said. Minister Coric wins vote of confidence ZAGREB, Nov 27 (Hina) - Economy and Sustainable Development Minister TomislavCoric has won the confidence of the parliament following a no confidence vote on Friday. Fifty-one MPs voted in favour of the no confidence motion of the necessary 76 votes for the motion to be adopted, while 76 voted against. There were no abstentions. "I declare that the decision on showing no confidence in Minister Corichas not been adopted," Parliament Speaker Gordan Jandrokovic said after the vote. The no confidence motion was launched by 40 opposition lawmakers claiming that Coric had granted preferential treatment to the investorin the Krs-Padjene wind park, for unlawful employment, and for a possible violation of the principle of impartiality when he participated in the re-appointment of Dragan Kovacevic as head of the JANAF oil pipeline company, as well as favouring the Hungarian MOL company at the detriment of the Croatian oil companyINA. During the debate in parliament, Coric denied all the claims while Prime Minister Andrej Plenkovic referred to the opposition's arguments as ridiculous adding that Coricenjoyed his full confidence. "Minister Coric is a good person and has my support," Plenkovic said then. Coric also enjoys the support of his party, the Croatian Democratic Union (HDZ) , which was confirmed on Friday by HDZ whip Branko Bacic. Bacic said that during the two-day debate on the no confidence motion, the opposition did not prove any unlawfulness in Coric's work. We managed to prove that a coalition exists on the political scene between the Social Democratic Party (SDP), Homeland Movement (DP), Bridge, Sovereignists andWorkers' Front, said Bacic. The leaders of these parties rejected Bacic's claims. MP Tomislav Tomasevic of the Green-Left Blocunderlined that Minister Coric has become a burden not just to the government but to the entire country too. He himself admitted that he is not competent for that portfolio. It is obvious he granted preferential treatment to the Krs-Padjene investor with whom he ate and drank in an illegal bar owned by the director of a public company that he as minister was responsible for, said Tomasevic. The public has said that it does not trust this minister and he is the most unpopular minister in the government, added Tomasevic. Parliament okaysdeployment of troops to nine international missions ZAGREB, Nov 27 (Hina) - Parliament on Friday gave the green light for the deployment of Croatian army personnel to nine international peacekeeping missions in 2021 and 2022. The proposal was put forward under six decisions each of which was put to a vote. They received between 108 and 112 votes in favour. The peacekeeping operations in question are:the UN's KFOR operation in Kosovo, the EU's Sea Guardian mission in the Mediterranean, NATO's Forward Enhanced Presence in Poland, Standing NATO Mine Countermeasures Group 2, EU Naval Force Somalia Atalanta, and UN peacekeeping operations. The ruling majority rejected the amendments submitted by the Social Democratic Party and the Green-Left Bloc proposing that the government submit to parliament an annual report on peacekeeping operations involving the Croatian armed forces. Parliament accepted the explanation by the State Secretary at the Defence Ministry, Zdravko Jakup, that the government would report on the participation of Croatian army personnel in international peace mission in an annual report on defence as had been the case so far. MPs discuss air marshals agreement with USA ZAGREB, Nov27(Hina) - Afinal bill on ratifying an agreement with the United States concerning the deployment of Air Marshals was discussed by Croatian members of parliament on Friday. Mario Kapulica of the Croatian Democratic Union (HDZ)announced support forthe ratification of the agreement aimed at the protection of Croatian and U.S. citizens on flights and called on all other lawmakers to support the ratification. Davor Dretar of the Homeland Movement also announcedsupport for the agreement which is perceived as a prerequisite for Croatia's admission to theU.S. Visa Waiver Program. The agreement defines the subject matter and area of application, relevant bodies to implement the agreement, operational procedures, general responsibility of both the country of departure and the country of arrival, training and technical support, as well as the issue of costs and dispute resolution. It also defines the term air marshal, who is in charge of the security of planes and their passengers and crew and provides defence in combatting terrorism and other security threats. The agreement contains provisions aimed at strengthening cooperation between parties to advance passenger safety in airtraffic or in combined air services and ensures a framework for the deployment of air marshals. Croatian FM pledges support to functional Bosnia and local Croats' projects ZAGREB, Nov 27 (Hina) - Croatian Foreign and European Affairs Minister Gordan Grlic Radman, who on Friday arrived in Mostar for a two-day visit, said that Croatia supported a stable and functioning Bosnia and Herzegovina as a state union of three equal and constituent peoples. After his meeting with the Catholic Bishop of Mostar, Petar Palic, the Croatian minister pledged the continued support of Zagreb to the Croats in Bosnia and Herzegovina and to their projects. He said that Croatia had also provided financial support to the Biblical Centre which the diocese in Mostar had launched. The project includes the construction of facilities housing the archives, museum artefacts and valuable artistic works as well as the construction of a conference hall. Bishop Palic, who was ordained recently to this position, thanked the minister for the support. Grlic Radman will take part in a conference on EU funds in Mostar on Saturday. Slovenia logs 1,609 infections, 48 deaths ZAGREB, Nov27(Hina) - In the past 24 hours 1,609 coronavirus infections have been confirmed in Slovenia as well as48deaths related to COVID-19, it was said on Fridayafterthe government extended the month-long lockdown for another week at least. In the past 24 hours, 6,587 people have been tested, with 24.3% tests coming back positive, down from 27.3% on Thursday, the government's COVID-19 spokesman, Jelko Kacin, told the press. He said that despite the somewhat better ***data***, the situation remained very serious and worrying. Slovenia has registered 72,682 coronavirus infections to date. Currently there are 20,268 active cases and the 14-day incidence is 967, according to the Health Ministry. The hospitalisation numbers continueto rise, with 1,324 patients currently on COVID wards, 37 more than on Thursday, including 199 in intensive care. The death toll has reached 1,293 andSlovenia ranks as the country with the most COVID-relateddeaths in relation to the population. The government on Thursday extended for at least another week restrictions which include a curfew, a ban on socialising outside one's family as well as on leaving one's municipality. Number of COVID-related deaths, infections rising in Serbia ZAGREB, Nov27(Hina) - In the past 24 hours 57 COVID-19 patients have died in Serbia and 7,780 infections have been confirmed after 22,404 tests, Predrag Kon of the crisis response team said on Friday, dismissing allegations that the health system was at breaking point. "I don't have information that seriouspatients are being sent home for treatment," he told the press in Belgrade. Kon was commenting on claims by anesthesiologist Rade Panic, a member of the United Against COVID doctors' association, who told N1 television that "the health system has broken" as more than 2,300 medical staff are infected. The situation is "very, very bad" and it's necessary to respond urgently, he said, because "not only will there be no room in hospitals in Serbia, there is already no room in COVID hospitals." Kon said 2,434 medical staff were currently infected and that 66 were hospitalised, calling Panic's assessments as "his personal view." He added that based on his information, "there's no talk of the health system breaking." Currently 6,901 patients are hospitalised for COVID-19, including 245 in intensive care. Since the start of the epidemic, 155,994 persons have contracted coronavirusand 1,423 have died, Kon said, adding that Belgrade continue to have the highest number of new cases, with 2,033 reported in the past 24 hours. 1,100 new coronavirus cases, 61 deaths in Bosnia ZAGREB, Nov 27 (Hina) -Bosnia andHerzegovina confirmed just over 1,100 new coronavirus cases on Friday and 61 deaths, however, health authorities claim that the COVID epidemic is under control and that the situation is significantly better than in other countries in the region. The situation is gradually improving in those areas that were previously hotspots, including Sarajevo, where the number of new cases is decreasing by the day, health authorities said, adding that the situation is not good but it is under control. In the past 24 hours atotal of 3,000 tests were taken in the entire country, confirming 738 positive cases in the Federation entity and 388 in the Republika Srpska entity. According to ***data*** from the Civil Affairs Ministry, the incidence rate over the past week was just under 230 per 100,000 inhabitants. Since the outbreak of the epidemic in March, more than 85,000 cases of the infection have been registered and more than 2,500 COVID-related deaths have occurred. Bosnia won't impose new COVID restrictions Bosnia and Herzegovina will not introduce additional coronavirus restrictions and a lockdown is a measure the authorities are not even considering, Council of Ministers President Zoran Tegeltija said on Friday. He met with the premiers and the health ministers of the country's two entities to discuss the pandemic situation and decide on additional measures at state level. Speaking to the press in Doboj, Tegeltija said the joint assessment was that the restrictions in force were enough. "There will be no additional measures in BiH which would restrict movement and the work of businesses. The estimate is that the measures are enough and that they keep the situation caused by COVID under control." The number of new infections has been stagnating and that of recoveries rising for the past week. Today a little over 1,110 infections were reported and health authorities claim the situation is under control and much better than in Croatia or Serbia. Masks are mandatory both indoors and outdoors,there is a night restriction on movement in the Federation entity and the Brcko District, and gatherings are limited to 30 people.All shops, service businesses, bars and restaurants are open until 11 p.m. US ambassador: At present Bosnia benefits only nationalist leaders ZAGREB, Nov27(Hina) - US Ambassador to Bosnia and Herzegovina Eric Nelson told its citizens on Friday the current situation was untenable and must be changed as it only benefitted "ethno-nationalist leaders" who sowed division to stay in power. In a post on his blog, Nelson said that 25 years after the Dayton Peace Agreement (DPA), the time had come for constitutional reform in BiH as the agreement was envisaged only as a documentwith a limited timeframe. "The DPA was never intended to be indefinite and its flaws need to be and can be corrected," he wrote, supporting BiH's plans to join the EU, on which there is a more or less clear consensus in the country, and NATO, which is resolutely opposed by Bosnian Serb politicians. Nelson wrote that the reforms on the EU path were the same as those on the NATO path, saying it is necessaryto establishelection integrity standards so that elections reflect the real will of voters, the rule of law, and equal employment rights that donot depend on membership or closeness to a political party. "The reforms on the EU path will ensure that BiH is a stable and secure home for the three constituent peoples -and that the rights of all citizens, including all others, are honored.BiH is a single state and only as such can its people benefit from EU membership -it is time for ethno-nationalist leaders to stop misleading you that it can be otherwise and sowing division to block the steps needed to carry you there. They are the few benefitting from the status quo of continuing division." Nelson said reforms and the establishment of a genuinely safe democratic society would be easier with NATO membership as it meant the support of its 30 member states. "The United States continues to stand by youto support your efforts to achieve progress," he said, adding that this was essential for ending "international supervision". He was alluding to reiterated demands for closing the Office of the High Representative whichmainly comefrom the Serbentity and are supported by Russia.The US is resolutely against closing the OHR until lasting security is ensured in BiH. Migrant arrested in Kosovo for Sarajevo murder ZAGREB, Nov27 (Hina) - Kosovo police have arrested an illegal migrant suspected of involvement in the murder of a man in Sarajevo last week,Sarajevo police said on Friday. After an intensive manhunt, it was established that the suspect had fled Bosnia and Herzegovina and was hiding in Pristina, the police said in a press release. The Sarajevo Canton Interior Ministry said "measures are being taken for his extradition." The suspect's nationality and age have not been disclosed. A Moroccan citizen was arrested in Belgrade yesterday also on suspicion of involvement in the murder of Jasmin Berovic, 36, of Sarajevo. He was killed last week during a clash withthree illegal migrants who were trying to enter by force abar owned by his brother. The migrants seriously injured two of Berovic's friends and fled. The third suspect is still at large. In other news: Agreement signed to open veteran-run retail shop in Zagreb ZAGREB, Nov 27 (Hina) - An agreement was signed on Friday to open a retail shop in Zagreb which would be operated by Homeland War veterans. The agreement was signed by the Minister of Veterans' Affairs, Tomo Medved, and the CEO of the Pleter-usluge company, Marijan Marekovic. The project represents a step forward in supporting businesses owned by veterans and their families and encourages further development of cooperatives, family farms and small businesses run by veterans, the Ministry of Veterans' Affairs said in a statement. The agreement provides that at least 70 percent of products in the shop must be produced by veteran-run cooperatives, farms and small businesses, while the remaining 30% may be other locally produced products. Conflict of Interest Commission meeting cancelled due to illness ZAGREB, Nov 27 (Hina) - Today's meeting of the Conflict of Interest Prevention Commission has been cancelled because the Commission Chair is ill, the Commission said in a press release on Friday morning. The Commission was to decide on the case of Minister of Economy and Sustainable Development Tomislav Coric as well as on the cases of MP Anka Mrak Taritas, Croatian National Bank Governor Boris Vujcic, his deputy Sandra Svaljek and vice-governors. HNB: National reference rate NRR continues falling ZAGREB, Nov 27 (Hina) -The national reference rate (NRR) continued falling in the third quarter, with the two most represented indices,six-month euro-pegged and kuna-pegged NRRs,dropping 0.2% and 0.3% respectively in comparison to the second quarter of 2020, the Croatian National Bank (HNB) reported on Friday. The NRR represents the average financing cost of the Croatian banking sector. It is one of the reference rates used for financial products and contracts in Croatia, including credit contracts concluded with consumers. "The NRR is a rate representing the average funding expenses of the Croatian banking sector in relation to the period under review (3, 6 or 12 months), the scope of funds (1 – for deposits of natural persons, 2 – for deposits of natural persons and legal persons from the non-financial sector, 3 – for all banks’ funding) and the relevant currency (HRK, EUR, USD, CHF)," the bank sayson its website. "The name of each NRR clearly indicates the duration of the period to which the original ***data*** based on which it is computed refer (3M, 6M or 12M), the scope of funds (1, 2 or 3) and the currency of funds (HRK, EUR, USD, CHF) — a total of 24 indices." HBOR CEO re-elected to EAPB Board ZAGREB, Nov27(Hina) -Croatian Bank for Reconstruction and Development (HBOR) Management Board President Tamara Perko has been re-elected to the European Association of Public Banks (EAPB) Board for a second term, HBOR said on Friday. Perko's re-electionconfirms HBOR's status as an important member and a representative of smaller development banks in this European association as well as an important actor in the implementation of common European policies, HBOR said in a press release. Philippe Mills, chief executive officer of the French SFIL, has been re-electedEAPB president for the third time. Speaking of her re-election, Perko has said that "in these challenging times, the contribution of state development banks is key for the recovery of national economies." HBOR has been an EAPB member since 2007. ZSE: Modest turnover, Crobex indices fall ZAGREB, Nov27(Hina) - The main Zagreb Stock Exchange indices decreased on Friday for the second consecutive day, the Crobex by 0.32% to 1,686.79 points and the Crobex10 by 0.35% to 1,055.81 points. Week on week, however, the indices increased, the Crobex by 0.08% and the Crobex10 by 0.54%. Regular turnover was a modest HRK 3.5 million today, about the same as on Thursday. No stock crossed the million kuna mark. The most traded stock was the preferred share of the Adris tourism and insurance group, turning over HRK 710,600. It closed at HRK 375 per share, up 0.81%. (€1 = HRK7.553292) THIS BULLETIN INCLUDES NEWS ITEMS RELEASED BY 2100 HRS FRIDAY (Hina) ms Masthead Brief News Bulletin is published by the Croatian News Agency HINA Marulićev trg 1610 000 ZagrebCroatia web:[*www.hina.hr*](http://www.hina.hr) mail: [*hina@hina.hr*](mailto:hina@hina.hr) phone: (+385 1) 48 08 660; fax (+385 1) 48 08 822 Publisher: Branka Gabriela Valentić, DirectorEditor in Chief: Serđo Obratov Bulletin Editor: Marija Šestan

**Load-Date:** November 27, 2020

**End of Document**



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Nature Climate Change

January 2021

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**Section:** Pg. 234-240; Vol. 11; No. 3; ISSN: 1758-678X,1758-6798

**Length:** 8362 words

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**Body**

Main

Climate change must be addressed by various actors including scientists, policymakers, companies, investors and civil society, all of whom operate under different mandates and capabilities. Both IPCC reports, and the Paris Agreement recognize that climate change mitigation goals cannot be achieved without a substantial contribution from forests but monitoring the extent to which forests impact atmospheric greenhouse gas (GHG) concentrations is challenging. Opposing fluxes (emissions from sources (+) and removals by sinks (-)) occur simultaneously within regions on the basis of where and when disturbance and management take place, interannual variability can be high and land-use patterns are more dynamic and operate on finer spatiotemporal scales than reflected in most global models. Furthermore, ability to distinguish anthropogenic from non-anthropogenic effects is limited on the basis of direct observation and most estimation methods offer few details about where, when and why forest fluxes occur. Yet understanding the magnitude, drivers and spatial distribution of carbon fluxes across the world’s forests, and how they can be managed both to reduce emissions and enhance removals, is increasingly important for climate policy and the various actors developing nature-based solutions.

Current estimates of terrestrial GHG fluxes vary with respect to scope, definitions, assumptions and level of transparency and completeness. At the global scale, the net annual carbon dioxide (CO2) flux from anthropogenic land-use and land-cover change—driven mainly by tropical deforestation—is estimated in IPCC reports, and the Global Carbon Project by a bookkeeping model, or by dynamic global vegetation models. The remaining non-anthropogenic sink of atmospheric carbon on land—predominantly forests—is then inferred as the residual of the other terms of the global carbon budget. Another approach compiles national GHG inventories (GHGIs), which reflect methodologies developed by the IPCC and agreed to under the United Nations Framework Convention on Climate Change,. The quality, methodological complexity and sources of ***data*** used by each country vary, as do the completeness and frequency of reporting. These approaches produce dissimilar global net forest fluxes; GHGI estimates compiled from country reports are 4.3 GtCO2 yr−1 lower than global estimates from models summarized in IPCC reports—a discrepancy larger than the total annual emissions of India, the world’s third highest emitter. A substantial part of this discrepancy (about 3.2 GtCO2 yr−1) can be explained by conceptual differences in what is counted in the anthropogenic forest sink. Beyond this large disparity in global estimates, ***data*** and methodological mismatches also exist across project, subnational and national forest GHG measurement systems, leading to complications around integrating smaller-scale activities into larger national or subnational monitoring programmes and around the potential international transfer of forest-related emission reductions versus those achieved as part of a country’s own nationally determined contribution. In sum, the complexity and lack of spatial detail in GHG measurement systems contributes to confusion about the role forests play in climate mitigation targets and discourages the transformational action and ambition needed in the forest sector to achieve global climate goals.

Here, we introduce a transparent, independent and spatially explicit global system for monitoring the ***collective*** impact of forest-related climate policies implemented by diverse actors across multiple scales. We complement existing global forest carbon flux estimation approaches of large area vegetation models and aggregation of national inventories with a third approach that capitalizes on recent advances in Earth observation. Using recently revised IPCC guidelines as a methodological framework,, we separately map GHG emissions (sources) and carbon dioxide removals (sinks) from global forest lands at 30-m resolution between 2001 and 2019 (). Areas of forest extent, loss and gain from the Global Forest Change product of Hansen et al. form the basis of the activity ***data***. By co-locating activity ***data*** with spatially explicit emission and removal factors developed from integrating ground and Earth observation monitoring ***data*** on land use and management type, forest type, forest age class, fire history and biomass and soil carbon stocks, we separately map gross annual carbon removals occurring within natural, seminatural and planted forests and gross annual emissions arising from five dominant drivers of forest disturbance. We then map the difference between gross emissions (+) and gross removals (−) as the net annual forest-related GHG flux, which may be positive or negative in an area depending on the balance of gross fluxes. Tracking gross emissions and removals separately, rather than solely the net balance between the two, underscores the dual role of forests as sources and sinks in the global carbon cycle and facilitates more complete and transparent accounting of the individual pathways involved in forest-based mitigation (reducing emissions and increasing removals).

Global distribution of forest emissions and removals

Between 2001 and 2019, deforestation and other satellite-observed forest disturbances resulted in global gross GHG emissions of 8.1 ± 2.5 GtCO2e yr−1 (mean ± s.d.). Carbon dioxide (CO2) was the dominant GHG; methane (CH4) and nitrous oxide (N2O) emissions from stand-replacing forest fires and drainage of organic soils in deforested areas accounted for 1.1% of gross emissions (0.088 GtCO2e yr−1). Over the same period, gross carbon removals by forest ecosystems were −15.6 ± 49 GtCO2e yr−1. Taken together, the balance of these opposing fluxes (gross emissions and gross removals) yields a global net GHG forest sink of −7.6 ± 49 GtCO2e yr−1 (Table and Fig. ). The large uncertainties in global gross removals and net flux are almost entirely due to extremely high uncertainty in removal factors from the IPCC Guidelines applied to old secondary temperate forests outside the United States and Europe (Supplementary Table ).

Forest-related GHG fluxes by climate domain and forest type

| **Climate domain** | **Forest type** | **Forest extent 2000 (Mha)** | **GtCO2e yr?1, 2001?2019** | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Gross emissions** | **Percentage of global total** | **Gross removals** | **Percentage of global total** | **Net GHG flux** | **Percentage of global totald** |
| Boreal | Primarya | 38 | 0.26 | 3.2 | ?0.044 | 0.28 | 0.22 |  |
| Old secondary (>20 yr) | 1,030 | 0.60 | 7.4 | ?2.4 | 15 | ?1.8 |  |  |
| Young secondary (?20 yr) | 22 | 0.015 | 0.19 | ?0.037 | 0.24 | ?0.022 |  |  |
| Plantations/tree cropsb | 0.21 | 0.000056 | 0.00070 | ?0.0027 | 0.017 | ?0.0027 |  |  |
| **Total boreal** | **1,090** | **0.88** ± **0.42** | **11** | **?2.5** ± **0.96** | **16** | **?1.6** ± **1.1** | **21** |  |
| Temperate | Primarya | 2.3 | 0.036 | 0.45 | ?0.0092 | 0.059 | 0.027 |  |
| Old secondary (>20 yr) | 560 | 0.71 | 8.8 | ?4.2 | 27 | ?3.5 |  |  |
| Young secondary (?20 yr) | 16 | 0.049 | 0.60 | ?0.039 | 0.25 | 0.0092 |  |  |
| Plantations/tree cropsb | 12 | 0.071 | 0.88 | ?0.14 | 0.92 | ?0.073 |  |  |
| **Total temperate** | **590** | **0.87** ± **0.60** | **11** | **?4.4** ± **48** | **28** | **?3.6** ± **48** | **47** |  |
| Subtropical | Primarya | 3.6 | 0.0062 | 0.076 | ?0.0058 | 0.037 | 0.00035 |  |
| Old secondary (>20 yr) | 270 | 0.46 | 5.7 | ?0.84 | 5.4 | ?0.38 |  |  |
| Young secondary (?20 yr) | 13 | 0.11 | 1.3 | ?0.067 | 0.43 | 0.040 |  |  |
| Plantations/tree cropsc | 54 | 0.40 | 5.0 | ?0.71 | 4.6 | ?0.31 |  |  |
| Mangroves | 0.070 | 0.000066 | 0.00082 | ?0.0040 | 0.026 | ?0.0040 |  |  |
| **Total subtropical** | **340** | **1.0** ± **0.59** | **12** | **?1.6** ± **0.56** | **10** | **?0.65** ± **0.81** | **8.6** |  |
| Tropical | Primarya | 1,010 | 1.8 | 22 | ?1.9 | 12 | ?0.12 |  |
| Old secondary (>20 yr) | 880 | 1.9 | 23 | ?3.8 | 24 | ?1.9 |  |  |
| Young secondary (?20 yr) | 47 | 0.76 | 9.5 | ?0.40 | 2.5 | 0.37 |  |  |
| Plantations/tree cropsc | 47 | 0.89 | 11 | ?0.73 | 4.7 | 0.16 |  |  |
| Mangroves | 7.2 | 0.010 | 0.12 | ?0.16 | 1.0 | ?0.15 |  |  |
| **Total tropical** | **1,990** | **5.3** ± **2.4** | **66** | **?7.0** ± **7.6** | **45** | **?1.7** ± **8.0** | **22** |  |
| Global | Primary | 1,060 | 2.1 | 26 | ?2.0 | 13 | 0.13 |  |
| Old secondary (>20 yr) | 2,750 | 3.7 | 45 | ?11 | 72 | ?7.7 |  |  |
| Young secondary (?20 yr) | 99 | 0.9 | 12 | ?0.54 | 3.5 | 0.39 |  |  |
| Plantations/tree crops | 113 | 1.4 | 17 | ?1.6 | 10 | ?0.23 |  |  |
| Mangroves | 8.7 | 0.012 | 0.14 | ?0.20 | 1.3 | ?0.19 |  |  |
| **Total global** | **4,029** | **8.1** ± **2.5** | **100** | **?16** ± **49** | **100** | **?7.6** ± **49** | **100** |  |

Average annual gross GHG emissions, gross GHG removals and net GHG fluxes across global forest lands between 2001 and 2019. Estimates reflect forest ecosystem fluxes only; harvested wood products are excluded. Uncertainties are expressed as s.d. Large uncertainties in net flux estimates should be interpreted with caution; s.d. are very large relative to the estimates in part because net flux estimates reflect the sum of negative (removals) and positive (emissions) terms, complicating the combination of their error terms.

aThe extent of primary forests was delineated differently for tropical and extratropical regions ().

bFluxes occurring within seminatural managed forests are reported in the relevant secondary forest category (old or young).

cFluxes reported in the plantation/tree crop category include those associated with conversion of natural forests to plantations or tree crops (for example, oil palm) over the 2001–2019 analysis period.

dCalculating percentages of net flux by forest type is complicated by the mixture of sources and sinks among forest types, and is thus omitted.

Forest-related GHG fluxes (annual average, 2001–2019).

a, Gross annual GHG emissions. b, Gross annual GHG removals. c, Net annual GHG flux. For display purposes, maps have been resampled from the 30-m observation scale to a 0.04° geographic grid. Values in the legend reflect the average annual GHG flux from all forest dynamics occurring within a grid cell, including emissions from all observed disturbances and removals from both forest regrowth after disturbance as well as removals occurring in undisturbed forests.

Tropical and subtropical forests contributed the most to global gross forest fluxes, accounting for 78% of gross emissions (6.3 ± 2.4 GtCO2e yr−1) and 55% of gross removals (−8.6 ± 7.6 GtCO2e yr−1) (Table ). While these forests removed more atmospheric carbon than temperate and boreal forests on a gross basis (−8.6 versus −4.4 and −2.5 GtCO2e yr−1, respectively), tropical and subtropical forests contributed just 30% to the global net carbon sink; about two-thirds of the global net sink was in temperate (47%) and boreal (21%) forests, resulting from substantially lower gross emissions there than in the subtropics and tropics (0.87 and 0.88 versus 6.3 GtCO2e yr−1, respectively).

Just six large forested countries (Brazil, Canada, China, Democratic Republic of the Congo, Russia and the United States) accounted for 51% of global gross emissions, 56% of global gross removals and 60% of net flux. Forests in nearly all countries were net carbon negative, that is, gross carbon removals from established and regrowing forests exceeded gross emissions from land-use change and other forest disturbances. The main exceptions were in Indonesia, Malaysia, Cambodia and Laos, where annual gross emissions across these countries (1.36 GtCO2e yr−1), including peat drainage and burning (0.14 GtCO2e yr−1), exceeded gross removals (−0.83 GtCO2e yr−1) (Fig. ). Globally, 72% of gross removals were concentrated in older (>20 yr) secondary natural and seminatural forests, 12% in tropical primary forests, 10% in plantations, 3.5% in young (<20 yr) forest regrowth, 1.3% in mangroves and 0.34% in boreal and temperate intact forest landscapes (Table ).

Gross and net GHG fluxes from forests by region (annual average, 2001–2019).

Net forest-related fluxes (grey bars) are shown with their two component gross fluxes: gross emissions from land-use change and other forest disturbances (purple) and gross removals occurring in undisturbed forests as well as removals from forest regrowth after disturbance (green). The top five countries per region are ranked high to low on the basis of gross emissions, with all other countries in the region grouped into ‘other countries’.

Fluxes for specific localities and drivers of forest change

Our analysis enables consistent evaluation of forest GHG dynamics across scales and in custom geographies beyond national or climate domain boundaries (Fig. ). For example, ~27% of the global net forest GHG sink occurred within protected areas. Forests in the Brazilian Amazon were a net carbon source of 0.22 GtCO2e yr−1 between 2001 and 2019, whereas forests across the larger Amazon River basin—encompassing 514 Mha of forests across nine countries—were a net carbon sink of −0.10 GtCO2e yr−1. Although smaller in extent than the Amazon, the net sink in forests of Africa’s Congo River basin (298 Mha) was approximately six times stronger (−0.61 GtCO2e yr−1), reflecting nearly identical gross removals (−1.1 versus −1.2 GtCO2e yr−1) but gross emissions that were half those of the Amazon basin (0.53 versus 1.1 GtCO2e yr−1).

From overlaying forest GHG flux maps in Fig. with a global map of dominant drivers of forest disturbance, we estimate that commodity-driven deforestation was the largest source of gross forest-related emissions between 2001 and 2019 (2.8 GtCO2e yr−1) and occurred primarily in the rainforests of South America and Southeast Asia. Forests in shifting ***agriculture*** landscapes, a dominant land use in the tropics characterized by cycles of small-scale forest clearing of both primary and secondary forests followed by secondary regrowth, contributed another 2.1 GtCO2e yr−1 to gross emissions and −3.3 GtCO2 yr−1 to gross removals, leading to a net sink in these areas of −1.2 GtCO2e yr−1. Gross emissions from stand-replacing forest fires, occurring primarily in temperate and boreal forests, averaged 0.69 GtCO2e yr−1. Forestry-dominated landscapes, comprised of both plantations and natural and seminatural forests, were a net sink of −3.3 GtCO2e yr−1 between 2001 and 2019. This reflects 2.4 GtCO2 yr−1 of gross emissions from harvest offset by −5.5 GtCO2 yr−1 of gross removals from forest management and regeneration and −0.16 GtCO2e yr−1 of increased carbon storage in harvested wood products.

A flexible ***data*** integration framework

The IPCC Guidelines used as the overarching methodological framework in this analysis, provide three tiers of methods, parameters and ***data*** sources for GHG flux estimation, where progression from Tier 1 to Tier 3 generally results in more accurate and precise estimates at the expense of more analytical complexity and larger ***data*** requirements. For forests, Tier 3 estimates are characterized by the incorporation of repeated, country-specific measurements over time but the land-use definitions and the spatial scale of ***data*** sources chosen can impact the resulting estimates. Therefore, in addition to estimating uncertainty in GHG estimates within geographies for which information was available to do so (climate domains), we also conducted sensitivity analyses to demonstrate how estimates change as ***data*** inputs and model assumptions are varied within our spatial ***data*** integration framework (). At the global scale, GHG flux estimates were relatively insensitive to changes in model assumptions; estimates for most pixels changed less than 15% in either direction and sources stayed sources while sinks stayed sinks.

However, estimates were more affected by changes in ***data*** sources, particularly at local scales. For example, replacing the global 30-m biomass map developed in this study as the basis of emission factors (Extended ***Data*** Fig. ) with a coarser (1-km) resolution biomass map produced by Saatchi et al. for the tropics produced 12% lower gross GHG emissions there than our original estimate. Replacing the 30-m annual tree cover loss ***data*** from Hansen et al. in the Brazilian Amazon with annual forest loss ***data*** from Brazil’s national forest monitoring system, which excludes deforestation events smaller than 6.25 ha, reduced average gross emissions there from 1.1 to 0.74 GtCO2e yr−1. This difference arises from increased detection of emissions from small forest clearings. Both examples highlight the value of our spatially detailed approach in capturing more changes and larger fluxes occurring at small scales where many human-induced forest changes are occurring. In the United States, replacing Tier 3 removal factors estimated specifically for US forest types and age classes from repeated inventory measurements with generalized Tier 1 defaults from the updated IPCC Guidelines led to a 38% stronger net carbon sink there than the original estimate. (See Supplementary Table and Extended ***Data*** Figs. – for additional examples.) These analyses quantitatively and spatially demonstrate tradeoffs between globally consistent analyses and locally derived values that are difficult to aggregate globally and may not be available or comparable across regions. The flexible spatial ***data*** integration framework introduced here enhances science-policy coordination by providing a more systematic, structured, transparent and verifiable system for exploring differences in ***data***, assumptions and resulting estimates than what has been available previously.

Forest fluxes in the global carbon budget

Our results are not directly comparable to other global estimates because other estimates typically reflect all terrestrial fluxes (versus forests only), report only net fluxes (versus gross and net fluxes), include only CO2 (versus all relevant GHGs) and make assumptions to partition between anthropogenic and non-anthropogenic net fluxes,. While the spatial, observation-based framework introduced here permits estimation of fluxes for any forest definition and the inclusion (or exclusion) of any geographic area of interest, it cannot distinguish between anthropogenic versus non-anthropogenic effects or between managed versus unmanaged land until the requisite spatial ***data*** become available to differentiate them. When considering only CO2 fluxes to improve comparability with the Global Carbon Budget, we estimate a larger net CO2 sink by forest ecosystems (−7.8 GtCO2 yr−1) than its estimate of −5.2 GtCO2 yr−1 for all terrestrial fluxes over the same time period. One potential reason for this difference is that our model underestimates gross forest-related emissions due to the exclusion of forest disturbances that go undetected and unquantified in the medium resolution satellite observations that underpin our analysis. Gross emissions from tropical forest degradation have been estimated as 2.1 GtCO2e yr−1, with selective logging, fuelwood harvest and non-stand-replacing fires accounting for 53, 30 and 17% of the total, respectively. Adding this (non-spatial) estimate of gross degradation emissions to our satellite-based gross carbon emission and removal estimates occurring within forest ecosystems, as well as −0.16 GtCO2 yr−1 of net removals in harvested wood products, yields a revised net forest-atmosphere CO2 flux of −5.8 GtCO2 yr−1 (Table ). Taken together, these estimates of gross removals (−15.6 GtCO2 yr−1) and gross emissions related to forests (including degradation: 10 GtCO2 yr−1) appear to nearly balance the global carbon budget (Table ) but other important fluxes are omitted from our analysis such as those occurring within grasslands, semi-arid savannas and shrublands (due to the 30% per 5 m of tree cover definition used in our analysis), non-stand-replacing fires, degradation outside the tropics and other terrestrial fluxes not previously included in any global budget to date. We include Table to highlight how our gross estimates of forest-related fluxes fit within the context of the global carbon budget but our research is geared towards highlighting forest emission and removal hotspots for policy-relevant applications and stakeholders (Fig. ), not towards producing a comprehensive and precise accounting of the full terrestrial carbon budget.

Comparison of results from this study to the Global Carbon Project, 2001–2018

| **Global carbon budget, 2001?2018 (GtCO2 yr?1)** | | | |
| --- | --- | --- | --- |
| **Global Carbon Project** | | **This study** | |
| **Sources** |  |  |  |
| Fossil fuel and cement | 32.0 | Fossil fuel and cement | 32.0 |
| Land-use change (net, anthropogenic)a | 5.3 | Forests (gross, all observed disturbances)b | 7.9 |
|  |  | Forests (gross, unobserved emission sources)c | 2.1 |
| **Total sources** | **37.3** |  | **42.0** |
| **Sinks** |  |  |  |
| Atmosphere | 16.9 | Atmosphere | 16.9 |
| Ocean | 8.7 | Ocean | 8.7 |
| Terrestrial (net, non-anthropogenic)d | 10.5 | Forests (gross, all forests)e | 15.6 |
|  |  | Harvested wood products | 0.16 |
| **Total sinks** | **36.1** |  | **41.4** |
| Land (net, all land) | ?5.2 | Forests (net, all forests)f | ?5.8 |
| Budget imbalanceg | 1.2 |  | 0.6 |

Estimates from the Global Carbon Project (GCP) and this study are not directly comparable due to differences in scope (all land versus forests, respectively), ***data***, methodologies and reporting structure. In GCP reporting, land-use change emissions (sources) reflect the net balance between anthropogenic emissions (+) and removals (–), thus the net emission estimate is lower than gross emissions reported in this study. Similarly, gross removals reported in this study reflect removals across all forest lands, including removals implicit (but unreported) in the net land-use change estimate of GCP.

aEstimates only net direct anthropogenic effects, including deforestation, afforestation/reforestation and wood harvest. Gross fluxes higher but not reported.

bGross emissions from all forest disturbances (anthropogenic and non-anthropogenic) observed from Landsat ***data***. Estimate includes CO2 only for comparability with GCP; non-CO2 emissions are 0.086 GtCO2e yr−1.

cGross emissions from forest degradation in 74 developing countries covering 2.2 billion hectares of forest, from Pearson et al..

dIn IPCC’s Fifth Assessment Report, calculated as the residual of all other terms in the carbon budget.

eGross removals from all forest processes (direct, indirect and natural).

fCalculated as the net balance between gross forest ecosystem emissions and removals (7.9 + 2.1–15.6 GtCO2 yr−1) plus an additional net removal of −0.16 GtCO2 yr−1 in harvested wood products.

gBudget imbalance is the difference between total sources and total sinks.

Limitations and future improvements

All forest monitoring systems reflect a balance between ***data*** availability, scale of applicability, measurement costs, reducing uncertainties and other constraints. Given the urgency of addressing climate change, the time and costs required to develop monitoring systems that reduce uncertainties as far as practicable must be balanced against the potential benefits of publicly accessible, operational and fit-for-purpose systems that provide enough spatial detail to incentivize real, near-term and sustained investment in nature-based climate solutions on the ground. In this study, we combined publicly available ***data*** into a global monitoring framework that generates consistent information on forest carbon fluxes cost-effectively over large spatial scales. However, this approach encounters limitations that should be addressed as research progresses.

First, the global forest change ***data*** used as the basis of activity ***data*** in our analysis are spatially detailed but contain temporal inconsistencies. While the forest loss product is updated annually through 2019, gain has not been updated past 2012 and represents a cumulative total (2000–2012). Therefore, although gross emissions can be estimated annually (Extended ***Data*** Fig. ), estimating annual trends in gross removals and net flux is limited by a lack of a consistent time series on forest regrowth. Globally, GHG flux estimates were relatively insensitive to this limitation; we estimate that expansion of forest extent observed after 2000 accounted for less than 5% of global gross carbon removals, with the vast majority occurring instead in forests established before 2000. However, accurate monitoring of the timing of recent regrowth becomes more important in local contexts where rapid forest loss/gain dynamics are occurring, such as in plantations with short rotation cycles and other dynamic areas dominated by intensive forestry or short-fallow shifting cultivation systems (Extended ***Data*** Fig. ). Temporal inconsistencies are also present within the global loss product; one algorithm covers years 2001–2010 and another covers 2011–2019, with later years of loss likely to be more sensitive to changes related to small-scale ***agriculture***, fires and other forms of forest degradation. For these reasons, we report only long-term averages and not annual trends in forest GHG fluxes. A forthcoming ‘version 2’ global tree cover loss product and an improved global gain product, already piloted for the lower Mekong region of Southeast Asia, will improve temporal consistency. Incorporating these improvements into the forest GHG flux model will more accurately capture interannual variability in emissions and removals over time and will thus provide a consistent basis for more temporally detailed monitoring of the long-term net impact of forests on atmospheric GHGs.

Second, information is currently lacking to develop globally consistent and spatially detailed maps of forest carbon removals. In our analysis, uncertainty in gross removals is substantially higher than uncertainty in gross emissions, driven primarily by high uncertainty in removal factors for established forests in temperate regions (Table and Supplementary Table ). Through the integration of ground and Earth observation ***data***, several biomass and soil carbon maps have been developed that inform spatially explicit emission factors. However, accurate and precise estimation of forest carbon removal factors requires information derived from long-term forest inventories applied consistently and repeatedly through time across different forest types and age classes. For many of the world’s forests, this information does not exist. Many developing countries have not completed their first forest inventory, let alone repeated inventories. Efforts to combine georeferenced plot networks with other spatially explicit ***data*** inputs to create maps over large scales of forest carbon accumulation rates over time, similar to what has been done to develop biomass density maps at a single point in time, have begun but are still in their infancy. We therefore applied removal factors using a stratification approach, where each forest pixel is assigned a removal factor on the basis of its geographic region, forest type and age class (). Removal factors reflect both ecological forest dynamics (tree growth, mortality and recruitment through natural regeneration) and indirect effects (long-term increases in atmospheric CO2 concentrations and temperature, ***nutrient*** fertilization). Going forward, new satellite missions such as GEDI, ICESAT-2 and BIOMASS will provide repeated measurements of forest height and biomass over time that should improve understanding of spatial variation in rates of carbon removal across heterogeneous forest landscapes.

The global forest carbon monitoring framework introduced here, and the main improvements identified above, allow for efficient prioritization and evaluation of how ***data*** updates and improvements influence GHG flux estimates and their uncertainties. As satellite- and ground-based forest monitoring improve, so too will the associated forest GHG flux estimates.

Conclusions

Our analysis reinforces the need to reduce gross emissions from tropical deforestation as a climate change mitigation strategy, while also highlighting the substantial but often underappreciated contribution of intact primary and older secondary forests to carbon dioxide removals. Quantifying gross emissions and removals separately and consistently across all forest lands—and producing maps in addition to tabular ***statistics***—improves transparency in the accounting of factors and geographies contributing to the global net forest GHG flux. It also provides a framework to integrate new and improved ***data*** sources over time. Governments interested in spatially prioritizing implementation and tracking of national and subnational forest mitigation targets can increasingly make use of such ***data***. Non-government actors, such as companies aiming to reduce emissions from deforestation associated with commodity supply chains and emerging market mechanisms considering the inclusion of forests for carbon offset programs, could benefit from a globally consistent and spatially explicit forest monitoring system developed using the same internationally accepted methods as national governments use but based on independent observations and with GHG estimates that can be linked to individual actions and generated at scales relevant to diverse climate-related policies, programmes and stakeholders.

The goals of the Paris Agreement—primarily, net zero anthropogenic emissions in the second half of this century—create an imperative to track forest-related emissions and removals transparently and at scales that link more closely to mitigation activities on the ground. As the capacity of national governments to ***collect***, process and analyse ***data*** continues to improve, the global forest carbon monitoring framework introduced here can help to enhance transparency, inform forest-related climate policy and implementation initiatives, underpin independent technical assessments, reconcile differences between national reports and scientific studies, and provide a more consistent and comparable basis for tracking progress at local scales and for assessing atmospheric impacts of global forest change under the Paris Agreement’s forthcoming Global Stocktake.

Methods

Study design and scope

We mapped gross and net GHG emissions by sources and removals by sinks from global forest lands by synthesizing information ***collected*** from more than 637,000 ground plots, 707,561 waveform lidar observations and other satellite ***data*** into a spatial forest carbon monitoring framework. The analysis covers 2001 to 2019 but can be extended to include later years as ***data*** are updated. To the extent possible, we adhered to IPCC Guidelines developed for the ***agriculture***, forestry and other land use (AFOLU) sector,. In the context of IPCC land-use categories, our analysis covers only forest-related transitions (forest to non-forest, non-forest to forest and forest remaining forest). We applied the IPCC gain-loss method (versus the stock-difference method), in which forest carbon (C) stocks in five ecosystem pools were estimated for a base year (2000) after which changes in C stocks were estimated by considering both annual C losses from land-use change and disturbance (conventionally represented by a + sign) as well as annual C gains from forest regrowth (represented by a – sign). We included harvested wood products as a sixth (human-created) carbon pool. We also included methane (CH4) and nitrous oxide (N2O) emissions from stand-replacement forest fires and drainage of organic soils associated with a loss of tree cover. We summarized GHG fluxes across all relevant gases and reported in units of CO2 equivalents (CO2e) using 100-yr Global Warming Potentials (without climate feedbacks) from the IPCC Fifth Assessment Report.

We set all ***data*** inputs to a common resolution of 0.00025° × 0.00025° to match the resolution of Landsat-based tree cover change ***data*** of Hansen et al.. Gross emissions and removals were modelled at this common resolution across approximately 90 billion individual pixels of global forest cover (defined below). We resampled all input layers to this resolution so that outputs can be flexibly aggregated to larger scales. Extended ***Data*** Fig. summarizes the overall conceptual approach and Supplementary Table provides a list of ***data*** inputs.

Forest definition and extent

Initially, we defined forest extent in the year 2000 similarly to Hansen et al., that is, any 30-m Landsat pixel that met a tree canopy threshold of at least 30% with trees taller than 5 m in height. This initial definition included natural and seminatural forests, plantations and ***agricultural*** tree crops such as oil palm and agroforestry systems where minimum height and cover thresholds were met. On the basis of available ***data***, we made four modifications to the original tree cover map to refine our global map of forest extent:

We included pixels of tree cover gain since 2000 in addition to tree cover already present in the year 2000.

We included only tree cover pixels that also had a corresponding value in the aboveground biomass density map (0.031% of tree cover pixels lacked a biomass value).

We excluded all areas of tree cover falling within oil palm plantation boundaries mapped for the year 2000 in Indonesia and Malaysia–.

We replaced tree cover extent from Hansen et al. with mangrove forest extent using ***data*** from Giri et al.; in areas of geographic overlap, mangroves had priority.

Forest aboveground live biomass density in 2000

We created a year 2000 map of aboveground live biomass density (AGB, in Mg ha−1) at 30-m resolution by combining two maps: one developed specifically for mangroves and the other developed to cover all woody vegetation globally (Supplementary ). In areas of geographic overlap, the mangrove biomass map had priority. The basic approach is the same as that used to map tropical biomass at 500-m (ref. ) and 30-m (ref. ) resolution; published height–biomass equations were applied to estimate biomass over specific regions and forest types around the world (Extended ***Data*** Fig. ). These equations, developed by linking observations from airborne or spaceborne lidar to 20,347 ground-measured biomass plots, were applied to estimate aboveground biomass density from spaceborne lidar observations across 707,561 locations globally. To create a continuous biomass map (Extended ***Data*** Fig. ), separate random forest models were trained for each of six biogeographic realms using predictor variables of Landsat imagery (bands 3, 4, 5 and 7), normalized difference vegetation index (NDVI), normalized difference infrared index (NDII), mean percentage tree cover, mean elevation, mean slope and monthly mean precipitation, temperature and bioclimatic ***data***. Additional details are provided in Supplementary .

Forest ecosystem carbon pools in 2000

From the 30-m global AGB map, we mapped belowground live biomass density (BGB) using a forest root-to-shoot ratio with mangrove-specific ratios based on defaults provided in Table 4.5 of the 2013 IPCC Wetlands Supplement. AGB and BGB values were converted to C density values using a biomass-to-carbon ratio of 0.45 for mangroves and 0.47 for all other forest types,. From the final 30-m AGB map we estimated dead wood and litter biomass densities per pixel as constant fractions of AGB using a lookup table based on global ecological zone, elevation and precipitation regime (Supplementary Table ). Dead wood and litter biomass densities were converted to C densities using IPCC conversion factors.

Soil organic carbon density in the top 30 cm of mineral soils was mapped using SoilGrids250 (v.2.0) after resampling from its original spatial resolution of 250 m to match the common 30-m resolution of our analysis. For mangrove forests, we used a 30-m soil carbon map developed specifically for mangroves. We delineated locations of organic (peat) soils using maps summarized in Supplementary Table .

We used these five forest carbon pool maps as the basis for estimating emission factors associated with various forest disturbances (see below).

Activity ***data***

Activity ***data*** were defined using the global forest change product of Hansen et al. with loss updated annually on Global Forest Watch. In the model, all pixels defined as forest were classified into one of four categories: (1) loss only; (2) gain only; (3) both loss and gain; or (4) no change over the period 2001–2019. Loss is defined by Hansen et al. as a stand-replacement disturbance and includes all disturbances (natural and anthropogenic) observable in Landsat imagery. Gain is defined as a non-forest to forest change, which includes tree cover gain observed after harvest and other disturbance. The loss product is annual, while the gain product represents a cumulative total (2000–2012). Loss and gain can co-occur on pixels undergoing forest management or other forms of disturbance and regrowth. Lack of annually updated gain ***data*** is addressed through the sensitivity analysis (Extended ***Data*** Fig. ). Due to a lack of information about tree cover gain after 2012, we assumed no additional areas of gain from 2012 to 2019. Areas of no change reflect forest areas established before 2000 that showed no observable disturbance in Landsat imagery between 2000 and 2019.

Emission factors

We assigned emission factors to tree cover loss pixels following an IPCC land-use classification framework, on the basis of whether each pixel maintained its land use or was converted to a new use over the analysis period. Since forest may remain in the same use despite a temporary loss of tree cover, we used the global 10-km map of Curtis et al. (updated through 2019) to attribute tree cover loss to one of five dominant drivers; these influence the C pools affected (Supplementary Table ) and thus the emission factors assigned to each individual loss pixel. Supplementary Table summarizes emission factors by forest type within each climate domain.

Commodity-driven deforestation and shifting ***agriculture***

The initial change in C stocks was estimated as a full loss of C in aboveground, belowground, dead wood and litter pools. In addition to CO2 emissions resulting from a loss of C stocks, we used IPCC equation 2.27 (ref. ) and a 1-km global burned area map to calculate CH4 and N2O emissions in loss pixels that overlapped with areas that burned the same year or the year before (to account for lag effects between fire occurrence and observed tree cover loss). For deforestation on mineral soils, soil C loss was estimated using IPCC equation 2.25 (ref. ); default soil stock change factors vary by ecological zone and were assigned spatially using ecozone boundaries. Per IPCC guidelines, 1/20th of the total soil C stock change was apportioned annually from the year of loss through the last year of the analysis period (2019) but assigned to the year of observed tree cover loss. Due to lack of information in the driver attribution map about the specific land use established after forest clearing, we assumed for the purposes of soil emission accounting that all deforested land on mineral soils for commodity-driven deforestation was converted to annual cropland with full tillage and medium inputs. A different factor was used to estimate loss of soil C on mineral soils (Table 5.10 in the IPCC Guidelines) in areas of shifting ***agriculture***, which were assumed to represent transient land-use conversions to cropland under shortened fallow, where vegetation recovery is not attained before re-clearing. Soil emissions were not estimated for areas of loss on mineral soils that overlapped with forest and wood fibre plantations, even if they fell within the broader commodity-driven deforestation or shifting ***agriculture*** classes, consistent with the assumption that loss of tree cover within tree plantations follows the forestry assumptions listed in Supplementary Table (see emissions from below). For loss on organic soils that overlapped with tropical plantations and tree crops planted since 2000, GHG emissions associated with drainage were estimated using CO2 and CH4 emission factors provided in the IPCC Wetlands Supplement. Like emissions from mineral soils, emissions from peat drainage were assumed to continue in each year after loss up through the last year of the analysis period (2019) but were assigned to the year of observed tree cover loss. Emissions (CO2, CH4 and N2O) from peat burning were also calculated on the basis of methods provided in the IPCC Wetlands Supplement where a loss pixel overlapped with areas burned the same year, or the year before, the loss event (on the basis of global burned area ***data***).

Urbanization

The same assumptions and calculations were used for calculating gross emissions from urbanization as for commodity-driven deforestation and shifting ***agriculture***, except a different factor was used to estimate the loss of soil C on mineral soils. We assumed that forest land converted to settlement was paved over and applied the IPCC default assumption that 20% of the soil C relative to the previous land use was lost as a result of disturbance, removal or relocation.

Forestry

Emission factors for loss attributed to forestry were estimated as the loss of C in live biomass only, following assumptions outlined in Supplementary Table that there is no net change to the dead organic matter or soil C pools in the case of mineral soils. Emissions from peat drainage and burning associated with forestry activities, as well as non-CO2 emissions in the case of forest fires, were included in the same way as for deforestation and shifting ***agriculture*** above. Emission factors for loss pixels within the ‘zero or minor loss’ category of the driver attribution map also followed assumptions for forestry (Supplementary Table ).

Wildfire

Within 10-km grid cells of the drivers map labelled wildfire, wildfire emission factors were applied only for 30-m pixels where loss occurred in the year of, or year after, a fire event in the 1-km burned area map. In these cases, we used IPCC equation 2.27 (ref. ) to estimate both CO2 and non-CO2 emissions from forest fire. The AGB map determined the mass of fuel available for combustion and a lookup table (Table 2.6 of the IPCC Guidelines) provided default combustion and emission factors that were applied on the basis of forest type (primary versus secondary). For boreal and temperate forests, combustion factors were applied on the basis of the assumption of a land-clearing fire, given that forest loss is defined in Hansen et al. as a stand-replacement disturbance. In cases where organic soils overlapped with burned areas, emissions from peat burning (CO2, CH4 and N2O) were estimated following guidance in the IPCC Wetlands Supplement. Forestry emission factors, rather than wildfire factors, were applied where loss did not overlap with a fire event in the 1-km burned area map.

Removal factors

We developed removal factors spatially by linking information about each pixel’s geographic region, ecological zone, forest type and age class to corresponding growth rates on the basis of best available information. Supplementary Table summarizes removal factors by forest type in each climate domain. In areas of geographic overlap, the priority of assigning removal factors to a given pixel reflects the order of ***data*** sources listed below. Removal factors include accumulation in live biomass only and reflect the net increase, accounting for both productivity and mortality. We assumed no change to the dead organic matter and soil organic carbon pools, consistent with the IPCC Tier 1 assumption of no net change to non-biomass pools in forest land remaining forest land. The number of years of carbon accumulation was assigned as 19 yr for undisturbed forest, 6 yr for areas of new tree cover gain and one less than the year in which tree cover loss occurred for loss-only forest.

Mangroves

We applied mangrove-specific growth rates and root-to-shoot ratios from IPCC Tables 4.4 and 4.5 of the Wetlands Supplement, respectively.

Europe

We assigned removal factors spatially according to a map of dominant tree species developed from 260,000 national inventory plot locations. For each species, we estimated mean annual increment (MAI) values from Table 4.11 of the updated IPCC Guidelines, FAO Planted Forest Assessment and national inventories (Supplementary Table ). These were converted to aboveground biomass growth rates using species-specific biomass conversion and expansion factors and belowground biomass increment was added on the basis of a root-to-shoot ratio.

Plantations and tree crops

Outside Europe, we assigned removal factors for plantations and tree crops using a variety of published ***data*** sources. For common plantation species, we used MAI and biomass conversion and expansion factors summarized in the updated IPCC Guidelines to estimate aboveground biomass increment and added belowground biomass increment on the basis of a root-to-shoot ratio. Rates in plantations were assigned on the basis of mapped species when known or, when unknown, the most common mix of plantation species grown in the region. Removal factors for tree crops such as oil palm and rubber as well as various types of agroforestry systems were estimated for areas mapped as such on the basis of regionally specific values derived from the published literature and from Tables 5.1 and 5.3 of the updated IPCC Guidelines. All removal factors used for plantations and tree crops, along with ***data*** sources and assumptions applied, are provided in the companion spatial attribute file associated with the global compilation of planted tree maps used in this analysis.

United States

We developed removal factors for three age classes (0–20, 20–100 and >100 yr) for forest types across 11 geographic regions using methods broadly similar to those of Smith et al., except that we included more forest types in each region, as well as more recent and comprehensive ***data*** from the US Forest Inventory and Analysis database. Removal factors were developed from approximately 130,000 inventory plot locations. Pixels were assigned removal factors on the basis of dominant forest type, age class and geographic inventory region.

Young secondary forests

Outside the United States and Europe, areas of tree cover gain that fell outside boundaries of mangroves and planted trees were assumed to be secondary natural forest regrowth <20 years old. We assigned natural forest regrowth removal factors to these areas using the 1-km map of Cook-Patton et al..

Primary forests

We used removal factors by ecological zone and continent from IPCC Table 4.9 of the 2019 IPCC Refinement and assigned them spatially between 30° N and 30° S within a tropical primary humid forest map. Outside 30° N and 30° S, we used a map of intact forest landscapes as a proxy for primary forests, which is likely to be highly conservative due to the relatively large extent criterion applied but represents the best available information by which to spatially delineate primary from old secondary forests in boreal and temperate regions.

Old secondary forests

We assigned removal factors from IPCC Table 4.9 (>20 yr) to all forest areas that fell outside the types identified above. Given no observed disturbance occurred in these areas since the year 2000, we assumed they were secondary natural forests at least 20 years old.

Harvested wood products

We used ***statistics*** reported in FAOSTAT and methods outlined in the 2019 Refinement to estimate emissions and/or removals arising from harvested wood products. Losses of harvested wood products in use were assumed to result in CO2 emissions to the atmosphere, with no explicit representation of the subsequent retention of disposed wood in solid waste disposal sites (SWDS) and eventual CO2 emissions from SWDS. Calculations rely on ***statistics*** reported by countries on production, import and export volumes for three aggregate semifinished wood product commodity classes: sawnwood, wood-based panels and paper and paperboard.

Uncertainty analysis

We estimated uncertainty in GHG flux estimates globally and at the scale of climate domains by combining uncertainties in the activity ***data*** and emission/removal factors following a Taylor series statistical approach as in Roman-Cuesta et al. and Carter et al.. This approach underlies the IPCC Approach 1 (simple error propagation) and produces similar results but reflect exact calculations of variances and s.d., whereas IPCC Approach 1 is an approximated approach that yields 95% confidence intervals.

Uncertainties of all major components of the flux model were included (activity ***data***, affected C pools of the emission/removal factors, combustion and emission factor uncertainties for fire-related emissions). Errors were assumed to be statistically independent (uncorrelated), normally distributed and without bias. Supplementary Table shows the contribution of each uncertainty component for domain and global gross emissions, removals and net flux, reported as the percentage reduction in output variances as each of the uncertainty components were assumed to have no variance. Variance of the net GHG flux was reduced the most when removing variance of the removal factor for temperate forests older than 20 yr. Variances are likely to be lower when estimated across smaller geographic regions. Estimation of uncertainty is currently limited to the global and biome scales based on available ***data*** for estimating uncertainty in the activity ***data***.

Reporting Summary

Further information on research design is available in the linked to this article.

Online content

Any methods, additional references, Nature Research reporting summaries, source ***data***, extended ***data***, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of ***data*** and code availability are available at [*https://doi.org/10.1038/s41558-020-00976-6*](https://doi.org/10.1038/s41558-020-00976-6).

**Acknowledgements**

We thank S. Gibbes for her work on preliminary model development and T. Maschler for his contributions to workflows enabling efficient ***data*** processing and generation of summary ***statistics***. Support for this research was funded in part by the Norwegian Ministry of Foreign Affairs (18/2721 Global Forest Watch Achieving Sustainability and Scaling Impact), the UK Department for International Development (DFID FGMC grant no. FGMC2018-21-WRI) and the US Agency for International Development (cooperative agreement no. 7200AA19CA00027 Global Forest Watch 3.0) in support of the Global Forest Watch Partnership convened by the World Resources Institute, by National Aeronautics and Space Administration Earth Science Division NNH12ZDA001 NICESAT2: studies with ICESAT and CryoSat-2 grant no. 12-ICESAT212-0022 to the Woods Hole Research Center and by the NASA Carbon Monitoring System Program Project ‘Estimating Total Ecosystem Carbon in Blue Carbon and Tropical Peatland Ecosystems’ (16- 30 CMS16-0073) to NASA Goddard. The contribution of M.H., S.deB. and D.R.S. was supported by CIFOR’s global comparative study on REDD+ (funded by NORAD), the European Space Agency CCI-Biomass project and the European Commission Horizon 2020 projects VERIFY (grant no. 776810) and REDD-Copernicus (grant no. 821880). ***Data*** used in part of this publication were made possible, in part, by an agreement from the United States Department of ***Agriculture***’s Forest Service. This publication may not necessarily express the views or opinions of the Forest Service.

**Notes**

Extended datais available for this paper at [*https://doi.org/10.1038/s41558-020-00976-6.Supplementary*](https://doi.org/10.1038/s41558-020-00976-6.Supplementary) informationis available for this paper at [*https://doi.org/10.1038/s41558-020-00976-6.Peer*](https://doi.org/10.1038/s41558-020-00976-6.Peer) review informationNature Climate Change thanks Gert-Jan Nabuurs, Seth Spawn and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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[***TOPIC PAGE: Construction - impact on chemicals***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60N5-3BY1-JCN4-H0M0-00000-00&context=1516831)

Global News + ICIS Chemical Business (ICB)

August 21, 2020 Friday

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**Length:** 7194 words

**Body**

More than 30 petrochemicals and specialty chemicals are key ingredients in products used for modern construction adhesives, ad-mixtures, sealants, coatings, paints, flooring, insulation, water proofing, and many more.

Those materials enjoy good demand when infrastructure development takes place, but the construction industry has been adversely impacted by the coronavirus pandemic, although to a lesser extent than automotive, another key end market for petrochemicals.

Public infrastructure investments can be a major contributor to reviving economies and employment during a crisis.

Petrochemicals used in construction and infrastructure are likely to post higher demand in some regions as governments try to revive their wilted economies post-pandemic.

Construction activity in Asia, where most countries are developing economies, is set to growth healthily as the region ramps up infrastructure spending.

Within Asia, China is planning a major infrastructure development campaign to bolster its slowing economy by spending billions of dollars in projects.

On this topic page we analyse the impact of the coronavirus crisis and efforts by different governments to revive economies by developing infrastructure on the chemicals markets, bringing together the latest news reported by ICIS.

Scroll down to see the latest interactive content and useful resources.

[1]Click here to register for regular updates to help you navigate these challenging times. Image credit: Shutterstock

ICIS Analytics viewpoint

Construction: Typically, there is a strong relationship between construction activity and overall economic growth. As a result, GDP forecasts serve as an important indicator in determining the future of the sector. Although restrictions are beginning to ease around the world, in its June 2020 outlook, the International Monetary Fund (IMF) further downgraded its global GDP forecast by 1.9% to -4.9% for 2020, with a very slow recovery seen in 2021.

The eurozone construction PMI is showing recovery, owing to measures taken by governments to boost the sector. The index increased to 48.3 in June, from an all-time low of 15.1 in April. However, the market is far from strong with a weak order book and many projects still postponed. Similarly, the UK s PMI recovered from an all-time low of 8.2 in April to 50.1 in June.

US housing registered an uptick of 4.3% month on month in May from its largest monthly decline in April. However, the country is still experiencing social unrest which is weighing down the economy in general. Lower government budgets, limited credit and low savings levels could hinder investment in H2 as well.

Like all other major economic regions, Asian construction is also under stress, with some countries worse hit than others. The speed and degree of recovery will largely depend on government stimulus packages, credit lines and the timely availability of skilled construction workers. India has been one of the worst affected with severe restrictions to mobility. However, China is on its way back to recovery, as investment in real estate grew by 8.1% year on year in May and slowly returning after the pandemic.

Given the state of key macro indicators, including GDP, unemployment, debt levels etc, a worst-case scenario where a recovery takes much longer than expected cannot be ruled out. In addition, a second phase of lockdowns is under way in some countries, which may prolong a recovery.

By Jincy Varghese, ICIS demand analyst, [2][*jincy.varghese@icis.com*](mailto:jincy.varghese@icis.com) and Rhian O Connor, ICIS senior analyst, [3][*rhian.oconnor@icis.com*](mailto:rhian.oconnor@icis.com)

LATEST HEADLINES

[4]Mexico s PVC demand from construction sector remains questionable By Luly Stephens 20-Aug-20 03:12 HOUSTON (ICIS)--Demand for polyvinyl chloride (PVC) from the construction sector in Mexico has not improved, despite the optimism that emerged in June when the local government considered construction an essential industry. Effective 1 June, and following the guidelines published by the Health and Labor Ministries, construction activity could be resumed in Mexico. But with the construction sector already sluggish prior to the virus crisis, and both public and private construction projects halted due to the rapid spread of the virus, the construction industry recorded a Q2 contraction estimated at -30%.

[5]US housing starts rise in July By Tracy Dang 20-Aug-20 06:26 HOUSTON (ICIS)--US privately owned housing starts in July rose for the third straight month, measured on a seasonally adjusted annual rate, the US Census Bureau said in a report. Year on year, new home construction was up. Building permits rose month on month, and housing completions rose.

[6]Asia PVC to see snug supply amid turnaround, limited deep-sea volumes By Jonathan Chou 20-Aug-20 13:29 SINGAPORE (ICIS)--Asia's spot polyvinyl chloride (PVC) supply is expected to remain snug amid an ongoing northeast Asian producer s turnaround, as well as limited deep-sea availability from the US. Supply of deep-sea material from the US has been limited since July amid improved domestic demand in the construction sector.

[7]Europe construction output climbs in 4.0% in June, down on year By Morgan Condon 20-Aug-20 18:34 LONDON (ICIS)--Construction output in Europe rebounded in June month on month, according to the latest ***data*** from ***Eurostat***. Production in the sector rose by 4.0% in the eurozone and by 2.9% in the wider EU in June as lockdown restrictions continued to ease. France marked the highest increase at 12.0%. As a key end-market for the chemicals industry, a pickup in construction is likely to support demand and prices for some products in the sector.

[8]Feedstock spreads for Middle East isocyanates reach new highs By Prateek Pillai 19-Aug-20 19:22 SINGAPORE (ICIS)--Feedstock spreads for toluene diisocyanate (TDI) and polymeric methylene diphenyl diisocyanate (PMDI) in the Middle East have risen to their highest levels in a year. In the week ended 14 August, the feedstock spread for TDI reached $1,469/tonne while the PMDI spread touched $1,123.50/tonne. This trend has been driven by an increasing disparity between demand and supply for both isocyanates as production levels have failed to keep up with growing downstream foam demand. TDI is used for the creation of foam products like mattresses, rugs and cushions while PMDI is used primarily for producing insulation foams used in the construction sector.

[9]US-Canada PVC sales outpace production, constricting exports By Bill Bowen 13-Aug-20 05:51 HOUSTON (ICIS)--Demand and production of polyvinyl chloride (PVC) remains out of balance in the US and Canada, and is muddying market participants' view of the remainder of 2020. Monthly domestic sales of US and Canada PVC resins climbed enough to put July's figures among the highest of the past five years, trimming exports and reducing inventories, according to preliminary figures released Wednesday by an industry group. July s sales outpaced production, reducing inventories to about seven days' worth of sales, the producer said.

[10]INSIGHT: Seasonally softer summer for styrene but September sentiment stronger By Helena Strathearn 11-Aug-20 23:50 LONDON (ICIS)--Summer holidays have taken some players out of the European styrene market and there is a downturn in manufacturing output as is traditional, but the slowdown is not expected to be as notable nor as long as usual and the outlook for September is stronger. August demand for styrenics will see a seasonal slump, most notably in southern Europe, but it will probably not be as impactful as in previous years. September demand is expected to pick up on restocking and also as many end-use markets such as construction can continue until the end of October, and some into November or early December. Construction, appliances, electronics, white goods packaging, fish boxes packaging and sanitary applications demand has been holding fairly well but not yet returned to 2019 levels.

[11]China ECH prices rise as domestic supplies tighten; outlook clouded By Ai Teng Lim 11-Aug-20 15:02 SINGAPORE (ICIS)--China s domestic prices for epichlorohydrin (ECH) recovered some lost grounds this week as domestic supplies bucked earlier anticipations to turn tighter, instead of lengthening further. But with demand conditions still broadly dampened by nagging global economic worries, this may serve to curtail upside potential of ECH spot pricing, even if supply constraints seen this week do persist for some time more.

[12]China's petrochemical prices consolidate in July, demand largely stable By Yvonne Shi 04-Aug-20 16:48 SINGAPORE (ICIS)--China's petrochemical market fluctuated within a narrow range in July. The prices of most chemical products saw limited changes. Overall demand appeared to be generally stable, whereas supply pressure differed from product to product. On the whole, the sustainability of demand into construction markets is better, followed by the automotive industry, while textiles are weaker.

[13]US June construction spending falls from May By Tracy Dang 04-Aug-20 03:11 HOUSTON (ICIS)--US construction spending in June fell month on month but rose year on year on a seasonally adjusted basis, the US Census Bureau said in a Monday report. Residential construction was down month on month and year on year. Nonresidential construction was down month on month but up year on year.

[14]European PVC July prices rise more sharply than ethylene, market tightens By Chris Barker 03-Aug-20 18:39 LONDON (ICIS)--Average European polyvinyl chloride (PVC) contract prices rose for July by more than the cost increase from ethylene as a result of tighter availability in the market. A number of sellers achieved increases of 45/tonne or more because of higher demand and tighter availability. However, larger buyers were in some cases able to avoid increases above the ethylene cost. Price trends were consistent across NWE and the Mediterranean, with UK increases assessed at similar levels. In central and Eastern Europe there was a higher settlement with one producer source noting increases of 50-55/tonne on average.

[15]INTERVIEW: Chemours sees TiO2 volume recovery in Q3 driven by architectural coatings - CEO By Joseph Chang 31-Jul-20 23:33 NEW YORK (ICIS)--The world s largest producer of titanium dioxide (TiO2), Chemours, expects a sequential rebound in volumes in the low- to mid-teens percentage-wise, driven by architectural coatings, its CEO said on Friday. As we pivot to the third quarter, we re seeing a pick-up on the coatings side but maybe a shift in North America to not just DIY (do-it-yourself) but also into contract painting. People are starting to get more comfortable painting outside as well as inside, said Mark Vergnano, CEO of Chemours, in an interview with ICIS. In the second quarter, which saw TiO2 volumes fall by around 20% sequentially versus Q1 and 9% year on year, demand was driven mostly by DIY coatings demand - from customers with their own stores or those with access to big box retailers, he noted.

[16]India PVC market to face sustained tight import supply By Zhi Xuan Ho 24-Jul-20 14:21 SINGAPORE (ICIS)--Trade in the polyvinyl chloride (PVC) market in India slowed this week, with business for August shipments largely concluded in the previous week. Sentiment in the market remains bullish, with many market players expecting supply to remain tight moving forward.

[17]US August oxo-alcohols price efforts driven partly by expected upstream pressure By Larry Terry 24-Jul-20 06:25 HOUSTON (ICIS)--US August oxo-alcohols price-increase initiatives have emerged on an anticipated increase in the upstream July propylene contract and persistent margin pressure. July propylene negotiations, however, are still underway, with talks protracted by rising spot bids and offers.

[18]Europe extrusion PC July prices fall for third month on weak demand, ample availability By Miguel Rodriguez Fernandez 23-Jul-20 18:32 LONDON (ICIS)--Contract prices for extrusion grade polycarbonate (PC) have fallen slightly for the third consecutive month in July amid weak demand and ample supply. Most monthly extrusion grade business was concluded with rollovers and double-digit reductions.

[19]Asia petrochemical demand mixed amid tightening supply By Felicia Loo 23-Jul-20 12:27 SINGAPORE (ICIS)--Demand for key petrochemicals in Asia is mixed, with some markets in the pits despite shrinking supply, while other products appear to fare better, as the onslaught of the coronavirus carries on. But the overall market outlook for the second half of the year will be dim amid weakness in the world's second-biggest economy.

[20]China 2020 H1 real estate development investment rises 1.9% By Fanny Zhang 16-Jul-20 14:37 SINGAPORE (ICIS)--China invested yuan (CNY) 6.28tr ($897bn) on real estate development in the first half of 2020, an increase of 1.9% from the same period in last year, reversing the continuous decrease in previous months, ***data*** from the National Bureau of ***Statistics*** (NBS) showed on Thursday.

[21]US polyester polyol prices decline on weaker feedstock costs By Zachary Moore 16-Jul-20 06:37 HOUSTON (ICIS)--US polyester polyol prices were assessed 2 cents/lb ($44/tonne) lower as key feedstock costs continue to trend lower. Sentiment in major polyester polyol feedstock markets suggests that these markets may be nearing a trough as energy costs move higher and general economic activity is improving from the low points seen in prior months.

Demand from the construction sector has bounced back quicker than many other major consuming sectors of polyols and downstream polyurethane systems, although overall demand levels remain below pre-crisis levels.

[22]US plastic, chemical demand remains soft, margins stay depressed By Al Greenwood 16-Jul-20 03:30 HOUSTON (ICIS)--Demand for plastics and basic chemicals in the US was soft, while margins remained depressed, the Federal Reserve said on Wednesday.

The anecdote was among several that the US central bank ***collected*** in its recent Beige Book, a summary of US economic activity during the past six weeks among the Fed's 12 districts. The latest Beige Book contains information ***collected*** through 6 July. The comments about demand came from the 11th Federal Reserve District, which includes northern Louisiana and all of Texas, and has many of the nation's refineries and petrochemical plants.

[23]China s amines market under pressure on high stocks and weak demand By Yuanlin Koh 15-Jul-20 17:03 SINGAPORE (ICIS)--China s ethanolamines market is looking bearish in the near term on excess supply, as demand continued to struggle. China, hit by the rains, saw a drop in demand, especially in DEA s (diethanolamines) downstream DEIPA (diethanol isopropanolamine) used mainly as cement aids in the construction industry. Demand in this sector was initially picking up after the coronavirus pandemic in the country, as the economy reopened, and with government support, demand for DEA flourished.

[24]Asian epoxy resins export discussions sink deeper on poor demand By Ai Teng Lim 14-Jul-20 15:21 SINGAPORE (ICIS)--Asian epoxy resins export discussions lost more ground this week as sellers lowered offers to boost demand. Epoxy resins is heavily used in automobile and construction sectors, both of which are still struggling to find a firmer footing in the pandemic-ravaged global economy.

[25]INSIGHT: Construction could pave the way for Q3 chemicals recovery in Europe By Morgan Condon 10-Jul-20 23:25 LONDON (ICIS) As with all forms of industry, the coronavirus came in like a wrecking ball, bludgeoning any chances of growth in the construction sector for the first half of 2020. The foundations have been laid for a return to industrial activity, however, as lockdown restrictions across Europe have been eased, which could provide support for chemicals used in the construction industry.

[26]US construction is returning to pre-Covid levels - trade group By Al Greenwood 19-Jun-20 01:37 HOUSTON (ICIS)--In many parts of the US, construction activity is returning to levels that predate the coronavirus (Covid-19), a trade group said on Thursday. The Associated General Contractors of America (AGC) based its finding on its new survey and on ***data*** from Procore, a construction-technology company. Procore analysed workers' hours. Based on that analysis, construction activity has returned to pre-coronavirus levels in 34 US states. Among eight large cities, Dallas, Texas, and Miami, Florida, are back to pre-pandemic levels. Some construction companies are adding new workers, the AGC said. According to its survey, 21% are adding employees. That compares with 25% that were letting workers go between March and May. In June, only 8% of construction companies were forced to furlough or lay off workers, the AGC said.

[27]US housing starts rebound in May By Tracy Dang 18-Jun-20 06:33 HOUSTON (ICIS)--US privately owned housing starts in May rose after three consecutive months of declines, measured on a seasonally adjusted annual rate, the US Census Bureau said in a report. Year on year, new home construction was down. Building permits fell month on month, and housing completions fell. The housing market is a key consumer of chemicals, driving demand for a wide variety of chemicals, resins and derivative products such as plastic pipe, insulation, paints and coatings, adhesives, and synthetic fibres, among many others. The American Chemistry Council (ACC) estimates each new home built represents some $15,000 worth of chemicals and derivatives used in the structure or in the production of component materials.

[28]June EPS demand improving in the US, but remains below pre-crisis levels By Zachary Moore 17-Jun-20 06:27 HOUSTON (ICIS)--US demand for expandable polystyrene (EPS) is improving as economic activity picks up and lockdown measures ease. However, overall activity and EPS consumption both remain below pre-crisis levels. Activity in the construction sector has improved as lockdown measures are eased, although there is some concern that most current activity revolves around the completion of existing projects, rather than the start-up of new projects. Projections from ICIS Analytics suggest that construction activity will rise above 2019 levels in 2021, although creditworthiness concerns may limit the number of new projects.

[29]Eurozone, EU construction continues dropping in April as lockdown limits production By Morgan Condon 17-Jun-20 19:06 LONDON (ICIS)--Construction throughout the EU plummeted in April as countries implemented quarantine restrictions to combat rising coronavirus infection rates, according to first estimates from EU ***statistics*** agency ***Eurostat*** on Wednesday. This has served to weigh on demand for chemicals used in the sector. Production in the construction sector decreased by 14.6% in the eurozone and by 11.7% in the wider EU area in April compared with the previous month and accounting for seasonal adjustment.

[30]China Jan-May real estate investment contracts 0.3% year on year By Fanny Zhang 15-Jun-20 14:22 SINGAPORE (ICIS)--China s real estate development investment in the first five months of 2020 slipped 0.3% year on year to Chinese yuan (CNY) 4.59tr ($647m), official ***data*** showed on Monday. The decline has eased from 3.3% recorded in January to April. Investment in house construction in January-May stood at CNY3.38tn, unchanged from the previous corresponding period. It was an improvement from the 2.8% fall in January-April 2020. Real estate developers house construction acreage in the five-month period increased 2.3% on year to 7.6bn square metres (sqm), slower than the 2.5% growth in January-April.

[31]Europe Melamine Q3 contract talks yet to begin, demand outlook remains uncertain By Melissa Hurley 11-Jun-20 23:54 LONDON (ICIS)--European melamine contract discussions for the third quarter could begin later than usual, as consumers find it challenging to plan volume requirements given the fragile state of the economy as lockdowns ease.

In the spot market, there is increased pressure, and prices have been assessed stable to softer this week. Demand outside contractual requirements is weak, given the demand issues experienced in the market.

The [32]construction industry has been adversely impacted by the coronavirus pandemic, although to a lesser extent than automotive, another key end market for petrochemicals.

[33]Europe PU feedstocks prices hit new lows as demand pickup lags By Fergus Jensen 11-Jun-20 20:28 LONDON (ICIS)--Incremental improvements in demand for polyurethane (PU) products have slowed downward pressure on the Europe isocyanates and polyols markets where supply is abundant, and producers are now hoping for a reversal in the coming months. June contracts for polyols, toluene diisocyanate (TDI), and crude and pure methylene diphenyl diisocyanate (MDI) were all settled below May contract levels, and in some cases at hit new record lows. According to one Europe-based reseller, the construction market in NWE was now at 90% of activity, compared with this time in 2019. Demand for adhesives and wood binding has also improved, as well as that for insulation panels and spray foam, among others.

[34]US MDI, TDI demand remains sluggish even as overall economic activity picks up By Zachary Moore 11-Jun-20 06:27 HOUSTON (ICIS)--Demand for US methylene diphenyl diisocyanate (MDI) and toluene diisocyanate (TDI) remain sluggish even as the broader macro-economy is observing some pick-up in activity. Localities throughout the US are gradually easing lockdown measures, leading to some improvement in broader economic indicators. The construction sector has been performing better than most of the other major sectors of polyurethane demand, although participants feel that the success of the sector may be temporary.

Much of the activity in the sector is being driven by work to complete projects that had been underway prior to the recent crisis. There are concerns that activity might slow down once these projects are completed. US housing starts fell 29.7% year on year in April 2020, according to ***data*** from the US Census Bureau.

[35]US epoxy players monitoring demand amid economic reopening By Tarun Raizada 10-Jun-20 05:21 HOUSTON (ICIS)--US epoxy is facing some uncertainty in June amid the economic reopening. Q2 demand has softened during the pandemic, with typical seasonal trends not materialising so far. There is stronger demand from architectural do-it-yourself (DIY) and packaging coatings, which is being more than offset by softer demand from architectural do-it-for-me (DIFM), automotive and industrial coatings. The US building and construction sector could prove to be far more resilient than the automotive sector. But the pandemic is creating a volatile backdrop for chemical companies as they navigate the road to recovery. Epoxy resins are used as adhesives on metals and construction materials, as well as in coatings and automobiles.

[36]Asian MA afloat on some buying, but demand uncertainties loom By Ai Teng Lim 05-Jun-20 09:52 SINGAPORE (ICIS)--As post-coronavirus production recovery commences gingerly across Asia this week, buying tempo also picked up in Asia s maleic anhydride (MA) market to keep spot prices afloat. But with longer-term global economic outlook still clouded by many uncertainties, from geopolitical tensions to macro-level demand-supply imbalances, it remains to be seen if the buying could sustain for long.

[37]North American PS sales drop 21.8% year on year in April By Zachary Moore 05-Jun-20 05:49 HOUSTON (ICIS)--North American total sales and captive use of polystyrene (PS) fell by 21.8% in April 2020 compared with the same month of the prior year, according to ***data*** recently released by the American Chemistry Council (ACC) and Vault Consulting. The coronavirus outbreak and subsequent containment measures caused a sharp drop in overall economic activity in April, impacting production and sales of PS across most consumption segments.

[38]US manufacturing contracts again in May but overall economy expands - ISM By Tracy Dang 02-Jun-20 06:53 HOUSTON (ICIS)--US manufacturing activity contracted for the third consecutive month in May, but at a slower pace from April, the Institute of Supply Management (ISM) said on Monday. The overall economy returned to expansion after a month of contraction, the report said.

Three months into the manufacturing disruption caused by the coronavirus pandemic, comments from the panel were cautious (two cautious comments for every one optimistic comment) regarding the near-term outlook, said Tim Fiore, chair of the ISM.

[39]European plasticizers see slightly better demand in June, but still very mixed By Jane Massingham 04-Jun-20 23:24 LONDON (ICIS)--The first days of June are continuing to portray a rather mixed picture in terms of demand for plasticizers. Various countries are seeing lockdown restrictions that are allowing some businesses to return to work. One seller noted it is still challenging and said: Demand is not so great and continues to be like that, but it is building up slowly and should be better as June progresses and July should be more. The automotive sector continues to be the hardest hit but there are sectors of the construction industry starting to come back.

[40]Europe chemicals to gain from EU green deal spending plans - bank By Tom Brown 04-Jun-20 21:10 LONDON (ICIS)--European chemicals players are expecting to see increased business momentum on the back of the EU s green deal expected to unlock hundreds of billions of euros of investment in sustainability projects, according to Credit Suisse. A virtual conference organised by the bank hosted management teams from 20 chemicals, ***agriculture***, packaging and cement firms address investors, with all chemicals firms present noting expectations for an increase in sales on the back of the mooted EU green investment plan.

However, little visibility on uplift from the measures is expected over the next 12-18 months.

[41]Thailand greenlights $9bn airport project to BBS consortium By Fanny Zhang 04-Jun-20 14:48 SINGAPORE (ICIS)--Thailand s cabinet approved a bid by BBS consortium to develop a $9bn U-Tapao Airport and Eastern Aviation City project at the country s southeastern coast, according to local media reports.The winning bid was approved on 2 June and the government is expected to sign the contract with BBS consortium on 19 June, these reports added. The announcement follows the passage of $58bln economic support package on 31 May by Thailand s parliament to ease the impact of the coronavirus on the economy and people.

[42]Australia launches A$680m stimulus for residential construction By Pearl Bantillo 04-Jun-20 12:33 SINGAPORE (ICIS)--Australia has launched a stimulus package worth Australian dollar (A$) 680m ($470m) to boost activity in the construction sector, which was hit by the coronavirus pandemic. Dubbed the HomeBuilder program , the funds will help support 140,000 direct jobs in the residential construction sector, Australian Prime Minister Scott Morrison said on Thursday.

Under the programme, all eligible owner-occupiers will receive a grant of A$25,000 either to build a new home or renovate an existing home. Construction must start within three months of the contract date. Based on eligibility criteria for applicants and price caps on new home builds (A$750,000) and renovation (A$150,000-750,000), the government expects to hand out 27,000 of such grants under the programme.

[43]INTERVIEW: US construction outlook far more positive than automotive - Huntsman CEO By Joseph Chang 03-Jun-20 06:56 NEW YORK (ICIS)--The US building and construction market is recovering and proving far more resilient than the automotive sector, the CEO of Huntsman Corp said on Tuesday. In homebuilding, DIY [do it yourself] and OSB [oriented strand board] are doing quite well. It s down from a year ago but nowhere near what we expected a month or two ago, said Peter Huntsman, CEO of Huntsman Corp, in an interview with ICIS amid the American Chemistry Council (ACC) virtual annual meeting.

Building products, furniture, insulation, and OSB are showing some resilience, he added. Huntsman is a major producer of methylene diphenyl diisocyanate (MDI), heavily used in the construction market in insulation, binding and coatings, and in the automotive sector in bumpers, conveyor belts and other parts, as well as coatings. Polymeric MDI is used as a binder in OSB, an engineered wood used in construction. Pure MDI is used in coatings, adhesives, sealants and elastomers (CASE).

[44]Covestro volumes down sharply in April-May, improvement expected for June By Tom Brown 29-May-20 00:46 LONDON (ICIS)--Covestro's core volumes dropped 30% in April and May, but order book levels point to an improvement in June, according to the company and analysts at Baader Bank. April automotive sector customer demand fell 60% in the EU and North America, with furniture market demand falling 45% year on year a 30% increase in medical polycarbonates (PC) demand unable to offset the scale of the falls elsewhere.

Overall polyurethanes (PU) volumes fell 40% in April while moves to channel PC material to less affected markets mitigated the volume decline in that division to 20%. Coatings, adhesives and sealants (CAS) sales dropping at a similar level, Baader said, citing an investor call chaired by Covestro CEO and CFO, Markus Steilemann and Thomas Toepfer, respectively.

[45]INSIGHT: Asia phenol market unlikely to recover until 2021 By Angeline Soh 25-May-20 19:02 SINGAPORE (ICIS)--Asia s phenol market is unlikely to make a full recovery in the second half of this year as the coronavirus pandemic has caused end-market demand to plummet. The International Monetary Fund (IMF) has predicted the global economy will shrink by 3% this year, describing the current crisis as the worst the world has faced since the Great Depression in the 1930s.

There has been a boom in end-use products heavily used during the pandemic such as packaging, disinfectants like hand sanitisers, and face masks. However, other segments like automobile and construction have been underperforming.

[46]China downplays pollution issue; still hopes to meet emission targets By Fanny Zhang 25-May-20 16:40 SINGAPORE (ICIS)--China has not emphasized pollution issues at its parliamentary sessions this year, toning down its commitment to emissions targets, as it places top priority to getting businesses back to normal amid the coronavirus pandemic.

Employment, poverty alleviation, control on financial risk, consumption growth and business recoveries are key topics of discussions at the country s biggest political gathering in Beijing, which kicked off on 22 May. The National People s Congress (NPC) and the Chinese People s Political Consultative Conference (CPPCC) are holding their annual meeting until 28 May.

[47]US May oxo-alcohols prices continue to trend weaker By Larry Terry 22-May-20 06:23 HOUSTON (ICIS)--Weaker pricing for US May oxo-alcohols free market contract ranges continues to be more evident, but the magnitude of declines is not yet clear. Major downstream construction- and automobile-coatings demand has yet to gain any seasonal momentum, with easing coronavirus strictures still in the early stages.

[48]US PVC contracts for June nominated higher as demand creeps back amid lower operating rates By Bill Bowen 22-May-20 06:09 HOUSTON (ICIS)--US producers of polyvinyl chloride (PVC) have separately nominated June contracts higher by 3 cent/lb ($66/tonne) as lower operating rates limit supply and demand begins to creep back. The announcements come as a bit of a surprise and some market participants say that the outcome will certainly depend on how demand recovers as coronavirus lockdowns ease.

US spot export prices have fallen sharply in recent weeks as coronavirus precautions destroyed demand in key exporting markets, including China, Turkey, India, Malaysia, Peru and Argentina, among others.

[49]US existing home sales fall to lowest level in 10 years By Stefan Baumgarten 21-May-20 22:55 HOUSTON (ICIS)--US existing-home sales fell to their lowest level in April since July 2010 amid the lockdowns and restrictions authorities imposed from mid-March through April to contain the coronavirus (Covid-19) pandemic.

Existing home sales fell 17.8% from March to a seasonally-adjusted annual rate of 4.33m in April, and they were down 17.2% year on year from April 2019, the National Association of Realtors (NAR) reported on Thursday.

[50]Weak soda ash demand in Asia may continue to offset output cuts in China By Helen Lee 20-May-20 16:31 SINGAPORE (ICIS)--Asia s soda ash market remains under pressure amid rising inventory pressure in China, on the back of weak downstream demand due to extended social isolation measures. Supply remained more than sufficient despite ongoing and impending shutdowns at several soda ash plants in China.

China s domestic demand was just as downbeat on account of liquidity issues and high inventories faced by downstream glass producers on the back of poor performance in the construction/real estate sector.

[51]BASF to work with a China university on infrastructure solutions By Fanny Zhang 20-May-20 13:50 SINGAPORE (ICIS)--BASF and China s Harbin Institute of Technology (HIT) have signed a cooperation agreement to jointly conduct research on material solutions for sustainable infrastructure applications, according to a statement from BASF.

According to the agreement, research teams from BASF and the HIT will work together on the testing of new applications for BASF s advanced materials to cut emissions and energy costs to the construction industry.

[52]Long-term outlook for Asia airport construction still strong - Fitch By Fanny Zhang 15-May-20 16:25 SINGAPORE (ICIS)--Long-term prospects for Asia s airport construction funded by public investment are expected to remain largely intact despite the ongoing coronavirus pandemic that crippled the aviation market, credit ratings firm Fitch said in a report.

We remain optimistic about the eventual recovery of the aviation sector in the medium to long term, and hence, continue to be bullish on the growth of Asia s airports sector, it said.

[53]China real estate development investment down 3.3% in Jan-Apr By Fanny Zhang 15-May-20 14:50 SINGAPORE (ICIS)--China s real estate development investment totalled yuan (CNY) 3.3 trillion in January-April, a decrease of 3.3% from the same period in last year, the National Bureau of ***Statistics*** (NBS) said on Friday. Investment in housing projects stood at CNY2.4tn in January-April, down by 2.8% year on year.

In January-April, real estate developers house construction acreage increased 2.5% on year to 7.4bn square metres (sqm), down from a 2.6% expansion in January-March period.

[54]US plasticizers ranges holding steady amid weak fundamentals By Larry Terry 15-May-20 07:18 HOUSTON (ICIS)--US diisononyl phthalate (DINP), dioctyl terephthalate (DOTP) and dioctyl phthalate (DOP) prices were unchanged amid continued pressure from softer April propylene and flat-to-weaker downstream demand so far in May. Some near-term upward price pressure may stem from higher 2-ethylhexanol (2-EH) spot prices in east Asia this week. The effect was expected to be mostly nominal, but enough to exert some counter pressure.

[55]Europe May ethanolamines talks ongoing amid mixed downstream demand, balanced supply By Jane Gibson 14-May-20 00:57 LONDON (ICIS)--May ethanolamines contract talks continued in Europe this week - with sellers looking for rollovers and buyers seeking lower prices.

[56]China PO prices rise in traditional off-season By Jady Ma 14-May-20 23:05 SINGAPORE (ICIS)--Propylene oxide (PO) prices in China have gained ground on higher feedstock prices and firm fundamentals, although the industry has entered its traditional off-season. On 14 May, PO prices in east China were assessed at yuan (CNY) 9,400/tonne, up by 20.1% compared with the prices on 17 April, according to ICIS ***data***

[57]US MMDI prices slide on falling downstream demand By Zachary Moore 14-May-20 06:46 HOUSTON (ICIS)--US prices for monomeric methylene diphenyl diisocyanate (MMDI) were assessed 4 cents/lb ($88/tonne) lower, as demand remains poor during the economic slowdown created by the coronavirus outbreak and subsequent containment measures.

Construction demand has been weak, as many projects have slowed or suspended operations owing to economic uncertainty, along with public health concerns.

RESOURCES

China's government is expected to focus on large-scale infrastructure and other development projects as ways to bolster economic growth and generate employment, especially more so now because of the fall out of the coronavirus pandemic.

ICIS has compiled a list of key existing projects that different provincial authorities have announced.

More than half of these are construction and infrastructure projects, while some are manufacturing plants and research and development (R&D) initiatives.

The source for the interactive is local NDRC. The list is incomplete and will be updated regularly by ICIS. Changes will happen as the government authorities and companies revise their development plans.

Construction in China - Asia s biggest and the world s second-largest economy - slumped at an annualized double-digit rate in the first quarter of 2020 as overall economic output shrank for the first time in two decades amid the coronavirus pandemic.

In 2019, the sector accounted for 7.2% of the country s GDP.

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HINA Digest

October 7, 2020 Wednesday

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**Length:** 10512 words

**Body**

Zagreb,Hrvatska07 October 2020 (Hina) - Croatia reports 363 new coronavirus cases, 5 dead ZAGREB, Oct7(Hina) - Over the past 24 hours 363 new coronavirus cases have been registered in Croatia, bringing the number of active cases to 1,830, and five persons have died, the national COVID response team said on Wednesday. Currently 344 patients are hospitalised, including 26 on ventilators, while 9,675 persons are self-isolating. Since February 25, when the first infection was registered in Croatia, 18,447 persons have been infected with the virus, of whom 309 have died, while 16,308 have recovered, including 116 in the last 24 hours. To date 338,594 persons have been tested, including 5,353 in the last 24 hours. Beros: We have micro-clusters as a result of family and public gatherings ZAGREB, Oct 7 (Hina) - Health Minister Vili Beros, commenting on the second worst day for new coronavirus infections in Croatia since the outbreak of the epidemic, said on Wednesday that micro-clusters had been registered in recent days as a result of family and public gatherings where people did not keep the necessary distance.

"Today is the second worst day. I think on September 3 we had 369 new infections. We have predicted thiswill happen with the arrival of colder weather, but the fact remains that, unfortunately, we have to learn from our own mistakes," Beros told the press after an inner cabinet meeting. "In recent days we have been seeing micro-clusters - family get-togethers or small or large public gatherings - generated by a number of people being close to each other indoors or outdoors," he added. Beros said that people with mild respiratory conditions, such as a cough or a sore throat, should avoid such gatherings regardless of mild symptoms. "In normal times, without coronavirus, such symptoms were not alarming and they could go to gatherings or to work, but in the COVID crisis it is essential that we avoid such gatherings because in that way we will avoid the virus spreading." He said that all people working with children, especially those working with children at risk, should be wearing face masks. The minister said that 344 infected people were receiving hospital treatment today, 10 more than yesterday. "This number is growing slowly, so we will have to respond with new measures at our disposal." Beros once again appealed to everyone to maintain a physical distance, wear face masks and use hand sanitiser as the most effective way of fighting against the virus. Jandrokovic: I feel well and hope to be back next week Parliament Speaker GordanJandrokovic, who contracted the coronavirus last week, said on Wednesday he was feeling welland hoping to be back in the parliament next week. "I hope we will see each other next week. I can hardly wait and until then greetings to all and hang in there," Jandrokovic said in aFacebook post. On the sixth day of contracting the disease, Jandrokovic has mild symptoms and feels well, he said in a video message, thanking everyone for the get well wishes he has received. "That means a lot in situations like this," he added. Jandrokovic went into self-isolation before being confirmed as having contracted the coronavirus. He is recovering at home. Varazdin, Istria counties among most successful European regions in fighting COVID-19 ZAGREB, Oct 7 (Hina) - Varazdin and Istria counties are among the most successful European regions in fighting the spread of the coronavirus, according to ***data*** released by the Belgian Foreign Ministry. Apart from the two Croatian counties, also described as epidemiologically safe regions are one Swedish region, four Polish regions, two Bulgarian and two Italian regions. County head: We identified challenges, set up response system on time According to available ***data***, the northern Varazdin County also has the lowest COVID-19 mortality rate in the country. Of 80 hospitalised patients, by October 5, one had died, the county authorities said. County head Radimir Cacic said they had identified the challenges on time and set up a system to deal with them, being constantly one step ahead in the implementation of measures designed to contain the virus and detect potential hotspots. The county was among the first, after Zagreb, Rijeka, Split and Osijek, to start testing for COVID-19, Cacic said. Since the start of the epidemic, 240 infections have been identified in the county, plus 16 people whom the county also has in its ***statistics*** because they have permanent residence in Varazdin County, he said. Kozlevac: This is result of cooperation between citizens, competent institutions The head of the Istria County COVID-19 response team, Dino Kozlevac, said that Istria County set an example to all other Croatian counties owing to its results in the fight against the coronavirus. That was possible thanks to cooperation and understanding between citizens and competent institutions, Kozlevac said, recalling that Istria residents had been wearing masks indoors for three months and that this was producing results and proving to be the most efficient measure of prevention. He noted that face masks were not obligatory only for school children. Todoric, Huljev, Canjuga and De Rossi acquitted ZAGREB, Oct 7 (Hina) - Former Agrokor owner Ivica Todoric has been acquitted of charges that he and three of his associates defrauded the now defunct ***agricultural*** and food conglomerate of €1.25 million, Zagreb County Court ruled on Wednesday. Former Agrokor managers Ante Huljev and Piruska Canjuga and the fourth defendant Nicole De Rossiwere also acquitted. The defendants denied all the charges. According to the indictment, Todoric, as chairman of the board, and Huljev, as chief financial officer, abused their corporate positions in 2013 by allowing the payment of €1.25 million to a Swiss consulting firm for consulting services, aware that no such services had been or would be provided toAgrokor. De Rossi, as the responsible person in the Swiss firm, was charged with helping Todoric and Huljev with issuing invoices for allegedly provided consulting services. Canjuga, a member of Agrokor's management board, was charged with inciting Todoric and De Rossi. The indictment alleged that Huljev and Canjuga were the actual owners of the Swiss firm. Todoric has been under investigation since November 2017 for illegal siphoning of more than HRK 1 billion (€133.3m) from Agrokor. The State Attorney's Office issued an indictment for this main part of the Agrokor case on September 15. Judges: Prosecutors failed to prove Todoric siphoned money out of Agrokor ZAGREB, Oct 7 (Hina) - Commenting on the acquittal of Ivica Todoric and his associates in the so-called "small Agrokor case", judge Maja Stampar Stipic said on Wednesday that the prosecution had failed to prove that Agrokor's former owner and his co-defendants had siphoned money out of the now defunct retail and food group. "In order fordefendants to be found guilty, each count of the indictment must be proved, which simply wasn't the case here," said the Zagreb County Court judge. The judges are of the view that the money was spent on the consulting services provided, while the prosecutors failed to furnish any evidence to contradict this finding. Stampar Stipic said that none of the witnesses confirmed that the third defendant Piruska Canjuga had asked the first defendant Todoric and the second defendant Ante Huljev to acquire undue gain for the Swiss company Sigman Invest AG. In the judges' opinion, the statement made by the witness Valentin Vicic, who said that he did the job for Agrokor based on an agreement with Huljev, was crucial for the acquittal. "Even aprosecution witness, who purchased Sigman Invest AG, confirmed having seen documents about the job done by Vicic. It was a successful job that preceded the purchase of Mercator by Agrokor," Stampar Stipic said. Shortly after the announcement of the acquittal, Todoric told the press that the prosecutors had presented to the court "a monstrous and fake" indictment sponsored by Prime Minister Andrej Plenkovic. The prosecutors in this case announced an appeal. Bankruptcy proceedings opened against Todoric's company owing HRK 233.5m ZAGREB, Oct 7 (Hina) - The Commercial Court in Zagreb has opened bankruptcy proceedings against the Agrokor Projekti company, whose sole founder, member and chief executive officer is Ivica Todoric, owing as much as HRK 233.5 million. The proceedings were launched following a motion filed by Fortenova Group, the successor to the Agrokor ***agricultural*** and food conglomerate. Snjezana Vrkljan was appointed official receiver and a report hearing was scheduled for February 9 next year. A report by an interim receiver submitted early this year shows that the debtor possesses shares in the state-owned HPB postal bank that can be cashed in, as well as shares in the Amsterdam-based Adria Group whose value is yet to be determined. The report says that although the company is under blockade, the debtor's assets are enough to settle the debt. Agrokor Projekti was established in February 2011 by Ivica Todoric, its sole founder, member and CEO. In November 2015 it increased its initial capital in rights from HRK 20,000 to as much as HRK 5.32 billion. The company was the subject of a legal dispute between the former government-appointed administrator of Agrokor, Ante Ramljak, and the dispossessed owner Ivica Todoric in which Ramljak moved for seizure of slightly over HRK 16 million from Agrokor Projekti. According to media reports, thisamount related to matured loans which Todoric as the owner of Agrokor granted to his company Agrokor Projekti. The agreement was signed by Todoric himself, the first time as the chairman of Agrokor's management board and the second time as the CEO of Agrokor Projetkti. Media reports also said that Agrokor Projekti was not part of the Agrokor conglomerate and was not covered by the law on emergency administration in systemic companies, dubbed Lex Agrokor, so it was possible to carry out debt enforcement proceedings against it. After all assets owned by Todoric were blocked, an injunction was issued in late 2017 preventing him from appropriating or encumbering his shares nominally valued at HRK 5.32 billion. HDZ whip: Opposition wants inquiry commission to have more powers than OZNA ZAGREB, Oct7(Hina) - The HDZ whip said on Wednesday the opposition wanted to give a parliamentary inquiry commission powers which not even the OZNA(Yugoslav security and intelligence service) had. Branko Bacic was respondingto the opposition's criticism that the ruling party was against the establishment of an inquiry commission which would look intopossible obstructions or influence by the authorities when it comes toindependent investigations. "I understand why the opposition is nervous. The documentthey worked on for weeks can't pass in parliament. They drew upa document which could have been written by a person living in 1947, 1948 who doesn't know that aCroatian state was establishedin which the judicial authority is independent," he said in parliament. He told the opposition the majority would not adopt an illegal and anti-constitutional decision. "That's why you're nervous," he said, dismissing their criticism that the HDZ did not want to actually deal with corruption and crime. Grmoja: If anyone knows how OZNA worked, it's the HDZ "If any party or government has been working on curbing corruption and crime, it's this government which has made it possible for DORH (State Prosecutor's Office), USKOK (anti-corruption office) and the police to be fully independent," Bacic said, adding that the opposition wanted to call judges to parliament to talk about their cases. "You want to prosecute the Croatian judiciary and the Constitutional Court and DORH in advance," he said. "If anyone knows how OZNA worked, you from the HDZ know. Nowhere else arethere more former members of the (communist) party and UDBA (Yugoslav secret police).You have filled the judiciary with your close friends," said Nikola Grmoja of Bridge. He said a debate on the establishment of the inquiry commission was not about law but politics. Sandra Bencic of the green-left coalition said she did not agree with the prime minister's assessment that the commission would conduct a too broad inquiry and bring into question the independence of the judiciary. We Can! platform says HDZ right to fear inquiry commission ZAGREB, Oct7 (Hina) - The We Can! political platform has saidthat theHDZ party isright to fear a proposal to form a parliamentary commission to investigate possible influenceby the authorities on investigations and prosecution of corruption, noting that it will not give up until that influence has been investigated. "They are afraid that the commission of inquiry could find answers to the questions of why we do not have convictions for corruption, why after billions of kuna stolen there are no culprits, and why long-term prison sentences are not being served," MPs Sandra Bencic and Tomislav Tomasevic said after the HDZ said that it would reject the Opposition's motion to form a commission of inquiry to investigate the work of state institutions and information leaks in the JANAF corruption case. The two MPs said they would not give up on the goals stated in the motion for the commission of inquiry regardless of whether the commission would be formed with the will of the HDZ-led parliamentary majority. "Our message to the HDZ is: We will investigate it one way or another, so you have reason to be afraid," they said. They dismissed PM Andrej Plenkovic's and the HDZ's justification for their opposition to the motion, such as that the commission's investigation would be too extensive, that the commission would bring into question court autonomy, that state institutions already function and that the same objectives could be achieved through existing parliamentary committees. Bencic and Tomasevic saythat the commission hasa very clear and narrow objective, which boils down to the influence of politics on investigations and the judiciary and the leaking of information frominvestigations. Commission would not bring court autonomyinto question The law on inquiry commissions says that a motion to form such a commission must refer to an entire area and an entire set of questions, and not just one, as claimed by Plenkovic, they say. Court autonomy does not entail a ban on the oversight of the judiciary as a system, and the purpose of the opposition's motion is not to investigate individual cases but rather the way the system works, its weakpoints with regard to resilience to corruption, and itscapacity to deal with big corruption cases, the two MPssay. They note that the commission willnot bring into question court autonomy but willask representatives of the judiciary to say, based on their experience,how the system can be improved. As for the PM's claim that "state institutions function", Bencic and Tomasevic wondered how it was possible for the Express weekly to publish a list of 60 big corruption scandals of which only a few resulted in a conviction and most involved members of the HDZ. Existing parliamentary committees cannot carry out the investigation because they lack the powers a commission of inquiry has. Nobody can refuse to testify before or submit documents requested by a commission of inquiry on pain ofpenalty, they say. Bencic and Tomasevic conclude that Plenkovic and the HDZ are afraid the commission would deal with systematic shortcomings in the fight against corruption and organised crime and that it would transpire that the HDZ hascreated and maintained asystem that isweak and susceptible to political influence, which is why it cannot resolveany major corruption case. Minister says opposition draft motion is flippant ZAGREB, Oct7(Hina) - Justice and Public Administration Minister Ivan Malenica said on Wednesday the State Prosecutor's Office (DORH), and the USKOK andPNUSKOK anti-corruption offices were independent and that there was no executive authority influence on their work, nor a reason to questionthat. "There is no executive authority influence on those bodies at all and I see no reason to question if it exists," he told the press ahead of an inner cabinet meeting. He said it was necessary to explain how DORH worked because some MPs and opposition politicians were bringing its work into question. DORH is independent and impartial in its work, the Criminal Procedure Act is clear on that, Malenica said, adding that USKOK and PNUSKOK did their job professionally and independently. He called the opposition's draft decision on theestablishment ofa parliamentary inquiry commission flippant. He said some things in it did not make sense and that some were not in line with the law because, he added, the law says that one question should be asked, while the opposition asked a dozen. They set the thing too broadly "They set the whole thing too broadly. Their draft is flippant, i.e. the proposal that the inquiry commission deal with certain things which are in the remit of a score of parliamentary committees as well as other bodies," Malenica said. There are alreadymechanisms and bodies which canaddress those questions, he added. AmCham officials meet justice minister to discuss improving judiciary ZAGREB, Oct 7 (Hina) - Representatives of the American Chamber of Commerce in Croatia (AmCham) on Wednesday met with Minister of Justice and Public Administration Ivan Malenica and presented their recommendations on how to improve the judiciary. The recommendations on how to improve the work of courts are aimed at resolving the problem of the backlog that occurred as a consequence of the Covid-19 crisis as well as permanently improving the efficiency of courts. AmCham recommends the introduction of two shifts for the courts, automatic delegation of cases based on type and number of cases, introducing deadlines for every degree of the court procedure, promoting alternative settlement procedures, changing the methodology to assess judges' performance, creating a national court register and conducting trials via electronic media, AmCham said in a press release. AmCham also recommends changing the Companies Act to remove obstacles to foreign entrepreneurs to make it possible for them to transfer their shares or close their companies in Croatia without having to physically come to Croatia and to prevent turning them away from doing business in Croatia if they see that they will be faced with a long procedure and expensive liquidation process should their business fall through. "We welcome the ministries' planned activities that should result in improving legal security and the business and investment climate in Croatia. The efficiency of the judiciary is of great importance for the business community which can be seen in AmCham's regular survey conducted each year among our members," said AmCham's Executive Director Andrea Doko Jelusic. After relaxing epidemiological measures and relaunching economic activities it was to have been expected that the judicial system would be additionally burdened with new cases - debt enforcement proceedings, bankruptcies, suits and others, which, in addition to the already existing backlog, would increase uncertainty in doing business in Croatia, Doko Jelusic said. Supreme Court: Our colleague informed court of her husband's arrest ZAGREB, Oct 7 (Hina) - After the media reported that yet another suspectin the JANAFscandal has a spouse who worksin the judiciary, the Supreme Court has saidthat the judge in question informed the court that her husband had been arrested as soon as she learned of the arrest. According to the media, the suspect in question isthe director of the JANAF Security and Protection Sector,Vlado Zoric, whose wifeIvana Zoric, ajudge at the Zagreb Municipal Court, was assigned to the Supreme Court a few years ago. The Supreme Court has said that Judge Zorichas worked at the court as an advisor since 15 January 2018 and that as soon as she heard of her husband's arrest, she informed the court's administration. "Immediately upon hearing of the arrest on 17 September 2020, MrsZoricinformed the court's administration of that fact and of the fact that hermarriage had practically ended on 1 July 2020," the Supreme Court said in a press release on its web site on Wednesday. AttorneyIvo Farcic, who is defending former JANAFCEODragan Kovacevic, has told the N1 television that he doesnot see any coincidence in this situation and that who is whose spouse is not important. SDP whip says speculation about party rift very dangerous ZAGREB, Oct 7(Hina) - Social Democratic Party whip Arsen Bauk said on Wednesday, following a rift in the SDP parliamentary group, that he hoped this was the last time something like that was happening because party members were fed up with conflicts and that conflicts would not continue. The SDP group in the parliamenton Tuesday rejected a proposal by the new SDP leader Pedja Grbin for changes in parliamentary positions held by the SDP. Bauk said speculation about a rift in the party was very dangerous, adding that one such situationhappened during the term of the last parliament, when the party began the term with one number of MPsand ended it with a different number. He expressed hope this would not happen again. "I have informed the parliamentary secretariat that the SDP presidency has decided that Pedja Grbin will be the new party whip, while Mirela Ahmetovic, Sinisa Hajdas Doncic, Sabina Glasovac and I will be his deputies, and we expect the secretariat to putthose changes on the parliament's official web site," said Bauk. The other proposals for appointments will not be forwarded by the party presidency butby the party's parliamentary group, in line with the parliament's standing orders. Since the parliament's standing orders say that party groups in the parliament are formed by political parties, I'm not sure the parliament's secretariat should arbitrate in parties' internal matters, said Bauk. He assumes that the new party whip, as soon as the parliament secretariat carries out the proposedchanges, would very shortly put forward a proposal for new personnel changes for the SDP. When asked if Grbin would do so contrary to the will of a majority of SDP MPs, Bauk said that the will of SDP MPs would be determined at a plenary session. Grbin on Wednesday would not comment on the conflict in the party, but made a brief comment in a Facebook post on HDZ leader Andrej Plenkovic's statement that there was continuity of conflicts in the SDP. "We do have problems, but we are dealing with them rather than sweeping them under the carpet. It's better to have the continuity of problems that are being dealt with than the continuity of not dealing with corruption," said Grbin. HDZ whip surprised by SDP's motion HDZ whip Branko Bacic told reporters he was surprised by the SDP's motion. A party cannot send such proposals to the parliament, only a parliamentary group can or requests for certain appointments can be submitted if backed by a certain number of MPs, 40 for a deputy parliament speaker and 15 for a committee chair, he said. "We are not a party state. Parties cannot propose bills or any other decision related to the work of the parliament. Under the standing orders, only parliamentary groups can do so or one should seek the support of a certain number of MPs. I'm surprised that Grbin, who chaired the Committee on the Constitution and Standing Orders, is putting forward a proposal which is, I won't say funny but is absolutely inappropriate and cannot be implemented, either under the law or under the standing orders," said Bacic, noting that the HDZ did not intend to arbitrate in the dispute in the SDP. PM says situation in SDP repeat of 4 yrs ago ZAGREB, Oct7(Hina) - Prime Minister Andrej Plenkovic said on Wednesday the opposition SDP was seeing a repeat of the situation of four years agowhen its former president resigned and his successor's personnel proposals were not supported, but added that he wished the party all the best. The Social Democratic Party's new president Pedja Grbin last night accused his predecessor Davor Bernardic of contesting the presidency's and members'decisions after the party's parliamentary group did not back his personnel proposals. "This is continuity now. Four years ago, when the previous president was resigning, we had the same scenario. Now there's a new president and we have the same scenario again," Plenkovic told the press, commenting on the fact that Grbindoes not have theSDP caucus' support for his personnel changes, which is why the parliamentary majority will decide on them. Plenkovic said he wished the strongest opposition party all the best. Opposition: Gov't bill on rehabilitation of credit institutions should be supported ZAGREB, Oct7(Hina) - A part of the parliamentary Opposition said on Wednesday that the government-sponsored bill on the rehabilitation of credit institutions and investment companies made life easier for Croatian citizens and should therefore be supported. The bill makes life easier for Croatian citizens, it offers security for savings deposits and stability of the financial system, Anka Mrak Taritas of the Women's Group said, agreeing with the position of Social Democrat MP Boris Lalovac. Lalovac said that deposit insurance mechanisms benefited citizens, that by 2008 deposits had been insured up to HRK 100,000, and that the limit was raised to HRK 750,000 when Croatia joined the single European market, while the deadline for the payment of compensation in the event of bank collapse was reduced to seven days. For the sake of the 12 of us debating in the parliament chamber, it needs to be said that the compensation to be paid equals the insured amount, the rest cannot be saved, Deputy Parliament Speaker Miroslav Skoro of the Homeland Movement said. Domagoj Ivan Milosevic of the HDZ said it was important that after the 2008 crisis the cost of bank rehabilitation was no longer paid by the state and taxpayers. Katarina Peovic of the Workers' Front expressed reservations towards the bill, noting that it was one more step towards renouncing one's own currency and that the central bank and the ruling majority were implementing changes necessaryto enter the euro area without having them democratically legitimised. Finance Ministry State-Secretary Stjepan Curaj said that the proposed changes continued the reform of the EU's banking sector, strengthened banks' ability to withstand financial shocks, minimised costs for taxpayers in cases of problems with the banking system, and established a single financial fund to be filled with payments from credit institutions rather than citizens. The bill includes regulations on the division of powers related to the rehabilitation ofcredit institutions and investment companies. As Croatia is joining a single rehabilitation mechanism, the Croatian National Bank (HNB) would be the rehabilitation authority for credit institutions, the HANFA financial services supervisory agency would take over the powers of the rehabilitation authority for investment companies, and the DAB agency for savings insurance and bank rehabilitation would be in charge of the national rehabilitation fund, manage the deposit insurance fund and have powers to implement bankruptcy proceedings and liquidate banks. Public ombudswoman warns about grey zone in enforced debt ***collection*** ZAGREB, Oct 7(Hina) - Following announcements of areduction ofdebt sales todebt ***collection*** agencies ahead of the expiry of amoratorium on enforced ***collection***, Croatia's Public Ombudswoman Lora Vidovic on Wednesday called for better regulation of the work of those agencies. Last week, the Finance Ministry put forward draft amendments to the Profit Tax Act,whereby one of the proposed changes is directed at reducing the sale of debts to debt ***collection*** agencies. Vidovic underscoresthatalthough it iswelcomed, thismeasure cannot address the problems facing overindebted citizens exposed to unpleasantnessdue to a lack of regulations for the work of such agencies. The press release issued by her office recalls that in her previous annual reports Vidovicrecommendedthat the ministry should draw uplegislative proposals regulating the workand remit of those agencies. A lack of standards and rules for debt ***collection*** agencies makes debtors more vulnerable and undermines their human rights, she says. The system of enforced debt ***collection*** operates as a vicious circle in which debtors are paralysed by their debts whereas creditors do not manage to gettheir receivables paid, she says. The country's constitution defines Croatia as a welfare state, and therefore Croatia is "supposed to create conditions for a dignified life of all its citizens," Vidovic added. €800 m from Recovery and Resilience Facility to be disbursed in early 2021 - minister ZAGREB, Oct7(Hina) -The first €800 million from the European Recovery and Resilience Facility will arrive at the beginningof next year, Regional Development and EU Funds Minister Natasa Tramisak said on Wednesday. Themoney is intended for the economy, job retention, liquidity and incentives for the development of the manufacturing industry, she said on Croatian Radio. The money is primarily intended for the continuation of the incentives schemesthe government launched at the beginning of this year, but also forinvestment incentives for business people, she added. The minister said there was interest and sound businesseswilling to invest. She said that since mid-2013, when it joined the EU, Croatia receivedHRK 28.3 billion more from the EU budget than it paid into it. Speaking of the current programme and financial perspective, Tramisak said 103.5% of projects had been contracted andthat 33% of funds from the EU budget had been absorbed, with 40% having been disbursed to beneficiaries. "Those numbers reflect a significant step forward. We still have two and a half to three years for the realisation of the contracted projects. We are talking about more than HRK 50 billion," she said, adding that several big projects would be contracted by year's end. In terms of contracting, Croatia ranks fifth in the EU, Tramisak said. She went on to say that it was necessary to work more on the realisation of large-scale projects which would resolvesome of Croatia's big strategic problems. She said the national development strategy, necessary for absorbing €22 billion from the next EU budget, wouldbe put to public consultation soon. 50% lower prices in hotels, restaurants and national parks on 16-25 Oct ZAGREB, Oct7(Hina) - More than 250 businesses in the hospitality industry have offered their participation in aprogramme designed by the Tourism Ministry to offer lower pricesin a week in the off-season, and 60 more applications are also beingconsidered, Tourism Minister Nikolina Brnjac said on Wednesday. The campaign called "Tjedan Odmora Vrijedan" ("A week's worth of vacationing in Croatia" in an unofficial translation) is scheduled for 16-25 October when local and foreign visitors are offered accommodation, restaurant meals, and admission tickets to national parks at 50%lower pricesthroughout Croatia. The campaignhas been launched by the Tourism Ministry for the first timeto encourage Croatian and foreign touriststo visit Croatia's resorts, national parks and other tourist facilitiesduring the off-season. Minister Brnjac said that the campaign would be conducted more than once a year in the future. Hoteliers' revenues to drop25-75%, recovery expected in 2 or more yrs ZAGREB, Oct7(Hina) - Croatian hoteliers expect this year's revenues to drop 25-75% due to the COVID pandemic andhalfbelieve recovery will take two or more years, with holiday tourismexpected to recover faster and conventiontourismmuch slower, a director in the Horwath HTL consulting company says. Such findings come from the company's analysis ofthe so-called COVID year in whichthe pandemic has affected every industry around the world, notably tourism. Sinisa Topalovic says the forecasts for 2021 and the growth of the global GDP are somewhat encouraging, but that recovery by country will depend and be faster if they are industrially strong, while being harder and slower in those focused on services such as Croatia. Global and country forecasts sayconsumption is expected to recover in 12 to 24 months, which is a very long time, notably intourism,which has been globally affected by the pandemic, from air travel to the hotel industry, which are recording drops in revenues from 60% to 80%, and theywill not recover soon, says Topalovic. Croatia at EU's bottom in hotel occupancy but nearthe top in prices In such circumstances, Croatia managed to generate above-average results when compared with the competition in the first eight months of the year, about 40% of last year's turnover, but next year could be at least 10 to 20 percentage points better, also thanks to this year's experience, according to a Horwath HTL analysis. Croatia's average hotel occupancy rate in the first eight months of this year was 24%, ranking it at the bottom of the EU, but in terms of prices it ranks relatively high becauseduring the short summer holiday season Croatian hoteliers managed to keep relatively good prices, which is good given that after beinglowered due to the 2008-09 crisis, they took a long time to recover, says Topalovic. Three markets saved the season The analysis shows that only three markets, of the more than 70 from which tourists came to Croatia in the past, saved this year's season, generatingup to 60% of the total turnover - Germany, Croatia and Slovenia. Croatian tourists "gave life to numerous destinations" and their arrivals and overnights registered the smallest decreases from the record year 2019, the analysis says. Coronacrisis has changed consumer habits, increased online shopping ZAGREB, Oct 7 (Hina) - The crisis caused by the Covid-19 pandemic has changed consumer habits and increased online shopping, it was said at the 32nd edition of the MAGROS 2020 conference for producers and retailers, organised by the Croatian Chamber of Commerce(HGK) and the Suvremena Trgovina(Modern Shopping) magazine. Economy Ministry State-Secretary NatasaMikus Zigman underlined that retail is important for economic development, supporting her claim with ***data*** on the share of distributive retail trade inGDP of 10%, and that 18% of all business entities are incorporated in that sector that employs 204,000 people or 15% of the total number of workers. During the pandemic, online shopping increased which shows, she said, that digital transformation is coming at an acceleratedrate. However, MikusZigmanunderlined that traditionalshopping should not be neglected as it is a key element for economic growth, particularly for local communities and for consumers who do not use digital technologyand people who prefer the traditional way of shopping. The HGK vice president for retail and finances, Josip Zaher, said that "we are living in very challenging and uncertain times in the midst of the coronavirus pandemic but restrictions can also be a challenge and an opportunity." "At the beginning of the year already we expected retail to grow in the overall economy, with tailwinds being provided by the record 2019 year,which after 11 years reached the level of retail of 2008. However, restrictions due to the pandemic have resulted in tectonic disruptions on the global level and that downturn was felt in consumption and a change in habits by consumers hence in March a fall in retail was recorded after the sector continually grewfor five and a half years," said Zaher. According to the State Bureau of ***Statistics*** (DZS), in the first eight months of the yearretail contracted by 6.9%, compared to the same period last year, said Zaher, noting that recovery is not expected to occur next year and online shopping and adapting to new business conditions will continue. He underlined that the ten strongest retailers account for 80% of the market which is very competitive, as can be seen with the arrival of Eurospin in the midst of the pandemic. "Despite that, we do not expect any significant rearrangements on the market," said Zaher. Online shopping increases by 14% Head of HGK's retail section Tomislava Ravlicpointed out the permanentgrowth in online shopping which, according to the DZS, increased by 13.9% in the first six months of the year. "That trend was certainly boosted by the pandemicwhich restricted physical shopping," she underlined. She too said that consumer habits are changing withmore peopleturning to online shopping because of the coronavirus. Household appliances, IT equipment, clothing and footwear are the most common products bought online with an increase in online food sales too, said Ravlic. Q2 house price rise in Croatia above EU average ZAGREB, Oct 7 (Hina) - Croatia is one of the European Union member-states with the highest property price risein the second quarter of 2020 compared to the corresponding quarter in 2019, according to a report provided by ***Eurostat*** on Wednesday. "In the second quarter of 2020, marked by COVID-19 containment measures in most Member States, house prices, as measured by the House Price Index, rose by 5.0% in the euro area and by 5.2% in the EU compared with the same quarter of the previous year," ***Eurostat*** says. "Compared with the first quarter of 2020, house prices rose by 1.7% in the euro area and 1.5% in the EU in the second quarter of 2020." In Croatia, house prices rose 9.1% in 2020 Q2 on the year, and they went up 1.8% quarter on quarter. "Among the Member States for which ***data*** are available, the highest annual increases in house prices in the second quarter of 2020 were recorded in Luxembourg (+13.3%), Poland (+10.9%) and Slovakia (+9.7%)," says ***Eurostat***, adding that prices fell in Hungary (-5.6%)and Cyprus (-2.9%) in Q2 on the year. Compared with the previous quarter, the highest increases were recorded in Luxembourg (+4.4%), Italy (+3.1%) and Austria (+2.5%), while decreases were observed in Hungary (-7.4%), Estonia (-5.8%), Latvia (-2.3%), Bulgaria (-1.1%) and Ireland (-0.1%). SSSH and NHS: Government taking advantage of crisis to change labour legislation ZAGREB, Oct 7 (Hina) - Two Croatian trade union federations warned on Wednesday that the government had decided to amend the Labour Act in this year of crisis in the interests of big business and labour market flexibility. The warningwas issued on the International Day for Decent Work, observed on October 7. When speaking about labour legislation, Croatian government officials rarely mention workers, and the truth is that Croatian workers are the biggest victims of poor labour legislation and its even worse application in practice,the Union of Autonomous Trade Unions of Croatia (SSSH) said. It said that one of the biggest problems with labour legislation was the organisation of working hours, which allows two in five workers to work overtime once or several times a week. According to last year's survey carried out by the Hendal market research agency, 60 percent of workers work overtime without the necessary written order from the employer, and in as many as 40 percent of cases no records are kept of overtime work and workers are not paid for it. The Independent Croatian Trade Unions (NHS) said that this year, when the coronavirus pandemic has claimed more than a million lives worldwide and left 35 million people infected and 400 million jobless, the government has decided to launch amendments to the Labour Act with the overwhelming support of employer organisations and individuals who have been pushing for years for labour market liberalisation and flexibility. "While countries across Europe and the world are doing all in their power to help their economies, citizens and workers overcome the crisis with as few consequences as possible, the Croatian government has decided to take advantage of it to change the Labour Act," the NHS said. Pensioners' status in Croatia shameful, says association ZAGREB, Oct 7 (Hina) -The Croatian Pensioners' Association (MUH) on Wednesday held its regular assembly at which MUH president Visnja Fortuna warned of the "shameful status of pensioners" who livein poverty, with an average pension allowance accounting for 38% of the average pay. "The average pension allowance is HRK 2,558 and is below the poverty line of HRK 2,710. We have to work a lot, with the government,the relevant ministries and the prime minister, to improve that because this is truly shameful," Fortuna said at the assembly of the largest association of pensioners, which has279,000 members. The lowest pension allowance amounts to HRK 1,050, while pensions of former members of parliament and those granted under special regulations are several times higher, Fortuna said. Shenoted that it is difficult to determine the amount of the pension allowance that would satisfy the needs of pensioners, who in addition to everyday costs have to pay for medicines and medical treatment. The National Council for Pensioners is expected to convene again in a month's time and call for a more favourable method of adjusting pension allowances to price and wage growth, and it has alsoinitiatedchanges to the family pension, which is often received by women whose late husbands' pension allowances were much higher. According to the currentmodel, the beneficiary of a family pension has to revoke their own pension allowance toreceive70% of their late spouse's pension allowance. The new model, which is being proposed by pensioners' associations, would increasethatrate to 80% and it also proposes the possibility of retaining one's own pension allowance and receiving a certain percentage of thelate spouse's pension allowance. MUH has also launched an initiative to increase the income threshold for free supplementary health insurance to HRK2,000 because when the last pension adjustment was conducted, as many as 10,000 pensioners were no longer eligible for free supplementary health insurance. HND appeals to president to stop calling out reporters ZAGREB, Oct 7 (Hina) - The Croatian Journalists Association (HND) on Wednesday appealed to President Zoran Milanovic "to stop calling out media and reporters, which he has been doing intensively lately via Facebook posts." Criticising public statements by MP Rada Boric, given in an interview with Jutarnji List daily, and political analyst Zarko Puhovski, who spoke for the RTL broadcaster, President Milanovic also criticised the two media outlets and in his latest post attacked Index news website reporter Neven Barkovic, the HND recalled. The umbrella journalists' association said that it would not engage in the polemic between the President of the Republic and other political stakeholders as he had the right to comment and enter into debates with all actors on the political and public scene, but it defended the democratic principle under which journalists and editors have the right to choose topics and interlocutors on their own. "The head of state, just as other representatives of the government, should not determine the editorial policy of journalists and media outlets," the HND said, noting that the president should encourage dialogue and public debates based on arguments. "With his posts the President is doing exactly what he has accused others of doing, shifting the focus from important issues in one of the biggest corruption affairs in the country to his comments," the HND said. Croatian Parliament Day to be observed on Thursday ZAGREB, Oct 7 (Hina) - Croatian Parliament Day is observed on Thursday in memory of 8 October 1991 when the first Croatian Parliament unanimously decided to sever all constitutional ties between Croatia and the Socialist Federal Republic of Yugoslavia. The decision was adopted after the expiry on 7 October of a three-month moratorium on its constitutional decision on independence and sovereignty of 25 June 1991 and after the Yugoslav Air Force bombed the government headquarters which at the time housed the offices of the state leadership headed by President Franjo Tudjman. For security reasons, Parliament held its historic session on 8 October 1991 in the head office of the INA oil company. Croatian Parliament Day will be marked with the playing of the national anthem "Our Beautiful Homeland", a minute of silence and an address by the chairman, DeputySpeaker of the Sabor Ante Sanader. Last year 8 October was observed as Independence Day, which was a national holiday and a non-working day. Under the new calendar of national holidays, 8 October will be marked as Croatian Parliament Day and it will be a remembrance day and a working day. PM places laurel wreath on anniversary of shelling of gov't building ZAGREB, Oct7(Hina) - Prime Minister Andrej Plenkovic on Wednesday placed a laurel wreath on a memorial plaque on the government building to markthe 29th anniversary of its shelling, saying it was a watershed moment as that night parliament voted for independence and severed all ties with Yugoslavia. Speaking to the press, he said that on 7 October 1991 Yugoslav People's Army (JNA) planes tried to kill President Franjo Tudjman,the then Croatian leadership and representatives of Croatia in the then still federal institutions. That was a watershed moment because that night the Croatian parliament voted for independence and severed all constitutional ties with the former state formally as well, after the decision of 25 June 1991, he added. "That's why it's important that we remember both this day and the victim killed then as well as the Croatian parliament's memorial day tomorrow, because that was one of the most crucial decisions which was adopted in special circumstances in (oil company) INA'sbasement 29 years ago." In the afternoon of 7 October 1991, JNA planes shelled and severely damaged the government building, which at that time was also the official residence of Croatia's first president, Franjo Tudjman, who was inside. One person was killed in the attack and four were injured. October 1991 marked the end of a three-month European Community moratorium on the Croatian parliament's decision on independenceand sovereignty from the previous June. The European Community was confident the Yugoslav crisis and the Serbian military aggression could be resolved peacefully, so it had asked Croatia todelay thedecision. On October 8, the first Croatian parliament adopted the historic decision on Croatia's independence. The decision was not adopted in the parliament building but at a session in INA's building. Police arrestingOvcara war crimes suspects ZAGREB, Oct 7 (Hina) - Police in Vukovar-Srijem County are arresting people suspectedof war crimes committed against Croats at the Ovcara farm in 1991, the Interior Ministrystated on Wednesday. The ministry's spokeswoman, Marina Mandic, confirmed toHina that the police wereconducting final operations within a criminal investigation into war crimes committed during the Homeland War which implicates several suspects. "Police officers in the war crimes investigations task force, in cooperation with the police administration in Osijek-Baranja and Vukovar-Srijem counties, and the county prosecutor's office in Osijek are conducting final operations within a criminal investigation into war crimes committed in November 1991 at Ovcara," said Mandic. The ministryhas statedthat more information will be available when the operationhas been completed. Localmedia outlets in Vukovar reported on Wednesday that several residents of Negoslavci had been arrested after the police raided their homes in the early morning hours. Negoslavci Mayor Dusan Jeckov told the local Radio Borovo that the Osijek police had apprehendedeight residents ofNegoslavciand that these were mainly people who had beenemployed atthe Vupik factory during the war. Vukovar Mayor Ivan Penava welcomed the police operation but noted that its timing was slightly suspicious. "The timing of the operation is suspicious, (it is happening) amidst corruption scandals, and we have learned that whenever there is a fire,a bone is thrown to Vukovar residents. Vukovar is a sensitive issue for the whole country, and forgetting about certain things is the easiest thing. Unfortunately, we have been witnessing such conduct and policy for 29 years," Penava told the RTL broadcaster. Museum: Red Star removed without media due to workers' wish for anonymity ZAGREB, Oct 7 (Hina) - The Museum of Modern and Contemporary Arts in Rijeka (MMSU) said on Wednesday that an installation artwork with a red star, erected on the top of a high-rise building in Rijeka on 20 September, was removed on 4 October, and that workers hired forthe erection andremoval of the installation requested anonymity. The museum emphasisedthat the artwork installation by author Nemanja Cvijanovic had been put on display only temporarily and that the removal was conducted without the presence of the media, as requested by workers hired to erect and put down the installation. This statement ensued as the museum's response to an article in the Rijeka-based newspaper "Novi List" whichclaimed that the red star installation had been removed in secrecy. The museum recalls that the artwork had been installed without the presence of the media and that upon the completion of the installation, a lengthy press release had been sent to media outlets about the event as well as about the symbols which the installation wanted to show and about the author of the installation. The press release also included official photographs of the event, the museum said. The museumalso notes that a Novi List photo-journalist had appeared at the top of the building when the installation was being removed, and he was explicitly requested to erase the photos he had taken and not publish them. However, the daily ignored the request andit also published "fake news" that the installation had been erected and removed in secrecy, the museum says. The institution also accuses the newspaper of violatingthe rights to privacy of persons who explicitly insisted on their privacy and whose role in theinstallation is of no interest to the general public. Novi List explains that its photo-journalist had heard from a citizen in Rijeka that the red star installation was being removed and he then went there to cover the event. After he took photos of Cvijanovic and workers, they demanded that he erase thephotos, but he declined their request.They have been published by the daily, with the faces of the workers blurred. President Milanovic meets with delegation of "Kali Sara" Roma association ZAGREB, Oct 7 (Hina) - President Zoran Milanovic on Wednesday met for talks with a delegation of the "Kali Sara" association of Croatian Roma, who spoke about the association's activities and informed the president of the problems still encountered by Roma, with employment discrimination being among the bigger ones. "The delegation said that one of the bigger problems is discrimination in the hiring process as well as the frequent lack of support by local authorities for projects of elected representatives of the Roma minority," reads a statement issued by the Office of the President. The Roma delegation said that the situation was nevertheless not the same in all counties, noting that a good example of coexistence and exercise of minority rights were Istria and Primorje-Gorski Kotar counties. Another topic of the meeting was education, with Roma representatives saying that it would be important to find a model that would enable more Roma to enrol at universities than was now the case. Kali Sara is one of the most active Roma associations in Croatia and it brings together the most members of the Roma community and cooperates with Roma ethnic minority councils at the level of counties, towns and municipalities. Croatia welcomes progress by EU membership candidates, supports further reforms ZAGREB, Oct 7 (Hina) - Croatia calls on EU membership candidates to implement reforms and is offering its support in that regard, the Ministry of Foreign and European Affairs (MVEP) said on Wednesday after the European Commission released itsprogress reports on candidate countries. The European Commission (EC) on Tuesday released its 2020 Enlargement Package which includes key findings on Southeast European countries aspiring for EU membership as well as releasing its Economic-Investment Plan for the Western Balkans aimed at spurring long-term recovery of the region. The country reports assess the progress over the past year on political criteria, public administration and judicial reform, the fight against corruption and organised crime, fundamental human rights and freedom of expression, economic criteria and ability to take on obligations arising from EU membership. MVEP on Wednesday welcomed "the progress achieved since the last report," and called and encouraged "all candidates and potential candidates to continue with reforms." "Croatia will continue to provide its assistance and support," the ministry's press release said and added that MVEP continues to strongly support the continuation of EU enlargement to countries in Southeast Europe. MVEP added that during its presidency of the Council of the EU, one of Croatia's priorities was a "credible enlargement policy, based on merit and fair conditionality," because it considers that "that effectively stimulates reform processes and is a guarantee of improvement and stability" in this part of Europe. It underscored that despite the challenges facing the EU, Croatia has managed to keep theenlargement issue in the EU's focus, and the crown of all that was the Zagreb Summit which sent "strong political support" to the Western Balkan countries, paved the way to accession negotiations with Albania and North Macedonia and opened the last chapter in negotiations with Montenegro. These are "great achievements of Croatia's presidency," the press release said. MVEP notes that "regional cooperation and development, and maintaining good neighbourly relations, remain key in the enlargement process, which is why it is important that the reports underlined the need for advancement in "sensitive issues" such as prosecuting war crimes and shedding light on the fate of missing persons as well as "creating a constructive atmosphere to overcome the legacy of the past and reconciliation." The ministry said that "bilateral issues have to be resolved prior to membership." In particular, the ministry underscored the necessity to resolve political issues with Bosnia and Herzegovina so that the county can "release its potential for reforms on its European integration pathway," underlining that it is essential to approach and fulfil the June political agreement between the leaders of political parties "in good faith" in order to remove the problems in the election process. Accession negotiations are continuing with two countries - Montenegro, which has made the greatest progress in the negotiations process, and Serbia. The first conferences on accession are expected to be held at the end of the year when Albania and North Macedonia will formally open the negotiation process. MVEP welcomes the progress achieved by Albania and North Macedonia as well as the first Inter-governmental conference with the two countries before the end of Germany's presidency of the EU. It also welcomes the Economic-Investment Plan for the Western Balkans which was announced at the Zagreb Summit. "This package should stimulate economic growth in the region and accelerate its economic convergence with the EU," the ministry said in the press release. Slovenia exceeds 300 new daily COVID cases for first time ZAGREB, Oct 7(Hina) - In the last 24 hours, there have been 356 new cases of infection with the novel coronavirus in Slovenia, the government stated on Wednesday. This is almost twice as high as on Tuesday when there were 189 new cases. In the last 24 hours, 3,998 tests for coronavirus have been performed. On Tuesday, Prime Minister Janez Jansa said that thesituation was "no longer funny". Since the outbreak of the infection in this country with about two million inhabitants, 7,100 people have tested positive and of them 160 have died. Currently,122 COVID-19 patients are receiving hospital treatment. In other news: Lika and Mali Losinj among top 100 world sustainable green destinations ZAGREB, Oct 7 (Hina) - The Lika region and Mali Losinj island have been included among the top 100 sustainable green destinations for 2020, chosenfor the sixth year in a row by the Global Green Destinations foundation. The list was presented earlier this week at the online conference Global Green Destination Days, the Lika Destination Cluster said, adding that they were happy that Lika was included on the list. They said that since the Cluster was established they have been working on developing a Smart Sustainable Destination. "The Cluster's core activity is the promotion of Lika as a tourist destination on the domestic and foreign markets based on its natural, cultural, historical, gastronomical and health features. Quality cooperation with eight protected nature areas, including three of eight national parks in Croatia, and creating a joint entry ticket for the Lika destination, conducting programmes to have guests spend more time in Lika, networking and connecting local producers under a joint brand - Lika Quality - and other sustainable tourist projects are just part of what we are working on to create conditions for the development of sustainable year-round tourism inLika," the Cluster's representatives said. They added that being included on the list was proof that destination development is going in the right direction in line with the latest global trends, which is also being recognised more on the tourism market. Among this year's finalists, Slovenia has been awarded in the Best of Europe category. Dinarides Protection Day marked under slogan "Dinarides Connect" ZAGREB, Oct7 (Hina) - Dinarides Protection Day, October 7, is being marked this year under the slogan "#DinaridesConnect" to draw attention to the impact of the coronavirus pandemic on protected areas as well as the need to deepen cooperation as a response to the new crisis. Parks Dinarides callon all stakeholders involved in the protection of nature and management of protected areas in the Dinaric Arc area to develop a system of protection for the Dinarides through joint planningand action in order to alleviate the consequences of the coronavirus pandemic as much as possible. Theyunderlinethe need to promoteregional cooperation in adjusting the operational management of protected areas. Dinarides Day was introduced on 29 May 2019 at a general assembly of Parks Dinarides, a network of protected areas in the Dinarides, in the Blidinje nature park in Bosnia and Herzegovina. The Dinaric Arc is one of Europe's biggest massifs connecting eight Southeast European countries - Albania, Bosnia and Herzegovina, Montenegro, Croatia, Kosovo, Macedonia, Slovenia and Serbia. Observance of that day points to the importance of the countries' natural and cultural heritage as well as the interconnectedness of the region's natural, cultural and historical wealth. This year the day will be observed online due to the coronavirus. Adapted air rifles for blind and visually impaired presented in Zagreb ZAGREB, Oct 7(Hina) - Air rifles, intended for use by vision impaired persons, were presented on Wednesday at the shooting range of theCroatian shooting sport federation for the disabled, which is located in the Kustosija suburb of Zagreb. The airrifles with safe handling adapted to persons with vision impairments enableblind and visually impaired persons to be better integrated as well as to participate in sporting activities. The riflesare equipped with the VIASS Proaiming system which works with sound. The higher the tone one can hear, the nearer they are aiming into the centre of the target. The VIASS Pro aiming system was launched in 2017 in Austria. About 50 blind and visually impaired persons have already expressed their wish to be included insports shooting with air rifles with the VIASS Pro system, the federation said today. Industrial producer prices in Sept drop 4.6% y-o-y ZAGREB, Oct7(Hina) -In September 2020, producer prices of industrial products decreased by 0.4% compared to August 2020 and by 4.6% compared to September 2019, according to the Croatian Bureau of ***Statistics***. A comparison of producer prices of industrial products, excluding energy, shows that in September 2020, as compared to August 2020, they remained stable. As compared to September 2019, they decreased by 0.5%. In September 2020, producer prices of industrial products on the domestic market remained stable compared to August 2020, while they decreased by 3.2% compared to September 2019. In September 2020, producer prices of industrial products on the non-domestic market decreased by 0.8% compared to August 2020 and by 6.4% compared to September 2019. In September 2020, as compared to August 2020, producer prices of industrial products increased in intermediate goods by 0.1% and in capital goods by 0.1%, while they decreased in energy by 1.8%, in durable consumer goods by 0.2% and in non-durable consumer goods by 0.2%. In September 2020, as compared to August 2020, producer prices increased in mining and quarrying by 14.2%, they decreased in manufacturing by 0.8%, while remaining stable in electricity, gas, steam and air conditioning supply and in water supply; sewerage, waste management and remediation activities. In September 2020, as compared to September 2019, producer prices increased in mining and quarrying by 6.7% and in water supply; sewerage, waste management and remediation activities by 0.6%. Theydecreased in manufacturing by 5.5%, while they remained stable in electricity, gas, steam and air conditioning supply. ZSE indices down amid modest trading ZAGREB, Oct 7 (Hina) - The Zagreb Stock Exchange (ZSE) indices weakened slightly on Wednesday amid very modest trading. The Crobex dropped by 0.41% to 1,611 points after going up for three days, while the Crobex10 went down by 0.34% to 1,004 points after going up for four days. Regular trading was a mere HRK 2.34 million, three million less than on Tuesday. The most traded stock was the HT telecommunications company, with a turnover of HRK 645,000. Its price stagnated at HRK 177 per share. (€1 = HRK 7.561209) THIS BULLETIN INCLUDES NEWS ITEMS RELEASED BY 2100 HRS WEDNESDAY. (Hina) rml ms Masthead Brief News Bulletin is published by the Croatian News Agency HINA Marulićev trg 1610 000 ZagrebCroatia web:[*www.hina.hr*](http://www.hina.hr) mail: [*hina@hina.hr*](mailto:hina@hina.hr) phone: (+385 1) 48 08 660; fax (+385 1) 48 08 822 Publisher: Branka Gabriela Valentić, DirectorEditor in Chief: Serđo Obratov Bulletin Editor: Marija Šestan

**Load-Date:** October 7, 2020

**End of Document**



[***Chinese whispers: COVID-19, global supply chains in essential goods, and public policy***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:67FK-J9R1-JCWX-C3FR-00000-00&context=1516831)

Journal of International Business Policy

November 2020

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**Section:** Pg. 408-429; Vol. 3; No. 4; ISSN: 2522-0691,2522-0705

**Length:** 11605 words

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INTRODUCTION

On January 30, 2020, the Director-General of the World Health Organization declared that the novel Coronavirus outbreak was a “public health emergency of international concern,”, which was the organization’s highest level of alert and longhand for a global pandemic. What began as a public health crisis soon had significant economic and commercial consequences, some of which were induced by the very public health and macroeconomic policy responses taken to confront the pandemic.

The shortages of personal protective equipment (PPE) that came to light in the first 6 months of 2020 have led many policymakers to conclude – if their public statements are anything to go by – that existing cross-border supply chains are no longer fit for purpose in essential goods sectors. Assertions have been made that an unhealthy overdependence on China has arisen, in short that globalization has gone too far.1

Governments of major economies have contemplated repatriating supply chains through a variety of incentives or by restricting access to public sector contracts to local producers. Independently of government, corporate executives and their advisers have begun to reconsider the configuration of their international supply chains, couching these initiatives in terms of “building resilience,” “diversification,” etc. (McKinsey Global Institute, ; Mirodout, ).

What is the intellectual significance of these developments for scholars of international business, economics, and political economy? To appreciate what is at stake, perhaps it is best to start by referring to another field of intellectual endeavor. In his magisterial history of pandemics and their societal consequences, the Yale historian Frank Snowden advanced the hypothesis that:

epidemics are not an esoteric subfield for the interested specialist but instead are a major part of the ‘big picture’ of historical change and development. Infectious diseases, in other words, are as important to understanding societal development as economic crises, wars, revolutions, and demographic change (Snowden, ).

The fit, then, is evident for an academic journal committed to examining the contribution of international business to “grand challenges” (Buckley, Doh, & Benischke, ; Lundan, ; Van Assche, ). Putting the matter more narrowly, to what extent were cross-border supply chains part of the problem, part of the solution to the COVID-19 pandemic, or both? Given that the pandemic is not over, the goal in this paper is to shed light on factors known now that are relevant to answering this question.

In this paper, particular attention is given to the conclusions drawn by leading policymakers concerning the efficacy of cross-border supply chains in the first 6 months of the pandemic. If policies are adopted in line with these conclusions, then they could have profound implications for the incentives and constraints faced by international business as they organize their cross-border operations (Altman, ; Kobrin, ). This would not be the first time that policy shifted sharply to harness multinational business, as the research of Stephen Kobrin, Raymond Vernon, and others have shown (Aguilera, Henisz, Oxley, & Shaver, ; Boddewyn, ; Graham, ; Ghemawat, , ; Kobrin, , ; Vernon , , ).2

Although the focus of this paper is on the inter-relationship between public policy intervention and cross-border supply chain performance in the early phase of the pandemic, three important points of context are worth bearing in mind. First, current and potential future reconfiguration of cross-border supply chains is taking place in the context of enhanced rivalry between leading economic powers, of which the Sino–U.S. trade and technology war is one salient manifestation (Blustein, ; Davis & Wei, ; Evenett & Fritz, ; Petricevic & Teece, ). It is not for nothing that political scientists are rethinking their understanding of Economic Statecraft (Baldwin, ; Aggarwal & Reddie, ).

Second, cross-border commercial operations are likely being recast in light of the build-up since the Global Financial Crisis of policies seeking to influence cross-border flows of goods and services, investments, ideas, and workers (Evenett, ). By and large, policies introduced to favor local firms have been far more prevalent than policies leveling the commercial playing field for foreign rivals. It may have taken the U.S.–China trade war to lay to rest claims that the World Trade Organization’s rulebook acted as a serious constraint on government policy choice, but companies with substantial in-house capacity to monitor trends globally had already picked up of these shifts (as the example of General Electric shows, see Bhatia, Evenett, & Hufbauer, ). These trends were well underway before many governments turned towards populism and economic nationalism (Rodrik, ).

Third, even before the U.S.–Sino trade war, and certainly before the COVID-19 pandemic, there was growing evidence “hidden in plain sight” that businesses themselves were reconfiguring supply chains (McKinsey Global Institute, ). The factors responsible include rising wages in China, speed-to-market growing in importance as a competitive strength of firms, shifts in public policy that encourage sourcing locally or in regional trade partners, adoption of digital technologies and more generally “intangibles” playing a greater role, and a greater appreciation of the risks faced from operating supply chains over long distances or in less well known cultures and business climates. Advocacy of “near-shoring,” “localization,” and “produce where you sell” strategies preceded the COVID-19 pandemic.

The remainder of this paper is organized as follows. The next section outlines the trade policy changes in two so-called essential goods sectors, namely, food and medical supplies and medicines, and the attendant disruption to cross-border supply chains. The focus on these sectors is warranted given their salience in the media and their apparent influence on policymakers’ perceptions of the performance to date of cross-border supply chains during the pandemic. Indeed, according to the Global Trade Alert database, 38% of commercial policy interventions this year implicate these two sectors.

The third section begins by documenting the dissatisfaction with the operation of cross-border supply chains by senior policymakers in leading economies including the insinuation that the dependence on China for essential goods is too high and needs to be reduced. These claims are then critically evaluated using a range of evidence. The implications of this evaluation for the way in which governments determine the policies likely to confront international business in the years ahead is discussed in the concluding section.

As this outline implies, the approach taken in this paper places a premium on ***collecting*** and assessing relevant up-to-date evidence that can inform thinking. Bringing to the attention of the scholarly community relevant, perhaps overlooked evidence, some of which was specifically ***collected*** by the author and his collaborators, is one of the intended contributions of this paper.3 Those seeking fancy econometrics or parsing of theories may be disappointed. The Nobel Prize winner and founder of modern economic analysis, Paul A. Samuelson, made the following point: “…the first duty of an economist is to describe correctly what is out there: a valid description without a deeper explanation is worth a thousand times more than a clever explanation of nonexistent facts” (Samuelson, ). That statement is the lodestar of this paper.

THE INITIAL TRADE POLICY RESPONSE TO THE PANDEMIC IN FOOD, MEDICAL SUPPLIES, AND MEDICINES, JANUARY–SEPTEMBER 2020

As COVID-19 spread, more governments began taking public health measures and restricting international travel including in some cases sealing borders. The former initiatives led to a surge in demand for many medical suppliers and medicines, raising fears about shortages. The disruption of cross-border shipments of goods also led to fears of food insecurity. Net importers of food and medical supplies worried that goods necessary to support basic living standards and health would not be delivered, even when contracted and paid for. For net exporters, concerns were raised that too many so-called essential goods were being exported and not enough held back for their own residents.

Given the large number of regional trade agreements (RTAs), and the global trade rulebook at the World Trade Organization (WTO), one might be tempted to conclude that the institutions and incentives were in place to deter disrupting trade in essential goods. In fact, the WTO rulebook has more extensive rules constraining the use of import restrictions than of export curbs, and the existing web of RTAs hardly fills in the gap. This rarely invoked lacunae in global economic governance was exposed once the pandemic began to spread beyond China, to the detriment of those firms engaged in international supply chains in the affected products.

An aggravating factor was the lack (initially at least) of any official monitoring of resort to export curbs. Without such information, policymakers and business decision-makers would have operated in factual vacuum, a situation ripe for fear dominating reason. Evidence on trade policy choices was assembled initially by the Global Trade Alert team based at the University of St. Gallen, and then in a joint initiative with the World Bank and European University Institute.4 That initiative sought to document all of the changes in export controls, import tariffs, import quotas, taxes on imported goods, and other relevant non-tariff barriers affecting global trade in food, medical goods, and medicines that were announced and implemented since January 1, 2020.5

By September 4, 2020, a total of 660 trade policy interventions in these essential goods sectors had been documented. A total of 459 such interventions implicate the medical goods and medicines sectors, while 238 implicate the food sector.6 Just under half of the interventions (328) restricted trade and 332 liberalized trade, implying that the media attention on export curbs told only part of the story. This initiative documented twice as many trade policy interventions as that of the International Trade Centre,7 one of the three international organizations that eventually began monitoring developments in this area.8 In what follows, developments in the medical goods and medicines sector are described first, then those in the food sector.

Medical Goods and Medicines

The map in Fig.  shows the first month in which a trading nation introduced an export control on medical goods or medicines. Those export controls took many forms, including outright export bans, export authorization schemes, export quotas, non-automatic export license schemes, state requisition policies that de facto prevent or restrict exports, state exhortation to local producers not to ship to customers abroad, and requirements that local producers reserve a minimum percentage or amount of their production for the local market.9 All of these forms of export control were witnessed in the medicines and medical goods sector this year. A total of 91 jurisdictions executed 202 different types of export controls (for which implementation dates exist). March and April 2020 witnessed a frenzy of export controls being introduced. Notwithstanding the significant differences in complexity of the cross-border supply chains across medical goods and medicines, the impact of these export controls was to disrupt operations (see Forini, Hoekman, & Yildirim, for case study evidence).

As the pandemic spread west, so did export controls on medical supplies and medicines.

While many national governments did resort to export curbs, there are notable exceptions. No export curbs on medical goods or medicines were introduced by Canada, Japan, Mexico, and New Zealand (or at least, none were detected). Australia introduced an export control that prevented buying personal protective equipment on the open market and shipping it abroad, however, no restriction was placed on the exports of these goods by Australian manufacturers. That the governments of these nations resisted the stampede towards export controls during one of the most serious global crises in recent times is telling, and may well influence corporate assessments of the political risk of such measures being introduced in the future, with potential implications for foreign direct investment and cross-border sourcing decisions.

Exclusive focus on export controls, however, would miss the significant number of import-liberalizing measures undertaken in the medical goods and medicines sector since the beginning of 2020 (see Fig. ). Before the pandemic hit, according to the WTO’s Tariff Download facility, 89 nations were charging tariffs on imported medical devices, 63 were doing so on imported medicines, 100 were taxing imported disinfectant, and 141 nations were taxing imports of soap (Evenett, ). One hundred and five jurisdictions took a total of 228 steps to ease imports of these products. Arguably, the contribution of cross-border supply chains in medical goods and medicines to fighting the pandemic was enhanced by the numerous trade reforms undertaken this year. Here, public policy complements commercial imperatives – unlike the case of export controls.

Over 100 nations cut import barriers on medical supplies and medicines since the pandemic began.

The question arises as to whether these developments will likely result in a clear break with pre-pandemic trade policies in the medicines and medical goods sector. If the export curbs and import liberalization measures were temporary, then there may be doubts on this score, implying the pandemic might have little lasting impact on trade flows. Not only was information ***collected*** on when a measure came into force but also when it was scheduled to lapse. In Fig. , for each month this year and for 2021 (all months taken together), the total number of export controls and import reforms in effect is plotted. Two important findings emerge. First, approximately 100 export controls have no phase-out date – this is also the case for a comparable number of import reforms, suggesting that supply chains in this sector may need to be altered in light of a non-transitory change in the trade policy landscape facing firms.

Around 100 of the import reforms and export controls on medical goods and medicines have no announced phase-out date.

Source: Compiled from the Global Trade Alert-World Bank- European University Institute monitoring initiative. ***Data*** extracted September 4, 2020

Second, although the total number of import reforms introduced since the beginning of this year (228) exceeds the total number of new export controls (202), only during the months April 2020 to August 2020 did the total number of import reforms in effect clearly exceed the comparable totals for export controls. Of course, counts of measures introduced need not reflect the scale of commerce affected, still the evidence does not point to an unperturbed trading environment for cross-border supply chains in medical goods and medicines.

No discussion of developments in the medical goods and medicines sector would be complete without reference to surges in demand for these products that followed the global spread of COVID-19. In March 2020, the WHO stated “To meet rising global demand, WHO estimates that industry must increase manufacturing by 40 per cent” (WHO, ). In May 2020, the OECD went further, reporting back-of-the-envelope estimates that equipping Chinese medical, manufacturing, and transport workers with masks would require 240 million per day (OECD, ). The OECD branded this estimate “conservative” and noted that it exceeded the 20 million masks produced per day in China in January 2020. Overall, the OECD () concluded “No country can meet the increased demand for face masks alone,” a conclusion that implies that cross-border supply would serve a useful societal purpose.

However, policies by major exporters of personal protective equipment (PPE) and other medical goods that de jure or de facto limit exports reduce supplies to the world market. As Bown () points out, “As the coronavirus took hold in China in January and February 2020, there was a considerable increase in Chinese demand for PPE. The result was both more Chinese imports and fewer Chinese exports. This reduced China’s net exports of PPE, diminishing supplies available to the rest of the world.”10 A compounding factor was bottlenecks in domestic and international distribution arising during the pandemic.

Production of essential medical kits did ramp up in Q1 and Q2 of 2020. The Chinese State Council reported that in April production of N-95 masks and non-N95 masks had increased 38 and 34 times, respectively, over February production levels. Daily production of the latter masks reached the 200 million mark mentioned above in OECD (). Daily production of PPE was reported to have risen by April 2020 to 90 times the level seen in January 2020.11

Food and Agri-food

Fears that the COVID-19 pandemic would lead to near-term food shortages – which in turn would trigger export restrictions on food – did not come to pass (see Fig. ). This contrasted with the sharp rise in the number of such export curbs in 2007–2008 when fears of food security were uppermost in many policymakers’ minds (Cullen, ). Thirty-three jurisdictions introduced a total of 53 export controls on food at some point during 2020. As Fig.  shows, unlike medicines and medical goods, the majority of those controls were not introduced in March and April 2020 but were spread more evenly across the first 9 months of 2020, suggesting a different dynamic was at work.

Far fewer export curbs in food were introduced than in medical supplies and medicines.

Of the major ***agricultural*** commodity exporters, Russia significantly tightened an export quota on grains in April 2020 and reversed course in July 2020. Vietnam, a major exporter of rice, introduced export curbs on March 25, 2020, that were reversed in steps thereafter. In the latter case, pressure from rice farmers was reported to be a decisive factor.

Both the total number of nations liberalizing cross-border trade in food and agri-commodities as well as the total instances of such reforms exceeded those for food export curbs (compare Figs.  and ). Although several large emerging markets introduced food trade reforms in January and February 2020, just under half of the total number of reforms (47) were introduced in March and April 2020. Another 32 were introduced in the months that followed. A total of 62 of these import reforms have announced phase-out dates.

Many more import reforms were introduced than export curbs in the food sector, January–September 2020.

One argument that has been advanced as to why many more governments rushed to impose export curbs in medicines and medical goods as opposed to food relates to transparency (Bown, ). After the 2007–2008 food security scare, governments established the ***Agriculture*** Market Information System (AMIS), whose task is to provide accurate information on current food stocks and prices. This is said to have allayed fears this year about the availability of food.

No such global monitoring system exists for the medical goods and medicines sectors. While discussions of supply-chain transparency typically refer to the information a firm has about the upstream and downstream commercial counterparts, a global monitoring system for the medicines and medical goods sector would require a significantly higher degree of transparency, as governments would have access to this information, presumably for each cross-border supply chain of a certain scale.

HAD GLOBALIZATION GONE TOO FAR? ASSESSING CLAIMS OF OVERDEPENDENCE ON CHINA

Once significant shortages arose in medical goods, a blame game ensued. Rather than acknowledge the role that surges in demand played or accepting any culpability for the export restrictions that they had imposed in creating shortages abroad, a remarkable number of senior policymakers blamed the configuration of pre-pandemic supply chains.

That many of those supply chains involved production in China where COVID-19 originated and, given the slump in Chinese exports of medical supplies in January and February, added a further twist. Several policymakers developed a broader critique, essentially that globalization had gone too far and created an overdependence on China that afforded that country too much leverage in times of crisis.

Add in the geo-political rivalry between China and the United States, in which relations were raw as a result of the ongoing trade war, and where the United States began demanding its allies take its side against China, then the critique of a prevalent form of international corporate organization – namely cross-border supply chains – acquired an even harder edge. Tellingly, this critique was not confined to those policymakers critical of offshoring before the pandemic struck.

The purpose of this section is to document the breadth of the shift in policymakers’ thinking and then critically evaluate that shift using a variety of evidence and expert judgement from regulators (and not from scholars or others that have advocated international economic integration).

Statements by Policymakers, Relevant Context, and Supply Chain-Related Policy Intervention

This account starts in the United States. Economic nationalists in the Trump Administration were quick to seize on shortages in the medical goods and medicines sector. Dr. Peter Navarro, Assistant to the President and Director of the Office of Trade and Manufacturing Policy, stated at a White House press conference in the presence of President Trump:

One of the things this crisis has taught us, sir, is that we are dangerously over dependent on a global supply chain. Never again should we depend on the rest of the world for essential medicines and countermeasures.12

The United States representative drew broader lessons about the root causes of the shortages and future U.S. policy. Ambassador Robert E. Lighthizer told G20 trade ministers in March 2020:

Unfortunately, like others, we are learning in this crisis that over-dependence on other countries as a source of cheap medical products and supplies has created a strategic vulnerability to our economy… For the United States, we are encouraging diversification of supply chains and seeking to promote more manufacturing at home.13

This critique from Trump Administration officials comes on top of pre-pandemic concerns raised in the United States Congress about Chinese industrial policy and its implications for the health of the American public, amongst other concerns. For example, the U.S. Senate Committee on Small Business and Entrepreneurship, under chairmanship of U.S. Senator Marco Rubio, issued on February 12, 2019, a report about the China 2025 industrial policy in which it was claimed:

The concentration of critical drug production in one country presents a threat to supply stability as well. For example, in 2016, a factory owned by the Chinese drug company Qilu exploded and triggered a global shortage of the drug piperacillin, an essential antibiotic for which the affected facility was the sole producer. In some cases, the Chinese government’s level of control over the supply chain already has resulted in direct leverage over trading partners (USC, ).

The apparent defense-related risks attendant to over-dependence on China had been singled out before the pandemic by U.S. Congressional representatives. For example, U.S. Senators Cotton and Warren in a letter14 to the U.S. Secretary of Defense dated December 5, 2019 argued:

An interruption in the supply of these products during an attack, either domestic or abroad, could have devastating consequences.

Specifically, overreliance on Chinese API exports raises the possibility that China could terminate or raise the cost of prescription drugs millions of Americans (including service members) rely on every day, in the event of escalating geopolitical tensions. This national security threat cannot be overstated. Should China seek to weaponize pharmaceuticals by restricting exports to the United States, incorporating lethal ingredients in final products, or any other means, our domestic pharmaceutical industry is not prepared to handle mass shortages for domestic or military use. Any interruption in the delivery of APIs or medicine would impact military readiness.

Such observations follow the publication in December 2017 of the Trump Administration’s first statement of its national security strategy.15 That document fused military, technological, and economic considerations and branded China (and Russia for that matter) a “revisionist power.”

Developments in the United States have been mirrored elsewhere, especially after the onset of the pandemic. Shinzo Abe, Prime Minister of Japan, the world’s third largest economy, went on record to declare the following shift in Japanese policy:

for those products with high added value and for which we are highly dependent on a single country, we intend to relocate the production bases to Japan. Regarding products that do not fall into this category, we aim to avoid relying on a single country and diversify production bases across a number of countries, including those of the Association of Southeast Asian Nations [ASEAN].16

Policymakers in the European Union hardened their position towards China, too. Even before the pandemic, in March 2019 the European Commission had branded China a “strategic competitor in the pursuit of technological leadership” and accused it of failing to open its markets on a reciprocal basis to European firms.17 That followed the French and German governments combining forces in February 2019 to launch A Franco-German Manifesto for a European industrial policy fit for the 21st Century.18 Although China is not referred to specifically in that document, which advocates greater resort to subsidization and a relaxation of EU merger review rules to facilitate the creation of regional champions amongst other initiatives, officials made no secret of the origin of the commercial threats they sought to address.

Developments in the medical goods and medicines sector were central to the case for a new approach to governing international commerce, and by implication international business. The French Minister of the Economy and Finance, Mr. Bruno Le Maire, has specifically advocated supply chain reform:

This pandemic is an occasion to reflect collectively on how to reorganise value chains; to reflect on the necessary investments for the health sector and on how to better protect our borders. And we shouldn’t be scared of the word “protection”. Protection is not the same as protectionism. Protection is the legitimate defense of our most strategic economic assets.19

The French President went further during a visit to French pharmaceutical manufacturer Sanofi in July 2020 observing that:

Everyone saw during this crisis that certain drugs were no longer manufactured in France or even in Europe. We must draw lessons from that...and the state is ready to invest in such reshoring projects.20

Mr. Le Maire’s German counterpart, Mr. Peter Altmaier, the Federal Minister for Economic Affairs and Energy, emphasized the importance of economic self-determination and the steps needed to attain it:

Minimizing one-sided dependencies in order to win back national sovereignty in sensitive areas is the right idea…I can well imagine a common European project for medicine production.21

If words alone determined the fate of cross-border supply chains, their days would be numbered for those that implicate China, at least in respect to essential goods such as medicines and medical goods. But have governments backed up these statements with policy initiatives? Here the evidence is mixed.

Perhaps first off the mark was Japan, whose stimulus plan announced on April 7, 2020 included 220 billion Yen (approximately $2 billion) in financial grants for firms moving production facilities out of China.22 In July 2020, Japan announced that 87 firms had successfully applied for $653 million of financial support to do so. Another 30 companies will receive financial support to move production facilities to the ASEAN region.

The United States has deployed the Defense Production Act of 1950 to, amongst others, offer financial incentives to expand production within the United States.23 At the direction of the president, the U.S. International Development Finance Corporation signed on July 28, 2020 a letter of intent with Kodak to commence production of pharmaceuticals in the United States.24 Kodak was to be given a state loan of $765 million to do so. Moreover, the U.S. Departments of Defense and Health and Human Services will “invest nearly $630 million to expand the domestic industrial base for medical resource suppliers,” according to a U.S. Department of Defense press release of August21, 2020.25 Unlike the Japanese approach of offering carrots to firms to move out of China, presidential rhetoric aside, during the pandemic the U.S. has offered financial incentives to expand production at home, thereby substituting imports.

In contrast, the French and German stimulus packages announced in the third quarter of 2020 do not appear to earmark specific funds for repatriating supply chains, somewhat undercutting the statement reported above by President Macron. Meanwhile, Canada,26 Brazil,27 India,28 Italy,29 Japan,30 Korea31, and Russia32 have provided state aid to producers of medical supplies and medicines in the first 8 months of 2020.

The Chinese government appears to be having second thoughts about the degree to which exports should contribute towards national economic growth. In May 2020, President Xi announced a new “dual circulation” initiative motivated in part, it was reported, by rising protectionism abroad.33 According to one well-placed observer, this

new economic strategy calls for the country to continue to expand domestic production for exports (“international circulation”) while shifting the economy towards greater relative emphasis on production for domestic consumption (“internal circulation)” (Pettis, ).34

At the time of this writing, few attendant policy interventions have been made public. A State Council announcement on June 17, 2020 indicated that different forms of financial support would be made available to selected firms that shift sales from export to domestic markets.35 Meanwhile, a subsequent State Council announcement on August 5, 2020 offered larger incentives to foreign firms investing in China.36 It would seem, therefore, that Chinese policymakers are altering the desired mix of contributions from domestic and international business to their nation’s economic development.

Overall, some governments have backed up their rhetoric on supply chain reconfiguration with financial support. Whether that support is sustained, augmented, or indeed is enough to incentivize many firms to reconfigure their supply chains is too soon to say. Nevertheless, if this does come to pass, there were plenty of warnings of what was to come delivered by policymakers during the fraught early months of the pandemic.

Global Flows in PPE

Having documented what could become a significant shift in the incentives and constraints facing international business, the discussion now turns to whether the premise of the many senior policymakers’ critiques can be sustained empirically. The principal contention examined here is that, for whatever reason, before the pandemic, the rest of the world grew too dependent on China for essential goods. Given the salience of PPE supplies during the early months of the pandemic, the latest available pre-pandemic international trade ***data*** are used to shed light on the sourcing patterns for masks and the like.

The policy discussion on over-dependence has a quality similar to U.S. Supreme Court Justice Potter Stewart’s definition of obscenity: “I know it when I see it.” An economic approach to the problem of the over-dependence may add some coherence to this discussion, even if it does not provide a specific test. A nation is more likely to be over-dependent on a trading partner to supply a product when the latter’s share of total imports is higher and the number of credible alternative supplies is lower.37 In this section, we rely on the most fine-grained international global trade ***data*** available for 2015 to 2018 to identify which nations are very dependent on China for supplies of PPE.

Figure  reports the average shares of total imports of PPE that each nation sourced from China during the 4 years 2015 to 2018. A 4-year average is less likely to be distorted by errant trade flows for a single year. Care is needed in interpreting the findings in this figure for the average Chinese import share is not equal to the average Chinese share in domestic consumption. Indeed, the larger is the amount of domestic production of PPE, the smaller is the country’s reliance on imports for the supply of PPE. Consequently, the Chinese import share provides an upper bound on the dependence of a nation’s PPE consumption on China.

Before the pandemic struck, few nations sourced more than half of their PPE imports from China.

The map in Fig.  reveals that outside of Africa, only a few nations source over 75% of their PPE from China. No American nations (north or south), no European nation, and no member of the Commonwealth of Independent States (which includes Russia) sources more than half of their PPE imports from China. Of the Group of G20 nations, China accounts for moderate to high shares of PPE imports by Australia and Japan. As will soon become clear, Japan is itself a major exporter of PPE, so that leaves Australia as being potentially vulnerable to arbitrary changes in Chinese supplies of PPE.

The second dimension to over-dependence is the availability of alternative suppliers. Using global trade ***data***, it is possible to identify which nations supplied between $500 million and $1 billion and more than $1 billion of PPE exports to the world market before the pandemic struck. The fewer such suppliers, the graver the concerns that there is a Chinese “chokepoint” in the supply of PPE.

Figure  produces a map showing which nations consistently export more than half a billion U.S. dollars of PPE. The headline finding is that buyers of PPE have many nations to turn to if China were to cut off or restrict supplies. Moreover, those alternative suppliers are spread across East Asia, North America, and Western Europe (not to mention Turkey). Therefore, even if a government found itself in a stand-off with neighboring countries, it could still source PPE from other regions.

Before the pandemic, many nations consistently exported more than $500 million of PPE per annum.

Did the existence of so many alternative suppliers before the pandemic translate into diversified sourcing patterns from a wide range of PPE exporters? Figure  answers that question by showing for each importing nation the number of foreign trading partners that furnish more than 1% of its total imports. Again, Mongolia and certain African nations (along with Greenland) stand out as concentrating their imports of PPE in a small number of foreign suppliers.

Outside of Africa, remarkably few nations had concentrated sourcing patterns for PPE before the pandemic.

None of the members of the G-20 economies have fewer than six suppliers supplying more than 1% of their imported needs (recall these needs can also be met by domestic PPE production). France and Germany have an unusually large number of foreign suppliers that deliver more than 1% of their import bills for PPE, undercutting claims by these nations’ policymakers that before the pandemic they were too dependent on any one supplier.

Taken together, these findings based on the latest available fine-grained global trade ***data*** for personal protective equipment call into question that cross-border supply chains resulted in undiversified sourcing patterns. In fact, a large number of nations consistently exported PPE and, whether by accident or design, more nations availed themselves of this bounty and diversified sourcing patterns were the result.

Evidence from Detailed Import ***Data***

In advancing the over-dependence thesis, many advocates refer to the sourcing patterns of specific medical goods or medicines. This statement by Pletka and Scissors () is typical of this line of argument:

Consider that Chinese firms are said to supply more than 90% of US antibiotics, 70% of acetaminophen (that’s Tylenol), and almost half of the anti-coagulant heparin.

Other examples can be found in Rosemary Gibson’s testimony to the U.S.–China Economic and Security Review Commission on July 31, 2019 in which she asserted that Chinese producers of penicillin formed a cartel and drove European and U.S. producers out of the market (Gibson, ). She also contends:

…China’s vitamin C (ascorbic acid) cartel forced the closure of the last U.S. production facility, and the last aspirin (acetylsalicylic acid) manufacturing facility ceased business because of predatory pricing by Chinese firms. Baxter Healthcare switched heparin suppliers from Wisconsin to China, and a lethal contaminant in heparin was later found that killed hundreds of Americans (Gibson, ).

The central research question is whether anecdotes like these are representative. Fortunately, the European Union and the United States ***collect*** very detailed import ***data***, far more detailed than that made available by the United Nations and used in the sub-section directly above.

With respect to the European Union, it was possible to identify 154 product categories at the eight-digit level of disaggregation that correspond to medical goods and medicines.38 For these product categories, it was possible to identify the number of instances where France, Germany, or the United Kingdom imported more than half of those products from a single trading partner. This provides some indication of the degree to which international sourcing patterns are concentrated. Furthermore, once those instances are identified, it is possible to identify the trading partners responsible for those shipments. Table  summarizes the findings.

Before the pandemic, China was the majority supplier of only a small number of medical goods and medicines to France, Germany, and the United Kingdom

| **Importer** | **Number of medical goods and medicine categories where largest foreign supplier accounts for more than half total imports (maximum 154 product lines)** | **Number of medical goods and medicine categories where more than half of imports are from China (maximum 154 product lines)** | **Total value of imports (USD in millions) where China is majority foreign supplier** |
| --- | --- | --- | --- |
| France | 48 | 4 (USA = 8, Germany = 16) | 31 |
| Germany | 35 | 6 (USA = 7) | 152 |
| United Kingdom | 57 | 6 (Germany = 12, USA = 17) | 168 |

Source: Computed from fine-grained (eight-digit) product annual ***data*** for 2019 available from ***Eurostat***.

In 57 out of the 154 products (or 37% of cases), the United Kingdom sourced more than half of their imports from a single country in the year before the pandemic (2019). The comparable percentages for France and Germany are lower, 31% and 23% respectively. On the face of it, this might suggest that concentrated sourcing is a concern in a range of imported medical goods and medicines. However, as column 3 of Table  shows, in no more than six products was the majority foreign supplier Chinese.

France, whose officials have made so much of the over-dependence thesis, saw just four medical and medicine products where China was the majority supplier. If anything, according to the ***statistics*** reported in the third column of Table , for every imported medical good that China is the majority foreign supplier there are two for which this is the case from the United States and four products where Germany is the majority foreign supplier. Such summary ***statistics*** put France’s apparent over-dependence on Chinese imported medical goods and medicines in context. The last column of Table  reveals the small values of total imports where China was the majority supplier of imported medicines and medical goods to these leading European economies before the pandemic.

In the case of the United States, the most fine-grained import ***data*** available are at the ten-digit level of disaggregation, available from the U.S. International Trade Commission. A total of 326 product categories relating to imported medical supplies, medical equipment, PPE, and medicines were identified and import ***data*** for 2019 extracted. Summary ***statistics*** on trading partners exporting more than $1 billion of these goods to the United States in 2019 are presented in Table  for each of the four product groups mentioned in the last sentence.

China is the largest foreign supplier to the U.S. in less than 30% of medical goods and medicine product categories

| **Trading partner** | **US medical imports in 2019 from trading partner, $bn** | **CAGR of US medical imports from trading partner 2017?2019, %** | **Medicines (pharmaceuticals) (73 ten-digit product codes)** | | **Medical supplies (83 ten-digit product codes)** | | **Medical equipment (75 ten-digit product codes)** | | **Personal protective products (99 ten-digit product codes)** | | **Import share in products where trading partner is largest foreign supplier to the US** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **% trading partners shipments to the US by value** | **Number of times the trading partner is the largest supplier to USA** | **% trading partners shipments to the US by value** | **Number of times the trading partner is the largest supplier to USA** | **% trading partners shipments to the US by value** | **Number of times the trading partner is the largest supplier to USA** | **% trading partners shipments to the US by value** | **Number of times the trading partner is the largest supplier to USA** |
| Ireland | 29.462 | 4.96 | 80.53 | 8 | 11.59 | 2 | 7.77 | 3 | 0.10 | 0 | 50.51 |
| Germany | 23.636 | 16.43 | 61.05 | 6 | 14.44 | 6 | 20.51 | **19** | 4.01 | 10 | 37.07 |
| Switzerland | 17.317 | 14.04 | 81.52 | 3 | 10.12 | 1 | 7.80 | 3 | 0.55 | 0 | 36.78 |
| China | 14.249 | **5.47** | 5.06 | 3 | 19.42 | **22** | 21.17 | 16 | 54.34 | **54** | **51.21** |
| Mexico | 11.001 | 8.30 | 3.05 | 0 | 27.81 | 7 | 48.92 | 12 | 20.22 | 7 | 35.76 |
| Italy | 8.945 | 26.76 | 91.84 | 5 | 2.77 | 1 | 3.12 | 2 | 2.28 | 1 | 69.86 |
| Canada | 8.696 | 13.03 | 57.84 | 11 | 15.67 | 8 | 8.36 | 3 | 18.12 | 6 | 50.71 |
| India | 8.060 | 11.87 | 92.50 | **17** | 1.48 | 3 | 3.63 | 0 | 2.39 | 0 | 28.66 |
| Japan | 7.865 | 17.40 | 52.33 | 1 | 13.23 | 4 | 25.06 | 2 | 9.39 | 7 | 54.56 |
| UK | 6.866 | 5.51 | 62.86 | 7 | 22.17 | 2 | 9.71 | 2 | 5.26 | 1 | 25.88 |
| Denmark | 6.838 | 37.41 | 90.34 | 1 | 7.48 | 2 | 1.50 | 0 | 0.67 | 1 | 53.06 |
| Belgium | 6.572 | 89.33 | 93.84 | 3 | 4.05 | 2 | 0.82 | 0 | 1.30 | 0 | 50.18 |
| Singapore | 5.923 | 13.75 | 62.23 | 1 | 12.40 | 1 | 23.62 | 3 | 1.75 | 1 | 35.22 |
| France | 4.784 | 9.21 | 65.90 | 2 | 14.02 | 1 | 12.59 | 0 | 7.50 | 2 | 33.02 |
| Israel | 3.518 | ? 18.65 | 55.58 | 1 | 13.16 | 1 | 24.52 | 2 | 6.74 | 2 | 34.47 |
| South Korea | 2.972 | 15.60 | 70.24 | 0 | 8.01 | 1 | 12.74 | 2 | 9.02 | 4 | 34.54 |
| Malaysia | 2.470 | 13.36 | 0.07 | 1 | 73.20 | 5 | 23.54 | 1 | 3.19 | 0 | 63.26 |
| Australia | 1.572 | 16.85 | 14.17 | 0 | 64.82 | 1 | 18.47 | 0 | 2.55 | 0 | 34.81 |
| Thailand | 1.279 | 16.01 | 0.73 | 0 | 62.94 | 1 | 17.36 | 1 | 18.97 | 0 | 55.00 |
| Taiwan | 1.262 | 12.08 | 15.27 | 0 | 16.32 | 1 | 27.89 | 0 | 40.52 | 0 | 19.17 |

Note: Compiled from U.S. import ***data*** for 330 product lines at the ten-digit level of disaggregation of the US Harmonized Trading System.

Note: ***Data*** highlighted in bold represent the largest number reported in a particular column.

With respect to medicines imported into the United States, India is the largest supplier in 17 of the 73 product categories. China is the largest foreign supplier in just three cases. With respect to medical equipment, Germany is the largest foreign supplier in 19 out of 75 product lines. China comes second here, being the largest foreign supplier in 16 products. With respect to medical supplies, China is the largest foreign supplier most often, 22 times out of a total of 83 product lines. Where China stands out as the largest foreign supplier is in PPE, where in 54 of 99 products it ships the most to the United States.

Counts are useful but ought to be supplemented by some measure of the scale of trade implicated. This is where the final column of Table  comes in as it reports, for the products where a trading partner is the largest supplier, the percentage of total imports into the United States that come from the trading partner in question. In China’s case, in the 95 cases where it was the largest foreign supplier before the pandemic, its share of imports was 52%. Add in the fact that U.S. domestic production of these goods can be used to supply American buyers, then the share of the U.S. market supplied from China almost certainly falls below 50%.39

What do these findings imply about the U.S. foreign sourcing patterns for these products before the pandemic? At most, U.S. dependence on China as a source is largely found in PPE and, even there, there are 45 PPE products where China is not the largest foreign supplier. For the 45% of Chinese medical goods and medicine exports that are not PPE, in just over a sixth of cases (17.7%) was China the largest supplier.

Moreover, contrary to any suggestions that China’s exports of medical goods and medicines were surging before the pandemic and knocking out other foreign suppliers, in fact the cumulative average growth rate of such imports from 2017 to 2019 was under 6%, well below the growth rate witnessed by many other U.S. trading partners. Concentration of U.S. imports of medicines and medical goods on China is at best a localized problem. Claims that there was a generalized over-dependence on China can be rejected. The anecdotes deployed by advocates of the over-dependence thesis are not representative of the broader trends in U.S. foreign sourcing behavior of medical goods and medicines.

Statements and Analysis by the U.S. Food and Drug Administration

The findings based on detailed import ***data*** presented above are confirmed by the statements and analysis of U.S. officials associated with the Food and Drug Administration (FDA). In a Fox News television interview on April 5, 2020, at a time when many governments were imposing export curbs on medical goods and medicines, the Commissioner of the FDA, Dr. Stephen Hahn, made the following remarks in response to questions put to him. On the subject of shortages he observed:

I can tell the American people that critical medications are available, but there are spot shortages because of increased demand, so we are working very closely with domestic and international suppliers to increase the supply of those.

On the subject of suppliers, including foreign suppliers using leverage:

Right now, we don’t have any evidence that there’s a drug in short supply because of anyone blocking the active pharmaceutical agreement ingredients coming to us.

Looking forward, he argued:

We absolutely must address the issue of redundancy in our manufacturing, and we must absolutely make an effort to have domestic manufacturing as well.

Comments such as these follow a long line of statements by FDA officials about what they do and do not know about U.S. over-dependence on foreign suppliers and on shortages. For example, on October 29, 2019, in testimony40 before the U.S. House Committee on Energy and Commerce’s Subcommittee on Health, Dr. Janet Woodcock, Director of the Center for Drug Evaluation and Research, summarized the national security findings of her analysis of over-dependence on China as follows:

The FDA’s information shows that, overall, the number of China’s API facilities is somewhat smaller than the United States, but comparable in size and growing. However, because of the limitations of available ***data***, we cannot assess the extent of U.S. dependence on China. For instance, we do not have information about the volume of API being produced in China or even in the United States, or how much of China’s API output reaches the U.S. market through other countries.

Similarly, we do not have information that would enable us to assess the resilience of the U.S. manufacturing base, should it be tested by China’s withdrawal from supplying the U.S. market. We do know that the U.S. drug supply is being compromised by drug shortages, in most cases triggered by manufacturing quality problems by U.S.-based as well as foreign producers.

Such comments are consistent with the observations made about the lack of transparency in cross-border supply chains in medical goods and medicines in the last section of this paper. They also imply that the ***data*** were not available to conclude, as some policymakers and analysts have done, that before the pandemic dependence on China was a national security threat to the United States.

Since the pandemic was declared, the FDA has given updates on the availability of medicines. On February 27, 2020, its Commissioner shed light on the current supply of medicines, including active steps it was taking to source from China41:

Since January 24, the FDA has been in touch with more than 180 manufacturers of human drugs, not only to remind them of applicable legal requirements for notifying the FDA of any anticipated supply disruptions, but also asking them to evaluate their entire supply chain, including active pharmaceutical ingredients (the main ingredient in the drug and part that produces the intended effects, e.g., acetaminophen) and other components manufactured in China.

Also, as part of our efforts, the FDA has identified about 20 other drugs, which solely source their active pharmaceutical ingredients or finished drug products from China. We have been in contact with those firms to assess whether they face any drug shortage risks due to the outbreak. None of these firms has reported any shortage to date. Also, these drugs are considered non-critical drugs.

As to the supply of medical equipment, Commissioner Hahn observed:

We are aware of 63 manufacturers which represent 72 facilities in China that produce essential medical devices; we have contacted all of them. Essential devices are those that may be prone to potential shortage if there is a supply disruption. We are aware that several of these facilities in China are adversely affected by COVID-19, citing workforce challenges, including the necessary quarantine of workers. While the FDA continues to assess whether manufacturing disruptions will affect overall market availability of these products, there are currently no reported shortages for these types of medical devices within the U.S. market.

Regarding personal protective equipment – surgical gowns, gloves, masks, respirator protective devices, or other medical equipment designed to protect the wearer from injury or the spread of infection or illness – the FDA has heard reports of increased market demand and supply challenges for some of these products. However, the FDA is currently not aware of specific widespread shortages of medical devices, but we are aware of reports from CDC and other U.S. partners of increased ordering of a range of human medical products through distributors as some healthcare facilities in the U.S. are preparing for potential needs if the outbreak becomes severe.

By March 2, 2020, the FDA noted42 that shortages were not pervasive but could become so:

Of note, the agencies are not currently aware of specific widespread shortages of personal protective equipment, but there are reports of increased ordering of these products and shortages have been observed in some U.S. health care institutions. The FDA and CDC are aware that as the COVID-19 outbreak continues to expand globally, the supply chain for these devices will continue to be substantially stressed as demand exceeds available supplies. Under the circumstances of this emergency, nationwide shortages are anticipated.

On March 28, 2020, the FDA acknowledged43 that there were shortages in PPE and ventilators but not in medicines. Foreign sourcing was seen as part of the solution, not the problem:

We are also open to importing PPE and other devices…The agency is taking steps to facilitate importation of PPE into the U.S. and we are ready and available to engage with importers to minimize disruptions during the importing process.

Indeed, the FDA claimed to be in contact with many manufacturers worldwide to meet surging demand:

The FDA has reached out to more than 1000 device manufacturing sites worldwide, focusing on essential devices. The outreach thus far has focused on two main types of essential devices: those that are in high demand due to the pandemic outbreak, such as PPE and ventilators, and devices that may be prone to potential shortage if there is a supply disruption.

On the basis of these comments, once demand for PPE and the like surged in the United States the FDA appeared willing to increase its “dependence” on foreign suppliers.

The FDA also monitors medicines shortages, producing both reports and ***data*** on them. Such information can be used to assess whether foreign suppliers, including Chinese suppliers, regularly cut off shipments to the U.S. market. In fact, on October 29, 2019, an FDA-led task force of U.S. Federal officials published a report on drug shortages as they refer to them. The following statement addresses both the consequences and, more importantly, the root causes of such shortages.

The Task Force found that the number of ongoing drug shortages has been rising, and that their impact is likely underappreciated. The Task Force analyzed 163 drugs that went into shortage from 2013 to 2017 and compared these medicines to similar drugs that did not go into shortage. Shortage drugs were more likely to be relatively low-price and financially unattractive drugs and were more likely to be sterile injectables. Shortages often occurred as a result of disruption in supply due to a variety of factors. Importantly, prices rarely rose after shortages began, and during shortages, production typically did not increase enough to restore supply to pre-shortage levels. Many manufacturers reported discontinuing the production of drugs before a shortage for commercial reasons (e.g., loss of profitability). These results suggest a broken marketplace, where scarcity of drugs in shortage or at risk for shortage does not result in the price increases predicted by basic economic principles. While there are no easy solutions to the problems identified, and there is no single cause of drug shortages, the Task Force offers three key recommendations to address the root causes of shortages.

Given the potential scale of impacts from drug shortages, and the fact that these impacts have continually been underestimated, it is likely that drug shortages will continue to persist absent major changes to this marketplace. The root causes of shortages involve economic factors that are driven by both private- and public-sector decision-making. This means that the types of enduring solutions proposed in the report will require multi-stakeholder efforts and rethinking business practices throughout all sectors of the health care system. It will also require a fuller characterization of the true costs of shortages and more comprehensive and reliable analysis of the effects shortages have on patients and the health care system (FDA ).

What is significant about these findings is that the root causes of medicine shortages are not blamed on cross-border supply chains but are much more complex in nature (Gereffi ). It is noteworthy that repatriation of production to the United States was not mentioned as a solution. The report also notes that Chinese and Indian firms are barred from supplying active pharmaceutical ingredients (API) to the U.S. Department of Defense, an observation that further casts doubt on the direct risk to the U.S. military of any Chinese attempt to limit shipments to the United States.

The FDA also maintains an up-to-date register of medicines shortages. For some entries, the FDA lists a reason or reasons for the shortage. For those shortages notified during 2020, information was extracted on the reasons provided by the FDA and this is summarized in Table . Of the 281 cases where reasons were given, 168 refer to demand increases. In only 26 cases were shortages of ingredients referred to. Even if all of those ingredient shortages were the responsibility of foreign suppliers, they would account for only 9% of the medicine shortages found this year by the FDA for which the cause could be identified. These ***statistics*** imply that surging demand rather than denial of supply were the predominant causes of medicine shortages in the United States this year.

Reasons provided by the FDA for drug shortages. September 2020

| **Reason(s) given (listed in alphabetical order)** | **Number of times this reason was given** |
| --- | --- |
| API shortage | 6 |
| Delay in shipping of the drug | 10 |
| Demand increase due to Covid-19 | 3 |
| Demand increase for the drug | 150 |
| Demand increase for the drug and shortage of an active ingredient | 4 |
| Discontinuation of the manufacture of the drug | 1 |
| Limited API availability | 2 |
| Other | 75 |
| Regulatory delay | 1 |
| Requirements related to complying with good manufacturing practices and demand increase for the drug | 11 |
| Shortage of an active ingredient | 17 |
| Shortage of an inactive ingredient | 1 |
| *Subtotals:* |  |
| All mentions of demand increases | 168 |
| All mentions of ingredient shortages | 26 |

Note: This table refers to the 281 drug shortages that the FDA identified a reason for a drug shortage where the initial posting of the shortage occurred on or after January 1, 2020.

Source: [*https://www.accessdata.fda.gov/scripts/drugshortages/*](https://www.accessdata.fda.gov/scripts/drugshortages/).

Overall, the picture that emerges about supply chains in medicines and medical goods from the health experts at the U.S. Food and Drug Administration is at odds with the critics of supply chains. The FDA acknowledged that supply chains came under strain during the pandemic and this was because of surging demand could not be met in the near term by ramping up supply, neither at home nor abroad. It is this supply and demand mismatch which is at the core of the problem, a finding reinforced by the FDA ***data*** on drug shortages this year in the U.S. market.

CONCLUDING REMARKS: CUI BONO?

That nations can trade reduces the risk that they are tied to local firms for supplies. Greater choice, lower prices, and flexibility in sourcing were supposed to be distinct advantages of an open trading system. The build-up and evolution of supply chains over recent decades were a key building block, and much research has been devoted to this corporate form, the challenges it faces, and its developmental, economic, and societal impact.

The COVID-19 pandemic could have been the moment when firms operating cross-supply chains meaningfully contributed to tackling a major societal threat. That countries witnessed surges in infection at different times implies that smoothly functioning supply chains could ramp up production and ship medical supplies and medicines to destinations where demand was surging. No such luck.

Instead, senior policymakers in many of the world’s leading economies, and not just those from governments associated with populist policies and economic nationalism, have drawn negative conclusions about this prominent corporate organizational form. Not only that, many policymakers have made statements consistent with the proposition that globalization had gone too far before the pandemic. Numerous governments have taken steps to encourage the repatriation of production or to stimulate domestic production to displace imports.

Analysts can respond to these statements by policymakers in at least four ways. First, some might aver “talk is cheap.” This may not be the appropriate conclusion, as governments have begun backing up their critique with policy intervention. Time will tell if these interventions are sustained.

Second, some might dismiss these statements as blame shifting. Given that it was often the same policymakers that disrupted supply chains in the medical goods and medicines sector once the coronavirus spread by resorting to over 200 export controls, there may be something to this. The wrinkle with this argument is that the Japanese government, which did not impose any export bans, has also joined the critique of cross-border supply chains and is financially supporting Japanese firms that move production facilities out of China.

Third, analysts may decide to critically evaluate the policymakers’ critique. That was the purpose of a large part of this paper and it should be evident that, by any reasonable standard of logic and evidence, the case made against cross-border supply chains is unconvincing. No objective standard by which cross-border supply chains were to be judged was enunciated by policymakers, although thinking through what such a standard should be in the context of a pandemic is worthwhile. In extremis, how should cross-border supply chains be judged?

A fourth reaction of analysts to the apparent shift in policymakers’ attitudes towards cross-border supply chains might be to ask “what’s really going on here?” It was not the purpose of this paper to address this question. Future research could generate powerful insights into the factors that influence when and how policymakers gauge the performance of international business. Potentially important pieces of the puzzle were, however, presented here. These include the pandemic’s attendant demand surge and high-profile media reports of shortages which likely reflect the limited incentives that firms have to maintain excess production capacity during normal times (see also Gereffi ).44 That few stockpiles were maintained by the public or private sectors in many countries may be another element.

But surely the changing geopolitical context must be considered as well. There are now important business, national security, non-governmental, and religious constituencies in the largest economies of the world that are alarmed by China’s rise for a variety of reasons. Did the pandemic create the opportunity to traduce cross-border supply chains with an eye to redrawing the terms upon which international business is enjoined to operate? Who benefits from this game of Chinese whispers?

Should the proponents of supply-chain repatriation and of renewed emphasis on import substitution retain the upper hand in the highest counsels of government, then analysts may want to reflect on the fragility of extant cross-border supply chains in sensitive sectors. They may also want to reflect on how such fragility came to pass despite the presence of global trade rules, an international organization to oversee them, and hundreds of regional trade agreements. Moreover, one might want to reflect on which international business models can thrive in the face of such fragility and intensifying geopolitical rivalry.

Notes

Statements to this effect can be found in section  of this paper.

For an informative account of how historical analysis can contribute to the analysis of international business, see Buckley ().

In places, the author quotes at length from the statements of policymakers and from official reports. This was done because somehow the force of the arguments made is lost in the anodyne and restrained paraphrasing that is standard practice in academic writing.

In the interest of transparency, the author created the Global Trade Alert initiative.

Details of the goods ***collected*** and the list of trade policy interventions tracked by this tripartite initiative can be found in a methodology document obtained at [*https://www.globaltradealert.org/reports/54*](https://www.globaltradealert.org/reports/54).

Note some policy interventions affect both food and medical goods sectors.

The ITC’s findings can be accessed here: [*https://www.macmap.org/covid19*](https://www.macmap.org/covid19).

The other two organizations were the WTO and the World Customs Organization. Once the former geared up their monitoring, the latter ceased its useful work.

The United States also temporarily denied exporters of medical equipment access to trade finance from the U.S. Export-Import Bank, see [*https://www.globaltradealert.org/intervention/79199*](https://www.globaltradealert.org/intervention/79199). Such a move discourages exports even if it does reduce the degree of subsidy-distorted competition in overseas markets.

Since Q1 2020 Chinese exports of PPE have rebounded.

See [*http://www.scio.gov.cn/zfbps/32832/Document/1681809/1681809.htm*](http://www.scio.gov.cn/zfbps/32832/Document/1681809/1681809.htm).

Comment made during a White House press conference on April 3, 2020. For video clip, see [*https://twitter.com/bennyjohnson/status/1245845521903882241*](https://twitter.com/bennyjohnson/status/1245845521903882241).

Quoted in a Reuters article dated March 31, 2020 available at [*https://www.reuters.com/article/us-health-coronavirus-trade-ustr/coronavirus-shows-us-too-dependent-on-cheap-medical-imports-ustr-says-idUSKBN21I042*](https://www.reuters.com/article/us-health-coronavirus-trade-ustr/coronavirus-shows-us-too-dependent-on-cheap-medical-imports-ustr-says-idUSKBN21I042).

Available at [*https://www.warren.senate.gov/imo/media/doc/2019.12.05%20Letter%20to%20DoD%20re%20pharmaceutical%20product%20supply%20chain.pdf*](https://www.warren.senate.gov/imo/media/doc/2019.12.05%20Letter%20to%20DoD%20re%20pharmaceutical%20product%20supply%20chain.pdf).

Available at [*https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf*](https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf).

Quoted in a news article in the South China Morning Post dated August 12, 2020 available at [*https://www.scmp.com/week-asia/opinion/article/3096911/coronavirus-has-complicated-china-japan-relations-how-will*](https://www.scmp.com/week-asia/opinion/article/3096911/coronavirus-has-complicated-china-japan-relations-how-will).

See [*https://ec.europa.eu/commission/sites/beta-political/files/communication-eu-china-a-strategic-outlook.pdf*](https://ec.europa.eu/commission/sites/beta-political/files/communication-eu-china-a-strategic-outlook.pdf).

See [*https://www.bmwi.de/Redaktion/DE/Downloads/F/franco-german-manifesto-for-a-european-industrial-policy.pdf%3F\_\_blob%3DpublicationFile%26v%3D2*](https://www.bmwi.de/Redaktion/DE/Downloads/F/franco-german-manifesto-for-a-european-industrial-policy.pdf%3F__blob%3DpublicationFile%26v%3D2)

Comments made at a press conference on April 2, 2020, available at [*https://www.gouvernement.fr/sites/default/files/locale/piece-jointe/2020/04/2108\_-\_bruno\_le\_maires\_speech\_-\_international\_press\_conference\_-\_english\_version.pdf*](https://www.gouvernement.fr/sites/default/files/locale/piece-jointe/2020/04/2108_-_bruno_le_maires_speech_-_international_press_conference_-_english_version.pdf).

As quoted in a Financial Times news article dated July 29, 2020, available at [*https://www.ft.com/content/80a4836b-ca25-48e0-996d-458186e968dc*](https://www.ft.com/content/80a4836b-ca25-48e0-996d-458186e968dc).

As quoted in a Reuters news article dated March 13, 2020 available at [*https://www.reuters.com/article/us-health-coronavirus-germany-pharmaceut/germany-would-like-to-localize-supply-chains-nationalization-possible-minister-says-idUSKBN2101BH*](https://www.reuters.com/article/us-health-coronavirus-germany-pharmaceut/germany-would-like-to-localize-supply-chains-nationalization-possible-minister-says-idUSKBN2101BH).

For more details, see [*https://www.globaltradealert.org/intervention/79328*](https://www.globaltradealert.org/intervention/79328).

See [*https://www.fema.gov/news-release/20200726/applying-defense-production-act*](https://www.fema.gov/news-release/20200726/applying-defense-production-act).

See [*https://www.dfc.gov/media/press-releases/dfc-sign-letter-interest-investment-kodaks-expansion-pharmaceuticals*](https://www.dfc.gov/media/press-releases/dfc-sign-letter-interest-investment-kodaks-expansion-pharmaceuticals).

See [*https://www.defense.gov/Explore/News/Article/Article/2319332/acquisition-enterprise-capabilities-to-continue-post-pandemic/*](https://www.defense.gov/Explore/News/Article/Article/2319332/acquisition-enterprise-capabilities-to-continue-post-pandemic/)

See the following “investments” by Canada’s Strategic Innovation Fund: [*https://www.canada.ca/en/innovation-science-economic-development/news/2020/08/government-of-canada-announces-major-steps-in-treating-and-preventing-covid-19-through-vaccines-and-therapies.html*](https://www.canada.ca/en/innovation-science-economic-development/news/2020/08/government-of-canada-announces-major-steps-in-treating-and-preventing-covid-19-through-vaccines-and-therapies.html), and [*https://www.canada.ca/en/innovation-science-economic-development/news/2020/05/minister-bains-announces-investment-in-antibody-discovery-technology-to-help-treat-covid-19.html*](https://www.canada.ca/en/innovation-science-economic-development/news/2020/05/minister-bains-announces-investment-in-antibody-discovery-technology-to-help-treat-covid-19.html). Although framed in terms of supporting companies working on medical research, the official announcements also refer to investments in manufacturing capacity.

For more details, see [*https://www.globaltradealert.org/intervention/79270*](https://www.globaltradealert.org/intervention/79270).

For more details, see [*https://www.globaltradealert.org/intervention/78924*](https://www.globaltradealert.org/intervention/78924), [*https://www.globaltradealert.org/intervention/79006*](https://www.globaltradealert.org/intervention/79006), [*https://www.globaltradealert.org/intervention/78923*](https://www.globaltradealert.org/intervention/78923), and [*https://www.globaltradealert.org/intervention/79005*](https://www.globaltradealert.org/intervention/79005).

For more details, see [*https://www.globaltradealert.org/intervention/79764*](https://www.globaltradealert.org/intervention/79764) and [*https://www.globaltradealert.org/intervention/79762*](https://www.globaltradealert.org/intervention/79762).

For more details, see [*https://www.globaltradealert.org/intervention/79598*](https://www.globaltradealert.org/intervention/79598).

Consistent news reports indicate that in May 2020 the Korean government set aside 1.2 trillion Won (approximately $980 million) to develop that nation’s medical equipment sector; see [*https://en.yna.co.kr/view/AEN20200513001100320*](https://en.yna.co.kr/view/AEN20200513001100320).

For more details, see [*https://www.globaltradealert.org/intervention/79860*](https://www.globaltradealert.org/intervention/79860).

See [*https://www.chinadaily.com.cn/a/202007/27/WS5f1e0c65a31083481725c184.html*](https://www.chinadaily.com.cn/a/202007/27/WS5f1e0c65a31083481725c184.html).

Blanchette and Polk () provide an alternative interpretation. Namely, that the dual circulation initiative amounts to a hedging strategy for Chinese policymakers.

For more information, see [*https://www.globaltradealert.org/state-act/44964/china-top-level-government-policy-released-by-state-council-to-encourage-exporters-to-sell-domestically*](https://www.globaltradealert.org/state-act/44964/china-top-level-government-policy-released-by-state-council-to-encourage-exporters-to-sell-domestically).

For more information, see [*https://www.globaltradealert.org/state-act/44965/china-state-council-releases-top-level-policy-detailing-measures-to-safeguard-and-encourage-inbound-foreign-investment*](https://www.globaltradealert.org/state-act/44965/china-state-council-releases-top-level-policy-detailing-measures-to-safeguard-and-encourage-inbound-foreign-investment).

The notion of direct import dependence developed here can be distinguished from the vulnerability of a nation to a shock in a trading partner. The transmission mechanism of any such shock need not only affect bilateral trade flows.

This list of products and their respective product codes are available from the author upon request.

In this regard, it is noteworthy that calculations by U.S. Federal Reserve Bank of St. Louis using 2018 ***data*** on 18 categories of medical products revealed that the total foreign share of U.S. domestic absorption (a measure of consumption) was under 0.3. China’s share was less than 0.09 (Leibovici, Santacreu, & Peake, ). These estimates are not strictly comparable to those presented in the main text of this sub-section, as the St. Louis study used six-digit disaggregated import ***data***.

Available at [*https://www.fda.gov/news-events/congressional-testimony/safeguarding-pharmaceutical-supply-chains-global-economy-10302019*](https://www.fda.gov/news-events/congressional-testimony/safeguarding-pharmaceutical-supply-chains-global-economy-10302019).

The statement is available here [*https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-supply-chain-update*](https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-supply-chain-update).

Statement available at [*https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-and-cdc-take-action-increase-access-respirators-including-n95s*](https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-and-cdc-take-action-increase-access-respirators-including-n95s).

Statement available at [*https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-takes-further-steps-help-mitigate-supply-interruptions-food-and*](https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-takes-further-steps-help-mitigate-supply-interruptions-food-and).

If anything, there may be pressures on firms from shareholders to strip out such capacity.

**ACKNOWLEDGEMENTS**

The author thanks Ruben Ernst and Piotr Lukaszuk for research support on this paper. The author thanks the Editor and Deputy Editor of this Journal for comments on an earlier draft of this paper.

**Notes**

Publisher's NoteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.Accepted by Ari Van Assche, Deputy Editor, 17 September 2020. This paper is part of a series of contributions dealing with the implications of the COVID-19 pandemic on international business policy, and it was single-blind reviewed.

**Load-Date:** September 20, 2023

**End of Document**



[***Is carbon sequestration on farms actually working to fight climate change?***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YP2-Y7D1-JDG9-Y0J1-00000-00&context=1516831)

Impact News Service

April 16, 2020 Thursday

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**Length:** 3374 words

**Body**

Washington: US Department of ***Agriculture*** has issued the following news release:

Trey Hill led a small group of fellow farmers to a field outside his office in Rock Hall on Maryland’s Eastern Shore. It was a cloudy February day, but the ground was alive with color — purple and red turnip tops mixing exuberantly with green rye, vetch and clover, and beneath it all, rich brown soil. Hill reached down, yanked a long, thick, white daikon radish from the earth and showed his visitors sumptuous coffee-colored clods clinging to hairy rootlets. Those clumps, he explained, hoard carbon — carbon that’s not heating the planet.

Hill didn’t adopt 'carbon smart' practices such as cover-cropping to fight climate change. He did it to build soil, retain water and make money. But when thethird-generation corn, wheat and soybean farmerlearned about Nori, a Seattle-based startup looking to sell credits for carbon stored in the soils of farms such as his, he was all in. Hill didn’t necessarily expect a windfall, but he wanted to show fellow farmers they could make money while helping fight climate change. 'If it works out and we make some money on it, that’s great,' Hill says. 'If it doesn’t, well, somebody’s got to be first, and we’re willing to take that risk.'

Earlier this year, Nori paid Hill $115,000 for just over 8,000 tons of carbon stored in Hill’s soil. In the future, if each of the 10,000 acres he farms can sock away an additional ton of carbon per year — around the best he could hope for, he says — he could earn up to $150,000 annually.

As efforts to wean society off fossil fuels have stalled, 'natural climate solutions' such as soil carbon sequestration rapidly have gained steam. In 2018, the National Academies of Sciences, Engineering and Medicine reported that 'negative emissions technologies' — techniques for removing carbon from the atmosphere, rather than simply reducing new emissions of carbon — are needed to stabilize global warming below 2 degrees Celsius, the level scientists believe could be catastrophic.

The academies’ report identified soil sequestration as a cost-effective and readily available climate solution, with the potential to remove 250 million metric tons or more of carbon dioxide per year in the United States alone. That’s about 5 percent of the U.S ’s annual CO2 emissions, which totaled5.4 billion tons in 2018.This month, a team led by researchers at The Nature Conservancy (TNC) estimated that if implemented globally, soil conservation and soil-building activities could providenearly 10 percent of the carbon reduction neededto avoid breaching the 2-degree barrier.

Millions of dollars are pouring into soil-climate initiatives from corporations such as Microsoft andGeneral Mills, philanthropists such as Leonardo DiCaprio and governments large and small. A Boston-based ***agricultural*** technology firm,Indigo Ag, says that thousands of farmers working more than 18 million acres of farmland, nearly all in the United States, have expressed interest in enrolling in its carbon-sequestration program. A consortium of food giants and non-profits such as TNC has raised more than $20 million to build a marketplace to sell soil carbon credits. Cities such as Boulder, Colorado and San Francisco are including soil carbon storage in their climate action plans. California already pays some farmers for reducing their greenhouse gas emissions, and Maryland legislators are considering new funding for 'carbon-smart' farmers such as Hill.

At the national level, U.S Sen. Cory Booker (D-New Jersey), Rep. Deb Haaland (D-New Mexico), and Rep. Chellie Pingree (D-Maine) have introduced bills that would pay farmers to adopt climate-friendly practices. Even Secretary of ***Agriculture*** Sonny Perdue has endorsed the concept.

But a growing number of scientists worry that mounting societal pressure to do something to counter climate change is pushing money into so-called carbon farming before the science needed to underpin it is mature. New studies reveal that even long-accepted carbon sequestration practices may not yieldhoped-for climate benefits. Measurements of soil at depths down to 6.6 feet have cast serious doubt on the climate impact of reducing soil tillage, and similar studies are questioning how much carbon cover crops can sequester in some circumstances. A massive ramp-up of soil carbon ***data*** from working farms is urgently needed, experts say.

Even some supporters want to rein in the hype.

'We’re in a period of carbon exuberance,' says Philip Taylor, an ecologist and co-founder of the Boulder-based regenerative ***agriculture*** organizationMad ***Agriculture***. 'Society’s hope and wish that ***agriculture*** will solve climate change is overstated.'

From when the first plow broke ground, ***agriculture*** has emitted carbon dioxide. Turning topsoil mixes underground carbon-containing molecules with atmospheric oxygen, creating the greenhouse gas that, more than any other, is imperiling civilization. Recent estimates suggest that some 133 billion tons of carbon, roughly a fourth of all carbon emitted by humans since the Industrial Revolution, has been lost from soils globally.

Technological advances dramatically have upped farming’s emissions in the last century. Fossil fuel use by the food system, including fuel for tractors and transport and energy for fertilizer production, accounts for more than 10 percent of all greenhouse gas emissions. Fertilizer added to soils can cause microbes to emit nitrous oxide, or N2O, a greenhouse gas 300 times more potent than carbon dioxide per molecule. N2O is responsible for around 6 percent of global warming, according to the U.S Environmental Protection Agency.

But there is hope that such trends could be reversed. In 2004, Rattan Lal, a soil scientist at Ohio State University, estimated that changes in farming and soil management practices could, in theory, coax up to two-thirds of all carbon lost from soils back underground, potentially drawing down atmospheric carbon dioxide considerably. Lal and others recommended practices shown to increase the fraction of carbon-containing compounds in upper soil layers, including reducing or eliminating tillage that exposes soil carbon to air, mulching fields with crop residues and planting cover crops — cereals, legumes or other vegetables grown not for harvest but to reduce erosion and enrich soil with ***nutrients*** and carbon-rich organic matter.

Some farmers, it turns out, already were adopting such practices. The U.S ’s no-till movement began in the 1940s, when soil conservation became a priority after plowing of arid Western land sparked the ruinous Dust Bowl, and newly available herbicides allowed farmers to kill weeds without turning soil. More than a third of U.S cropland is farmed without tillage, and another third is under so-called low-till management, according to U.S Department of ***Agriculture*** (USDA) ***statistics***.

Cover crops also have gained steam, though more slowly. In 1992, to reduce pollution into the Chesapeake Bay, Maryland began paying farmers to plant cover crops on bare fields. Hill, despite being skeptical that he would benefit, was an early adopter. 'It had nothing to do with climate or soil health,' Hill says. 'All of us thought it was a bunch of environmental BS… Then we found that it works and saw that the soil started to change.' Where Hill grew cover crops, his soils eroded less and held more water.

Maryland boasts the nation’s highest cover-cropping rate. Cutting-edge farmers such as Hill have graduated from single-species plantings to diverse mixtures such as the one he showed off in February, which provide not just erosion and runoff reduction but also nitrogen fixation and food for pollinating insects. The practice is starting to catch on widely, with a 50-percent increase in nationwide cover-cropping rates from 2012 to 2017.

The idea of paying farmers for actually drawing down carbon, however, has not taken off. No one knew how to accurately, yet affordably, measure the small, slow changes in soil carbon that might accrue over one or even multiple growing seasons. The gold standard for soil carbon measurement involves extracting multiple cylindrical cores from a field, drying them, combusting them in an oven and measuring the carbon dioxide released — a time-consuming and expensive process.

Technology finally has started to catch up with ambition. Hill, like many farmers, uses software that logs rivers of ***data*** about his farming practices — every time he drives a field, sprays a chemical or plants a crop — into a software program called Granular, which helps him fine-tune his inputs and decision making. The same ***data***, scientists realized, can be used to estimate a farm’s carbon sequestration and greenhouse gas emission rates.

Granular staff connected Hill with Nori, a startup company launched in 2017 by idealistic young environmentalists looking to use tech to bring down the costs of compensating farmers for carbon sequestration. Nori staff thought Hill’s Granular ***data*** could help crack the carbon measurement problem. What followed was an educational process for both sides. Nori’s founders weren’t familiar with the subtleties of conservation tillage. Hill didn’t know much about blockchain, the theoretically secure, bank-free technology that Nori wanted to use to funnel payments to farmers from carbon-dioxide emitters seeking offsets.

After two years of conversation, Nori decided to sell credits based on five years’ worth of Hill’s carbon-sequestering practices, from 2014 to 2018. Nori would calculate Hill’s climate impact using COMET-Farm, a digital tool produced by the USDA. COMET-Farm takes in farming practice information from platforms such as Granular, mixes it with weather ***data*** from satellites and sensors and soil information from USDA databases, and uses sophisticated computer models to estimate how quickly carbon builds up in soils and greenhouse gases escape.

By not requiring a site visit or soil samples, which can run thousands of dollars, Nori kept verification costs low. The verification process cost Hill around $3,500, although he will need to pay for an audit in 10 years to confirm that carbon actually was stored.

On Oct. 7, Nori offered Hill’s credits for $16.50 per ton, with $1.50 going to Nori and $15 to Hill. A total of 342 buyers purchased 8,010 tons’ worth of credits out of 14,011 offered, according toNori. Available on the company’s website are satellite images of Hill’s fields along with the number of credits sold against each and even the names of some buyers, which included individuals looking to buy just a credit or two; companies such as the travel company BootsnAll, whose leaders wanted to reduce their firm’s carbon footprint; and institutions such as Arizona State University andthe University of Southern California’s Schwarzenegger Institute.

That radical transparency is what sets apart Nori’s program for Hill. He has blockchain-certified evidence that his crops are grown using climate-friendly methods, which he hopes will help him sell wheat and soybeans for a premium, perhaps to affluent, climate-conscious consumers in the nearby Washington, D.C , area. And he’s investing the money into making his operation even more sustainable. He just ordered a piece of equipment called a roller-crimper that kills cover crops without chemicals and plants a cash crop in the same field pass. Hill says the new machine will enable him to spray less herbicide and drive his fields fewer times in a season, racking up additional gains that will support further sales through Nori.

Despite the strong launch, Nori’s success is not assured. When I spoke with Christophe Jospe, Nori’s chief development officer, in December, he hoped to sell 100,000 tons’ worth of credits by the end of the first quarter of 2020, but to date the company has not held another sale; Jospe says more than 150 farmers representing more than 500,000 acres are working through the verification process, with the plan to sell their credits later this year.

Competitors are close on Nori’s heels. In June, Indigo Ag announced that it would open a carbon market. The company will publish its monitoring and verification methods this spring and hopes to sell credits by the end of the year. A third organization, the Ecosystem Services Market Consortium, will target corporate, municipal and other large buyers, offering credits for carbon sequestration as well as water quality and avoided runoff. The marketplace is piloting its program on 50,000 acres of farmland and has announced a nationwide target launch date of 2022.

With legislation that would provide incentives to adopt regenerative ***agriculture*** techniques under consideration in both chambers of Congress, farmers soon may have even more ways to get paid for fighting climate change. Things are happening internationally as well. Australia and the Canadian provinces of Alberta and Saskatchewan have paid farmers for soil carbon sequestration, and the French government in 2015 launched the'4 per 1000'initiative to increase soil carbon stocks by 0.4 percent per year.

'There’s very strong momentum,' says Lal. 'I’m very impressed with what is happening.'

A growing number of scientists, however, are not as impressed as they’d like to be with the science underpinning the soil carbon sequestration gold rush.

In 2006, USDA soil scientist John Baker analyzed studies that had measured the effects of no-till on carbon through 1-meter-deep soil samples. Historically, most studies have measured only the top 8 to 12 inches — the so-called plow layer — and found carbon building up there. The few studies that went deeper, however, often found that a roughly equal amount of carbon disappeared in the layers below 30 centimeters. No-till appeared to change the vertical distribution of carbon rather than the total amount sequestered, Baker and colleaguesreported (PDF). More recent papers have confirmed Baker’s findings.

Cover crops have maintained a stronger reputation as a climate solution. The TNC study published this month estimated that if farmers around the globe adopted the practice, they could take up nearly half a billion tons of carbon dioxide annually.

But the study, like most others to date, relied on measurements made mainly in the plow layer. Recent deep-soil studies have questioned cover crops’ climate benefits. In a 10-year experiment that sampled down to 3.3 feet, soil scientists at Iowa State University found that deep-rooted perennials and cover crops revved up soil microbes that released much of the crops’ deposited carbon back into the atmosphere. 'Simply adding more carbon in doesn’t necessarily mean that carbon is going to stay there,' says study coauthor Steven Hall.

University of California, Davis researchers, in a 19-year study that measured down to 6.6 feet depth, found that cover-cropping alone didn’t add carbon, unless supplemented by compost, which can be expensive. 'It was really surprising to us,' Nicole Tautges, the study lead, says. 'The way we see it, at least in our semi-arid Mediterranean production context, cover crops don’t seem to be doing what people say they do.'

Still other studies have found that increasing soil carbon, in some cases, can supercharge soil microbes that consume nitrogen and emit the powerful greenhouse gas nitrous oxide, potentially offsetting carbon sequestration’s climate benefits unless nitrogen fertilizers are carefully managed.

Studies questioning soil carbon sequestration’s benefits, however, are often conducted at long-term university or government research plots, which do not necessarily replicate the many and various management decisions made on real-world farms, experts say. 'The papers that go against the initiative I think have as many holes as the papers that argue that you can do it,' says Mark Bradford, a soil scientist at the Yale School of Forestry & Environmental Studies.

COMET-Farm, the tool Nori relies on, reflects both the promise and the limitations of today’s soil science. It is based largely on computer models that the U.S uses to annually report ***agriculture***-related greenhouse gas emissions to the United Nations. Numerous people, including Bradford, say these models — validated by ***data*** gathered from more than 100 research sites — are among the best attempts to simulate soil’s complex chemistry and biology.

But even 100 sites capture only a tiny sample of the 300,000 known soil types and the thousands of decisions a farmer could make over a career’s worth of growing seasons. COMET-Farm also essentially punts on the deep soil question, considering only changes in carbon in the upper 12 inches of the soil.

For William Schlesinger, president emeritus of the Cary Institute of Ecosystem Studies in Millbrook, New York, who hasstrongly questionedwhether soil carbon sequestration can fight climate change, ignoring the subsoil is a potentially fatal flaw for emerging carbon markets. 'Before payments were achieved, I’d want to see somebody having sampled down to (3.3 feet) depth, and only pay for the net total accumulation, if any,' Schlesinger says.

Keith Paustian, a soil ecologist at Colorado State University who leads the development of COMET-Farm, says his team soon will publish statistical uncertainty estimates for the model’s predictions, which will aid Nori and other users. But he thinks the science is already robust enough to support carbon markets. 'We’ve got a pretty solid empirical base from decades of soil science and field measurements,' Paustian says. 'I definitely think that we know enough to move forward.'

Last year, Bradford assembled a group of researchers from academia and conservation to assess whether available science supported soil-based climate solutions. Ina paper in Nature Sustainability, the authors agreed that regenerative ***agriculture*** practices can sequester carbon. But they acknowledged that existing methods cannot accurately measure how quickly that carbon accumulates on a particular farm. One of Bradford’s doctoral students is developinga handheld field scannerto provide such measurements by correlating properties of light reflected off soils with soil carbon content.

Bradford also calls for dedicated experiments to sample a far wider range of farms, growing practices and soil types. He is advising Indigo Ag on such a project, theTerraton Experiment, that’s slated to run through at least 2029 and will support the company’s carbon market. The study already has sampled soils on tens of thousands of acres, some to a depth of 3.3 feet, and ultimately will compile the biggest dataset ***collected*** to assess the climate impact of farming practices, says Dan Harburg, Indigo’s senior director of systems innovation.

One participating farmer, Tom Cannon of Oklahoma, told me Indigo researchers visit his farm weekly to take soil samples and interview him about his practices. 'It’s the most comprehensive amount of ***data*** anybody has asked me for,' he says.

Beyond scientific and measurement uncertainties, scientists also worry that simple biophysical limitations of soil carbon sequestration are being overlooked. USDA’s Baker notes how easy it is for carbon stored in topsoil to be released back to the atmosphere if, say, a farmer decides to till after years of no-till, or soil microbe respiration rates increase as the globe warms — something predicted by multiple studies. 'You’re not locking carbon in a vault,' he says.

Additionally, notes Hanna Poffenbarger, a soil scientist at the University of Kentucky, no soil is a bottomless carbon sink. Even topsoil, where potential carbon gains are best documented, re-equilibrates to a stable carbon concentration after a few decades of no-till farming or cover cropping.A 2018 review from researchers in the United Kingdomnoted that that is already happening in some places.

Everybody I spoke with agrees that regenerative ***agriculture*** is good for soil health and has important environmental benefits that may be worth paying for. Most believe that soils may have a role to play in drawing down carbon. But nearly all scientists also want more certainty before wholeheartedly endorsing fighting climate change using farming practices.

Says Baker: 'To rely on those for real mitigation of climate change is, I think, a risky business.'

**Load-Date:** April 17, 2020

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[***Federal Register: National Organic Program; Proposed Amendments to the National List of Allowed and Prohibited Substances per April 2019 NOSB Recommendations (Livestock and Handling) Pages 34651 - 34655 [FR DOC #2020-11840]***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:603C-NCP1-JDG9-Y0JV-00000-00&context=1516831)

Impact News Service

June 8, 2020 Monday

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**Length:** 5337 words

**Body**

Washington: Office of the Federal Register has issued the following notice:DEPARTMENT OF AGRICULTUREAgricultural Marketing Service7 CFR Part 205[Document Number AMS-NOP-19-0053; NOP-19-02]RIN 0581-AD92National Organic Program; Proposed Amendments to the National List of Allowed and Prohibited Substances per April 2019 NOSB Recommendations (Livestock and Handling)AGENCY: ***Agricultural*** Marketing Service, USDA.ACTION: Proposed rule.-----------------------------------------------------------------------SUMMARY: This proposed rule would amend the National List of Allowed and Prohibited Substances (National List) section of the United States Department of ***Agriculture***'s (USDA's) organic regulations to implement recommendations submitted to the Secretary of ***Agriculture*** (Secretary) by the National Organic Standards Board (NOSB). This rule proposes to add the following substances to the National List: Oxalic acid dihydrate as a pesticide for organic apiculture; pullulan for use in organic handling in products labeled, ``Made with organic (specified ingredients or food group(s))''; and collagen gel casing as a nonorganic ***agricultural*** substance for use in organic handling when organic forms of collagen gel casing are not commercially available.DATES: Comments must be received by August 7, 2020.ADDRESSES: Interested persons may comment on the proposed rule using the following procedures: Federal eRulemaking Portal: [*https://www.regulations.gov*](https://www.regulations.gov). Follow the instructions for submitting comments. Mail: Robert Pooler, Standards Division, National Organic Program, USDA-AMS-NOP, 1400 Independence Ave. SW, Room 2642-S, Ag Stop 0268, Washington, DC 20250-0268. Telephone: (202) 720-3252. Instructions: All submissions received must include the docket number AMS-NOP-19-0053, NOP-19-02, and/or Regulatory Information Number (RIN) 0581-AD83 for this rulemaking. When submitting a comment, clearly indicate the proposed rule topic and section number to which the comment refers. In addition, comments should clearly indicate whether the commenter supports the action being proposed and, also clearly indicate the reason(s) for the position. Comments can also include information on alternative management practices, where applicable, that support alternatives to the proposed amendments. Comments should also offer any recommended language change(s) that would be appropriate to the position. Please include relevant information and ***data*** to support the position such as scientific, environmental, manufacturing, industry, or impact information, or similar sources. Only relevant material supporting the position should be submitted. All comments received will be posted without change to   [*https://www.regulations.gov*](https://www.regulations.gov). Document: To access the document and read background documents or comments received, go to   [*https://www.regulations.gov*](https://www.regulations.gov). Comments submitted in response to this proposed rule will also be available for viewing in person at USDA-AMS, National Organic Program, Room 2642--South Building, 1400 Independence Ave. SW, Washington, DC, from 9 a.m to 12 noon and from 1 p.m to 4 p.m Eastern Time, Monday through Friday (except official Federal holidays). Persons wanting to visit the USDA South Building to view comments received in response to this proposed rule are requested to make an appointment in advance by calling (202) 720-3252.FOR FURTHER INFORMATION CONTACT: Robert Pooler, Standards Division, National Organic Program. Telephone: (202) 720-3252.SUPPLEMENTARY INFORMATION: I. Background On December 21, 2000, the Secretary established the National List within part 205 of the USDA organic regulations (7 CFR 205.600 through 205.607). The National List identifies the synthetic substance allowances and the nonsynthetic substance prohibitions in organic farming. The National List also identifies synthetic and nonsynthetic nonagricultural substances and nonorganic ***agricultural*** substances that may be used in organic handling. The Organic Foods Production Act of 1990, as amended (7 U.S.C 6501-6524) (OFPA), and the USDA organic regulations specifically prohibit the use of any synthetic substance in organic production and handling unless the synthetic substance is on the National List. Section 205.105 also requires that any nonorganic ***agricultural*** and any nonsynthetic nonagricultural substance used in organic handling be on the National List. Under the authority of OFPA, the National List can be amended by the Secretary based on recommendations presented by the NOSB. Since the final rule establishing the National Organic Program (NOP) became effective on October 21, 2002, USDA's ***Agricultural*** Marketing Service (AMS) has published multiple rules amending the National List. This proposed rule addresses NOSB recommendations to amend the National List that were submitted to the Secretary on April 26, 2019. Table 1 summarizes the proposed changes to the National List based on these NOSB recommendations. Table 1--Substances Being Added to the National List or Current Listings Being Amended---------------------------------------------------------------------------------------------------------------- National list Substance section Proposed rule action----------------------------------------------------------------------------------------------------------------Oxalic acid dihydrate...................... Sec. 205.603 Add to National List.Pullulan................................... Sec. 205.605 Add to National List.Collagen gel casing........................ Sec. 205.606 Add to National List.----------------------------------------------------------------------------------------------------------------[[Page 34652]]II. Overview of Proposed Amendments The following provides an overview of the proposed amendments to designated sections of the National List regulations:Sec. 205.603 Synthetic Substances Allowed for Use in Organic Livestock ProductionOxalic Acid Dihydrate The proposed rule would amend the National List to add oxalic acid dihydrate to Sec. 205.603 as a synthetic substance allowed for use in livestock production. Table 2 illustrates the proposed listing. Table 2--Proposed Rule Action for Oxalic Acid Dihydrate------------------------------------------------------------------------ Current rule: N/A------------------------------------------------------------------------Proposed rule action:.................. Add oxalic acid dihydrate to Sec. 205.603(b).------------------------------------------------------------------------ On October 3, 2017, AMS received a petition to add oxalic acid dihydrate to the National List as a parasiticide treatment of Varroa destructor (``Varroa'') mites in beehives.\1\ Oxalic acid is a naturally occurring substance and oxalic acid dihydrate is produced through a chemical process. The EPA has approved the use of oxalic acid dihydrate to control Varroa mites (EPA Registration no. 91266-1).\2\ Oxalic acid dihydrate may be applied to beehives by solution or vapor treatment and to package bees by solution. According to the petition, the only treatment for controlling Varroa mite infestation in beehives that is currently available to organic honey producers is formic acid.--------------------------------------------------------------------------- \1\ Oxalic acid petition:   [*https://www.ams.usda.gov/sites/default/files/media/OxalicAcidPetition10032017.pdf*](https://www.ams.usda.gov/sites/default/files/media/OxalicAcidPetition10032017.pdf). \2\ U.S Environmental Protection Agency, Notice of Pesticide Registration, March 10, 2015,   [*https://www3.epa.gov/pesticides/chem\_search/ppls/091266-00001-20150310.pdf.---------------------------------------------------------------------------*](https://www3.epa.gov/pesticides/chem_search/ppls/091266-00001-20150310.pdf.---------------------------------------------------------------------------) In its recommendation to add oxalic acid dihydrate to the National List, the NOSB noted that formic acid hive fumigation may be detrimental to the bee brood. The NOSB determined that oxalic acid dihydrate would provide organic honey producers with a substance that may be an alternative to, or used in rotation with, formic acid to lessen the potential for pesticide resistance. The NOSB reviewed and considered this petition, a technical report, and public comments on oxalic acid dihydrate at its public meeting on April 26, 2019.3 4 At this meeting, the NOSB determined that adding oxalic acid dihydrate to the National List is consistent with the OFPA criteria. In its recommendation to add oxalic acid dihydrate as a pesticide in apiculture, the NOSB noted that there were no environmental concerns with this substance, it would provide additional use benefits over formic acid, and would be supported by beekeepers.\5\--------------------------------------------------------------------------- \3\ Technical Evaluation Report for oxalic acid dihydrate:   [*https://www.ams.usda.gov/sites/default/files/media/OxalicAcidTR.pdf*](https://www.ams.usda.gov/sites/default/files/media/OxalicAcidTR.pdf). \4\ Access to written and oral public comments submitted for the April 2019 NOSB meeting is available here:   [*https://www.ams.usda.gov/event/national-organic-standards-board-nosb-meeting-seattle-wa*](https://www.ams.usda.gov/event/national-organic-standards-board-nosb-meeting-seattle-wa). \5\ NOSB recommendation for oxalic acid dihydrate:   [*https://www.ams.usda.gov/sites/default/files/media/LSOxalicAcidApril2019FinalRec.pdf.---------------------------------------------------------------------------*](https://www.ams.usda.gov/sites/default/files/media/LSOxalicAcidApril2019FinalRec.pdf.---------------------------------------------------------------------------) AMS reviewed the petition, technical report, and NOSB's recommendation for oxalic acid dihydrate. AMS concurs with the NOSB's determination that oxalic acid dihydrate, when manufactured as described in the petition, is a synthetic substance. To address the NOSB's recommendation, AMS is proposing to add oxalic acid dihydrate to the National List as an allowed pesticide only in apiculture. As described in the petition, the only effective Varroa mite treatment on the National List that is currently available to organic honey producers is formic acid. Sucrose octanoate esters is also on the National List as a treatment for Varroa mite infestation. However, there are no current EPA registered products for sucrose octanoate esters, and the NOSB has recommended that sucrose octanoate esters be removed from the National List.\6\ AMS agrees with the NOSB recommendation that it is necessary for organic producers to have another substance, in addition to formic acid, to control Varroa mite infestation. Oxalic acid dihydrate may be used in place of formic acid because of lower toxicity to the bee brood or in rotation with formic acid to reduce the potential for pesticide resistance. Consequently, this proposed rule would allow oxalic acid dihydrate as a pesticide in organic apiculture.--------------------------------------------------------------------------- \6\ NOSB recommendation (October 2018) available at:   [*https://www.ams.usda.gov/sites/default/files/media/LS2020SunsetFinalRecOct2018.pdf.---------------------------------------------------------------------------Sec*](https://www.ams.usda.gov/sites/default/files/media/LS2020SunsetFinalRecOct2018.pdf.---------------------------------------------------------------------------Sec). 205.605 Nonagricultural (Nonorganic) Substances Allowed as Ingredients in or on Processed Products Labeled as ``Organic'' or ``Made With Organic (Specified Ingredients or Food Group(s))''Pullulan The proposed rule would amend the National List to add pullulan to Sec. 205.605(a) as an ingredient allowed in products labeled, ``Made with organic (specified ingredients or food group(s)).'' Table 3 illustrates the proposed listing. Table 3--Proposed Rule Action for Pullulan------------------------------------------------------------------------ Current rule: N/A------------------------------------------------------------------------Proposed rule action:.................. Add pullulan to Sec. 205.605(a).------------------------------------------------------------------------ On January 31, 2018, AMS received a petition \7\ to add pullulan as a nonsynthetic substance allowed for use in organic handling as an ingredient in tablets and capsules for dietary supplements labeled ``made with organic (specified ingredients or food group(s)).'' Pullulan, as described in a technical report solicited by the NOSB, is a natural extracellular polysaccharide excretion resulting from carbohydrate fermentation by the yeast-like fungus Aureobasidium pullulans and other non-toxic fungi strains.\8\ The fungus A. pullulans is ubiquitous in nature and is most common in temperate zones in locations such as forest soil, freshwater, on plant leaves, and on seeds. The technical report also explains that the U.S Food and Drug Administration (FDA) allows pullulan for use as a tablet coating, as an excipient, and as an alternative to gelatin in capsule production. Pullulan has been self-affirmed as GRAS (Generally Recognized as Safe) for specified uses in food including as an emulsifier, ***nutrient*** supplement, thickener, and texturizer (GRN No. 99).\9\--------------------------------------------------------------------------- \7\ Pullulan petition:   [*https://www.ams.usda.gov/sites/default/files/media/PullulanPetition18131.pdf*](https://www.ams.usda.gov/sites/default/files/media/PullulanPetition18131.pdf). \8\ Pullulan technical report:   [*https://www.ams.usda.gov/sites/default/files/media/PullulanTechnicalReportFinal09072018.pdf*](https://www.ams.usda.gov/sites/default/files/media/PullulanTechnicalReportFinal09072018.pdf). \9\ GRAS Notice (GRN) No. 99, ``Pullulan,'' available at:   [*https://www.accessdata.fda.gov/scripts/fdcc/?set=GRASNotices.---------------------------------------------------------------------------*](https://www.accessdata.fda.gov/scripts/fdcc/?set=GRASNotices.---------------------------------------------------------------------------) At its April 26, 2019, public meeting, the NOSB considered the petition, technical report, and public comments, and determined that (1) pullulan is a nonsynthetic substance and (2) the use of pullulan as an ingredient used in tablets and capsules for dietary supplements is consistent with the OFPA evaluation criteria for National List substances. Therefore, the NOSB recommended adding pullulan to Sec. 205.605(a) as a nonsynthetic, nonagricultural substance allowed for use in organic handling.\10\--------------------------------------------------------------------------- \10\ NOSB Pullulan recommendation:   [*https://www.ams.usda.gov/sites/default/files/media/HSPullullanApr2019FinalRec.pdf.---------------------------------------------------------------------------*](https://www.ams.usda.gov/sites/default/files/media/HSPullullanApr2019FinalRec.pdf.---------------------------------------------------------------------------) AMS has reviewed the NOSB recommendation on pullulan and agrees that pullulan, as petitioned, is a nonsynthetic, nonagricultural substance[[Page 34653]]that meets the OFPA criteria for listing as a substance allowed for use in organic handling. AMS recognizes that other manufacturing methods may yield pullulan which could be classified as ***agricultural*** and certified organic. Consistent with the NOSB recommendation, AMS proposes to amend the National List by adding pullulan for use in tablets and capsules for dietary supplements labeled ``Made with organic (specified ingredients and food group(s)).'' AMS welcomes additional information on the proposed classification of pullulan as a nonsynthetic, nonagricultural substance and whether it may be certifiable as organic.Sec. 205.606 Nonorganically Produced ***Agricultural*** Products Allowed as Ingredients in or on Processed Products Labeled as ``Organic''Collagen Gel Casing The proposed rule would amend the National List to add collagen gel casing as a nonorganic ***agricultural*** substance listed in Sec. 205.606 for use in organic handling. Table 4--Proposed Rule Action for Collagen Gel Casing------------------------------------------------------------------------ Current rule: N/A------------------------------------------------------------------------Proposed rule action:.................. Add collagen gel casing to Sec. 205.606 ------------------------------------------------------------------------ On February 23, 2018, AMS received a petition to add collagen gel to the National List for use in organic handling as an ingredient in a co-extrusion organic sausage production system.\11\ The petition explains that in sausage production collagen gel forms an edible film that binds and forms the meat, acts as a protective barrier, and is an ingredient in the final product. Collagen gel is an alternative to natural (animal byproducts) or manufactured (cellulose) casings traditionally used in sausage production. Collagen gel, as described in the petition, is derived from animal collagen that has been subjected to a limited (partial) protein hydrolysis via acid/base treatment, and a particle size reduction through a physical sieve. Water is then added to the resulting collagen pulp and the mixture is physically agitated to produce a gel. The final step involves lowering the gel pH to a range of 2.4-2.8 with an acid treatment.--------------------------------------------------------------------------- \11\ Collagen gel petition:   [*https://www.ams.usda.gov/sites/default/files/media/CollagenGelPetition.pdf.---------------------------------------------------------------------------*](https://www.ams.usda.gov/sites/default/files/media/CollagenGelPetition.pdf.---------------------------------------------------------------------------) At its April 26, 2019, public meeting, the NOSB considered the petition to add collagen gel to the National List for use in organic handling. As part of its review, the NOSB considered a technical report on collagen gel that described its manufacture, industry uses, chemical properties, and regulation.\12\ The USDA Food Safety and Inspection Service regulates collagen gel as an ingredient in meat products (9 CFR 319.104 and 319.140).--------------------------------------------------------------------------- \12\ Collagen gel technical evaluation report:   [*https://www.ams.usda.gov/sites/default/files/media/CollagenGelGelatinCasingsTechnicalReport01282019.pdf.---------------------------------------------------------------------------*](https://www.ams.usda.gov/sites/default/files/media/CollagenGelGelatinCasingsTechnicalReport01282019.pdf.---------------------------------------------------------------------------) After considering the petition, technical report, and public comments on collagen gel, the NOSB determined that the allowance of nonorganic collagen gel for use as an ingredient in organic handling is consistent with the OFPA evaluation criteria for National List substances.\13\ The NOSB handling subcommittee discussed the collagen gel manufacturing process and considered whether this process induces change in the collagen chemical structure which would classify this as a synthetic substance. The NOSB determined that it is an ***agricultural*** substance and should be listed in Sec. 205.606 because the collagen protein is denatured, but the structure is not chemically changed. Subsequently, the NOSB recommended adding collagen gel casing to Sec. 205.606 as a nonorganically produced ***agricultural*** product allowed as an ingredient in or on processed products labeled as ``organic'' when organic forms are not commercially available.--------------------------------------------------------------------------- \13\ NOSB recommendation, collagen gel:   [*https://www.ams.usda.gov/sites/default/files/media/HSCollagenGelApr2019FinalRec.pdf.---------------------------------------------------------------------------*](https://www.ams.usda.gov/sites/default/files/media/HSCollagenGelApr2019FinalRec.pdf.---------------------------------------------------------------------------) AMS has reviewed the NOSB recommendation on collagen gel and agrees that collagen gel meets the OFPA evaluation criteria for an allowed substance on the National List. AMS is proposing to list collagen gel casing as a nonorganic ***agricultural*** ingredient allowed when an organic form is not commercially available. This action would require organic handlers to source organic forms of collagen gel before using any nonorganic source of this ingredient. If the organic form of the ingredient is not commercially available, the nonorganic form may be used.\14\--------------------------------------------------------------------------- \14\ See 7 CFR 205.606 and 7 CFR 205.2 for definition of ``Commercially available.''--------------------------------------------------------------------------- AMS is seeking comment on whether collagen gel is properly classified as an ***agricultural*** substance and could potentially be certified organic. According to the collagen gel petition, the manufacturing process includes a procedure that adjusts the pH of the gel to a target range between 2.4-2.8 (strongly acidic) by treating it with three acids: Acetic, lactic, and hydrochloric acids. AMS welcomes additional information on whether the use of acid induces chemical change(s) in the collagen gel which should cause the substance to be classified as a nonagricultural, synthetic substance.\15\--------------------------------------------------------------------------- \15\ A change in collagen gel's chemical structure would potentially categorize it as a synthetic substance, as defined by the OFPA (7 U.S.C 6502(22)).---------------------------------------------------------------------------III. Related Documents AMS published a notice in the Federal Register (83 FR 60373) on November 26, 2018, announcing the Spring 2019 NOSB meeting. This notice invited public comments on the NOSB recommendations on the substances addressed in this proposed rule.IV. Statutory and Regulatory Authority The OFPA authorizes the Secretary to make amendments to the National List based on recommendations developed by the NOSB. Sections 6518(k) and 6518(n) of the OFPA authorize the NOSB to develop recommendations for submission to the Secretary to amend the National List and establish a process by which persons may petition the NOSB for the purpose of having substances evaluated for inclusion on or deletion from the National List. Section 205.607 of the USDA organic regulations permits any person to petition to add or remove a substance from the National List and directs petitioners to obtain the petition procedures from USDA. The current petition procedures published in the Federal Register (81 FR 12680, March 10, 2016) for amending the National List can be accessed through the NOP Program Handbook on the NOP website at   [*https://www.ams.usda.gov/rules-regulations/organic/handbook.A*](https://www.ams.usda.gov/rules-regulations/organic/handbook.A). Executive Orders 12866 and 13771, and Regulatory Flexibility Act This action falls within a category of regulatory actions that the Office of Management and Budget (OMB) has exempted from Executive Order 12866. Additionally, because this proposal does not meet the definition of a significant regulatory action, it does not trigger the requirements contained in Executive Order 13771. See OMB's Memorandum titled ``Interim Guidance Implementing Section 2 of the Executive Order of January 30, 2017 titled `Reducing Regulation and Controlling Regulatory Costs'[thinsp]'' (February 2, 2017). The Regulatory Flexibility Act (RFA) (5 U.S.C 601-612) requires agencies to consider the economic impact of each rule on small entities and evaluate alternatives that would accomplish the objectives of the rule without unduly[[Page 34654]]burdening small entities or erecting barriers that would restrict their ability to compete in the market. The purpose of the RFA is to fit regulatory actions to the scale of businesses subject to the action. Section 605 of the RFA allows an agency to certify a rule, in lieu of preparing an analysis, if the rulemaking is not expected to have a significant economic impact on a substantial number of small entities. The Small Business Administration (SBA) sets size criteria for each industry described in the North American Industry Classification System (NAICS) to delineate which operations qualify as small businesses. The SBA has classified small ***agricultural*** producers that engage in crop and animal production as those with average annual receipts of less than $1,000,000. Handlers are involved in a broad spectrum of food production activities and fall into various categories in the NAICS Food Manufacturing sector. The small business thresholds for food manufacturing operations are based on the number of employees and range from 500 to 1,250 employees, depending on the specific type of manufacturing. Certifying agents fall under the NAICS subsector, ``All other professional, scientific and technical services.'' For this category, the small business threshold is average annual receipts of less than $16.5 million. AMS has considered the economic impact of this proposed rulemaking on small ***agricultural*** entities. ***Data*** ***collected*** by the USDA National ***Agricultural*** ***Statistics*** Service (NASS) and the NOP indicate most of the certified organic production operations in the United States would be considered small entities. According to the 2017 Census of ***Agriculture***, 18,166 organic farms in the United States reported sales of organic products and total farmgate sales in excess of $7.2 billion.\16\ Based on that ***data***, organic sales average $400,000 per farm. Assuming a normal distribution of producers, we expect that most of these producers would fall under the $750,000 sales threshold to qualify as a small business.--------------------------------------------------------------------------- \16\ U.S Department of ***Agriculture***, National ***Agricultural*** ***Statistics*** Service. 2017 Census of ***Agriculture***.   [*https://www.nass.usda.gov/Publications/AgCensus/2017/Full\_Report/Volume\_1,\_Chapter\_1\_US/*](https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_US/). The number of organic farms includes both certified and exempt farms.--------------------------------------------------------------------------- According to the NOP's Organic Integrity Database, there are 19,671 organic handlers that are certified under the USDA organic regulations.\17\ The Organic Trade Association's 2018 Organic Industry Survey has information about employment trends among organic manufacturers. The reported ***data*** are stratified into three groups by the number of employees per company: Less than 5; 5 to 49; and 50 plus. These ***data*** are representative of the organic manufacturing sector and the lower bound (50) of the range for the larger manufacturers is significantly smaller than the SBA's small business thresholds (500 to 1,250). Therefore, AMS expects that most organic handlers would qualify as small businesses.--------------------------------------------------------------------------- \17\ Organic Integrity Database:   [*https://organic.ams.usda.gov/Integrity/*](https://organic.ams.usda.gov/Integrity/). Accessed on April 13, 2020.--------------------------------------------------------------------------- The USDA has 78 accredited certifying agents who provide organic certification services to producers and handlers. The certifying agent that reports the most certified operations, nearly 3,500, would need to charge approximately $4,200 in certification fees in order to exceed the SBA's small business threshold of $15 million. The costs for certification generally range from $500 to $3,500, depending on the complexity of the operation. Therefore, AMS expects that most of the accredited certifying agents would qualify as small entities under the SBA criteria. The economic impact on entities affected by this rule would not be significant. The effect of this proposed rule would be to allow the use of three additional substances in organic crop production and organic handling. Adding three substances to the National List would increase regulatory flexibility and would give small entities more tools to use in day-to-day operations. AMS welcomes public comment on our assessment of costs and benefits and whether commenters have any additional information that would help establish that the action has total costs less than zero and therefore qualifies as an E.O 13771 deregulatory action. One way to have `costs less than zero' is to show that the rule allows business activity that is not allowed under the current regulations. Providing the monetary amount of such allowed business activity would be ideal.B. Executive Order 12988 Executive Order 12988 instructs each executive agency to adhere to certain requirements in the development of new and revised regulations in order to avoid unduly burdening the court system. This proposed rule is not intended to have a retroactive effect. Accordingly, to prevent duplicative regulation, states and local jurisdictions are preempted under the OFPA from creating programs of accreditation for private persons or state officials who want to become certifying agents of organic farms or handling operations. A governing state official would have to apply to USDA to be accredited as a certifying agent, as described in section 6514(b) of the OFPA. States are also preempted under sections 6503 through 6507 of the OFPA from creating certification programs to certify organic farms or handling operations unless the state programs have been submitted to, and approved by, the Secretary as meeting the requirements of the OFPA. Pursuant to section 6507(b)(2) of the OFPA, a state organic certification program that has been approved by the Secretary may, under certain circumstances, contain additional requirements for the production and handling of ***agricultural*** products organically produced in the state and for the certification of organic farm and handling operations located within the state. Such additional requirements must (a) further the purposes of the OFPA, (b) not be inconsistent with the OFPA, (c) not be discriminatory toward ***agricultural*** commodities organically produced in other States, and (d) not be effective until approved by the Secretary. In addition, pursuant to section 6519(c)(6) of the OFPA, this proposed rule would not supersede or alter the authority of the Secretary under the Federal Meat Inspection Act (21 U.S.C 601-624), the Poultry Products Inspection Act (21 U.S.C 451-471), or the Egg Products Inspection Act (21 U.S.C 1031-1056), concerning meat, poultry, and egg products, respectively, nor any of the authorities of the Secretary of Health and Human Services under the Federal Food, Drug and Cosmetic Act (21 U.S.C 301 et seq.), nor the authority of the Administrator of the EPA under the Federal Insecticide, Fungicide and Rodenticide Act (7 U.S.C 136 et seq.).C. Paperwork Reduction Act No additional ***collection*** or recordkeeping requirements are imposed on the public by this proposed rule. Accordingly, OMB clearance is not required by the Paperwork Reduction Act of 1995, 44 U.S.C 3501, Chapter 35.D. Executive Order 13175 This proposed rule has been reviewed in accordance with the requirements of Executive Order 13175, Consultation and Coordination with Indian Tribal Governments. The review reveals that this regulation will not have substantial and direct effects on tribal governments and will not have significant tribal implications.[[Page 34655]]F. General Notice of Public Rulemaking This proposed rule reflects recommendations submitted by the NOSB to the Secretary to add three substances to the National List. A 60-day period for interested persons to comment on this rule is provided.List of Subjects in 7 CFR Part 205 Administrative practice and procedure, ***Agricultural*** commodities, ***Agriculture***, Animals, Archives and records, Fees, Imports, Labeling, Organically produced products, Plants, Reporting and recordkeeping requirements, Seals and insignia, Soil conservation. For the reasons set forth in the preamble, 7 CFR part 205 is proposed to be amended as follows:PART 205--NATIONAL ORGANIC PROGRAM01. The authority citation for 7 CFR part 205 continues to read as follows: Authority: 7 U.S.C 6501-6522.02. Amend Sec. 205.603 by redesignating paragraphs (b)(8) through (11) as paragraphs (b)(9) through (12) and adding new paragraph (b)(8) to read as follows:Sec. 205.603 Synthetic substances allowed for use in organic livestock production.\* \* \* \* \* (b) \* \* \* (8) Oxalic acid dihydrate--for use as a pesticide solely for apiculture.\* \* \* \* \*03. Amend Sec. 205.605 in paragraph (a) by adding, in alphabetical order an entry for ``Pullulan'' to read as follows:Sec. 205.605 Nonagricultural (nonorganic) substances allowed as ingredients in or on processed products labeled as ``organic'' or ``made with organic (specified ingredients or food group(s)).'' (a) \* \* \* Pullulan--for use only in tablets and capsules for dietary supplements labeled ``made with organic (specified ingredients or food group(s)).''\* \* \* \* \*04. Amend Sec. 205.606 by redesignating paragraphs (d) through (w) as paragraphs (e) through (x) and adding new paragraph (d) to read as follows:Sec. 205.606 Nonorganically produced ***agricultural*** products allowed as ingredients in or on processed products labeled as ``organic.''\* \* \* \* \* (d) Collagen gel casing.\* \* \* \* \*Bruce Summers,Administrator, ***Agricultural*** Marketing Service.[FR Doc. 2020-11840 Filed 6-5-20; 8:45 am] BILLING CODE 3410-02-P

**Load-Date:** June 9, 2020

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[***Blue bioeconomy localities at the margins: Reconnecting Norwegian seaweed farming and Finnish small-scale lake fisheries with blue policies***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6BGY-HK51-JBMY-H420-00000-00&context=1516831)

Environment and Planning C: Politics and Space

November 2020

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**Section:** Pg. 1465-1483; Vol.38; No.7-8; ISSN: 2399-6544, 2399-6552

**Length:** 9359 words

**Byline:** Moritz Albrecht

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**ABSTRACT**

The blue bioeconomy is gaining momentum in EU policy debate and various national government strategies as a pathway towards a more sustainable society. Linked to the circularity of economic processes, it combines the promise of (regional) economic development with a sustainable, bio-based transition focused on increased and novel utilisation of aquatic resources. Nonetheless, portrayed as a holistic approach, the political visions of blue bioeconomy reside predominantly in marine environments with little integration of freshwater perspectives or alternative development paths. Rooted in concepts of policy mobility, assembling processes and the positionalities of involved entities, this paper displays two regionally embedded blue bioeconomy developments – Norwegian coastal seaweed farming and Finnish lake fisheries – and their spatially diverse reconnections with national and international policy narratives. By framing a freshwater and a coastal marine case, and their spatial reconnections with an overarching yet diversely translated policy realm, the paper taps into the multiple ontologies of water in blue bioeconomy governance and presents initial empirical and methodological steps towards a relational understanding of its governance processes. Based on four key topical reconnections, the article points to a variety of challenging mismatches between policy narratives, local development processes and potentials. It also suggests conceptual and methodological implications of this approach for further research into “blue” resource governance.

**FULL TEXT**

**Introduction**

The bioeconomy and its aquatic subsidiary the blue bioeconomy are both strands of a wider green economic transition that currently plays a key role in government strategies and pathways towards a more sustainable society. Linked to the circularity of economic processes, both combine the promise of (regional) economic development with a sustainable, bio-based transition (EC, 2018, 2019a). The concept of land-based bioeconomy has been scrutinised through a variety of academic lenses, including its visions, sustainability aspects and locality studies (e.g. Albrecht, 2019; Bugge et al., 2016; Pfau et al., 2014). This academic attention is less present for blue bioeconomy developments despite the fact that 71% of the earth’s surface is covered by water (Peters, 2010) and the pivotal role that aquatic resources are expected to play within a sustainable societal transition (EC, 2018, 2019b). In its role as a green transition policy and in comparison to land based resource exploitation, the blue bioeconomy is hailed for its capacity to relieve pressure on land use and create value without necessarily overexploiting resources by focusing on water areas, largely perceived as underutilised (e.g. EESC, 2019; MMM, 2016). In this vein, much of the blue bioeconomy is not only earmarked as “green” in itself, but there is a circular component of environmental improvement (e.g. rejuvenation, CO2 storage, reduced land-use pressure) attached to many of its current developments.

While the blue bioeconomy is defined as “ … any economic activity associated with the use of renewable aquatic biological resources to make products … ” (EUMOFA, 2018), its current political and academic treatment (re-)produces it as a chimera taking forms through either blue growth, marine/coastal planning or watershed management paradigms that lack interconnectivity. In the EU, and elsewhere, the lack of concrete and institutionalised blue bioeconomy policies promote this divide while core aspects of blue bioeconomy policy are located in different and partially contrasting policy fields with a predominant focus on marine/coastal environments (e.g. EC, 2017). This situation is a derivative of the split responsibilities of various European Commission bodies (e.g. DG’s R&I, MARE, ENVI, TRADE), their various focal areas, and from the different approaches of how countries interpret the blue bioeconomy. For instance, in the EU Finland is an exception because it actively includes inland waters in its current blue bioeconomy development (MMM, 2016), while even the current working group for an EU blue bioeconomy strategy pays only lip service to inland waters. Nevertheless, emerging political calls for a more inclusive blue bioeconomy have been raised (e.g. EC, 2019b; EESC, 2019), which places the blue bioeconomy in the initial phase of policy mobility processes and translation (e.g. McCann and Ward, 2012).

Aside from this divided and biased political employment, treatment of the blue bioeconomy and water-based governance research is further criticised as lacking an in-depth relational spatial focus that would allow its underlying processes and local materialisations to be displayed (e.g. Steinberg and Peters, 2015; Winder and LeHeron, 2017). The often normative sector or institutionally framed treatment of blue bioeconomy developments enables valuable assessments of blue policy visions, regional innovation networks, or water-based spatial planning (e.g. Silver et al., 2015; Voyer et al., 2018). The blue bioeconomy is more than the narrow definition above, it must be considered as part of a wider green/sustainable transition process that spans beyond land-sea and aquatic-society dualisms (e.g. Anderson and Peters, 2016; Yates et al., 2017). There is consequently a need to scrutinise not only the core, but also the margins of its potential developments. Based on their predominant approaches, many current academic treatments seem ill suited to portray alternative blue bioeconomy developments not framed by a highly visible innovation component that propels them to the forefronts of policy or academic attention. Yet, despite their small public imprint, such developments are important pieces in the assembling of blue bioeconomy governance and its local materialisations. Furthermore, academic treatment of blue bioeconomy policies remains largely restricted to its particular field of policy (e.g. EU Water Framework Directive, Blue Growth Strategies) due to the lack of a uniting strategy similar to the EU circular economy package (EC, 2015). Consequently, more inclusive blue bioeconomy focused evaluations of national approaches and their role for particular local developments are currently missing.

Hence, this paper aims to contribute to two interlinked academic fields to forward an initial and deepened understanding of blue bioeconomy governance and address multiple water ontologies (Peters and Steinberg, 2019; Winder and LeHeron, 2017). First, it opens up the blue bioeconomy as an uncharted field of research to overcome the dualistic treatment criticised above and calls for more academic endeavours into this realm, including alternative developments. Second, it contributes to research on policy mobilities as assembling processes by scrutinizing both the initial moments when a policy is mobilized and subsequent loops of translation (Kortelainen and Albrecht, 2014). In this way it offers a conceptual and analytical frame suitable for researching blue economy initiatives within water related governance. As the paper is designed as a starting point, it does not aim to portray a detailed picture of blue bioeconomy governance but exemplifies the conceptual framings above through two particular cases in Europe and their local implementation processes: inland fisheries in North Savonia, Finland and seaweed farming in Møre and Romsdal county, Norway. The rationale for the case studies derives not from their inherit values as representative, comparable cases of blue bioeconomy developments but through their capacity to illustrate and connect diverse characteristics of blue bioeconomy policy framing and developments in a terrestrial, freshwater and marine coastal environment. Based on these cases, the paper evaluates two interlinked aspects of blue bioeconomy governance and their effects: 1) the role and characteristics of blue bioeconomy envisioned through national and regional strategies, and 2) the role of alternative developments within these green policy frameworks at the local/regional implementation level.

Based on qualitative research in the different national and regional contexts, and framed through policy mobility and translation assemblages (e.g. Baker and McGuirk, 2017; McCann and Ward, 2012), we use the cases to exemplify four key discursive-material “reconnections” (e.g. Braun and Whatmore, 2010) in the emergent stakeholder networks. These reconnections are linked to 1) valuations of resources; 2) technology and innovations; 3) local markets; and 4) emergent governance arrangements. Combined, the four elements offer a valuable perspective of the different translations and materialisations of the blue bioeconomy and counter the linear perspectives portrayed through most green/blue economy strategies and their regional potential analysis.

**Case studies and methods**

This paper focuses on two separate case studies of regional blue bioeconomy development at the margins of their respective political and economic fields. The case study in Finland examines the governance, value-chains and potentials of inland fisheries in the North Savonia region. The main ***data*** was ***collected*** in a series of workshops with experts carried out in Kuopio, the regional capital, between August 2018 and March 2019. The Norwegian case study involves the development of small-scale seaweed farming in Møre and Romsdal county on the western coast, located in the island municipality of Herøy. ***Data*** ***collection*** for the Norwegian case was conducted during a 3-week research visit to Norway, including the case study locality in summer 2019.

The paper uses a multi-methods approach as its research ***data*** stems from two separate research projects following different ***data*** ***collection*** approaches and foci. While this constellation restricts the possibilities for structural comparison between the cases (e.g. Yin, 2009), the ***data*** from the two cases are employed as examples to illustrate multiple processes of alternative developments, their translation and assembling processes in different transnational and regional environments. Additionally, their focus on different water environments yet both linked to transnational debates on blue bioeconomy development provides their employment with the potential to bridge some of the divides in water governance raised above. Both case studies rest on a set of multiple ***data*** sources with a key focus on qualitative ***data*** ***collection*** and qualitative analysis through topical entitation (Cloke et al., 2006).

For Finland, the analysis builds on the regional knowledge co-creation process on blue bioeconomy carried out through a series of seven workshops. The workshops focused on scoping the challenges, opportunities and uncertainties of the current situation, setting feasible transition goals, building pathways to achieve change by utilising a tool specifically designed for the purpose and, finally, verifying the results in several commentary rounds. Overall, 14 specialists with a variety of backgrounds in business, administration, networks and NGOs participated in the workshops, which lasted approximately 26 hours excluding the commentary work between the meetings where 10 additional commentators were included. All the discussions were recorded, and the key insights were documented by notes, videos and photographs. Additionally, three scoping interviews were arranged prior to the workshops and an assessment seminar six months after completing the workshop series.

For Norway, the key ***data*** set rests on 13 in-depth, open-ended interviews with local seaweed entrepreneurs, political bodies, planners and experts at the municipal and county levels, Norwegian Fisheries Directorate, Norwegian Seaweed Farm Association, environmental NGOs (Trondheim and Brussels), Mission of Norway to the EU and a private Norwegian institute involved in seaweed research. Interviews were conducted in English and lasted between 50 minutes and 2.5 hours. A visit to the case study site included ethnographic components, such as visits to the farm site (by boat), processing facilities and a commented walk along the coast (Winkler, 2010), including wild algae harvesting and tasting with the owner of a local seaweed farm in order to achieve a detailed picture of local seaweed potentials and challenges. Additional ***data*** derives from a document analysis focused on blue bioeconomy and aquaculture related strategy papers, legal documents and position papers from industrial associations and NGOs in Norway and at the EU level. Finally, statistical ***data*** sets on local socio-economic parameters and aquaculture ***statistics*** in Norway complement the case study.

**Approaching blue bioeconomies as assemblages**

Current research on blue bioeconomy topics falls into three categories with little connection. First, the blue economy is addressed in a variety of fields, such as marine and coastal spatial planning, and fisheries, where the core foci include blue economy visions and aquaculture governance, “blue” technology solutions and ecological potentials and processes for future development (e.g. Voyer et al., 2018). Transformation focused geographical accounts have treated matters of coastal community resilience (Kokorsch and Benediktsson, 2018), yet much literature is confined to the EU blue-growth agenda and its aspects of marine spatial planning (Lillebo et al., 2017). Similar academic focus prevails in the case study countries (e.g. Kvalvik and Robertson, 2017; Salmi, 2018). Second, freshwater governance literature focuses on river basin/watershed management and the EU water framework directive (WFD) (e.g. Boeuf and Fritsch, 2016). Additionally, integrated water resource management, adaptive water planning or a variation of nexus approaches linking water with a related entity, such as food or climate, evaluate water governance (Benson et al., 2015; Soininen and Platjouw, 2018). Attempts to integrate the politics of scale into water governance to overcome the technocratic treatment of waters by employing their co-constructed spaces have also been published (Norman et al., 2012). Third, land based bioeconomy research with a water focus is a comparably small field. It largely treats the effects of terrestrial bioeconomy developments on various water bodies (O’Brien et al., 2015) rather than regarding water bodies as potential blue bioeconomy development areas in themselves. Exceptions to this include closed system studies on CO2 and ***nutrient*** sequestration potentials of organisms such as microalgae for biofuel, chemicals, food or feed. Thus, the complexity of blue bioeconomy processes is reflected by this variety, yet the predominant economic centred and divisionary foci are at odds with a relational ontology to understand the spatialities of blue bioeconomy governance processes (Albrecht, 2019; Steinberg and Peters, 2015).

To overcome some of these restrictions this paper follows an assemblage approach (e.g. Anderson et al., 2012; Baker and McGuirk, 2017) framed through policy mobility and translation literature (McCann and Ward, 2012; Peck and Theodore, 2015) that allows the evaluation of the spatialities inherent to the implementation processes of blue bioeconomy governance (see also Albrecht, 2019). Subsequently, assemblage approach is primarily employed as a methodological-analytical framework (Baker and McGuirk, 2017) to access the reconnections of localized processes rather than to conceptualize the heterogeneous assembling processes of material and expressive elements, territorializations, codings or relations of exteriority (e.g. Woods, 2016). In human geography, assemblage approaches are employed largely to study relational configurations of terrestrial based processes such as urban development, policy mobility (McCann and Ward, 2012; McFarlane, 2011) or the assemblage of localities (Woods, 2016). Thus, it is well suited for a transnational policy field, such as the blue bioeconomy, wherein aspects of policy narratives, translations, mutation and localised implementations play a decisive role in its governance processes, outcomes and trajectories (Albrecht, 2019). The paper follows Peck and Theodore’s (2015) suggestion to not merely follow the policy, in this case blue bioeconomy strategies through their institutional frameworks, but to assess the spatial processes at their resting places to understand their materialisation and implications for future development. Hence, in the cases at hand, national policy translations such as blue bioeconomy strategies are translated through the localised assemblages that are (re-)produced through locally embedded transnational relations and thereby not only shape the materialisation (e.g. Albrecht et al., 2017) of blue bioeconomy development but determine the outcomes of policy.

In order to grasp the elusive spatiality of a relational perspective (Massey, 2005), the paper supplements its methodological-analytical assemblage approach through the integration of blue entrepreneur positionalities and their localised material reconnections with the national policy sphere (Harvey, 1990). While the concept of positionality enables the evaluation of the spatial relations which guide the activities of entities within various assemblages (Albrecht, 2019; Sheppard, 2002), looking at processes through particular reconnections allows us to portray some of the entities’ key relations of positionality and therefore assembling processes.

The reconnection approach is a feasible analytical device while conceptualizing the policy assemblages from the perspective of localities. The attention to *reconnections* has been called for in research on alternative food networks and geographies of production and consumption (Crang, 1996; Morris and Kirwan, 2010). Morris and Kirwan (2010) frame reconnection as a practice of creating alternative knowledge and imaginaries on food based on environmental gains and rural development opportunities, thus enabling the de/refetishising of commodities in markets. Reconnections enable features of locality and origin to be attached to products in commodity markets, which can also imply aspects of quality and environmentally sound production methods (Thorsøe et al., 2018: 76), but may also carry elements of nostalgia and longing for past practices (see Kneafsey et al., 2008: 32). Therefore, it is important to note that reconnection is by no means “a coherent concept”, although it helps to illuminate relational aspects in the mutating policy assemblages. According to Kneafsay et al. (2008: 32–34), it refers to diverse processes of discursively and materially connecting producers with markets, consumers with production processes, people with nature or, as in this paper, local development processes with policy narratives.

The value of the approach is methodological since it offers a means of conceptualising processes between different structural, material and discursive elements which take place under the umbrella of blue bioeconomy. It is valuable in acknowledging the active role of producer networks in forming alternative market spaces, but the conceptualisation of the ‘practice of reconnection’ also reveals the crucial role of technical development and local governance in enabling the emergence of ‘alternative’ blue bioeconomy assemblages. Moreover, the reconnections approach helps to partially bridge the dualisms in the blue bioeconomy, especially the freshwater/coastal binary, by highlighting commonalities in production dynamics and livelihoods. The reconnections are focal points in local actor configurations and valuable in articulating their perspectives towards national and transnational governance frameworks. In the following section we turn to the national case studies on blue bioeconomy governance in Finland and Norway.

**Alternative blue bioeconomies**

**Case descriptions**

The issue of ‘underutilised fish stocks’ came into focus through two interconnected collaborative governance interventions carried out in the North Savonia region in Eastern Finland from 2017–2019. The challenge is linked to increasing the catch of fish species that have traditionally been left untouched, while also linking to developing market demand and food production uses for these species. Furthermore, these challenges emphasise the need to reconsider the role of professional fisheries and local value chains in the region, which creates several reconnections and repositions entities in the local actor networks.

The seaweed farm in Herøy, Møre and Romsdal county was established in 2017 and has its roots in seaweed research projects at Møreforsking Institute. It is owned and managed by a former researcher together with local entrepreneurs involved in the local fisheries/seafood sector. The farm has two licenses covering an area of 43 hectares, of which only two hectares are currently utilised in active production based on an initial pilot scale production strategy. While we do not treat this farm as a representation of seaweed farms in Norway, it portrays the localised positionalities that (re-)produces the development processes in relation to the material reconnections raised above that many of the current seaweed farmers are subjected to in Norway very well.

**The role of national strategy**

Both national bioeconomy strategies here, as most others around the world (Bioökonomierat, 2015), are framed through a policy conceptualisation that aims to green economic conduct through a focus on circular and more efficient biomass resource utilisation, reduce climate impacts and our dependence on fossil fuel resources, and increase value creation and employment (Norwegian Ministries, 2016; TEM, 2014). However, they differ greatly based on their national translations of transnational policy ideas and therefore create very different environments for blue bioeconomy development processes (e.g. Albrecht et al., 2017).

In European and global comparison, Finland is seen as an exception because it stresses natural resource utilisation rather than knowledge production (Bosman and Rotmans, 2016). The national bioeconomy strategy for Finland was published in 2014 and its main emphasis is on improving the efficiency of natural resource utilisation, especially in the forest industry and related sectors (TEM, 2014). The blue bioeconomy is not mentioned as a concept because the focus is extensively in ‘green’ resources, especially those resources for the forest industry. However, water receives several mentions throughout the strategy as an underutilised resource-base by providing biomass, ecosystem services and clean water as an environment to be protected through purification technologies and process innovations. Both frames are well aligned with the general approach of resource based bioeconomy and can be considered as a starting point for more systematic work on constructing the national development plan for a blue bioeconomy that was introduced in late 2016 (MMM, 2016) and was followed up by the national research and development agenda “*Out of the Blue”* (MMM, 2018). The plan provides a substantially different framing of bioeconomy by suggesting services and knowledge production as the main development areas of the blue bioeconomy in addition to an improved resource base. The plan also lays out the metrics and goals of how the different areas of the blue bioeconomy are contributing to the economy.

The plan anticipates substantial economic growth in all sectors over a ten-year timespan by proposing actions in four distinct areas (public-private collaboration, servitisation, education, and internationalisation) connected to the knowledge-based bioeconomy agenda. The underlying vision of the plan is to tap into sustainable utilisation of blue resources in different forms, while also turning the currently fragmented knowledge base into an exportable commodity to tackle global water-related challenges. Regarding fisheries, the blue bioeconomy strategy builds on and legitimises goals set in the national aquaculture strategy 2022 (Council of State 2.12.2014) and the national location allocation plan for aquaculture (MMM and YM, 2014), which have created anticipation for growth in blue resource utilisation. Each of the national strategies are grounded in the sustainability challenges facing global food production systems and the less-than-good ecological status of the Baltic Sea. However, the strategies also paint a very straightforward picture of development, based almost uniformly on increasing coastal fish aquaculture.

The national blue bioeconomy policy trajectory thus carries potentially unaddressed challenges. *First*, the agenda confounds the blue bioeconomy with more general blue growth strategies. Much of the added value is expected from technological development and process innovations related to such issues as water purification, closed-circuit production chains and industrial symbiosis that indirectly contribute to the state of the environment and blue resources. Thus, the development in resource utilisation and services can be interpreted as secondary to knowledge-based business. *Second*, the role of policy in the governance of natural resources remains weakly addressed in the strategy. Public policy is framed as a passive facilitator and provider of financial basis or as a silo where critical expertise is currently locked up and which needs to be opened up for more dynamic utilisation. However, it is evident that policies have a much more prominent role in creating market conditions for new products and addressing the state of the environment and could thus merit a more balanced positioning.

In Norway the blue bioeconomy operates within a very different policy and economic realm. While not bound to the EU bioeconomy strategy and its policy framework, Norway’s bioeconomy approach nonetheless links to the initiation of transnational bioeconomy policy strategies at the OECD and EU levels. The Norwegian bioeconomy strategy’s focus, while framed through a knowledge-based approach, includes a strong resource use perspective, which additionally highlights food production, resource efficiency and the aim to develop the most profitable resource use as overarching principles (Norwegian Ministries, 2016). Its knowledge-based context particularly derives from its orientation towards currently underutilised areas of biomass and its cross-sectoral approach to resource efficiency and innovation, for example the utilisation of side streams from fisheries or forestry. Additionally, the Norwegian strategy sets rather strong emphases on market creation and the reduction of market uncertainty for new bio-based products to facilitate innovative developments.

Despite being a core focus in Norway’s bioeconomy strategy due to its current underutilisation, the forest based bioeconomy, which plays the lead role in other northern European countries, is clearly second to blue, ocean and coastal based economic developments in Norway’s policy focus; though it appears ahead of ***agriculture*** (Norwegian Ministries, 2016). Similarly, expectations of Norwegian bioeconomy development are highest within the aquaculture sector (Hansen and Bjørkhaug, 2017). While the term “blue” in relation to economic sectors and supply chains is utilised, the concept of blue bioeconomy does not appear in either the Norwegian Bioeconomy or the ocean strategies (MTIF and MPE, 2017). Nonetheless, blue bioeconomy sectors are attributed a key role in both with a focus on marine/coastal aquaculture and fisheries, including its technologically focused affiliated industries and research. New knowledge and technology are regarded as paramount to tap into the promising potentials from the mesopelagic zone (between 200 – 1000 m deep) for fisheries, as well as to overcome current challenges and exploit potentials in aquaculture development.

Thus, while potentials in the fisheries sector require a vertical leap into the mesopelagic zone, blue bioeconomy development on and near the surface is envisioned largely through aquaculture. Increased resource exploitation, thus blue growth, remains a core aspect in policy aims by focusing on sustainable extraction (e.g. MCE, 2017). Aquaculture increase is separated into two fields within the Norwegian bioeconomy Strategy; 1) fish based aquaculture with a focus on salmon farming and attempts to tackle current challenges regarding their environmental impacts, such as nutrition and phosphorous off flow, sea lice, disease, and escapes; and 2) aquaculture related to alternative species with a focus on macroalgae (Norwegian Ministries, 2016). Theoretical growth potentials for macroalgae (seaweed) have been calculated as high as 4 M tonnes by 2030 (Olafsen et al., 2012) and up to 20 M tonnes by 2050 (Skjermo et al., 2014) with current production being 180 tonnes in 2018 (Fiskeridirektoratet, 2019). In relation to macroalgea cultivation, the Norwegian bioeconomy strategy and related policy documents generally portray a bright future. Their potentials are not merely portrayed as a resource to develop value added products, such as biofuels, base chemicals or food and feed applications, but also as environmental remediation tools to solve other challenges in blue bioeconomy development. Particularly their theoretical capacities to recycle ***nutrients*** and phosphorus from salmon farms through *integrated multi-trophic aquaculture* (IMTA), aquaculture consisting of a combination of fish and other species (e.g. seaweed, muscles) in close proximity is highlighted.

Parallel to required technological advancements that are supported by a variety of research and development programmes and funds, two aspects of Norwegian bioeconomy policy are considered decisive to enable future aquaculture growth. First, to facilitate and streamline spatial planning and licensing processes to guarantee increased availability of farming sites and avoid water use conflicts; and, second, to increase public knowledge on novel products and support market creation (Norwegian Ministries, 2016). Both directly support the blue growth logic that underpins not only the bioeconomy strategy but also other blue economy related frameworks, like the Norwegian ocean and aquaculture strategies (MFC, 2009; MTIF and MPE, 2017).

Consequently, compared to the Finnish strategies, the Norwegian policy framework seems well suited to support alternative and novel blue bioeconomy developments, particularly related to seaweed farming due to its emphasised role in the main policy documents. However, seaweed farming realities along Norway’s coast reveal that it is a marginal economic sector with 23 companies operating 172 licenses and 178 tonnes of production (Fiskeridirektoratet, 2019) in comparison to an annual wild seaweed harvest of approximately 150 000 tonnes (Havforskningsinstitutet, 2017), and more than 1.35 M tonnes of fish from aquaculture production (Fiskeridirektoratet, 2019). Hence, seaweed farming is in its infancy, which brings along a series of technological and socio-economic challenges and requires an alternative reading of regional blue bioeconomy development. The same holds true for Finland, where the national strategies emphasise economic growth achieved by increasing coastal fish aquaculture and focused research activities. For example, the National Fish Aquaculture Strategy 2022 aims at doubling the amount of annually farmed fish in coastal areas (MMM, 2014). In practice, fish production might even decline as the EU WFD prevents ecological permits for additional economic activities in areas with a less-than-good status. The blue bioeconomy policies mention the potentials linked to “underutilised fish stocks” (species of fish that are not the focus of commercial fisheries, but which could be harvested without compromising the status of lake environments) with little consideration. The annual catch of the underutilised fish stocks counts for about 4500 tonnes compared to the commercial catch of 150 000 tonnes and fish aquaculture production of 145 000 tonnes (Luke, 2019).

Hence, when looking at national translations of blue bioeconomy related policies a diverse picture evolves portraying different approaches and potentials for future development. Next we turn to the positionalities and assembling processes related to local materialisations, their reconnections with, and translations of blue bioeconomy policy. This move beyond assumptive policy narratives (Albrecht, 2019) consequently allows us to access the relations that are (re)produced for seaweed farmers and lake fisheries to understand the wider assembling processes that guide blue bioeconomy development and the effects on policy mobility.

**Discussion: Alternatives and reconnections of (regional) blue bioeconomy**

While the national translations of blue bioeconomy policy aspects portray a smooth picture of governing spaces (e.g. Wood, 2016), the regional materialisations and associated practices of specific developments are entangled through their own positionalities within blue bioeconomy assemblages (Albrecht, 2019). The following section discusses these processes through four key reconnections that link and visualise local processes with various contested realms of blue bioeconomy development.

**Reconnecting blue resource values**

In Finland commercial inland fisheries have dominantly focused their catch on one fish species, vendace (*Coregonus albula*), which is a small plankton eating fish. The vendace catch of approximately 5000 tonnes has been relatively stable and represents 50% of the annual inland fish catch (Luke, 2019). In national blue bioeconomy policies the inland fisheries are not given much consideration, but the shallow lakes are seen as vulnerable to eutrophication, which is also a key measure in the EU WFD and river-basin management regimes. However, the fisheries have pointed out that increasing the catch of selected species and targeting specific areas could potentially contribute significantly to the removal of ***nutrients*** from lakes, reduce eutrophication and help rejuvenate bodies of water. Currently, lake rehabilitation activities are exclusively managed and carried out by environmental authorities, but a link with commercial fisheries seems promising – especially if the value of fisheries is considered beyond the economic value of the catch. This connects to much traditional local thinking, where fisheries are framed as ‘the guardians of lakes’, emphasising the role of nurturing fish stocks and the ecological status of lakes to sustain its reproductive capacities. The support for and acknowledgement of the alternative roles of fisheries could create continuation in the sector, but also support better utilisation of the catch as currently less than 9% of the annual catch is employed in food processing even though the market demand for alternative fish sources has grown steadily (see biotalous.fi 2019).

In Norway, this reconnection appears via the initial and policy based valuation of seaweed farming through envisioned potentials on bio-refined, high added-value products to generate profit margins, such as chemicals, cosmetics or functional food and animal feed. Yet, the weak cost competitiveness of small-scale, farmed Norwegian seaweed compared to wild harvested seaweed from Europe or farmed seaweed from Asia make it very challenging to enter the field if the aim includes the economic feasibility of the farm (see also Chapman et al., 2015). Hence, for farms not largely financed through research funding or co-owned by large corporations (e.g. Ocean Forest) farming for predominantly local human consumption has become the key valorisation to generate turnover. In the case of Herøy farm, the result is that much of the value chain from farming to processing and final product distribution is integrated in their work despite limited resources. It also opens up challenging relations to sectors such as food retailing and market regulations and their complex legislative frameworks for these farmers. Not surprisingly, the current profitability or sustained economic feasibility of most farms is challenging and was even widely questioned throughout the interviews. Additionally, this development significantly decouples local development from the policy narratives of key political documents. Another related aspect of this first reconnection of seaweed farming is its valuation as an environmental remediation tool for fish based aquaculture. While it plays no direct role in the Herøy case, it affects the wider policy assemblage development and policy translation in which the farm operates, as will become more visible in the second reconnection.

**Reconnecting technology and innovations**

In the context of North Savonia, vendace fishing is usually carried out by trawling and winter-seining techniques that are optimised to match the seasonal schooling patterns of the fish. The “underutilised” fish stocks refer mostly to predatory species, such as perch, roach, pike and pike-perch, that are caught in smaller quantities and in some cases as a bycatch of vendace. This poses a potential challenge for the fisheries as the handling and sorting of the catch needs to be re-organised to match the demands of the value-chain. This also creates space for the new social and technological innovations that take time to develop. First, some fisheries have already moved to digital ‘tagging’ of their catches to keep track of the available fish resource through the whole refinement chain and form larger batches. Second, investments in ***collective*** infrastructures, such as freezing units, have enabled the storing and combining of smaller catches over time and reduce the seasonality of the activity. Third, innovations related to trawling have reduced the harm to endangered fish species in the lakes and thus enabled a more focused catch. Finally, reconsideration of the fisheries practices as self-sufficient entities has led to collaboration between the geographically proximate fisheries to combine catches, share economic risks and invest in modern equipment. The innovations are not expensive, but they demand new ways of understanding the fisheries in relation to technologies and collaboration.

In Norway this reconnection is related to the technology/innovation systems of seaweed farms. The handling of biological processes through technical solutions are key to successful farming, such as seeding or harvesting systems as well as post harvesting treatment. Due to the complex biological processes, even small errors in these fields have the potential to destroy any useful product. Generally, the current technical requirements of harvesting and processing were described as rather low-tech, carried out with small vessels and often in do-it-yourself prototype processing facilities (e.g. drying chambers) due to the small amounts, limited financial resources and trial and error approach based on a lack of knowledge with the biological processes during farming. On the contrary, it was pointed out that the local innovation capital based on the marine sector’s expertise to provide and generate low cost, partially self-made solutions to fix problems in farming (e.g. rig constructions, rope connectors, etc.) is extremely high and important for the farms to draw upon. Another technical aspect related to seaweed materialities, particularly its rapid biological decay above surface, are solutions that enable swift processing (e.g. drying) after harvesting. While there are multi-million euro research grants to design industrial scale harvesting vessels or projects with chemical producers for large scale processing, these solutions circumvent small-scale farmers. In Herøy, this challenge is mainly solved by proximity between the farm and landing/processing site, which are approximately 500 m from each other. Finally, seaweed farming is presented as an innovative practice to solve environmental challenges of fish-based aquaculture. While this is a complex issue in terms of nutrition uptake and circularity of phosphorous flows that go beyond the scope of this paper, compared to most policy narratives of IMTA based seaweed farming, a farm manager involved in large-scale development simply pointed out that, *“we saw that it’s impossible to have seaweed farm next to a fish farm”* (Interviewee I) due to a variety aspects ranging from boat traffic to disease control. Yet these innovation focused policy narratives continue to play a key role in public and political accounts of seaweed farming potentials in Norway and elsewhere. Similar doubts were raised in relation to the technical and economic feasibility of offshore farming deemed as necessary for the foreseen growth potentials and related industrial scale valuations of seaweed farming (e.g. Broch et al., 2016).

**Reconnecting blue markets and products**

In Finland the share and value of imported fish has been steadily growing to the annual level of 350 M euros. In the case of underutilised fish, the development of local markets poses a chicken-and-egg dilemma: most fisheries postpone investments in novel technologies because the existing market-demand is non-existent and the processing industry and institutional kitchens remain uninterested because the individual fisheries cannot provide enough fish to meet large-scale demands. However, there is potential in North Savonia, as the new products developed from the fish biomass processed from the lake catch have gained popularity in other regions. Different actors share a sentiment that the public sector, especially industrial kitchens, should act as an intermediary that could coordinate and bundle together the dispersed catches from several fisheries to meet larger demands, cover seasonal variations and enable investments in the food processing industry. However, the rules for public procurement are currently strictly tied to the price signals and, for example, Atlantic pollock can be purchased at half the price of local roach. Some “rebel-municipalities”, like Kiuruvesi at the northern edge of the region, have demonstrated alternative procurement practices in collaboration with local fisheries but they have faced jurisdictional consequences. Therefore, a more active public sector role in market creation would benefit from policy translations that integrate such localised positionalities and allow for changes in the governance approach. However, the active and enabling role of the public sector in the transition phase is not unique to the blue bioeconomy.

Norwegian food culture and market creation for seaweed products portray a similar chicken-and-egg problem. While seaweed in sushi restaurants is familiar to Norwegians, the use of local seaweed for human consumption is not part of Norwegian food culture, thus it requires market creation from scratch. Looking at Norwegian consumer markets, it was stated that, *“ … the most sceptical customers, they’re here by the coast of Norway … ”* (Interviewee II). Contrary to the fish aquaculture industry with its lobby groups, like Seafood Norway, the task of market creation for seaweed as food remains largely with the farms themselves despite being a core aim of the Norwegian bioeconomy strategy (Norwegian Ministries, 2016). [Hence, Norwegian Seaweed association members bundle their efforts with joint activities, for instance a stall at the 2019 food festival in Bergen. For the Herøy farm, potential markets are broadly separated into a local and the national/foreign market. While locally the regional character of the product is key, the transnational, largely urban markets are in the organic and sustainable health food segment. For this reason, all products are certified organic and customers in Oslo were described as being similar to German customers rather than to Norwegians in the rural coastal areas. This need for market creation pushes local farmers to develop their own “spear head products” to increase customer interest for the actual product, dried seaweed. In the Herøy case, algae covered nuts have been designed for this purpose. While these snacks have opened up local and (inter)national markets and created positive feedback for the company, it kind of reduced the locality of the product resources due to the low seaweed content. Compounding these market issues, food regulations, such as ingredient labelling and official nutrition tables, play a crucial role in market access and heavily affect the positionalities of entrepreneurs and localised blue bioeconomy assemblages. Additionally, as with market creation, there is a mismatch between the supportive measures portrayed in national policy translations and their availability to stakeholders involved in alternative, small-scale developments to tackle these complex issues.

**Reconnecting water governance arrangements**

In Finland lakes are managed as a common resource that are maintained by administrative water co-operatives. The membership of co-operatives is based on property ownership along the waterbodies. However, the geographical boundaries of the co-operatives are often arbitrary and a result of historical path dependencies, which make them difficult to identify on the water. There are 23 water co-ops in the North Savonian region alone, and their memberships consist extensively of elderly people. The co-ops have been successful in maintaining a shared understanding of the water and sharing of leisure rights for fishing and water use. However, they pose a specific challenge for the development of commercial fishing as the fisheries need to reach official agreement with each of the co-ops in their operational area. In an extreme case this means that a commercial fisher must form and maintain personal relations with each landowner in his/her fishing area, which is an enormous effort and displays the heterogeneous realms that affect localised assembling processes in blue bioeconomy governance. In addition, commercial fishing carries the stigma of over-fishing based on some historical experiences, which makes the dialogue problematic in several cases. The developer network *Eastern Finland Fishery Group* has been especially active in arranging tailored counselling for the co-ops as well as organising mergers of the most dysfunctional units. However, development has been modest and stakeholders in the fisheries sector call for increased governance intervention.

In Norway the fourth reconnection is exemplified by the shifting requirements of spatial planning and licensing schemes for seaweed aquaculture. Aquaculture legislation and planning processes in Norway are designed for fish. While licensing schemes are slowly revised, it was pointed out that currently *“everything is framed around fish, particularly salmon* [and that] *licensing and concession applications make no sense … ”* (Interviewee III). To improve the situation for interested parties, Herøy Municipality along with the seaweed farm in Herøy, Norwegian Institute for Water Research, and Runde Environmental Centre conducted a project called “KOM TIL TARE” (*Communal Guidelines for Coastal Seaweed Farming*) that created a step by step guide to understand and move through the seaweed farming application processes (Herøy kommune, 2017). Yet, the changing legislative framework has made parts of the tool obsolete and there is no follow up focusing directly on seaweed. Still, seaweed farming is in the same spatial planning context than the highly criticised and negatively perceived salmon farming despite its different spatial requirements (e.g. depth, water flow) and despite its zero input character contrary to the high input based (feed, medical/chemical treatment) fish aquaculture. In the case of Herøy, the farm can draw on high quality GIS seabed maps and the municipality planning office is experienced with seaweed issues due to past projects. However, a local planning expert pointed out that this was not the norm in many Norwegian coastal communities. Current expectations on coastal planning for the planning period of 2019–2023 highlight an inter-municipal approach to improve the situation (MLGM, 2019), but it remains to be seen if this solves or creates additional challenges related to the complex positionalities of those involved.

The four reconnections overlap in several aspects and, as previously stated, do not represent an inclusive picture but display some key assembling processes that bind or decouple the challenging blue bioeconomy positionalities of the entities that implement local, alternative developments to the (trans)national assemblages of mobile policies and their translation. There are several social and technical innovations taking place that are not necessarily measured in added millions of export revenues, but rather in enhanced local resilience, environmental condition, culture and self-sufficiency. But the reconnections also show clear mismatches between nationally framed policy narratives (Wood, 2016) and the policy tools that aim to support inclusive blue bioeconomy development and local implementation realities (see also Albrecht, 2019). Thus, the “practical work of reconnecting” reaches beyond creating links between geographies of production and consumption and involves relational assembling processes that span a multitude of socio-economic realms and move beyond the sea/land and marine/freshwater dualisms present in current water governance (Steinberg and Peters, 2015; Winder and LeHeron, 2017). Hence, they not only connect spatially variegated challenges in the places of policy translation for a more diverse understanding of policy mobility processes (e.g. Peck and Theodore, 2015) but also display how multiple ontologies in water governance (e.g. Peters and Steinberg, 2019) are an integrative part of local and transnational blue bioeconomy assembling processes. The final section concludes with some key messages on the effects between the interlinkages of policy strategies and their often assumptive narratives and local alternative implementation positionalities for the blue bioeconomy in Europe. It also raises some needs for future research.

**Conclusion**

This article has displayed two exemplifying, alternative local blue bioeconomy developments and their positionalities in relation to the heterogeneous spatial assembling processes of national blue bioeconomy policy translation and locally grounded implementations. Rather than providing a detailed account of the particular assembling processes that guide policy translation and implementation in the separate case studies, this study has focused on four key reconnections that highlight some challenges and mismatches, but also potentials that may arise between national blue bioeconomy policy assemblages and their localised assemblages of implementation. While the reconnections are applicable in both freshwater and marine environments, the focus on positionalities has enabled a valuable linkage between terrestrial and aquatic spatial processes. We consider the reconnections approach framed in a wider conceptualisation of policy mobility and translation as an overarching methodological tool to see what is aligned in the (trans)national assembling of blue bioeconomy governance and what is not. It can open perspectives to articulate and mobilise local requirements for alternative approaches, but also reveal gaps between strategies and localised processes of implementation.

The reconnection approach also displays a variety of relations between national and international blue growth/bioeconomy strategies and the local geographies they are connected to through the processes of implementation. In Finland the knowledge-intensive framing of the blue bioeconomy could benefit from understanding knowledge production from the perspective of embeddedness to local practices and networks, which were exemplified in the case of underutilised fish stocks. In Norway, the extreme growth expectations of industrialised seaweed farming are misaligned in terms of current socio-technological realities and a more nuanced understanding of the ecological, technological and social aspects of the emerging sector could provide a better basis for future development and provide sustained room for small-scale developments. Similarly, a de-coupling from fish based aquaculture in various aspects would reduce mismatches and allow for policy translations in line with the local positionalities of seaweed farmers. Hence, the displayed reconnections are not intended to create normative counter-discourses for the hegemonic blue-growth policies, but as a locally and socially embedded way of re-reading challenging processes that (re-)produce bioeconomic governance assemblages that are currently missing from key policy narratives, and which therefore limit the potentials of alternative developments. Finally, the framework further points to the potentials to engage with localized blue (bio)economy developments through a more profound assemblage conceptualization (e.g. Woods, 2016). While this has been beyond the scope of this paper, it would allow a more detailed, relational picture of blue (bio)economy localities, contested trajectories and their continuous and heterogeneous unfolding to be evaluated in future research.

Returning to the study at hand, several practical recommendations can be drawn from the analysis. First, the reconnection and assemblage approaches question the purpose and need for singular strategies that target wider economic audiences and point towards the potentials of more inclusive, adaptive and knowledge-based approaches in mobile policies. The problem is in the societal lock-ins around goals that only benefit specific actors and their inability to adjust to alternative interpretations that might be more beneficial in different regional implementation contexts and follow different values as assessment criteria. On the contrary, it highlights a set of spatial processes inherent to both inland and marine blue bioeconomy governance and thereby promotes an academic treatment of blue bioeconomy governance that avoids the current gaps between these realms. Second, the claim of combining economic growth and environmental sustainability at the core of bioeconomy discourses might benefit from a recalibration. Both cases present encouraging approaches to bridge this gap, but they are the results of rather small-scale activities that are not readily scaled-up, at least not without calling into question the sustainable and local character of these developments. Nevertheless, they are examples of how stronger local/regional networks with value drawn from places other than increased resource exploitation could be formed. Third, the regional reconnections reveal an active and enabling role of public policy as a certain necessity. In the case studies at hand, this is particularly true concerning market creation and access for locally sourced products. The public policy role – weak in the Finnish strategy and unsuitable to the needs of local seaweed farmers needs in Norway – could take an active role in orchestrating the actors in the field and intermediating across the scales of blue bioeconomy governance. Fourth, acknowledging the role of regional assembling processes based on stakeholder positionalities enables blue bioeconomy understanding and development that matches local spatialities. For example, elements such as food cultures, non-standardised product-chains, and low-tech innovations that do not align with nationally shaped growth- and innovation-oriented policy translations must be taken more seriously, particularly in academic studies in order to grasp the multiple ontologies of water in governance processes. While these have potential also in terms of employment and economic gains, they are not that easy to quantify and commodify through fixed indicator sets as practiced in most policy narratives. However, they generate an array of alternative values for local and transnational (blue) bioeconomic development that require continuous scrutiny in research and policy integration.

**Notes**

Declaration of conflicting interestsThe author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.; FundingThe author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Research by Jani Lukkarinen on the inland fisheries in the North Savonia Region has been funded by The Strategic Research Council at the Academy of Finland project BlueAdapt (grant number 312650).; ORCID iDMoritz Albrecht [*https://orcid.org/0000-0002-5784-7793*](https://orcid.org/0000-0002-5784-7793)

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**Load-Date:** March 29, 2024

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[***Nitrogen emissions along global livestock supply chains***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H841-F129-P4CW-00000-00&context=1516831)

Nature Food

July 2020

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**Section:** Pg. 437-446; Vol. 1; No. 7; ISSN: 2662-1355

**Length:** 5667 words

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**Body**

Main

Over the past few decades, livestock systems across the world have been transformed from local, small-scale, mixed crop-livestock systems to global, demand-driven supply chains, in which animals are often spatially disconnected from the production of the feed they consume,. These changes, largely driven by economic opportunities, have altered the way in which the livestock sector impacts global nitrogen (N) biogeochemical flows, which have transgressed the planetary boundary for N (refs. ,) and caused a range of environmental effects. Currently, just 50 countries, accounting for 75% of the global population, consume around 95% of synthetic N fertilizer.

The livestock sector contributes to global N flows through the application of synthetic N fertilizer and manure to both cropland and grassland, the management and accumulation of manure, and the transport of N-rich products such as feed, food and manure. These developments have changed the pattern of atmospheric N emissions such as nitrous oxide (N2O), a potent greenhouse gas, as well as ammonia (NH3) and nitrogen oxides (NOx), which contribute to air pollution, pose risks to human health and cause eutrophication and acidification,. Emissions of nitrates (NO3−) and organic N, two common sources of water pollution and biodiversity loss,–, have also increased.

The United Nations 2030 Agenda for Sustainable Development has highlighted the urgency with which these environmental threats must be understood and mitigated. Existing literature has increasingly considered livestock as components of broader food systems,– or the global economy; however, the level of aggregation of most analyses does not allow measures to be drawn specifically for the livestock sector. A recent study has provided a more detailed analysis of global acidification and eutrophication induced by the production of animal-sourced food, but this relied mostly on observations from commercial farms in industrialized countries. A comprehensive analysis of the contribution of the livestock sector to N emissions for the European Union found that livestock supply chains represented 82% of total ***agricultural*** NH3 emissions and 73% of all ***agricultural*** N emissions to water bodies. So far, no work has performed a global, yet disaggregated assessment (that is, spatially explicit and distinguishing between different species, commodities and systems) of N use in livestock supply chains and their contribution to global N emissions.

We fill this knowledge gap by elucidating the magnitude and diversity of N flows and the resulting emissions in global livestock supply chains from ‘cradle-to-primary-processing gate of animal products’, while accounting for international trade. Our study covers 275 countries and territories grouped in 10 regions and uses an updated version of the Global Livestock Environmental Assessment Model (GLEAM) for 2010. We use the most detailed geo-referenced information available, highlighting the diversity of livestock supply chains and international trade. Furthermore, we quantify N-use indicators of life-cycle nitrogen use efficiency and life-cycle net nitrogen balance (see ), identifying hotspots of N emissions and ultimately suggesting targeted interventions to reduce emissions ().

Results

N emissions from the livestock sector

Our analysis shows that livestock supply chains contributed ~65 Tg N yr−1 to global human-induced N emissions in 2010, in the form of NO3− (29 Tg N yr−1), NH3 (26 Tg N yr−1), NOx (8 Tg N yr−1) and N2O (2 Tg N yr−1) (Fig. ). These emissions represented ~39% of anthropogenic NO3− released to surface and groundwater, 60% of total NH3 emissions, 23% of NOx emissions and 32% of N2O emissions globally. The bulk of N emissions takes place during feed production and manure management systems (Fig. ). Feed production releases around 44 Tg N yr−1, in particular through manure deposited on grasslands, manure spreading and synthetic fertilizer application to croplands. Manure management in the animal production stage is the second main source of N emissions, with ~20 Tg N yr−1 lost through volatilization, N leaching and manure used to produce energy. N emissions from the processing of animal-sourced food are minor in comparison (~1 Tg N yr−1).

Global N flows and sources of N compound emissions allocated to the livestock sector.

N emissions associated with manure used to produce food crops and non-food products are aggregated. Losses of N2 to the atmosphere from manure management systems are estimated at 8.3 Tg N yr−1 and are not shown here. All numbers are expressed in Tg N yr−1.

Livestock emissions represent ~35% of estimated N emissions from the ***agricultural*** sector, and ~29–34% of N emissions from the entire global economy, (). Acknowledging the methodological differences and uncertainties of these global estimates, we estimate that the sector represents about one-third of global human-induced N emissions. We also estimate that total synthetic fertilizer and biological N fixation used to produce livestock feed (76 Tg N yr−1) (Fig. ) has already reach the planetary boundary for nitrogen (that is, 62–82 Tg N yr−1).

N emissions per supply chain

Globally, ruminant supply chains of milk, meat and co-products such as hides and skins release ~46 Tg N yr−1 (or 71% of the total N emissions from livestock), with the production of eggs and meat from chicken and pork contributing the remaining 29% (Fig. and ). More specifically, mixed cattle and buffalo supply chains alone are responsible for 44% of the total N emissions, with most of it taking place in South Asia (Fig. ). Supply chains of grazing cattle (dairy and beef) and pig (backyard, intermediate and industrial) each account for ~16% of total N emissions, with the latter concentrated in East and Southeast Asia (Fig. ). The projected expansion of total animal production (74%) in low- and middle-income regions by 2028 is likely to further increase N emissions from these systems.

Disaggregated global N emissions from livestock supply chains.

a, Distribution of N emissions by livestock species for 10 regions (in Gg N yr−1). b, Regional contribution of different livestock systems to total N emissions (in Tg N yr−1).

Regional hotspots of N emissions

Most N emissions take place in the regions of South Asia (23 Tg N yr−1), East and Southeast Asia (18 Tg N yr−1) and Latin America and the Caribbean (7 Tg N yr−1), given the high numbers of livestock held in mixed and grazing ruminant systems and backyard monogastric systems (Fig. ). In South Asia, large buffalo and cattle populations with low productivity are responsible for 87% of regional livestock N emissions. In Latin America and the Caribbean and North America, beef and dairy cattle production systems account for 72% of N emissions. Cattle production contributes considerably to N emissions in Sub-Saharan Africa, North Africa and the Near East, while pigs and cattle are the main contributors in Western and Eastern Europe (Fig. ).

We observe considerable spatial variability in disaggregated N emissions along livestock supply chains per unit of land (Figs. and ). N emissions are allocated to the grid cell where animals are located, even if, in reality, they take place at another location (see ). Most N2O emissions from pig, chicken and cattle systems take place in Western Europe, East and Southeast Asia, Oceania and Latin America (Fig. ). NH3 emissions are concentrated in East and Southeast Asia, Oceania (East Australia and New Zealand), Western Europe, Latin America (Colombia), North America (east coast of the United States) and the Nile Delta (Fig. ). High NO3− emissions are modelled for the Indo-Gangetic plain, East and Southeast Asia, the Nile Delta and Latin America (Fig. ). In the Indo-Gangetic plain, emissions are related to a high density of cattle and buffalo and are associated with poor manure management, high synthetic fertilizer applications and the use of manure as fuel. In most East Asian countries, high NH3, N2O and NO3− emissions are explained by the geographical concentration of animals in large-scale farms (industrial pig, chicken and mixed dairy cattle) and backyard pig farms, and are associated with unregulated manure disposal and high synthetic fertilizer application rates. These systems produce more manure than can be recycled in the surrounding ***agricultural*** area—on which synthetic fertilizer is concurrently applied—resulting in high emissions per unit of area. For Latin America, high emissions per hectare of land used to produce feed are related to backyard pig and chicken supply chains that rely mostly on swill and scavenging for feed, considered in our analysis to be of low land requirements (zero land use allocation). Here, N emissions follow the uneven distribution of livestock densities, and their concentrations in certain hotspots result in regional N pollution levels that exceed regional N boundaries, (Extended ***Data*** Fig. ).

Global distribution of N2O and NH3 emissions from livestock supply chains.

a, Spatial distribution of N2O emissions. b, Spatial distribution of NH3 emissions. Emissions are aggregated for all livestock species and consist of N2O and NH3 emissions taking place in feed production and animal production (manure management systems) per hectare of land used to produce feed.

Spatial distribution of NO3− emissions to surface and groundwater from livestock supply chains.

N emissions are aggregated for all livestock species and consist of NO3− emissions taking place in feed production, animal production (manure management) and processing of animal-sourced food per hectare of land used to produce feed.

N indicators across regions and systems

We analysed life-cycle N-use efficiency (life-cycle-NUEN), that is, the efficiency of recovering N mobilized at each stage into the animal-sourced food, across livestock supply chains (Fig. and ). Our results show variability across countries and livestock systems, indicating considerable differences with respect to livestock management practices, feed resources, animal performance and improvement potential around the world. Except for beef cattle feedlots, this variability is most pronounced in ruminant systems, reflecting the relative diversity observed in these systems in terms of species, breeds, practices and size.

Distribution of N indicators by species, commodity and systems.

a, Life-cycle nitrogen use efficiency. The systems are ranked in decreasing order of the median values. b, Life-cycle net nitrogen balance. The systems are ranked in increasing order of the median values. In both graphs, boxes represent the 25th to 75th percentiles, the centre lines indicate median, the diamonds show means and the dots represent outliers. The colour indicates the livestock species. To better visualize the results, values above 150 kg N ha−1 were excluded from b.

The highest life-cycle-NUEN values were computed for the three poultry systems, ranging from 32–67% for broiler, to 6–60% for backyard chickens and 3−60% for layers (Fig. ). The results for the seven ruminant-meat systems are far more diverse, ranging between 1 and 72%. Among those, large ruminants show lower life-cycle-NUEN values than small ruminants. These trends are explained by differences in management practices, feed sources and animal genetics, with a larger diversity among ruminants,.

Life-cycle net nitrogen balance (life-cycle-NNBN) is calculated by aggregating the N losses, regardless of the geographical location where they take place across the supply chain, and dividing the sum of the land area required to produce feed and fodder (Fig. and ). The lowest median life-cycle-NNBN values are computed for supply chains that either generate relatively low N emissions (for example, broiler chickens or industrial pigs) or that use large ***agricultural*** areas to produce feed (for example, small ruminants), which effectively dilutes the emissions per unit of land. The high median values computed for backyard pigs and chicken supply chains result from the zero land use allocation to the production of swill.

N emissions from domestic consumption

Embedded N emissions from the production of internationally traded livestock commodities (either in the form of traded feed or animal-sourced food) amount to ~5.5 Tg N yr−1 (8% of total emissions) (Fig. ). These emissions are driven by the volume of internationally traded commodities and N emissions associated per unit of product in the exporting country.

Embedded N emissions in international trade of feed and livestock commodities.

a, Feed commodities (1.5 Tg N yr−1). b, Livestock commodities including feed used to produce them (4 Tg N yr−1). The ribbon colours distinguish the countries of import and export and the arrowhead of each ribbon points to N emissions caused in each exporting country by a given importing country. The size of the arrow indicates the relative magnitude of embedded N emissions in each graph. The direction of the arrow indicates the attribution of N emissions in imported commodities. For clarity, we represent only the major flows (representing 50% of embedded N emissions).

For feed commodities, N emissions generated in exporting countries are estimated at 1.5 Tg N yr−1 and relate mostly to the fertilization of feed (Fig. and Supplementary Figs. and ). Of this amount, 59% is associated with the trade of cereals (wheat, barley and maize, with a total traded volume of 6.4 Mt), 39% with soybean and soybean cake trade (with a traded volume of 1.2 Mt) and 2% with the trade in palm products and cassava. Most of these emissions take place in five exporting countries where feed production has expanded because of the availability of land, low-cost synthetic fertilizer, mechanization and energy—namely the United States (21%), Australia (13%), India (12%), Brazil (12%) and Argentina (7%). Of the importing countries, China (18% of embedded N emissions), Japan (6% of embedded N emissions), Iran, Indonesia and the Netherlands (4% of embedded N emissions each) are reallocating N emissions from where they import feed: demand for feed in China, for example, generates 261 Gg of N emissions in several countries, including the United States (42%, mostly from soybean production), Australia (24%, mostly from barley and wheat production) and Brazil (17%, mostly from soybean production). Similarly, demand for feed in Japan generates 83 Gg of N emissions in the United States (30%, from soybean, maize and wheat), Australia (27%, from barley and wheat), India (14%, from soybean) and China (10%, from soybean and maize).

Emissions embedded in the trade of animal commodities include emissions from all stages of production (that is, feed and animal production) and geographical locations along the supply chain. They are estimated at ~4 Tg N yr−1 (Fig. and Supplementary Figs. –) and stem from the production of beef (41%), milk (31%), pork (15%), chicken meat (8%), sheep meat (3%) and eggs (1%). Most of these emissions take place in major exporting countries: Australia (21%), Germany (8%), Brazil (8%), the Netherlands (7%), United States (7%), Canada (5%) and New Zealand (4%). In New Zealand, Australia and the United States, embedded N emissions are associated with the export of beef and milk products, whereas in Brazil they are associated with the export of beef and chicken meat. For Germany, the Netherlands and France, dairy product exports are the driver of embedded N emissions. Regarding importers, the consumption of beef in Japan is linked to 262 Gg N emissions in Australia, while Japan’s imports of meat (beef, chicken and pork) from the United States are associated with ~29 Gg N of emissions. These embedded N emissions are in line with previous estimates. The consumption of beef in the Republic of Korea and the Russian Federation relates to ~235 Gg N emissions in Australia, Brazil and the United States, while demand for livestock products in Germany, the Russian Federation, United States and the United Kingdom is linked to ~951 Gg N emissions in Australia, New Zealand, United States and the Netherlands.

Discussion

This study provides a disaggregated assessment of global N use and emissions, using a consistent level of granularity and precision for all supply chains. Except for NOx emissions, the estimated emissions of single N compounds found in this study are lower than those previously reported, despite the subsequent increase in animal herds between 2000 and 2010 (Supplementary Table ). Some previous studies have used default N excretion factors, default emission factors and an empirical model to estimate N emissions from the field and manure. Contrastingly, our study relies on the latest methods, for the manure model and N dynamics in the soils and allocates only a share of N emissions from manure management systems to animal-sourced food. Our higher estimates for NOx emissions are due to the inclusion of on-farm energy use and international transport of feed and livestock commodities, which had not been considered ().

Regarding embedded N emissions in major exporting countries (such as Australia, Brazil and the United States), they take place in geographically concentrated farms. This situation is fuelled by the increasing global demand for feed and livestock commodities in Asia. For example, export volumes of beef from the United States have grown at an average annual rate of 7% during the past three decades. For the importers, the displaced N emissions through international trade are not included in national inventories, leading to a lack of domestic policies to increase N use efficiency along the entire value chain.

Given the complexity of the model we used, the assumptions therein and the need for global detailed ***data*** to populate the model, significant uncertainties arise (). Yet, our estimate of the substantial contribution of the livestock sector to global N emissions is robust () and our analysis allows for the drivers of N emissions worldwide to be identified. These drivers are described in the Discussion, together with a brief discussion of mitigation options.

Livestock supply chains are a major source of N emissions, contributing roughly one-third of global anthropogenic emissions, with significant impacts on pollution, climate change and biodiversity losses. Our study has shown how traded commodities carry embedded emission across borders, which is in agreement with previous studies,. These findings highlight the need to renew policy attention to ***nutrient*** pollution from livestock supply chains and to develop initiatives consistent with the increasingly transnational nature of the issue.

This analysis has identified a few regions and supply chains where most N emissions are taking place. Targeting national N management policies and regional collaboration towards these hotspots is expected to improve the cost-effectiveness of actions. For example, fertilizer policies in South Asia, East and Southeast Asia and North America can be improved to consider locally available sources of N, including crop residues and manure. We showed that emissions take place at all stages of the supply chain, but are mostly related to feed production for ruminant systems—except in mixed buffalo meat and cattle systems—and manure management for monogastric systems (Supplementary Table ). Strategies concomitantly targeting sources of N emissions from feed and livestock production are required, acknowledging that ***nutrient*** emissions are largely driven by the spatial disconnect between animal and crop production (feed or food). The two are often produced separately, particularly in the large-scale mixed cattle, feedlot beef, pig and poultry operations purchasing most of the feed materials (Supplementary Table ). Incentivizing farmers to ***collect***, transport and recycle manure to available croplands could help reduce N emissions, but this intervention is often limited by high transportation costs,. Designing a livestock production system that is spatially less concentrated and where feed and livestock are regionally integrated could improve N efficiency, in North America, Western Europe and East and Southeast Asia.

Technical solutions and good practices, however, may not be sufficient to reduce impacts to acceptable levels. In parts of the world, a reduction in the production and consumption of livestock products is probably necessary to keep global N emissions within planetary boundaries,,. Such reduction should not come at the expense of food security,, particularly in contexts where livestock plays a major role in addressing malnutrition and building food systems’ resilience to climate change,. Rather, it should be considered in a targeted way, appreciating the large diversity of livestock systems and their contribution to food security and poverty eradication, together with the many products and services they provide,.

The need for an intergovernmental coordination mechanism on nitrogen policies has been recognized in the resolution of the United Nations Environment Assembly (UNEA-4) on sustainable nitrogen management. In light of the magnitude and complexity of our results, we recommend the creation of a global initiative to tackle N pollution, with representation from the public and private sectors, civil society, academia, as well as stakeholders from the livestock and ***agriculture*** supply chain. Such an initiative should provide a platform for science-based dialogue on policies to mitigate N pollution from the livestock sector and support the development of integrated solutions for natural resource governance, markets information, standards and regulations, along with awareness-raising and advisory services. This integrated approach would also help to address the many trade-offs between N management and other sustainability goals.

Methods

The GLEAM model

The Global Livestock Environmental Assessment Model (GLEAM) is a spatially explicit biophysical model developed at the Food and ***Agriculture*** Organization of the United Nations (FAO) to assess the contribution of global livestock supply chains to environmental issues. It is based on a life-cycle assessment and covers the main stages of livestock supply chains, including feed production, animal production, processing of animal products and transportation. GLEAM has been used to estimate the contribution of livestock systems to global human-induced emissions of greenhouse gases and has been further developed, for the purposes of this study, to estimate N flows and associated emissions. A description of GLEAM 2.0, the specific version used in this Article, is available at [*http://www.fao.org/gleam/resources/en/*](http://www.fao.org/gleam/resources/en/).

GLEAM accounts for N flows and emissions at a resolution of 5 arcmin, for combinations of species, commodities, production systems and agro-ecological zones. We model N flows and emissions in three stages of the livestock supply chains: feed production (including farm mechanization, fertilization, international transport and processing), animal production (including manure management systems) and processing of animal products and transport. We apply the indicator framework developed by Uwizeye et al. to estimate life-cycle-NUEN and life-cycle-NNBN based on supply-and-use matrices (). These indicators are calculated using four matrices: (1) N embodied in the final products at each stage (P); (2) N transferred from one stage to another or recycled, which contains loops (for example, crop residues) and feedbacks (for example, manure) (I); (3) N resulting from N stock change at each stage (S); (4) N fixed biologically or industrially from nature or sourced from other ***agricultural*** activities (M) and N losses at each stage (L) (Supplementary Table ). These matrices are used to estimate N use indicators for each supply chain. For the life-cycle-NUENwhere is the amount of N required to recover 1 kg N in the animal products and is the diagonal matrix of N stock changes induced by each unit processwhere is the third element of the matrix M\* related to the processing stage of animal products.

For the life-cycle-NNBNwhere L refers to the total N emissions at each stage, F refers to a biophysical allocation factor between co-products at each stage and A refers to the total land required to produce feed.

Model development

Specific new developments of GLEAM were carried out to perform this analysis. An overview is provided in Supplementary Fig. .

N modelling in soils

We have upgraded the feed module in GLEAM to account for all sources of N input to the soil, including biological N fixation, synthetic fertilizer, manure, crop residues and atmospheric N deposition and soil N stock change. We incorporated a stepwise approach to reflect the N mass balance for each feed item and to account for N emissions from each source of N inputs. For feed items produced within a country, N emissions were estimated as the sum of N losses via volatilization, runoff and leaching. For imported feed items, N input ***data*** and yields were estimated as the national average in exporting countries weighted by the trade volumes reported in the FAO trade matrix (). We used the Intergovernmental Panel on Climate Change (IPCC) method (Tier 2) to estimate NH3 volatilization and N2O emissions from soils, then combined the information on global land cover, slope and precipitation to calculate NO3− loads via runoff (). The fraction of N emissions via leaching was estimated using a mass balance approach. We also estimated NOx emissions from field operations, transport and manufacturing of synthetic fertilizer and pesticides, and harvesting and crop processing using a proxy of the CO2 to NOx ratio,.

N modelling in international transport

Trade matrices were initially obtained from FAOSTAT for the individual feed (for example, soybean cake and maize bran) and livestock items (for example, milk whole fresh cow and meat cattle boneless; ). To homogenize year-to-year variations in trade flows, a three-year average (2009–2011) was calculated. We then computed trade matrices for aggregated feed items (for example, soy, maize and wheat) and livestock items (for example, eggs hen in shell, meat cattle and meat chicken) by summing individual items and applying FAOSTAT conversion factors to distinguish crop primary and secondary products, ().

For each exporting country, if the exported quantity was higher than that produced, the difference was considered as re-export. Thus, the proportion of re-exports to total exports was calculated and assumed similar for each aggregated item and all its related individual items. For every single item, trade flows between re-exporters and final importers were reallocated to flows between primary exporters and final importers. This reallocation was done proportionally: re-exported commodities were reassigned to primary exporters, according to their relative contribution to the imports of re-exporters. These re-exported commodities were then allocated to final importers according to their relative contribution to the exports of re-exporters. For each item, the result was a corrected trade matrix with the same total volumes of trade and modified trade flows to link primary exporters to final importers directly ().

For livestock products, all the emissions related to transport were allocated to livestock, but, for some feed products, we corrected the trade matrix to distinguish feed from food use. Among the different individual items considered, it was assumed that 100% of soybean cake, maize bran and wheat bran were used as feed (and hence allocated to livestock production). For the other items (wheat, barley, maize grains, soybeans, palm and cassava), the total feed intake of all livestock species was retrieved from GLEAM, and we assumed that the total feed intake came from imports and national production proportionally to their relative value in each country ().

We estimated sea transport distances associated with the international trade of feed and livestock commodities on the database developed by CERDI (French Centre for Studies and Research on International Development). For major exporting or importing countries with a large area and several important ports (for example, Argentina, Australia, Brazil, Canada, China and the United States), sea distances were calculated by considering their two main ports (weighted average). A sea distance matrix for each feed commodity was thus created ().

We estimated the fuel consumption, assuming an average fuel consumption of 1.3 g t−1 km−1 (Notteboom and Cariou, personal communication). We assumed that 86% of the fuel consumed was in the form of heavy fuel oil and the remainder in marine diesel oil across all countries. We then used the European Environment Agency (EEA) methodology to calculate the total NOx emissions by multiplying the distance and volume of a commodity in the corrected FAO trade matrix, as well as the associated fuel consumption and emission factors. Finally, we assigned NOx emissions to each production system proportionally to the volume of feed commodity used ().

N losses during manure management

We utilized the method developed by EEA to estimate N emissions associated with manure management. This method estimates N emissions from animal houses or yards and manure storage from the fraction of the total ammoniacal nitrogen (TAN), which represents the total amount of N in the forms of NH3 and NH4+. We estimated TAN based on mineralized N in urine and faeces according to ref. . N emissions were estimated by multiplying TAN by the share of each manure management category and the corresponding emission factor. For NH3, we considered emissions from house or yard and manure storage. For N2O emissions, leaching and direct and indirect emissions from manure storage were estimated (). The release of N2 was considered as a recycled flow to the atmosphere and, although calculated, it was excluded in the further analysis of N emissions. For NOx emissions, we distinguished emissions from manure used as biofuel or incinerated to recover energy from those from manure management. NO3− emissions were estimated based on manure leaching and unregulated disposal into surface and groundwater based on IPCC and literature ***data***– (). We then estimated manure available for recycling that was used to compute the manure application and deposition rate in each pixel (). The detailed equations are provided in the Methods.

N losses beyond the farm gate

A mass-balance approach was used to estimate N emissions downstream of the farm as the difference between N in primary products and live-animals and N in final products. It was assumed that most N was lost in the form of wastewater and untreated organic wastes from slaughterhouses and milk processing plants.

***Data*** description

The GLEAM database was completed and updated for some topics. For feed production, we used the new version of the Global Agro-Ecological Zones (GAEZ) yield maps for feed crops (resolution of 5 arcmin). We added new ***data*** on biological N fixation for legumes, estimated based on the Livestock Environmental Assessment and Performance (LEAP) Partnership guidelines. For other non-legume crops, we considered default values from the literature,. Crop-specific ***data*** on synthetic fertilizer applications were obtained by dividing the total fertilizer consumption for each crop from the International Fertilizer Association (IFA) by the harvested area from FAOSTAT for the main fertilizer-consuming countries. Other ***data*** on synthetic fertilizer were obtained from the Common ***Agricultural*** Policy Regionalised Impact model (CAPRI) for Europe, and from ref. for the United States at a subnational level. For Australia, ***data*** were obtained from ref. . For the rest of the world we used FAOSTAT ***data***. For the fertilizer applied to the grassland, we used ***data*** from IFA and the literature. ***Data*** on atmospheric N deposition were obtained from ref. . Manure deposited on grassland and applied to cropland was calculated iteratively from the model, prioritizing the application of manure to available arable lands in the cell where it was produced before applying it to other surfaces (grassland or grazed marginal land; ). ***Data*** on crop residues were calculated from GAEZ yield maps based on IPCC equations. ***Data*** on global land cover, slope and precipitation were used to calculate spatially explicit runoff rates (). For imported feed items, we estimated N inputs and yield ***data*** as the national average, in each importing country, from the values of exporting country weighted by the trade volumes reported in the FAO trade matrix, corrected for re-export. For countries with missing ***data***, we filled gaps with regional or continental average ***data*** ().

For animal production, we ***collected*** additional ***data*** on manure management for the main livestock-producing countries. ***Data*** were based on national greenhouse gas inventories for Brazil, Australia, Japan, Switzerland and New Zealand, the NH3 inventory for the United States and national ***statistics*** for Canada. ***Data*** for the European Union were detailed at the NUTS2 level, and ***data*** for China, India, Mexico and Vietnam were derived from the literature,– (Supplementary Table ).

Reporting Summary

Further information on research design is available in the linked to this article.

**Acknowledgements**

This work was supported by the Teagasc Walsh Fellowship Scheme (ref. 2012230), the Livestock Environmental Assessment Performance (LEAP) Partnership (GCP/GLO/369/MUL) and the Livestock Information, Sector Analysis and Policy Branch (AGAL) of the Food and ***Agriculture*** Organization of the United Nations (FAO). This work was supported in part through the project ‘Supporting the Implementation of the Koronivia Joint Work on ***Agriculture*** Roadmap’ (GCP/GLO/998/GER) supported by the Federal Ministry of ***Agriculture*** (BMEL) of Germany. We thank G. Cinardi for supporting the modelling of ruminant systems, J. C. Lopes for her comments on an earlier version of this manuscript and G. Virgili and C. Ciarlantini for designing Fig. .

**Notes**

Extended datais available for this paper at [*https://doi.org/10.1038/s43016-020-0113-y.Supplementary*](https://doi.org/10.1038/s43016-020-0113-y.Supplementary) informationis available for this paper at [*https://doi.org/10.1038/s43016-020-0113-y.Publisher’s*](https://doi.org/10.1038/s43016-020-0113-y.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

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[***Bank of England not ruling out negative interest rates as inflation drops to 0.8% - as it happened; Rolling coverage of the latest economic and financial news, as UK central bank tells MPs it is keeping its 'lower bound' under reviewLatest: BoE governor Andrew Bailey says tools are under reviewInvestors pay to lend to BritainUK annual inflation almost halved last monthCoronavirus - latest updatesSee all our coronavirus coverage***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YY4-98X1-JCJY-G476-00000-00&context=1516831)

The Guardian (London)

May 20, 2020 Wednesday 7:52 AM GMT

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**Section:** BUSINESS; Version:18

**Length:** 12761 words

**Byline:** Graeme Wearden

**Body**

block-time published-time 5.26pm BST

Closing summary

Time for a recap

[*The governor of the Bank of England has refused to rule out introducing negative interest rates in the UK*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc). Andrew Bailey told MPs that his views have changed in the light of the coronavirus pandemic - the BoE is reassessing all its tools, as it tries to fight the worst downturn in centuries.

Bailey was speaking shortly after the UK sold government debt at negative yield for the first time. [*Investors effectively paid for the chance to lend to Britain*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) -- perhaps partly because the BoE has pledged to buy the gilts under its stimulus programme.

Related: [*UK sells government bond with negative yield for first time*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

The pandemic is pushing inflation down across the globe. In the UK, [*the Consumer Price Index dropped to just 0.8% last month*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) , down from 1.5% in April - with fuel and clothing prices dropping last month.

Eurozone inflation fell to 0.3%, while in Canada [*the inflation rate turned negative for the first time since 2009*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc).

The WTO warned that world trade in goods has fallen dramatically this year, as the economy contracts.

Despite this concern, global stock markets have risen today on hopes of economic recovery later this year.

Related: [*WTO reports big slump in global trade as coronavirus takes toll*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

And there's deep gloom in Derby tonight as Rolls-Royce announces thousands of job cuts.

Related: [*Rolls-Royce to cut 9,000 jobs as Covid-19 takes toll on airlines*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

But McDonald's has cheered some of its fans, by reopening 33 drive-through outlets.

Related: [*McDonald's reopens 33 drive-throughs: full list of UK restaurants*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

Goodnight. GW

block-time published-time 4.52pm BST

European market close higher

Optimism that the world economy will start to recover from the Covid-19 recession soon has lifted shares across Europe.

The main indices have closed around 1% higher tonight, as global markets hit their highest levels in 10 weeks.

* Stoxx 600: up 3.5 points or 1.05% at 343.4

1. FTSE 100: up 64 points or 1% at 6067
2. German DAX: up 170 points or 1.5% at 11,245
3. French CAC: up 40 points or 0.9% at 4,498
4. Italian FTSE MIB: up 178 points or 1% at 17,213

Stocks are also higher in New York, with the Dow gaining around 1.7%.

Connor Campbell of [*Spreadex*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) explains that investors are shrugging off rising tensions between Washington and Beijing:

The Dow Jones was keen to rebound on Wednesday, shaking off the Moderna vaccines doubts that plagued it on Tuesday.

Rising close to 400 points, the Dow returned to 24600, pretty much reversing the losses incurred last night thanks to some solid earnings, persistent optimism regarding a vaccine and the hopes of some more Fed stimulus down the line. That meant the Dow ignored Donald Trump's latest inflammatory comments towards China, the President claiming it was the 'incompetence' of Beijing that caused the virus to spread.

block-time published-time 4.35pm BST

And finally.... Treasury committee chair Mel Stride returns to the issue of negative interest rates, which [*governor Andrew Bailey refused to rule in or out*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc).

Q: What criteria need to be met for the Bank to go for negative rates?

Governor Andrew Bailey replies that he has changed his position on negative interest rates a little, given recent events.

We need to reassess our tools, and keep them (negative interest rates) as an option, he tells the committee.

But there are lot of issues to consider -- including how it would affect the stability of the financial system, and how an interest rate cut below 0% would be transmitted through the system.

We also need to consider any other measures that Bank would take alongside it, Bailey adds, cautioning that there are "some pretty mixed reviews" about how negative rates have worked elsewhere.

block-time published-time 4.28pm BST

Conservative MP Steve Baker has challenged the Bank of England over its QE programme.

Isn't it "quite extraordinary" that we have one major borrower (the UK government), and one major buyer (the Bank) in the market, giving bond traders the confidence to buy gilts because they know they can sell them onto Threadneedle Street?

We are facing a "quite extraordinary situation", governor Andrew Bailey replies.

But he doesn't accept that the Bank is simply monetising government borrowing. Instead, he argues, the Bank is reacting to economic conditions by expanding its QE programme -- just as the government is reacting to economic conditions by issuing more debt.....

block-time published-time 3.46pm BST

Q: What impact will Covid-19 have on the UK property market?

Elisabeth Stheeman, a member of the BoE's Financial Policy Committee, replies that commercial property - particularly offices outside London - will be hit as companies reassess how much office space they need.

block-time published-time 3.42pm BST

Back at the Treasury committee e-hearing, Bank of England policymaker Jonathan Haskel has warned that self-employed workers, younger people, and those with fewer skills will be most hurt by the recession.

These workers, such as those in the hospitality sector and hotels, will be reliant on a pick-up in aggregate demand in the economy, Haskel adds.

block-time published-time 3.38pm BST

Two arrested over Ghosn escape

Breaking away from the Bank of England hearing... a former US Green Beret soldier and his son have reportedly been arrested over Carlos Ghosn's shock escape from Japan last December.

[*Reuters has the details*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) :

U.S. authorities on Wednesday arrested a former special forces soldier and another man wanted by Japan on charges that they enabled the escape of former Nissan Motor boss Carlos Ghosn out of the country.

Former U.S. Green Beret Michael Taylor and the other man, Peter Taylor, are expected to appear by video conference before a federal judge in Worcester, Massachusetts, according to court records.

block-time published-time 3.36pm BST

The BBC's Faisal Islam points out that the Bank of England has helped to push UK borrowing costs below zero today.

The BoE has pledged to buy £200bn of gilts through its asset purchase scheme, lifting its QE total to £645bn. That means investors feel confident buying UK gilts, as they can sell them onto the Bank.

enltrGovernment is funding 10m wages, 1 in 3 jobs at cost of £15bn ish a month... Govt getting the cash from markets, at low, today negative rates, ie being paid to borrow the money. Markets can sell these debts directly to the Bank of England, under QE scheme aimed to boost economy

- Faisal Islam (@faisalislam) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 3.21pm BST

Andrew Bailey's comments on negative interest rates are very timely - just hours after [*the UK borrowed for free for the next three years*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc).

Our economics editor Larry Elliott writes:

Britain has sold a government bond with a negative yield for the first time after plunging inflation raised the prospect of the [*Bank of England*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) cutting official interest rates below zero.

In a development that effectively means investors have to pay to lend money to fund the government's response to the [*Covid-19*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) pandemic, investors bought gilts knowing they would get back less than they paid for them when the bonds mature in three years' time.

The [*debt management office*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) (DMO) said it had sold £3.8bn of three-year gilts at a yield of -0.003%, with the result that Britain has joined a small group of countries - such as Germany and Japan - that have persuaded investors to accept a negative return.

Related: [*UK sells government bond with negative yield for first time*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 3.19pm BST

Deputy governor Ben Broadbent denies that the Bank is anticipating a V-shaped recovery from the pandemic.

He tells MPs that in the Bank's latest scenario, the economy shrinks by around 25% in the April-June quarter, and doesn't return to its pre-crisis levels until 2022.

There's no doubt that in our scenario, the recovery takes a lot longer than the downturn, Broadbent insists, saying it doesn't really sound like a V....

block-time published-time 3.16pm BST

MPs then press the Bank of England on its decision to force UK banks to [*scrap their dividends back in March*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc).

Andrew Bailey insists this was a sensible business decision, not good politics. It strengthens the banks' balance sheets - and if the economy recovers faster than hoped, they can reassess dividend policy.

block-time published-time 3.09pm BST

Andrew Bailey seems to be keeping his options open, on [*whether to impose negative interest rates on the UK economy*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) in an attempt to stimulate the economy.

Here's some reaction:

enltrBank of England governor Andrew Bailey gives little away on whether the UK will see negative interest rates: 'We're not ruling it in but we're not ruling it out'

- Harry Robertson (@harrygrobertson) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltr'We are doing work on all those tools and will continue to do it, because we know that we may have to draw on that toolkit at any point'

- Harry Robertson (@harrygrobertson) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltrAsked about whether the Bank of England would contemplate negative interest rates or buying more risk assets - Governor Andrew Bailey says they never rule anything out as a matter of principle - and 'given what we've had to do in the last weeks it is of course under active review

- Jessica Omari (@JessicaOmari) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltr'Not ruling it in, not ruling it out'

- Jessica Omari (@JessicaOmari) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltrGBPEUR springing around on BoE - Bailey saying BoE is not ruling out negative rates; in fact keeping negative rates "under review".

- Vonnie Quinn (@VonnieQuinn) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 2.59pm BST

BoE governor: Foolish to rule out negative interest rates Bank of England governor Andrew Bailey on a video conference call with MPs today Photograph: Parliament Live

The Treasury committee moves onto monetary policy -- and asks whether the Bank of England could cut rates below zero:

Q: Would you contemplate negative interest rates and buying riskier assets?

We do not rule things out as a matter of principle - that would be foolish, replies governor Andrew Bailey smoothly.

He explains that the MPC has a history of keeping the 'lower bound' of monetary policy under review -- ie, how low it can actually cut rates. [UK interest rates are currently just 0.1%, a record low].

We are keeping our tools under active review in the current situation, Bailey adds.

Bailey says it is "looking carefully" at the experience that other central banks have had with negative interest rates, where it has been "quite a nuanced policy tool".

He doesn't name them -- but one obvious candidate is the European Central Bank. The ECB imposes -0.5% interest rates on commercial bank deposits to encourage them to lend to the real economy, rather than leave money in its vaults.

As he puts it:

We're not ruling it in, and we're not ruling it out.

The governor insists that this is the "right time" to assess all the Bank's tools, including the purchase of riskier assets, as the BoE may need to "move rapidly" in the future.

He also explains that communication would be "absolutely critical", if there was any move on negative interest rates.

block-time updated-timeUpdated at 3.05pm BST

block-time published-time 2.42pm BST

Bank of England governor Andrew Bailey is testifying, remotely, to the UK parliament's Treasury Committee.

He's "accompanied" by deputy governors Ben Broadbent and Jon Cunliffe, and external policy members Elisabeth Stheeman and Jonathan Haskel.

Q: Are Britain's banks as well-capitalised as they should be to trade through the Covid-19 crisis, given the slump in their share prices? (as economist Sir John Vickers fears)?

Bailey argues that it makes more sense to assess the value of a bank's assets (the book value), when stress-testing them.

If you had used banks' share price in the run-up to the 2008 financial crisis, for example, you'd have been given a wildly erroneous view of their strength.

The better question, Bailey says, is why are bank shares so low? It's partly because the market has doubts about some banks' business model, he reckons - rather than on the value of their assets.

block-time published-time 2.24pm BST

UK sells bonds at negative yield

In a landmark development, investors have paid for the opportunity to lend money to the UK government.

Britain auctioned off £3.75bn of three-year bonds this morning, at an average yield (or interest rates) of -0.003%. That means that investors paid more than the face value of the bonds - meaning they are guaranteed a very small loss if they hold the debt until it matures in 2023.

Back in 2016, the UK did sell some short-term debt at below zero -- but City experts say this is the first time a three-year bond has been sold at a negative yield.

enltr2/ The UK sold a one-month bill at a negative yield in 2016, but this represents the first time it has sold a conventional longer term bond at yield below zero.

- Linda Yueh (@lindayueh) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

This shows that investors are pessimistic about the prospects for UK inflation, and anticipating further stimulus measures to support the economy.

It also shows that there's still demand for UK debt - the auction was more than two-times oversubscribed, so investors had accept this small negative yield in order to win a slice of the auction.

Here's the official results:

UK auction of 3-year bond results Photograph: Refinitiv

Here's Reuters' take:

Britain sold a government bond that pays a negative yield for the first time on Wednesday - meaning that Britain's government is effectively being paid to borrow as investors agreed to be paid back slightly less than they lent.

The bond, which matures in July 2023, sold at an average yield of -0.003%.

While investors will receive an annual interest payment of 0.75%, they paid above face value for the bond so the actual return in cash terms is less than they have lent.

The Financial Times reckons investors are expecting the Bank of England to launch further stimulus moves soon:

The UK has sold bonds with a negative yield for the first time, with a fall in inflation heaping further pressure on policymakers to take new action to prop up the economy.

The sale effectively means that investors are paying for the privilege of lending to the UK government, reflecting growing investor expectations that the Bank of England may need to take additional steps to push inflation back to its 2 per cent target.

The BoE has so far resisted cutting its main interest rate below zero but other central banks, such as the European Central Bank and Bank of Japan had already pushed their rates into negative territory even before the Covid-19 crisis.

The UK sold £3.8bn of three-year gilts at a yield of minus 0.003 per cent, according to the Debt Management Office. The slightly negative yield suggests investors who hold the debt to maturity will get back less than they paid, when accounting for regular interest payments and the return of principal.

enltrUK sold bonds with negative yield for 1st time. It effectively means investors are paying for privilege of lending to gov UK sold £3.8bn of 3-year gilts at yield of -0.003% suggests investors who hold the debt to maturity will get back less than they paid [*https://t.co/17zU7jIiwB*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

- Linda Yueh (@lindayueh) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time updated-timeUpdated at 2.24pm BST

block-time published-time 2.07pm BST

Here's my colleague Richard Partington on the WTO's trade slowdown warning:

International imports and exports have fallen to their lowest level for at least four years, according to [*World Trade Organization*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) figures revealing the economic damage caused by the coronavirus pandemic.

Warning there was little evidence of the downturn ending soon as Covid-19 brings the world economy to an effective standstill, the global authority on trade said it believed import and export activity would fall "precipitously" in the first half of 2020.

The WTO's quarterly [*goods trade*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)   [*barometer*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc), which provides real-time information on the trajectory of world merchandise trade relative to recent trends, slumped to 87.6 on a scale where anything below 100 indicates a downturn. Suggesting a sharp contraction in world trade extending into the second quarter of 2020, the reading was the lowest value on record since the indicator's launch in July 2016.

Related: [*WTO reports big slump in global trade as coronavirus takes toll*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 2.04pm BST

This is the first time Canada's inflation rate has turned negative since the financial crisis over a decade ago:

enltrKABOOM! Bloomberg Canada@BloombergCA Inflation goes negative in Canada for the first time since the 2009 recession [*https://t.co/bzT6Cmtin2*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)   [*pic.twitter.com/if926i0F65*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

- Bruce McWilliam Associates Landscape Design Group (@bemcwilliam) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 1.43pm BST

Canadian inflation sinks to minus 0.2%

Newsflash: Canadian inflation has fallen below zero as the Covid-19 pandemic continues to grip the global economy.

The annual Consumer Prices index across Canada fell by 0.2% in April, according to ***Statistics*** Canada. That's down from a 0.9% year-on-year rise in March.

In April alone, the CPI dropped by 0,7% in April after a 0.9% monthly drop in March.

As in the UK, fuel and clothing both became cheaper under the lockdown - although food prices did jump.

***Statistics*** Canada explains:

Compared with April 2019, consumers paid less for transportation (-4.4%), clothing and footwear (-4.1%), and recreation, education and reading (-0.7%). In contrast, the growth in food prices (+3.4%) accelerated in April 2020 and recorded the largest year-over-year increase of any major component.

Gasoline price slumped by 39.3% on a year-over-year basis in April, the largest year-over-year decline on record. Clothes and food prices fell 5.9% during April, which is the biggest monthly drop on record.

But food became significantly more expensive; including rice (+9.2%), eggs (+8.8%) and margarine (+7.9%) as consumers scrambled to stock up.

Higher sales and supply issues, including a slowdown in cross-border shipping due to COVID-19, contributed to higher prices for pork (+9.0%) and beef (+8.5%), ***Statistics*** Canada adds.

enltr???? Inflation Rate YoY Actual: -0.2% Expected: -0.1% Previous: 0.9% [*https://t.co/ruONg1c4O7*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

- DailyFX Team Live (@DailyFXTeam) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltr???? Inflation Rate MoM Actual: -0.7% Expected: -0.6% Previous: -0.6% [*https://t.co/ruONg1c4O7*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

- DailyFX Team Live (@DailyFXTeam) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 12.49pm BST

Big Mac dreams satisfied as drive-throughs reopen The drive-through McDonalds at Bushey Photograph: Joanna Partridge

My colleague Joanna Partridge has travelled to Bushey, near Watford, to meet some of the McDonalds customers keen to buy fast food again:

An hour after [*reopening for the first time in 8 weeks*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc), a queue of cars containing customers hungry for Big Macs and Happy Meals has formed outside the McDonald's drive-through in Bushey, east of Watford.

A McDonald's employee in a high-vis jacket is marshalling the queue of vehicles as the line stretches beyond the restaurant's waiting area onto the A41. Ruby Hibbitt, 18, and her housemate Paige Bush, 19, had been told by a friend that the restaurant was open and had got straight in the car to buy lunch.

They'd both been dreaming of a burger and diet coke, they said.

The drive-through McDonalds at Bushey Photograph: Joanna Partridge

block-time updated-timeUpdated at 1.34pm BST

block-time published-time 12.29pm BST

The Bank of England's new governor, Andrew Bailey, must write to the UK chancellor to explain [*why inflation is just 0.8%*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc), far from its target of 2%.

But what might he say? Our economics editor Larry Elliott has some ideas:

He might start by saying that the shuttering of much of the economy meant the April inflation rate had to include a bit of informed guesswork on the part of the Office for National ***Statistics*** (ONS) - because the usual field surveys that go into ***collecting*** prices were impossible during lockdown - but that the main reason for the drop in inflation was the [*collapse in oil prices*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc), owing to a mismatch between global demand and supply.

But Bailey will also tell Sunak that underlying inflationary pressures are also weak. Clothing prices fell sharply because retailers were desperate to get rid of excess stock. The cost of travel goods were also down because nobody is travelling.

Related: [*What will Bank governor say to chancellor about inflation drop?*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 12.14pm BST

Greece's finance minister has warned that its economy will probably shrink by at least 10% this year.

The Covid-19 pandemic is crushing Athens' hopes of economic recovery in 2020, after years of extremely painful austerity. PM Kyriakos Mitsotakis is expected to outline his plans to revive the economy later today.

Reuters has the details:

Greece's economy may shrink 10 to 13% this year following a lockdown imposed to stem the spread of the novel coronavirus, but the government will take steps to mitigate the impact, the country's finance minister said on Wednesday.

Finance Minister Christos Staikouras told Greek radio Real FM that the economy, which emerged from a decade-long debt crisis and three international bailouts in 2018, can withstand a possible second wave of infections in autumn.

The conservative government will support businesses and protect jobs, he said, and plans to take measures that could contain the estimated recession by as much as 8 points.

"We aim for the economy to gradually return to the dynamic it had before the health crisis, in February," Staikouras said.

block-time published-time 11.32am BST

Fast food chain McDonald's has taken another step towards normality by resuming drive-through services at nearly 40 restaurants in the UK and Ireland.

All the UK restaurants are in the South East of England - including in Luton, Peterborough, Chelmsford, Ipswich, Watford, Medway, Harrow and West Sutton. Six sites in Dublin are also reopening.

McDonalds says it expects high demand. It has introduced new safe working measures to prevent Covid-19 spreading, but warns that sites could close again if necessary to protect staff.

enltrWe are reopening 39 Drive Thru lanes across the UK and ROI. These Drive Thru pilot restaurants were all chosen as they are close to one of our distribution centres as we continue to prepare our supply chain for reopening. [*pic.twitter.com/HqvctFo63k*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

- McDonald's UK (@McDonaldsUK) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

Related: [*McDonald's reopens 32 drive-throughs: full list of restaurants*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 10.21am BST

WTO: Global trade volumes are slumping

World trade volumes are likely to "fall precipitously" in the first half of 2020 as the Covid-19 pandemic batters the global economy.

That's the latest warning from the World Trade Organisation, which says its goods barometer is now "flashing red" as trade volumes fall.

This index of trade volumes has slumped to 87.6, the lowest since it was launched in July 2016 - and some way below the 100 points baseline.

The WTO warns that there is "no sign of the trade decline bottoming out yet".

Today's figures are consistent with the WTO's April forecast that world merchandise trade could decline by between 13% and 32% in 2020, depending on how long the pandemic lasts - and how effective governments are at combating it.

Shipments of new cars have fallen particularly dramatically, the WTO adds, although technology products are holding up better.

The automotive products index (79.7) was weakest of all, due to collapsing car production and sales in major economies. The sharp decline in the forward-looking export orders index (83.3) suggests that trade weakness will persist in the short-run.

Declines in the container shipping (88.5) and air freight (88.0) indices reflect weak demand for traded goods as well as supply-side constraints arising from efforts to suppress COVID-19. Only the indices for electronic components (94.0) and ***agricultural*** raw materials (95.7) show signs of stability, although they too remain below trend.

block-time updated-timeUpdated at 10.27am BST

block-time published-time 10.13am BST

City analyst Kit Juckes of Société Générale has spotted some interesting trends in the [*this morning's UK inflation report*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) :

enltrSo.. upward pressure on CPI from games, pizzas and burgers, whisky, lager, cigarettes and balls of wool. Downward pressure from clothes, petrol, electricity, gas, water, and transport services. The way we live.....

- Kit Juckes in lockdown.... (@kitjuckes) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 10.06am BST

Eurozone inflation drops to 0.3%

Newsflash: Inflation across the eurozone has slumped to its lowest level in almost four years - just like in the UK.

Consumer prices in the euro area only rose by 0.3% annually in April, ***Eurostat*** reports. That's the lowest reading since August 2016, down from 0.7% in March.

It says:

In April 2020, a month marked by COVID-19 containment measures in all countries, the euro area annual inflation rate was 0.3%, down from 0.7% in March. A year earlier, the rate was 1.7%.

As in Britain, lower energy prices pulled CPI down - thanks to the glut of crude oil caused by the pandemic and the price war between Saudi Arabia and Russia.

But, ***eurostat*** also found that food, alcohol and tobacco prices rose last month:

In April, the highest contribution to the annual euro area inflation rate came from food, alcohol & tobacco (+0.67 percentage points, pp), followed by services (+0.52 pp), non-energy industrial goods (+0.09 pp) and energy (-0.97 pp).

enltrEuro area annual [*#inflation*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) down to 0.3% in April (0.7% in March)   [*https://t.co/gPzBf1Ixg1*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)   [*pic.twitter.com/onkUQjK5tu*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

- EU\_***Eurostat*** (@EU\_***Eurostat***) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 9.55am BST

My colleague Zoe Wood explains how M&S's sales have deteriorated under the lockdown:

In the six weeks to 9 May, clothing and home sales dropped 75%, while sales in Marks & Spencer's food halls, excluding its restaurants, were down 4.6%.

The company said even though its website had continued to operate, demand for clothing in the initial weeks was very low, although it had begun to improve. Over the last three weeks online sales were 20% higher than last year.

Related: [*M&S takes £145m hit on unsold stock as clothing sales fall 75%*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 9.37am BST

Just in: UK house prices picked up in March, just before the pandemic forced the housing market to freeze.

The ONS says:

* UK average house prices increased by 2.1% over the year to March 2020, up from 2.0% in February 2020.

1. Average house prices increased over the year in England to £248,000 (2.2%), Wales to £162,000 (1.1%), Scotland to £152,000 (1.5%) and Northern Ireland to £141,000 (3.8%).
2. London's average house prices increased by 4.7% over the year to March 2020; this is the largest 12-month growth London has seen since December 2016.

block-time published-time 9.26am BST

Here are more details of Marks & Spencer's plan to ride out the pandemic, via the BBC's Emma Simpson.

enltrSome snippets from [*@marksandspencer*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc) results. Like everyone else, can't forecast year ahead. Base case scenario is a £2.1bn hit to sales over the year. Already able to mitigate that by £1bn through cost savings, no dividend pay out and biz rates holiday.

- Emma Simpson (@BBCEmmaSimpson) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltrAnd company stresses it's got plenty liquidity/headroom to weather the storm. Early days, but says it's already £150m ahead. Being prudent.

- Emma Simpson (@BBCEmmaSimpson) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltrIt's going to introduce "guest brands" on the website. Not going down route of rival Next, though. And boss, Steve Rowe, says "we don't intend to be an online department store. That's not what we want to do."

- Emma Simpson (@BBCEmmaSimpson) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltrAnd when it launches its grocery home delivery service with Ocado in September, you can buy clothing as well. 1600 clothing and homeware lines over the year. Kicks off with 850 lines from new Autumn ***collection***. Makes perfect sense if they can pull it off!

- Emma Simpson (@BBCEmmaSimpson) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 9.22am BST

Here's our news story on today's inflation report:

Related: [*UK inflation tumbled to lowest level in four years in April, says ONS*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 9.09am BST

Looking ahead... Tom Stevenson, investment director at Fidelity Personal Investing, warns that inflation could spike once the pandemic is over

He points out that the huge stimulus measures launched by central banks and governments could ultimately push up the cost of living:

"The drop in inflation to its lowest level since 2016 reflects a fall in petrol costs as well as the impact of lower end demand on factory gate prices.

"In the short term, disinflationary pressures will mount as the economy slows under lockdown, consumers become more cautious and companies start to prepare for life beyond furlough support by reducing their workforces. Further out, there is a growing fear that monetary and fiscal policy choices could lead to higher inflation, perhaps significantly so.

"Investors have started to prepare for a more inflationary environment by adding to their holdings of gold, the traditional hedge against rising prices. The precious metal is trading close to a seven-year high."

But in the short-term, the trend is clearly downward:

enltrNice summary of today's UK price inflation figure for April. [*https://t.co/zWFvqDUTV4*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)   [*pic.twitter.com/YtcobFEPoe*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

- Rupert Seggins (@Rupert\_Seggins) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 9.02am BST

An M&S store in Barrow-in-Furness, north west England. Photograph: Paul Ellis/AFP via Getty Images

High street chain Marks & Spencer has outlined how the lockdown will hurt its business - and it's an alarming picture.

Under M&S's Covid-19 scenario, the current government guidelines continue for a period of at least four months - resulting in a 70% drop in clothing and home sales in April-July, and a 20% drop in food sales (compared to previous forecasts).

M&S has already been hit by the pandemic, telling shareholders:

The Covid-19 crisis started to have an impact on the business in the first week of March with reductions in UK Clothing & Home sales which declined by 6.2% and 26.9% the week after.

With the onset of lockdown, the effect on sales, colleagues and customers in both businesses has been dramatic. Clothing sales at the low point dropped to 16% of their level a year ago

The firm also reported that costs and stock write downs for Covid-19 have cost £212.8m. This helped to push pre-tax profits down by a fifth in the last financial year, to £67.2m from £84.2m.

Retailers are expected to slash prices in the months ahead, to shift the huge stockpiles of unsold clothes which they've not been able to sell. That would continue [*the drop in clothing prices seen in April's inflation report*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc), keeping the cost of living lower.

block-time published-time 8.32am BST

British justice secretary Robert Buckland says the government will try to hep Rolls-Royce and its staff.

Asked about the firm's plan to axe 9,000 job cuts, Buckland replied:

"Clearly we will have to go to work with the employer to look at the options.

"All of us will be looking not just at Rolls Royce but at the whole sector and the implications of this for the supply chains as well, let's not forget them, to make sure we are doing everything we can in terms of plans and action to support what is a very high skilled part of our economy."

( thanks to Reuters for the quotes )

block-time updated-timeUpdated at 8.33am BST

block-time published-time 8.15am BST

Rolls-Royce cuts 9,000 jobs

Grim news: The Covid-19 pandemic is forcing Rolls-Royce to slash 9,000 jobs - or nearly a fifth of its workforce.

Rolls-Royce, one of the jewels in UK manufacturing's crown, is wielding the axe after seeing slumping demand for its jet engines due to the pandemic. With airlines suspending flights and mothballing planes, the Derby-based firm faces a serious crisis.

Warren East, the chief executive, told the City:

"This is not a crisis of our making. But it is the crisis that we face and we must deal with it.

Our airline customers and airframe partners are having to adapt and so must we.

"Being told that there is no longer a job for you is a terrible prospect and it is especially hard when all of us take so much pride in working for Rolls-Royce.

"But we must take difficult decisions to see our business through these unprecedented times."

Here's the full story:

Related: [*Rolls-Royce to cut 9,000 jobs as Covid-19 takes toll*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 8.09am BST

Biggest drop in inflation in a decade

Britain's economy has a lot of problems right now, but inflation doesn't appear to be one of them.

[*With CPI almost halving last month*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc), Equals Group chief economist Jeremy Thomson-Cook says weak economic demand will keep prices low:

With headline consumer inflation at 0.8% and producer price inflation - simply price rises at the beginning of a supply chain - falling 5.1% in April alone courtesy of the recent declines in oil prices, we are more likely to hear concerns about deflation from central bankers.

As we have noted in the past, you need to have demand to create inflation and, for now, there is little demand. Some will return as employees earnings recover and more businesses reopen allowing consumers to spend more on different sectors but, similar to the pace of the economy reopening, is likely to be slow."

UK inflation to April Photograph: UK inflation to April 2020

Ruth Gregor y of Capital Economics has spotted that this is the biggest drop in inflation in over a decade:

The slump in CPI inflation from 1.5% in March to 0.8% in April (consensus 0.9%; CE 0.8%) was the biggest drop since December 2008 and left inflation at its lowest since August 2016. This was largely due to energy effects, as fuel inflation slipped from -2.4% to -12.2% and utility inflation dropped from 3.9% to -6.8% (due to the decline in Ofgem's price cap).

There was a partial offset from food price inflation, which rose from 1.1% to 1.3%, reflecting higher inflation for fresh fruit, meat and fish. The games, toys, hobbies and computer software categories provided also provided further upward pressure.

The slump in inflation will intensify speculation that the Bank of England could cut interest rates below zero (their currently 0.1%, a record low), says Chris Bailey, European Strategist at wealth managers Raymond James :

"Talk of negative interest rates has been doing the rounds in recent weeks, but with inflation now trailing expectation, falling from 1.5% to 0.8%, that debate has become very real.

All eyes now turn to the Governor of the Bank of England's comments later today for signs of further action to boost economic activity. The Bank of England does have room to move, if it wishes, and Governor Bailey has already laid out the red carpet for lower interest rates, so we can be sure it's at the front of his mind.

block-time published-time 7.52am BST

Fast food prices jump

Did your lockdown takeaway feel a little pricier this month? If so, you're not alone.

Prices at fast food outlets and takeaway services rose last month, the Office for National ***Statistics*** reports.

The largest monthly price increases came from takeway and delivery pizzas (up 7.3%) and takeaway burgers (up 4.6%).

block-time published-time 7.47am BST

Although food prices fell slightly, vegetable became pricier - possibly due to a switch to British potatoes.

The inflation report explains:

Food prices overall fell by 0.1% between March and April this year....

The largest upward contribution came from vegetables (including potatoes and tubers), where prices rose between March and April this year but fell between the same two months a year ago. This month's price movements for vegetables could be a consequence of switching from internationally to domestically grown produce.

Sky's Scott Beasley points out that this partly eroded the benefits from cheaper oil.

enltr?? Inflation: very sharp drop ?? to 0.8% in April from 1.5% in March

- Scott Beasley (@SkyScottBeasley) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltrBig deflationary impacts on consumer inflation from: ?? petrol & diesel ?? domestic energy

- Scott Beasley (@SkyScottBeasley) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

enltr??So that collapse in oil prices has fed through to the prices we pay ?? Food price inflation pretty stable but fresh vegetables up

- Scott Beasley (@SkyScottBeasley) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 7.41am BST

Factory gate inflation turns negative

The slump in the oil price has also driven down producer price inflation (basically, how much companies charge for their goods charge) to -0.7%.

That means goods at the factory gate are actually cheaper than a year ago, suggesting consumer price inflation will remain low in the coming months.

The ONS says:

* The price for materials and fuels used in the manufacturing process displayed negative growth of 9.8% on the year to April 2020, down from negative growth of 3.1% in March 2020.

1. Petroleum products made the largest downward contribution to the change in the annual rate of output inflation.
2. Crude oil provided the largest downward contribution to the annual rate of input inflation.

enltrFactory gate inflation (the price of goods when leaving the factory before any retail profits or additional costs are added) was negative 0.7% on the year to April 2020, down from 0.3% in March 2020 [*https://t.co/FYV5ElR6ar*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)   [*pic.twitter.com/dMz9CnatEL*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

- Office for National ***Statistics*** (ONS) (@ONS) [*May 20, 2020*](https://www.theguardian.com/business/live/2020/may/20/uk-inflation-tumbles-energy-clothes-discounting-covid-19-ftse-pound-business-live?page=with:block-5ec535578f0886ce4f5d71dc#block-5ec535578f0886ce4f5d71dc)

block-time published-time 7.37am BST

Toy prices went up

Although overall inflation fell, the cost of games rose in April -- as families scrambled to find interesting things to during the lockdown.

The ONS explains:

There was an upward contribution (of 0.11 percentage points) from games, toys and hobbies where prices for items like computer games consoles, preschool activity toys, craft kits, dolls, construction toys, and sit and ride toys overall rose by 0.5% in the month compared with a fall of 5.8% a year ago.

There were further upward contributions of 0.07 percentage points from ***data*** processing equipment, principally computer software, and 0.05 percentage points from recording media, including CDs and DVDs purchased online and music downloads.

block-time published-time 7.35am BST

Stock shortages drove up wool prices rose last month -- perhaps due to isolating Brits taking up knitting?

The ONS says:

For other clothing and accessories, most of the upward movement came from balls of knitting wool, where there were recoveries from sales and higher price comparable items as a result of stock shortages in some stores.

block-time published-time 7.33am BST

Petrol prices hit their lowest level in four years, today's inflation report shows:

Petrol prices fell by 10.4 pence per litre between March and April 2020, to stand at 109.0 pence per litre, and diesel prices fell by 7.8 pence per litre, to stand at 116.0 pence per litre.

In comparison, between March and April 2019, petrol and diesel prices increased by 3.8 and 2.3 pence per litre to stand at 124.1 and 133.0 pence per litre, respectively. Petrol prices were last lower in May 2016 (when a litre cost 108.7 pence), and the 10.4 pence per litre drop in petrol prices is the largest monthly fall since the current ultra-low sulphur or unleaded petrol series began in 1990.

Good news for drivers! But there is a proviso. With millions of employees working from home, and non-essential driving curbed, few will have actually benefited much from cheaper fuel prices.

block-time published-time 7.19am BST

UK inflation drops to just 0.8%

Good morning, and welcome to our rolling coverage of the world economy, the financial markets, the eurozone and business

Britain's inflation rate has fallen to its lowest rate in over three and a half years last month, due to a drop in energy prices and discounting by shops desperate to sell stock during the Covid-19 lockdown.

The Consumer Price Index plunged to just 0.8% year-on-year in April, the Office for National ***Statistics*** reports, down from 1.5% per year in March.

That's its lowest rate since August 2016.

In April alone, prices fell by 0.2%, bringing some relief to struggling households and firms.

Cheaper energy bills and petrol prices has a downward impact on the cost of living.

That's due to falling crude prices as the coronavirus outbreak hits demand, and the cap on UK energy bills. Gas prices, for example, fell by 3.5%.

The ONS says:

* Falling energy and fuel pump prices resulted in the largest downward contributions to the change in the inflation rate between March and April 2020.

1. Rising prices for recreational goods resulted in a partially offsetting upward contribution to change.

Discounting was also a factor -- with clothes prices dropping last month during the lockdown:

The ONS explains:

For garments, prices overall fell by 2.3% between March and April 2020 compared with a small increase of 0.4% a year ago. There were a greater number of items recorded as being discounted this year, when compared with April 2019, with reductions across a range of women's and men's clothing items.

The larger number of items recorded as being on sale could reflect retailers' efforts to encourage online purchases or potential difficulties as a result of the current economic situation.

More to follow....

Also coming up today

Inflation ***data*** from the eurozone and Canada are expected to also show a sharp slowdown last month.

David Madden of CMC Markets has the details:

Eurozone CPI for April is anticipated to fall from 0.7% in March to 0.4% in April. The core update is anticipated to be 0.9%, and that would be a fall from the 1% registered in March. The figures will be announced at 10am (UK time).

Canadian CPI will be released at 1.30pm (UK time). The report is expected to be -0.1% and that would be a huge drop from the 0.9% posted in March.

UK high street chain Marks & Spencer is reporting results, updating the City on its performance during the lockdown. And there could be queues at your local McDonalds outlets, as the fast food chain reopens around 40 outlets across the county.

The agenda

* 10am BST: Eurozone inflation ***data*** for April

1. 1.30pm BST: Canadian inflation ***data***
2. 2.30pm BST: Bank of England governor Andrew Bailey and colleagues testify to parliament's Treasury committee

block-time updated-timeUpdated at 7.35am BST

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false true [*https://media.guim.co.uk/8a60caf5d6b00c1bbf063d0315368f2313678404/0\_232\_3500\_2101/500.jpg*](https://media.guim.co.uk/8a60caf5d6b00c1bbf063d0315368f2313678404/0_232_3500_2101/500.jpg) false en true Time for a recap The governor of the Bank of England has refused to rule out introducing negative interest rates in the UK. Andrew Bailey told MPs that his views have changed in the light of the coronavirus pandemic - the BoE is reassessing all its tools, as it tries to fight the worst downturn in centuries. Bailey was speaking shortly after the UK sold government debt at negative yield for the first time. Investors effectively paid for the chance to lend to Britain -- perhaps partly because the BoE has pledged to buy the gilts under its stimulus programme. The pandemic is pushing inflation down across the globe. In the UK, the Consumer Price Index dropped to just 0.8% last month, down from 1.5% in April - with fuel and clothing prices dropping last month. Eurozone inflation fell to 0.3%, while in Canada the inflation rate turned negative for the first time since 2009. The WTO warned that world trade in goods has fallen dramatically this year, as the economy contracts. Despite this concern, global stock markets have risen today on hopes of economic recovery later this year. And there's deep gloom in Derby tonight as Rolls-Royce announces thousands of job cuts. But McDonald's has cheered some of its fans, by reopening 33 drive-through outlets. Goodnight. GW Optimism that the world economy will start to recover from the Covid-19 recession soon has lifted shares across Europe. The main indices have closed around 1% higher tonight, as global markets hit their highest levels in 10 weeks. Stoxx 600: up 3.5 points or 1.05% at 343.4 FTSE 100: up 64 points or 1% at 6067 German DAX: up 170 points or 1.5% at 11,245 French CAC: up 40 points or 0.9% at 4,498 Italian FTSE MIB: up 178 points or 1% at 17,213 Stocks are also higher in New York, with the Dow gaining around 1.7%. Connor Campbell of Spreadex explains that investors are shrugging off rising tensions between Washington and Beijing: The Dow Jones was keen to rebound on Wednesday, shaking off the Moderna vaccines doubts that plagued it on Tuesday. Rising close to 400 points, the Dow returned to 24600, pretty much reversing the losses incurred last night thanks to some solid earnings, persistent optimism regarding a vaccine and the hopes of some more Fed stimulus down the line. That meant the Dow ignored Donald Trump's latest inflammatory comments towards China, the President claiming it was the 'incompetence' of Beijing that caused the virus to spread. And finally.... Treasury committee chair Mel Stride returns to the issue of negative interest rates, which governor Andrew Bailey refused to rule in or out. Q: What criteria need to be met for the Bank to go for negative rates? Governor Andrew Bailey replies that he has changed his position on negative interest rates a little, given recent events. We need to reassess our tools, and keep them (negative interest rates) as an option, he tells the committee. But there are lot of issues to consider -- including how it would affect the stability of the financial system, and how an interest rate cut below 0% would be transmitted through the system. We also need to consider any other measures that Bank would take alongside it, Bailey adds, cautioning that there are "some pretty mixed reviews" about how negative rates have worked elsewhere. Conservative MP Steve Baker has challenged the Bank of England over its QE programme. Isn't it "quite extraordinary" that we have one major borrower (the UK government), and one major buyer (the Bank) in the market, giving bond traders the confidence to buy gilts because they know they can sell them onto Threadneedle Street? We are facing a "quite extraordinary situation", governor Andrew Bailey replies. But he doesn't accept that the Bank is simply monetising government borrowing. Instead, he argues, the Bank is reacting to economic conditions by expanding its QE programme -- just as the government is reacting to economic conditions by issuing more debt..... Q: What impact will Covid-19 have on the UK property market? Elisabeth Stheeman, a member of the BoE's Financial Policy Committee, replies that commercial property - particularly offices outside London - will be hit as companies reassess how much office space they need. Back at the Treasury committee e-hearing, Bank of England policymaker Jonathan Haskel has warned that self-employed workers, younger people, and those with fewer skills will be most hurt by the recession. These workers, such as those in the hospitality sector and hotels, will be reliant on a pick-up in aggregate demand in the economy, Haskel adds. Breaking away from the Bank of England hearing... a former US Green Beret soldier and his son have reportedly been arrested over Carlos Ghosn's shock escape from Japan last December. Reuters has the details: U.S. authorities on Wednesday arrested a former special forces soldier and another man wanted by Japan on charges that they enabled the escape of former Nissan Motor boss Carlos Ghosn out of the country. Former U.S. Green Beret Michael Taylor and the other man, Peter Taylor, are expected to appear by video conference before a federal judge in Worcester, Massachusetts, according to court records. The BBC's Faisal Islam points out that the Bank of England has helped to push UK borrowing costs below zero today. The BoE has pledged to buy £200bn of gilts through its asset purchase scheme, lifting its QE total to £645bn. That means investors feel confident buying UK gilts, as they can sell them onto the Bank. Andrew Bailey's comments on negative interest rates are very timely - just hours after the UK borrowed for free for the next three years. Our economics editor Larry Elliott writes: Britain has sold a government bond with a negative yield for the first time after plunging inflation raised the prospect of the Bank of England cutting official interest rates below zero. In a development that effectively means investors have to pay to lend money to fund the government's response to the Covid-19 pandemic, investors bought gilts knowing they would get back less than they paid for them when the bonds mature in three years' time. The debt management office (DMO) said it had sold £3.8bn of three-year gilts at a yield of -0.003%, with the result that Britain has joined a small group of countries - such as Germany and Japan - that have persuaded investors to accept a negative return. Deputy governor Ben Broadbent denies that the Bank is anticipating a V-shaped recovery from the pandemic. He tells MPs that in the Bank's latest scenario, the economy shrinks by around 25% in the April-June quarter, and doesn't return to its pre-crisis levels until 2022. There's no doubt that in our scenario, the recovery takes a lot longer than the downturn, Broadbent insists, saying it doesn't really sound like a V.... MPs then press the Bank of England on its decision to force UK banks to scrap their dividends back in March. Andrew Bailey insists this was a sensible business decision, not good politics. It strengthens the banks' balance sheets - and if the economy recovers faster than hoped, they can reassess dividend policy. Andrew Bailey seems to be keeping his options open, on whether to impose negative interest rates on the UK economy in an attempt to stimulate the economy. Here's some reaction: The Treasury committee moves onto monetary policy -- and asks whether the Bank of England could cut rates below zero: Q: Would you contemplate negative interest rates and buying riskier assets? We do not rule things out as a matter of principle - that would be foolish, replies governor Andrew Bailey smoothly. He explains that the MPC has a history of keeping the 'lower bound' of monetary policy under review -- ie, how low it can actually cut rates. [UK interest rates are currently just 0.1%, a record low]. We are keeping our tools under active review in the current situation, Bailey adds. Bailey says it is "looking carefully" at the experience that other central banks have had with negative interest rates, where it has been "quite a nuanced policy tool". He doesn't name them -- but one obvious candidate is the European Central Bank. The ECB imposes -0.5% interest rates on commercial bank deposits to encourage them to lend to the real economy, rather than leave money in its vaults. As he puts it: We're not ruling it in, and we're not ruling it out. The governor insists that this is the "right time" to assess all the Bank's tools, including the purchase of riskier assets, as the BoE may need to "move rapidly" in the future. He also explains that communication would be "absolutely critical", if there was any move on negative interest rates. Bank of England governor Andrew Bailey is testifying, remotely, to the UK parliament's Treasury Committee. He's "accompanied" by deputy governors Ben Broadbent and Jon Cunliffe, and external policy members Elisabeth Stheeman and Jonathan Haskel. Q: Are Britain's banks as well-capitalised as they should be to trade through the Covid-19 crisis, given the slump in their share prices? (as economist Sir John Vickers fears)? Bailey argues that it makes more sense to assess the value of a bank's assets (the book value), when stress-testing them. If you had used banks' share price in the run-up to the 2008 financial crisis, for example, you'd have been given a wildly erroneous view of their strength. The better question, Bailey says, is why are bank shares so low? It's partly because the market has doubts about some banks' business model, he reckons - rather than on the value of their assets. In a landmark development, investors have paid for the opportunity to lend money to the UK government. Britain auctioned off £3.75bn of three-year bonds this morning, at an average yield (or interest rates) of -0.003%. That means that investors paid more than the face value of the bonds - meaning they are guaranteed a very small loss if they hold the debt until it matures in 2023. Back in 2016, the UK did sell some short-term debt at below zero -- but City experts say this is the first time a three-year bond has been sold at a negative yield. This shows that investors are pessimistic about the prospects for UK inflation, and anticipating further stimulus measures to support the economy. It also shows that there's still demand for UK debt - the auction was more than two-times oversubscribed, so investors had accept this small negative yield in order to win a slice of the auction. Here's the official results: Here's Reuters' take: Britain sold a government bond that pays a negative yield for the first time on Wednesday - meaning that Britain's government is effectively being paid to borrow as investors agreed to be paid back slightly less than they lent. The bond, which matures in July 2023, sold at an average yield of -0.003%. While investors will receive an annual interest payment of 0.75%, they paid above face value for the bond so the actual return in cash terms is less than they have lent. The Financial Times reckons investors are expecting the Bank of England to launch further stimulus moves soon: The UK has sold bonds with a negative yield for the first time, with a fall in inflation heaping further pressure on policymakers to take new action to prop up the economy. The sale effectively means that investors are paying for the privilege of lending to the UK government, reflecting growing investor expectations that the Bank of England may need to take additional steps to push inflation back to its 2 per cent target. The BoE has so far resisted cutting its main interest rate below zero but other central banks, such as the European Central Bank and Bank of Japan had already pushed their rates into negative territory even before the Covid-19 crisis. The UK sold £3.8bn of three-year gilts at a yield of minus 0.003 per cent, according to the Debt Management Office. The slightly negative yield suggests investors who hold the debt to maturity will get back less than they paid, when accounting for regular interest payments and the return of principal. Here's my colleague Richard Partington on the WTO's trade slowdown warning: International imports and exports have fallen to their lowest level for at least four years, according to World Trade Organization figures revealing the economic damage caused by the coronavirus pandemic. Warning there was little evidence of the downturn ending soon as Covid-19 brings the world economy to an effective standstill, the global authority on trade said it believed import and export activity would fall "precipitously" in the first half of 2020. The WTO's quarterly goods trade barometer, which provides real-time information on the trajectory of world merchandise trade relative to recent trends, slumped to 87.6 on a scale where anything below 100 indicates a downturn. Suggesting a sharp contraction in world trade extending into the second quarter of 2020, the reading was the lowest value on record since the indicator's launch in July 2016. This is the first time Canada's inflation rate has turned negative since the financial crisis over a decade ago: Newsflash: Canadian inflation has fallen below zero as the Covid-19 pandemic continues to grip the global economy. The annual Consumer Prices index across Canada fell by 0.2% in April, according to ***Statistics*** Canada. That's down from a 0.9% year-on-year rise in March. In April alone, the CPI dropped by 0,7% in April after a 0.9% monthly drop in March. As in the UK, fuel and clothing both became cheaper under the lockdown - although food prices did jump. ***Statistics*** Canada explains: Compared with April 2019, consumers paid less for transportation (-4.4%), clothing and footwear (-4.1%), and recreation, education and reading (-0.7%). In contrast, the growth in food prices (+3.4%) accelerated in April 2020 and recorded the largest year-over-year increase of any major component. Gasoline price slumped by 39.3% on a year-over-year basis in April, the largest year-over-year decline on record. Clothes and food prices fell 5.9% during April, which is the biggest monthly drop on record. But food became significantly more expensive; including rice (+9.2%), eggs (+8.8%) and margarine (+7.9%) as consumers scrambled to stock up. Higher sales and supply issues, including a slowdown in cross-border shipping due to COVID-19, contributed to higher prices for pork (+9.0%) and beef (+8.5%), ***Statistics*** Canada adds. My colleague Joanna Partridge has travelled to Bushey, near Watford, to meet some of the McDonalds customers keen to buy fast food again: An hour after reopening for the first time in 8 weeks, a queue of cars containing customers hungry for Big Macs and Happy Meals has formed outside the McDonald's drive-through in Bushey, east of Watford. A McDonald's employee in a high-vis jacket is marshalling the queue of vehicles as the line stretches beyond the restaurant's waiting area onto the A41. Ruby Hibbitt, 18, and her housemate Paige Bush, 19, had been told by a friend that the restaurant was open and had got straight in the car to buy lunch. They'd both been dreaming of a burger and diet coke, they said. The Bank of England's new governor, Andrew Bailey, must write to the UK chancellor to explain why inflation is just 0.8%, far from its target of 2%. But what might he say? Our economics editor Larry Elliott has some ideas: He might start by saying that the shuttering of much of the economy meant the April inflation rate had to include a bit of informed guesswork on the part of the Office for National ***Statistics*** (ONS) - because the usual field surveys that go into ***collecting*** prices were impossible during lockdown - but that the main reason for the drop in inflation was the collapse in oil prices, owing to a mismatch between global demand and supply. But Bailey will also tell Sunak that underlying inflationary pressures are also weak. Clothing prices fell sharply because retailers were desperate to get rid of excess stock. The cost of travel goods were also down because nobody is travelling. Greece's finance minister has warned that its economy will probably shrink by at least 10% this year. The Covid-19 pandemic is crushing Athens' hopes of economic recovery in 2020, after years of extremely painful austerity. PM Kyriakos Mitsotakis is expected to outline his plans to revive the economy later today. Reuters has the details: Greece's economy may shrink 10 to 13% this year following a lockdown imposed to stem the spread of the novel coronavirus, but the government will take steps to mitigate the impact, the country's finance minister said on Wednesday. Finance Minister Christos Staikouras told Greek radio Real FM that the economy, which emerged from a decade-long debt crisis and three international bailouts in 2018, can withstand a possible second wave of infections in autumn. The conservative government will support businesses and protect jobs, he said, and plans to take measures that could contain the estimated recession by as much as 8 points. "We aim for the economy to gradually return to the dynamic it had before the health crisis, in February," Staikouras said. Fast food chain McDonald's has taken another step towards normality by resuming drive-through services at nearly 40 restaurants in the UK and Ireland. All the UK restaurants are in the South East of England - including in Luton, Peterborough, Chelmsford, Ipswich, Watford, Medway, Harrow and West Sutton. Six sites in Dublin are also reopening. McDonalds says it expects high demand. It has introduced new safe working measures to prevent Covid-19 spreading, but warns that sites could close again if necessary to protect staff. World trade volumes are likely to "fall precipitously" in the first half of 2020 as the Covid-19 pandemic batters the global economy. That's the latest warning from the World Trade Organisation, which says its goods barometer is now "flashing red" as trade volumes fall. This index of trade volumes has slumped to 87.6, the lowest since it was launched in July 2016 - and some way below the 100 points baseline. The WTO warns that there is "no sign of the trade decline bottoming out yet". Today's figures are consistent with the WTO's April forecast that world merchandise trade could decline by between 13% and 32% in 2020, depending on how long the pandemic lasts - and how effective governments are at combating it. Shipments of new cars have fallen particularly dramatically, the WTO adds, although technology products are holding up better. The automotive products index (79.7) was weakest of all, due to collapsing car production and sales in major economies. The sharp decline in the forward-looking export orders index (83.3) suggests that trade weakness will persist in the short-run. Declines in the container shipping (88.5) and air freight (88.0) indices reflect weak demand for traded goods as well as supply-side constraints arising from efforts to suppress COVID-19. Only the indices for electronic components (94.0) and ***agricultural*** raw materials (95.7) show signs of stability, although they too remain below trend. City analyst Kit Juckes of Société Générale has spotted some interesting trends in the this morning's UK inflation report: Newsflash: Inflation across the eurozone has slumped to its lowest level in almost four years - just like in the UK. Consumer prices in the euro area only rose by 0.3% annually in April, ***Eurostat*** reports. That's the lowest reading since August 2016, down from 0.7% in March. It says: In April 2020, a month marked by COVID-19 containment measures in all countries, the euro area annual inflation rate was 0.3%, down from 0.7% in March. A year earlier, the rate was 1.7%. As in Britain, lower energy prices pulled CPI down - thanks to the glut of crude oil caused by the pandemic and the price war between Saudi Arabia and Russia. But, ***eurostat*** also found that food, alcohol and tobacco prices rose last month: In April, the highest contribution to the annual euro area inflation rate came from food, alcohol & tobacco (+0.67 percentage points, pp), followed by services (+0.52 pp), non-energy industrial goods (+0.09 pp) and energy (-0.97 pp). My colleague Zoe Wood explains how M&S's sales have deteriorated under the lockdown: In the six weeks to 9 May, clothing and home sales dropped 75%, while sales in Marks & Spencer's food halls, excluding its restaurants, were down 4.6%. The company said even though its website had continued to operate, demand for clothing in the initial weeks was very low, although it had begun to improve. Over the last three weeks online sales were 20% higher than last year. Just in: UK house prices picked up in March, just before the pandemic forced the housing market to freeze. The ONS says: UK average house prices increased by 2.1% over the year to March 2020, up from 2.0% in February 2020. Average house prices increased over the year in England to £248,000 (2.2%), Wales to £162,000 (1.1%), Scotland to £152,000 (1.5%) and Northern Ireland to £141,000 (3.8%). London's average house prices increased by 4.7% over the year to March 2020; this is the largest 12-month growth London has seen since December 2016. Here are more details of Marks & Spencer's plan to ride out the pandemic, via the BBC's Emma Simpson. Here's our news story on today's inflation report: Looking ahead... Tom Stevenson, investment director at Fidelity Personal Investing, warns that inflation could spike once the pandemic is over He points out that the huge stimulus measures launched by central banks and governments could ultimately push up the cost of living: "The drop in inflation to its lowest level since 2016 reflects a fall in petrol costs as well as the impact of lower end demand on factory gate prices. "In the short term, disinflationary pressures will mount as the economy slows under lockdown, consumers become more cautious and companies start to prepare for life beyond furlough support by reducing their workforces. Further out, there is a growing fear that monetary and fiscal policy choices could lead to higher inflation, perhaps significantly so. "Investors have started to prepare for a more inflationary environment by adding to their holdings of gold, the traditional hedge against rising prices. The precious metal is trading close to a seven-year high." But in the short-term, the trend is clearly downward: High street chain Marks & Spencer has outlined how the lockdown will hurt its business - and it's an alarming picture. Under M&S's Covid-19 scenario, the current government guidelines continue for a period of at least four months - resulting in a 70% drop in clothing and home sales in April-July, and a 20% drop in food sales (compared to previous forecasts). M&S has already been hit by the pandemic, telling shareholders: The Covid-19 crisis started to have an impact on the business in the first week of March with reductions in UK Clothing & Home sales which declined by 6.2% and 26.9% the week after. With the onset of lockdown, the effect on sales, colleagues and customers in both businesses has been dramatic. Clothing sales at the low point dropped to 16% of their level a year ago The firm also reported that costs and stock write downs for Covid-19 have cost £212.8m. This helped to push pre-tax profits down by a fifth in the last financial year, to £67.2m from £84.2m. Retailers are expected to slash prices in the months ahead, to shift the huge stockpiles of unsold clothes which they've not been able to sell. That would continue the drop in clothing prices seen in April's inflation report, keeping the cost of living lower. British justice secretary Robert Buckland says the government will try to hep Rolls-Royce and its staff. Asked about the firm's plan to axe 9,000 job cuts, Buckland replied: "Clearly we will have to go to work with the employer to look at the options. "All of us will be looking not just at Rolls Royce but at the whole sector and the implications of this for the supply chains as well, let's not forget them, to make sure we are doing everything we can in terms of plans and action to support what is a very high skilled part of our economy." (thanks to Reuters for the quotes) Grim news: The Covid-19 pandemic is forcing Rolls-Royce to slash 9,000 jobs - or nearly a fifth of its workforce. Rolls-Royce, one of the jewels in UK manufacturing's crown, is wielding the axe after seeing slumping demand for its jet engines due to the pandemic. With airlines suspending flights and mothballing planes, the Derby-based firm faces a serious crisis. Warren East, the chief executive, told the City: "This is not a crisis of our making. But it is the crisis that we face and we must deal with it. Our airline customers and airframe partners are having to adapt and so must we. "Being told that there is no longer a job for you is a terrible prospect and it is especially hard when all of us take so much pride in working for Rolls-Royce. "But we must take difficult decisions to see our business through these unprecedented times." Here's the full story: Britain's economy has a lot of problems right now, but inflation doesn't appear to be one of them. With CPI almost halving last month, Equals Group chief economist Jeremy Thomson-Cook says weak economic demand will keep prices low: With headline consumer inflation at 0.8% and producer price inflation - simply price rises at the beginning of a supply chain - falling 5.1% in April alone courtesy of the recent declines in oil prices, we are more likely to hear concerns about deflation from central bankers. As we have noted in the past, you need to have demand to create inflation and, for now, there is little demand. Some will return as employees earnings recover and more businesses reopen allowing consumers to spend more on different sectors but, similar to the pace of the economy reopening, is likely to be slow." Ruth Gregory of Capital Economics has spotted that this is the biggest drop in inflation in over a decade: The slump in CPI inflation from 1.5% in March to 0.8% in April (consensus 0.9%; CE 0.8%) was the biggest drop since December 2008 and left inflation at its lowest since August 2016. This was largely due to energy effects, as fuel inflation slipped from -2.4% to -12.2% and utility inflation dropped from 3.9% to -6.8% (due to the decline in Ofgem's price cap). There was a partial offset from food price inflation, which rose from 1.1% to 1.3%, reflecting higher inflation for fresh fruit, meat and fish. The games, toys, hobbies and computer software categories provided also provided further upward pressure. The slump in inflation will intensify speculation that the Bank of England could cut interest rates below zero (their currently 0.1%, a record low), says Chris Bailey, European Strategist at wealth managers Raymond James: "Talk of negative interest rates has been doing the rounds in recent weeks, but with inflation now trailing expectation, falling from 1.5% to 0.8%, that debate has become very real. All eyes now turn to the Governor of the Bank of England's comments later today for signs of further action to boost economic activity. The Bank of England does have room to move, if it wishes, and Governor Bailey has already laid out the red carpet for lower interest rates, so we can be sure it's at the front of his mind. Did your lockdown takeaway feel a little pricier this month? If so, you're not alone. Prices at fast food outlets and takeaway services rose last month, the Office for National ***Statistics*** reports. The largest monthly price increases came from takeway and delivery pizzas (up 7.3%) and takeaway burgers (up 4.6%). Although food prices fell slightly, vegetable became pricier - possibly due to a switch to British potatoes. The inflation report explains: Food prices overall fell by 0.1% between March and April this year.... The largest upward contribution came from vegetables (including potatoes and tubers), where prices rose between March and April this year but fell between the same two months a year ago. This month's price movements for vegetables could be a consequence of switching from internationally to domestically grown produce. Sky's Scott Beasley points out that this partly eroded the benefits from cheaper oil. The slump in the oil price has also driven down producer price inflation (basically, how much companies charge for their goods charge) to -0.7%. That means goods at the factory gate are actually cheaper than a year ago, suggesting consumer price inflation will remain low in the coming months. The ONS says: The price for materials and fuels used in the manufacturing process displayed negative growth of 9.8% on the year to April 2020, down from negative growth of 3.1% in March 2020. Petroleum products made the largest downward contribution to the change in the annual rate of output inflation. Crude oil provided the largest downward contribution to the annual rate of input inflation. Although overall inflation fell, the cost of games rose in April -- as families scrambled to find interesting things to during the lockdown. The ONS explains: There was an upward contribution (of 0.11 percentage points) from games, toys and hobbies where prices for items like computer games consoles, preschool activity toys, craft kits, dolls, construction toys, and sit and ride toys overall rose by 0.5% in the month compared with a fall of 5.8% a year ago. There were further upward contributions of 0.07 percentage points from ***data*** processing equipment, principally computer software, and 0.05 percentage points from recording media, including CDs and DVDs purchased online and music downloads. Stock shortages drove up wool prices rose last month -- perhaps due to isolating Brits taking up knitting? The ONS says: For other clothing and accessories, most of the upward movement came from balls of knitting wool, where there were recoveries from sales and higher price comparable items as a result of stock shortages in some stores. Petrol prices hit their lowest level in four years, today's inflation report shows: Petrol prices fell by 10.4 pence per litre between March and April 2020, to stand at 109.0 pence per litre, and diesel prices fell by 7.8 pence per litre, to stand at 116.0 pence per litre. In comparison, between March and April 2019, petrol and diesel prices increased by 3.8 and 2.3 pence per litre to stand at 124.1 and 133.0 pence per litre, respectively. Petrol prices were last lower in May 2016 (when a litre cost 108.7 pence), and the 10.4 pence per litre drop in petrol prices is the largest monthly fall since the current ultra-low sulphur or unleaded petrol series began in 1990. Good news for drivers! But there is a proviso. With millions of employees working from home, and non-essential driving curbed, few will have actually benefited much from cheaper fuel prices. Good morning, and welcome to our rolling coverage of the world economy, the financial markets, the eurozone and business Britain's inflation rate has fallen to its lowest rate in over three and a half years last month, due to a drop in energy prices and discounting by shops desperate to sell stock during the Covid-19 lockdown. The Consumer Price Index plunged to just 0.8% year-on-year in April, the Office for National ***Statistics*** reports, down from 1.5% per year in March. That's its lowest rate since August 2016. In April alone, prices fell by 0.2%, bringing some relief to struggling households and firms. Cheaper energy bills and petrol prices has a downward impact on the cost of living. That's due to falling crude prices as the coronavirus outbreak hits demand, and the cap on UK energy bills. Gas prices, for example, fell by 3.5%. The ONS says: Falling energy and fuel pump prices resulted in the largest downward contributions to the change in the inflation rate between March and April 2020. Rising prices for recreational goods resulted in a partially offsetting upward contribution to change. Discounting was also a factor -- with clothes prices dropping last month during the lockdown: The ONS explains: For garments, prices overall fell by 2.3% between March and April 2020 compared with a small increase of 0.4% a year ago. There were a greater number of items recorded as being discounted this year, when compared with April 2019, with reductions across a range of women's and men's clothing items. The larger number of items recorded as being on sale could reflect retailers' efforts to encourage online purchases or potential difficulties as a result of the current economic situation. More to follow.... Also coming up today Inflation ***data*** from the eurozone and Canada are expected to also show a sharp slowdown last month. David Madden of CMC Markets has the details: Eurozone CPI for April is anticipated to fall from 0.7% in March to 0.4% in April. The core update is anticipated to be 0.9%, and that would be a fall from the 1% registered in March. The figures will be announced at 10am (UK time). Canadian CPI will be released at 1.30pm (UK time). The report is expected to be -0.1% and that would be a huge drop from the 0.9% posted in March. UK high street chain Marks & Spencer is reporting results, updating the City on its performance during the lockdown. And there could be queues at your local McDonalds outlets, as the fast food chain reopens around 40 outlets across the county. The agenda 10am BST: Eurozone inflation ***data*** for April 1.30pm BST: Canadian inflation ***data*** 2.30pm BST: Bank of England governor Andrew Bailey and colleagues testify to parliament's Treasury committee 33597 false false Graeme Wearden Bank of England Governor Andrew Bailey, who says the BoE is keeping its policy tools under review amid coronavirus downturn Bank of England governor Andrew Bailey on a video conference call with MPs today UK auction of 3-year bond results The drive-through McDonalds at Bushey The drive-through McDonalds at Bushey An M&S store in Barrow-in-Furness, north west England. UK inflation to April

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HINA Digest

April 22, 2020 Wednesday

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**Length:** 3698 words

**Body**

Zagreb,Hrvatska04 April 2020 (Hina) - Croatia's COVID-19 stats: 47 new cases, four more deaths, 119 cases of recovery ZAGREB, April 4(Hina) - The Croatian health authorities reportedon Saturday that in the last 24 hours,out of 583 samples tested for COVID-19, 47 people were positive, bringing their total to 1,126. There have been four more deaths in the last 24 hours, all in ahospital in the eastern city of Osijek where four elderlypatients with underlying medical conditions succumbed to the infection.The deceased were aged 71,78, 85 and 92, and two of them were on ventilators. They all suffered from different medical conditions, including heart trouble, chronic kidney failure and pneumonia, and those were severe chronic diseases, the director of the Osijek Clinical Hospital Centre (KBC), Zeljko Zubcic, said earlier in the day Currently, Croatia'scoronavirus-related death toll stands at 12. The COVID-19 crisis management team told a regular news conference on Saturday afternoon that39 hospital patients diagnosed with this disease were on ventilators. Since the first confirmed positive case registered on 25 February, a total of 119 peoplehave recovered from this infectious disease, including 27 since yesterday. Also, 9,833 samples have been tested since the outbreak of the disease in Croatia. Health Minister Vili Beros told a news conference in Zagreb on Saturday that the next two to three weeks would be critical for defining the course which the country would take in battling the disease.

"So let's beresponsibleand observethe rules," he said. Informing about the situation in Osijek, Zubcic told a news conference in that eastern city that atotal of 89 persons in Osijek-Baranja County hadcontracted the COVID-19 virus to date. Twenty-six people are currently hospitalised in Osijek, including five who are on ventilators, and 11 have been discharged to recover at home, Zubcic said. He said that all infectious disease specialists at the KBC had tested negative for coronavirus. Croatian senior citizens homes fending off coronavirus ZAGREB, April 4 (Hina) - The head of the Croatian Institute ofPublic Health (HZJZ), Krunoslav Capak, said on Saturday that retirement homes had to date managed to prevent the spread of COVID-19 among their beneficiaries. According to information ***collected*** from the field, institutionscaring for the elderly andinfirm are sticking to the measures imposed to curb the infection, and the virus has not appeared to date in those institutions, Capak said at a news conference at which Croatia's authorities presented latest coronavirus-related ***statistics***. Asked about the average age of the COVID-19 patients put on ventilators, the head of Zagreb's Fran Mihaljevic Hospital for Infectious Diseases, Alemka Markotic, said that she could not provide the ***data*** for the whole of the country, noting that the youngest coronavirus patient on a ventilator in her hospital was born in 1974. "In our hospital, the four current patients on ventilators due to COVID-19 are middle-aged with some underlying medical conditions," Markotic said. Interior Minister Davor Bozinovic called on Croatians not to relax in the coming warmer days. "We are still battling the epidemic," he underscored. 893 Croatians repatriated to date, several hundred to return this weekend ZAGREB, April 4 (Hina) - A total of 893 Croatians have been repatriated since the outbreak of the coronavirus epidemic and several hundred are due to return this weekend, Foreign Minister Gordan Grlic Radman said on Saturday. A total of 155 passengers, mostly Croatians as well as several citizens of Slovenia, Bosnia and Herzegovina, and Montenegro, are arriving in Zagreb on Saturday evening aboard special Croatia Airlines flights from Portugal, Spain, Italy and Sweden, he said. The Ministry of Foreign and European Affairs has sent protective masks and gloves for the passengers, who will need to observe social distancing rules. Upon arrival at the airport, they will be examined by doctors and will be ordered into quarantine or self-isolation if necessary, the minister said, noting that it was the government's obligation under the constitution to ensure repatriation of Croatian nationals. On Sunday, 37 Croatians are due to arrive in Zadar by catamaran from Ancona and more than a hundred are expected to arrive in several buses from Tyrol. Grlic Radman said that the governments of Slovenia, Hungary, Austria and Italy had helped the Croatian authorities with previous repatriations. "This situation has shown how solidary we can be and how much we can do together. When you act alone, you cannot do much but you need to work in cooperation with others." A total of 893 Croatians have been repatriated to date, including 564 from third countries such as India, the United Arab Emirates (Dubai), Morocco and Peru. Last week, 13 Croatians returned by bus from Tyrol, and as many arrived in a six-car convoylast night, the minister said. Interior minister warns about phishing scams in e-banking ZAGREB, April 4(Hina) - Interior Minister Davor Bozinovic on Saturday alerted citizens to malicious emails aimed at obtaining sensitive information in e-banking. He said that recipients of such fraudulentemails should notopen links contained in them and were advised to delete them immediately. Speaking at a news conference at which health authorities presented the latest COVID-19 ***statistics***, Bozinovic said that a total of 382,191 e-passes had beenapproved and 9,625 applications for such e-passes had been rejectedsince the introduction of e-passes earlier this week. Passes, given under strict criteria, are one of the measures regulating themovement of persons since the recent imposition of lockdown measures due to the coronavirus epidemic. The minister said that over 1,000 cases of violation of self-isolation rules had been confirmed by the law enforcement authorities. Maric: Efficiency and rationality crucial in dealing with epidemic fallout ZAGREB, April 4 (Hina) - Efficiency and rationality will be crucial in dealing with the fallout of the coronavirus epidemic, given the limited resources that will be available in the time ahead, Finance Minister Zdravko Maric said in a newspaper interview on Saturday. "Efficiency must be the first and basic criterion forall our further actions. A rapid response and adjustment to new situations and business conditions will differentiate those who are successful from those less successful, not just in the enterprise sector but in the public sector as well," Maric told Vecernji List. He said that the present crisis had revealed the necessity to change the structure of the Croatian economy, which currently has a relatively low share of industry and a large share of the services sectorin added value and is considerably dependent on imports. "The national economy will need to be transformed to make it more export-oriented and to better utilise our comparative advantages. This crisis has shown the importance of ***agriculture*** and the food industry in securing sufficient supplies for our population because in the event of transport disruptions and closure of the borders it is extremely important to have sufficient amounts of food from domestic sources. It has also shown the importance of the domestic pharmaceutical industry, including the production of medicines, protective agents and medical equipment," the finance minister said. Maric said that the IT industry and digitisation had turned out to be very important because they made it possible for all the measures, both epidemiological and economic ones, to be implemented quickly and effectively, and the industry's adaptability allowed both the private and the public sector to adapt to teleworking relatively painlessly. "These examplesshow the direction in which way the future economic strategy and economic policy measures should be going," Maric concluded. Companies in Varazdin County producing protective visors against COVID-19 ZAGREB, April 4(Hina) - Three companies in Varazdin County have started manufacturing face masksas part of protective gear in the fight against the infection with coronavirus, and the first batch of 500 visors was donated to the Varazdin Hospital on Saturday. The companies engaged in this production are Fripol from the municipality of Ljubescica, Plastik Santek from the town of Novi Marof and Gumiimpex from the city of Varazdin. These visors can be disinfected and reused. The mayor of Ljubescica, Nenad Horvatic, said during the presentation of the donation, after the idea had appeared about this production, only seven days passed before the start of the production. To date, the three factories havemade 3,500 visors. Apart from the donation to the hospital, also local firefighters and police forces in Varazdin will be provided with the face shields made by the three factories. Some of their visorswill be shipped to Vukovar, Vinkovici and Osijek, Horvatic said. He explained that the manufacturing capacity of the three companies is 1,000 visors a day. Horvatic explained the main difference between the visors manufactured in the factories and those made by 3D printing method lay in the fact that the factory-made face maskscould be used more times, while 3D printed face shields are single-use visors. The hospital director Nenad Kudelic thanked for the donation. He underscored that although there were no newly infected cases in Varazdin County for the last five days, there was no reasonfor local residents to relax and called on them to stay home. Erste bank and Erste Card Club donate HRK 1.3 m to two Zagreb hospitals ZAGREB, April 4 (Hina) -Erste&Steiermärkische Bank and Erste Card Club will donate a total of HRK 1.3 million (€170,000) to two hospitals in Zagreb for the purchase of medical equipment needed to combat the coronavirus epidemic and repair the damage caused by a recent earthquake, the bank announced in a statement on Saturday. The bank will donate HRK 1 million (€130,000) to the Fran Mihaljevic Hospital for Infectious Diseases to help in efforts to contain the spread of the COVID-19 epidemic, while the credit card company Erste Card Club will donate HRK 300,000 (€40,000) to the Hospital for Children's Diseases which was damaged in the March 22 earthquake. "The seriousness and complexity of the situation in which we are requires a responsible response from all members of society. In this way we want to make our contribution to efforts aimed at overcoming the challenges that are facing all of us, while at the same time providing support to doctors and medical staff whose roles in the current circumstances are extremely important and deserve great respect," saidChristoph Schoefboeck, president of the bank's management board. ELFAC confederation warns about COVID-19 consequences for large families ZAGREB, April 4, 2020 (Hina) - A Croatian civil society association called "Familiy3plus" on Saturdaywarned about specific problems facing large families during the COVID-19 pandemic worldwide. The association of families with three or more children is a member of the European Large Families Confederation (ELFAC) which has issued a press release underscoring specific troubles large families are exposed to when many countries and areas are in lockdown, such as a lack of IT equipment for all children in a large family for distance learning, a ban on several persons riding in a vehicle and discrimination against large families. "Episodes of intolerance have been recorded in Germany, where families have asked for a ‘certificate’” in order to be able to carry out their ‘extra-large’ shopping without being suspected of improper supply," reads the press release. "In Spain, a father was fined for going with his son by car to do the shopping for his family of 8 children, two grandparents and great-grandmother (more than one person per car was prohibited). "In Latvia, the private company Samsung had to intervene to allow part of children of large families to get a tablet for e-classes at home, helping Government to solve the problem for all schoolchildren; this problem was also raised by the Italian Association of Large Families and even in Estonia, which has a leading position in computerization. Many large families have only one computer or two, which is not sufficient, for example, for five children," reads the press release about various difficulties that the public is not aware of. "These are just some examples of life for large families during COVID19 in Europe, where, according to ***Eurostat*** ***data***, 1/3 of children live with at least two siblings," says the press release. This confederation, which comprises 25 associations from23 European countries, including the Croatian"Familiy3plus" association, called on the European Commission, Commissioner Ursula van der Leyen and Vice-President fro Demography Dubravka Suica "to speed up and deepen the discussion for 'the child guarantee'." ELFAC urges member-states "to always take into account the number of family members in income support measures and to safeguard the right to education." Documenta NGO calls for solidarity in combating coronavirus ZAGREB, April 4 (Hina) - The non-governmental organisation Documenta - Centre for Dealing with the Past has called for solidarity in facing the global crisis caused by the coronavirus pandemic, and called on the government to support the initiative by the UN secretary general for a worldwide truce. While respecting the fact that at this moment the Croatian government is focused on managing the double crisis caused by the coronavirus pandemic and the March 22 earthquake, in these days global solidarity is needed more than ever, the NGO said in a statement. Noting that now was a historic chance to bring an immediate end to wars in the world, it called on the government to support the initiative by UN Secretary General Antonio Guterres for an immediate ceasefire across the globe "so that we can focus together on 'the true fight of our lives' - the fight against the COVID-19 pandemic." The initiative has so far been supported by 43 organisations and 173 individuals, including EU foreign policy chief Josep Borell Fontelles, who said that "only by pulling together and cooperating across borders can we beat the virus and contain its consequences", and Pope Francis. "For an effective fight against the pandemic we need 'pansolidarity'. A global ceasefire will create space for solidarity in combating the virus and building peace which is not just an absence of war but which includes sustainable development, health and well-being, responsibility and transparency, confidence building and reconciliation, inclusiveness and equality," Documenta said. Slovenia: Coronavirus case toll reaches 934; 22 deaths ZAGREB, April 4 (Hina) - A month after the first confirmed case of coronavirus infection and 21 days after the first death, Slovenia is believed to be halfway through the COVID-19 epidemic, and the cost of aid to the national economy has already reached €3 billion. According to ***data*** published in Ljubljana on Saturday, 25,921 people have been tested for coronavirus since 27 January, with 934 testing positive, and 22 people have died to date. The first case was registered on 4 March in a 60-year-old man from Ljubljana who had visited Morocco with a group of compatriots as part of an arrangement by a travel agency. He returned by air to Venice and from there by road to Slovenia. The first coronavirus-related death was recorded on 14 March. It was an elderly man who had several other conditions. He was a resident of a nursing home in Metlika, a town close to the border with Croatia. Metlika became a hotspot of the disease after a doctor, who had returned from a skiing trip to Italy, passed it on to several of his patients and co-workers and to residents of the local nursing home. A total of 109 infected persons are currently being treated In four hospitals, and 31 of them are in intensive care. Between five and ten people are discharged per day after recovering, but thecase growth rate varies from day to day. It has stabilised in recent days, so the government believes that the epidemic might reach its peak and begin its downward trend in a few weeks. This week the Slovenian parliament adopted a €3 billion "first aid" package for households and businesses, which should suffice until 30 May. New bills have been announced to ensure liquidity and restart the economy after the epidemic ends. Many economists believe that this might not be enough if the crisis continued into the autumn. The Slovenian Chamber of Commerce estimates that the country's GDP might fall by between 6% and 16%this year, worse than during the global financial crisis of 2008 when it shrank by 8%. Prime Minister Janez Jansa is one of nine EU leaders who have called for so-called "corona bonds" to be issued to help countries worst hit by the pandemic. The proposal has been rejected by influential countries such as Germany and the Netherlands. Serbia's COVID-19 death toll stands at 44, total number of infected 1,624 ZAGREB, April 4(Hina) - In the last 24 hours there have been five more COVID-19-related deaths in Serbia, where to date this infectionhas taken 44 lives, the health authorities reported on Saturday afternoon. To date, 1,624 people have tested positive, including 148 new cases in the last 24 hours. Currently 1,046 patients are being treated in hospitals for coronavirus, and of them 89 are placed on ventilators. Since the outbreak of the epidemic in mid-March to date, 6,401 samples have been tested. Bosnia's coronavirus stats: 19 deaths, over 600 infected ZAGREB, April 4 (Hina) - Bosnia and Herzegovina's health authorities stated on Saturday that in the last 24 hours there were two more deaths due to the infection with coronavirus, and the number of infected patients increased to 617. All those patients who have succumbed to the infection were elderly people with underlying medical conditions. The northwestern city of Banja Luka is still a hotspot with 172 people who have contracted this disease so far. Montenegro reports 23 new coronavirus cases, 197 in total ZAGREB, April 4 (Hina) - Twenty-three new cases of the coronavirus infection have been confirmed in Montenegro in the last 24 hours, bringing their total to 197, the country's Public Health Institute said in a statement on Saturday. Since the first case was registered in the country on 17 March, two infected persons have died and one has recovered. "A majority of newly-infected people are contacts of previously registered cases," the statement said. The director of the Public Health Institute, Boban Mugosa, said that one funeral ceremony alone had resulted in 40 infections, adding that a religious gathering in a suburb of the capital Podgorica had become a new hotspot of the disease. Police regularly process all people found to be in violation ofthe government measures to contain the spread of the virus and report their arrests in the media. In Podgorica onFriday evening, two persons were taken into police custody for visiting a friend of theirs, while in Budva six persons were detained after police found them playing cards in a hotel. A crime of disobeying rules for containing the coronavirus epidemic carries a sentence of one year's imprisonment. In other news: President visits coast guard in Dalmatia ZAGREB, April 4 (Hina) - Croatian President Zoran Milanovic, who is the supreme commander of the Armed Forces, on Saturday visited the patrol boat "Omis", the presidential office said in a press release. The president, accompanied by the defence minister Damir Krsticevic and the armed forces' chief-of-staff, Admiral Robert Hranj, was informed of a state of affairs in the Croatian navy and the readiness of its personnel. The president offered support to the coast guard staff in performing their duties in the current circumstances marked by the COVID-19 epidemic. Miroslav Skoro formally registers his party ZAGREB, April 4 (Hina) - Former presidential candidate Miroslav Skoro has formally registered his political party, the Homeland Movement. The Homeland Movement has been notified by the Public Administration Ministry that it has been entered in the Register of Political Parties, Skoro announced in a Facebook post on Friday evening. "Observing the measures to contain the coronavirus, we will organise our activities as much as we can through digital platforms," he wrote. Skoro said that "anyone who puts Croatia's interests above their own" was welcome to join the party. Zagreb residents protest against mayor from their windows and balconies ZAGREB, April 4(Hina) - Residents of Zagreb came to their windows and balconies on Friday evening and banged at their pots and pans and blew whistles in protest at how Mayor Milan Bandic was running the city in the present situation caused by the coronavirus pandemic and the March 22 earthquake. The protest was initiated by a civil society group called "Zagreb Is Calling You", who called on residents to come to their windows and balconies at 7pm and express their anger for five minutes at how the mayor was handling the crisis. The group said that the mayor was not up to the task. "His arrogance and impertinence have reached a culmination. In these difficult times when volunteers, associations and initiatives are working round the clock to help their city, the quasi-mayor is turning his back on them," the protest organisers said. "We hope that both he and the government hearus because in a time of crisis they can remove the mayor from office. Step down, you're guilty, we've had enough! You're the worst disaster that has ever hit Zagreb," they said. The initiative was supported by opposition councillors and architects through videos posted on social media. THISBULLETIN INCLUDES NEWS ITEMS RELEASED BY 2100 HRS SATURDAY. (Hina) ms Masthead Brief News Bulletin is published by the Croatian News Agency HINA Marulićev trg 1610 000 ZagrebCroatia web:[*www.hina.hr*](http://www.hina.hr) mail: [*hina@hina.hr*](mailto:hina@hina.hr) phone: (+385 1) 48 08 660; fax (+385 1) 48 08 822 Publisher: Branka Gabriela Valentić, DirectorEditor in Chief: Serđo Obratov Bulletin Editor: Marija Šestan

**Load-Date:** April 22, 2020

**End of Document**



[***Agroecology, Information and Communications Technology, and Smallholders’ Food Security in Sub-Saharan Africa***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6BH2-VXY1-JBMY-H498-00000-00&context=1516831)

Journal of Asian and African Studies

December 2020

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**Section:** Pg. 1194-1208; Vol.55; No.8; ISSN: 0021-9096, 1745-2538

**Length:** 5164 words

**Byline:** Cheng Wei

**Body**

**ABSTRACT**

As a bottom-up, grassroots paradigm for sustainable rural development, agroecology is particularly promising for smallholders in many countries in sub-Saharan Africa. However, by adopting agroecology, smallholders will be challenged to take on new perspectives and compile and integrate different sourced information to innovate. Today’s fast evolving information and communications technology in sub-Saharan Africa represents great opportunities for rural populations to enhance the adoption and success of agroecology and to address their daunting challenges simultaneously while conserving, protecting and enhancing natural resources. Agroecology combined with information and communications technology will probably be smallholders’ “precision ***agriculture***” in many developing countries to enhance their food security and livelihood.

**FULL TEXT**

**Introduction**

Every era has its challenges. And each challenge demands specific responses . . . The quest is now to find farming systems that are truly sustainable and inclusive and that support increased access for the poor so that we can meet the world’s future food needs (FAO, 2014a).We find ourselves in the midst of the greatest information and communications revolution in human history . . . We must take advantage of this rapid technological change to make the world more prosperous and inclusive (World Bank, 2016a).The future of ***agriculture*** is not input intensive but knowledge intensive. We need the integrated approach that agroecology can offer (FAO, 2018a).

Sub-Saharan Africa (SSA) is faced with huge challenges such as food insecurity, pervasive poverty and youth employment. The Green Revolution that boosted yields in other regions largely bypassed Africa (FAO, 2011b). ***Agricultural*** productivity remains lower in SSA than in any other region of the world (FAO, 2014a). Today, SSA accounts for roughly 12% of the world’s population, while a disproportionate 237 million hungry people or 29% of the world’s undernourished live in SSA (FAO and ECA, 2018). And the number of people living in extreme poverty (US$1.90 a day or less) is on the rise in SSA (413 million), comprising more than half of the extreme poor worldwide in 2015 (World Bank, 2019a).

Youth employment is another fundamental development challenge across the subcontinent. Half of the population in the SSA region is under 25 years of age (UNECA, 2016). Given a stagnant, labor-intensive industrial sector, non-farm wage jobs in SSA will be able to provide employment for only half of young Africans entering the labor force even under the most optimistic projections (AGRA, 2016). The lack of a steady income makes it extremely difficult for most young workers to move out of poverty (Foresight Africa, 2019). In addition, the growing threat of climate change (FAO, 2016c; HLPE, 2012; IPCC, 2014) and rampant land degradation (Glatzel et al., 2014; Glover et al., 2012) make the challenges especially daunting particularly as rapid population growth and rising urbanization increase the pressure on ***agriculture*** systems to deliver more and better food (World Bank, 2008).

So, a “new uniquely African Green Revolution” (United Nations, 2004) that would enhance food security, environmental sustainability and economic opportunity is critically needed. It will require solutions beyond the Asian Green Revolution epitomized by the intensive application of high-yield seeds, fertilizer, pesticides and irrigation (FAO, 2011b). There will be no “silver bullet” technology package that can broadly apply across the subcontinent and a systematic approach is needed with research grounded in local contexts to develop locally appropriate technological and ecological solutions (National Research Council, 2010). Agroecology1 is an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and ***agriculture*** systems and aims to optimize the sustainable management of natural resource and ecosystem services (FAO, 2018e; HLPE, 2019). Bottom-up and territorial processes-based agroecology is particularly promising for highly diversified smallholders for helping to deliver contextualized solutions to local problems and reduced external inputs requirements (HLPE, 2013; IAASTD, 2009a). However, agroecology is information2 intensive (FAO, 2018e; HLPE, 2019; Silici, 2014). Information and communications technology (ICT), providing an ideal means for communicating, disseminating information and channels for feedback and sharing (FAO, 2014b; World Bank, 2017), has already been used in ***agriculture*** to improve resource efficiency, reduce negative externalities and enhance the flow of environmental goods and services (Chapman and Slaymaker, 2002; World Bank, 2016b). Today’s fast evolving ICT in SSA represents great opportunities for rural populations to enhance the adoption and success of agroecology and to address their daunting challenges simultaneously while conserving, protecting and enhancing natural resources.

**Agroecology and food security in sub-Saharan Africa**

“Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life” (FAO, 2016a). This definition encompasses four dimensions: food availability, food access, food use/utilization and food stability (FAO, 2016b). To be food secure, the four dimensions should be addressed simultaneously.

**Agroecology and food availability**

*Food availability: the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports.*

Agroecology is not a totally new thing, at least, agroecological practices (e.g. crops diversification, agroforestry, soil ***nutrient*** management and water harvesting) is not unfamiliar to the smallholder farmers in East Asia (mainly China, Japan, Vietnam and Korean Peninsula). The traditional ***agriculture*** in ancient East Asia basically falls into the category of agroecology (King, 1911; Li, 1998). And the history of ***agriculture*** in East Asia has been one of constantly improving crop yields through innovations, improvements in techniques and intensification (Li, 1998). Nearly two centuries ago, average cereal yields in China reached 1.84–2.75 tons/ha (Table 1), about 42–112% more than yields in SSA during 2005–2014, primarily owing to so-called agroecological practices, for example, the rice-fish farming widely adopted in South China (HLPE, 2017a). Without any agrochemical inputs and modern ***agricultural*** machinery, farmers in East Asia fed over 450 million people (about 45% of the world’s population at that time) with just around 100 million ha of cultivated land nearly 200 years ago.3 However, the huge size and agroecological diversity of East Asia, which leads to a wide range of farming systems from near desert to forest-based systems, are similar to SSA (FAO, 2001).

**Table 1.**

Main indicators of ***agricultural*** production and social development between SSA (2001–2010) and China (1831–1840).

|  | **SSA (2001–2010)** | **China (1831–1840)** |
| --- | --- | --- |
| Population (millions) | 688–877[1] | 400–416[2] |
| Cultivated area (Mha) | 192[3] | 73–80[4] |
| Per capita cultivated area (ha) | 0.22–0.28 | 0.18–0.19 |
| Yield (t/ha) | 1.1–1.3[5] | 1.84–2.75[6] |
| Fertilizer (kg/ha) | 8–14[7] | 0 |
| Tractors used in ***agriculture*** | 129,000[8] | 0 |
| Proportion irrigated (%) | 4–5[9] | 25–30[10] |
| Main crops | Maize, sorghum, rice, millet, cassava, yams, pulses[11] | Rice, wheat, maize, pulses, sorghum, millet, sweet potato[12] |
| Road density(km/103 km2) | 201[13] | NA |
| Adult illiteracy (%) | 40[14] | gthan80[15] |
| Proportion of rural population (%) | 60[16] | ≈90[17] |

Source: [1]World Bank (2019b); [2]Cao Shuji and Ge Jianxiong (2001); [3]WRI (2005); [4]Zhihong (2011); [5]FAO (2014a); World Bank (2016c); [6]Maddison (1998); Guo Songyi (1995); Zhihong (2012); Hui (2016: 193–212); [7]World Bank (2016); [8]FAO and AUC (2018); [9]FAO (2001); World Bank (2008); [10]Maddison (1998); [11]Li Pangen (1998); [12]FAO (2001) (revised by author); [13]World Bank (2008); [14]OECD ***statistics***; [15]Yonghua (2017); [16]AGRA (2016); World Bank (2008); [17]Li Beibei (2008); Zhihong (1993).

SSA: sub-Saharan Africa.

Similarly, a review of 286 agroecological projects covering 37 million hectares in 57 developing countries also found that farmers had increased ***agricultural*** productivity by an average of 79% by adopting “sustainable farming technologies and practices” (e.g. locally available natural resources and intensification of production from microenvironments in farm systems) while improving the supply of critical environmental functions (Pretty et al., 2006).

Diverse ***agricultural*** production systems exist in many developing countries; however, the majority are unsustainable, traditional low-input farming systems, for example, the widely practiced bush-fallow system in the SSA region (IAASTD, 2009b). Estimated yield gaps (expressed as a percentage of potential yields) exceed 50% in most developing regions, and are largest in sub-Saharan Africa, at 76%, and lowest in East Asia, at 11% (FAO, 2014a). That is to say, the growth of yield started from a very low base in many developing countries. So, substantial increases, say 50–100%, in ***agricultural*** productivity are convinced when adopting a variety of agroecological methods (Altieri et al., 2012; De Schutter, 2011; Pretty et al., 2011).

**Agroecology and food access**

*Food access: access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet.*

While food availability at the national level may be ensured by domestic production and imports (if required), households and individuals only have access to food if they can earn or are entitled to enough income to buy or produce enough to feed themselves (FAO, 2018c). Reducing poverty and food insecurity and improving nutrition outcomes cannot be achieved without increased employment and income (FAO, 2018c; Sen, 2013). However, demographic dynamics are expected to result in a spike in the number of young people who will join the ranks of the labor force, particularly in rural areas and the pressure will be enormous for SSA, where jobs are likely to be scarce (ILO, 2015).

***Agriculture*** in SSA holds considerable promise in terms of growth and jobs. According to World Bank projections, the value of the subcontinent’s food and beverage markets is expected to reach US$1 trillion by 2030 mainly driven by rising incomes and urbanization (AGRA, 2015). ***Agriculture*** and related activities will still play a key role in creating jobs to absorb more than 10 million new entrants in the labor force each year in the next two decades (FAO and ECA, 2018). However, ***agriculture*** and food systems transformations must be compatible with sustainability, through innovations that reduce resource use without compromising yields (FAO, 2017a).

**Employment on the farm**

Farming will continue to account for the majority of employment of the labor force in most countries in the SSA region for the next decade or more (Filmer and Fox, 2014; Yeboah and Jayne, 2016). Yet, the drudgery and poor remuneration associated with low-productivity family farming turn the youth away from ***agriculture*** (FAO, 2018d). Agroecology provides a promising solution as a source of decent rural employment; one that offers a choice and alternative to migration (FAO, 2018b). Agroecological systems build on smallholders’ strengths as investors (labor, intelligence) and avoid their constraints (expensive external inputs) (HLPE, 2019; IAASTD, 2009a). Due to the complexity of managing different plants and animals on the farm (e.g. crop rotation and inter-cropping) and recycling the waste produced (e.g. composting and use of livestock manures), agroecology is more labor intensive (Parmentier, 2014), and generally involves a higher share of labor-intensive crops, such as fruits and vegetables (Reganold, 2016). In developing countries, this higher labor-intensity also allows a better use of available family labor which tends to be under-occupied for part of the year (Levard and Apollin, 2013). Moreover, agroecological farming spreads the need for labor more evenly throughout the year, allowing for full-time employment of farm laborers (IPES-Food, 2016).

**Employment beyond the farm**

Although ***agriculture*** may still have the potential to create new jobs, the pace of labor absorption is slower than population growth in SSA (FAO, 2017a). As the non-farm sector in many SSA countries is not generating enough jobs to absorb the new entrants, it is estimated that of the 220 million young people who will enter the SSA labor force by 2035, only 25% will find wage employment even under optimistic projections (AGRA, 2016; Page, 2019). So ***agriculture***’s role in job creation needs to go “beyond the farm”, by boosting the non-farm economy through the development of agroprocessing, trading and related activities (FAO, 2017a).

At the same time, as urbanization accelerates in SSA and, with it, new small cities and towns spring up in former hinterland areas, many farmers find themselves living closer to urban areas (FAO, 2017a) and enjoy more favorable market access conditions than they used to (Chamberlin and Jayne, 2013; Richards et al., 2016). Rapid urbanization provides opportunities for farmers to grow more and diversified crops and to market them through local urban markets. Due to the growth of the middle classes and rising income levels, domestic markets for ***agricultural*** produce and high-value food will grow considerably (FAO, 2017a). Historically, ***agricultural*** progress has been paved by the development of a market economy led by urban markets (HLPE, 2013). If domestic farm production is able to keep up with rising urban demand, the urban markets will be used as the powerful engines of ***agricultural*** and economic growth they are (HLPE, 2017a). And the diversification of agroecological farming activities entails the massive development of wholesale, transport, packing and processing activities both upstream from production and downstream from marketing of ***agricultural*** products, which represent important opportunities for employment and inclusive transformation (FAO, 2017a; Levard and Apollin, 2013).

**Agroecology and food utilization**

*Food utilization: Utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met.*

**Food safety**

Compared with conventional ***agriculture***, agroecology often produces safe food with lower dependence on agrochemical inputs (HLPE, 2019; Reganold, 2016). A study shows concentrations of pesticide metabolites were six times lower in preschool aged children eating organic fruits and vegetables compared with levels found in children eating conventional produce (Curl et al., 2002). At the same time, lack of access to safe and clean water for drinking and hygiene was long ago identified as a key underlying cause of malnutrition, particularly in children (UNICEF, 1990). However, safe drinking water coverage (basic drinking water service: an improved source within 30 minutes’ round trip to ***collect*** water) was only 58% in SSA in 2015 (WHO and UNICEF, 2017). Globally, it is estimated that 159 million people still ***collected*** drinking water directly from surface water sources in 2015, 58% of whom lived in SSA (WHO and UNICEF, 2017). Agroecology emphasizes the use of management practices rather than the use of synthetic off-farm inputs and entails less risk of agrochemical pollution (e.g. nitrate and phosphorus leaching) of ground and surface waters than conventional ***agriculture***. In fact, in some developed countries, government waterworks have encouraged conversion to organic ***agriculture*** to reduce the cost of purifying drinking water (FAO, 2003).

In addition, the storage and distribution of food, especially perishables, create many opportunities for contamination and food quality losses and waste, with negative consequences for diets and health. Agroecological farming often builds more direct links between producers and consumers (e.g. direct marketing or a local supply chain) (HLPE, 2013, 2017a), so perishable foods such as fruits, vegetables and animal-sourced foods can be consumed within a short space of time and close to their place of origin (e.g. vegetables are typically sourced from a “catchment area” within a radius of 3–4 hours’ travel time from a city without cold storage and transportation) (FAO, 2017a).

**Balanced nutrition**

Consuming a diverse range of cereals, pulses, fruits, vegetables and animal-sourced products contributes to improved nutritional outcomes (HLPE, 2017b). There is an urgent need to diversify diets as a response to rising malnutrition in all its forms (undernutrition and obesity) and associated non-communicable diseases (FAO, 2018c). Closing the production and nutrition gap requires a transformation of current ***agriculture*** and food systems towards greater diversity (Li and Siddique, 2018). Generally, agroecological farming systems provide a range of foods with different nutritional elements to the farming household and those accessing the produce in local markets (HLPE, 2013, 2017b). Diversity in household ***agricultural*** production has direct linkages with dietary diversity and nutrition (Bachman et al., 2009; Ecker and Qaim, 2011). For example, as a traditional ***agricultural*** practice, farmers in Guangdong, China, plant three crops a year: two of rice and one of legumes. The rice paddies also double as fishponds, and the dikes between them are often planted with sugarcane and mulberry trees (Weng, 2000). This simultaneously provides rice, necessary for food security, fish and legumes, important for providing protein, fatty acids and micronutrients that are especially needed by children and pregnant women. And sugarcane and mulberry can also be nutritious food.

**Agroecology and food stability**

*Stability of the food system: To be food secure, a population, household or individual must have access to adequate food at all times.*

Climate change is projected to compromise ***agricultural*** production, especially in smallholder systems with little adaptive capacity, as currently prevalent in many parts of Africa (Müller et al., 2010). Soil health is a fundamental determinant of farm resilience and productivity (Nicholls and Altieri, 2012; Scialabba and Niggli, 2012). Today some 80% of the total arable land in SSA has serious soil fertility and/or physical soil problems (AGRA, 2014). Agroecological practices (e.g. mulching, cover cropping, green manuring, application of compost, intercropping, mixed cropping, crop rotation, agroforestry) improve and stabilize the soil’s physical structure, enhance its ability to absorb and store water and plant ***nutrients***, and stimulate the activity of soil organisms, roots and finally plant performance (FiBL, 2011). Consequently, agroecologically managed farms have frequently been shown to produce higher yields than their conventional counterparts during a drought or flood (Arslan et al., 2015; Holt-Giménez, 2002; Lockeretz et al., 1981; Lotter et al., 2003; Rodale Institute, 2015).

Agroecological systems are diverse, maximizing the synergies between different components (e.g. soil, water, crops, livestock, trees, human processes) to deliver greater resource-use efficiency and resilience (FAO, 2018b). One example is the Native American “three sister” production system (Milburn, 2004): Maize has high nitrogen requirements, and beans bring atmospheric nitrogen into the soil with the help of symbiotic bacteria. The maize stalks in turn provide structural support to the climbing bean plants. With their large round leaves, squash plants shade the soil and as such help conserve moisture and reduce weeds. Integrated plantings may also reduce pest problems. Also, in Yunnan, China, farmers who switch from rice monocultures to planting mixtures of local varieties and hybrids achieved 89% higher yields and suffered 94% lower blast incidence when compared with single-variety fields, and without the need to use fungicides (Zhu et al., 2000).

Furthermore, the position of many smallholder farmers in markets can often be weakened when the production system is based on a few products (i.e. sell at harvest when prices are low, buy when prices are high) (HLPE, 2013). The diversified agroecological production helps smallholders spread harvests more evenly throughout the year, which not only keeps farmers from starvation, but also stabilizes their income. For example, some agroforestry systems in SSA use the leaves of nitrogen fixing leguminous trees to feed livestock, use manure to fertilize the soil and grow pulses to provide extra protein during periods of seasonal food insecurity. Livestock also reduce the risks resulting from seasonal crop failures, as they add to the diversification of production and income sources (FAO, 2002; HLPE, 2016).

**ICT: to enhance the adoption and success of agroecology in SSA**

ICT includes any device, tool, or application that permits the exchange or ***collection*** of ***data*** through interaction or transmission (World Bank, 2017). One of the most important contributions of ICT to ***agricultural*** development is the ability to disseminate critical information to farmers through various channels. Real-time and cost-effective information on the weather, market prices, pests, diseases and services allows farmers to make more informed decisions about land preparation, planting, harvesting and marketing (World Bank, 2017). Today’s fast evolving ICT in SSA represents a tremendous opportunity for rural populations to access markets, to enhance the adoption of agroecology and to improve food and nutrition security.

First, ICT facilitates farmers’ access to real-time information on market, weather and so on, which contributes to greater market participation. With rapid urbanization and higher income, the value of urban food markets in SSA is projected to grow to US$500bn until 2030 (FAO, 2017a). However, the increases in productivity can only be achieved if the linkages to markets are working (HLPE, 2013). Thus, Africa should not only focus on growing more food, but also look towards connecting farmers to markets (Mylonas, 2010). Yet, throughout history, most rural populations in SSA lived in remote areas behind a de facto wall of poor infrastructure and inaccessibility, without links to dynamic sources of effective demand, particularly cities (FAO, 2017a). This is now changing. The use of ICT tools in ensuring market access for smallholder farmers has grown and evolved rapidly over recent years and effectively shortens the distance between isolated smallholders and other actors involved in the markets (FAO, 2014a, 2017). “Given the incentive, African farmers can produce” (Mylonas, 2010), and better access to markets will be a key driver of agroecological innovations for SSA’s smallholders.

Second, the operating environment for ***agricultural*** knowledge and information systems has been fundamentally transformed by ICT. Information always matters in ***agriculture*** (World Bank, 2017). However, new technology and agronomic practices often take too long to transmit and spread in the traditional, linear top-down model with distinguished roles between creating, transferring and using knowledge and technologies (Figure 1), especially in some once sparsely populated SSA countries. Also, the highly diversified needs of practical farming cannot be communicated sufficiently to the scientific community (IAASTD, 2009a). As ICT has developed and become more pervasive, it has dramatically expanded access to knowledge and information, and promoted communication and cooperation between smallholders and other stakeholders. The typically linear top-down structure has also progressively been replaced by a participatory or collaborate social network approach involving co-creation and sharing of knowledge and information through real-time and cost-effective interactions between smallholders and other stakeholders in the food chain on various ICT platforms (Figure 2).

**Figure 1.**

Information often takes too long time to reach the farmers in linear top-down structures with distinguished roles between creating, transferring and using knowledge and technologies.

**Figure 2.**

Co-creation and sharing of knowledge and information through real-time and cost-effective interactions between smallholders and other stakeholders in the food chain on various ICT platforms.

Third, ICT can be beneficial for ***collective*** actions of smallholder farmers and can connect vulnerable groups. One strategy for smallholder farmers to access productive assets and expand their capacities is to collaboratively, voluntarily organize to pursue a shared goal and build useful links with public and private actors (World Bank, 2017). Evidence shows when smallholders are organized rather than acting alone, they are more viable market actors because they have better access to information and power to negotiate to help them seize more market opportunities (Jensen, 2007; Mittal, 2012). ICT also places a strong focus on the rights of women, youth and indigenous peoples and empowers them with secure and equitable access to assets and enhanced skills and know-how (FAO, 2011a, 2017) which will increase their productivity and incomes as well as protect their food security and livelihoods (World Bank, 2017).

**Discussion and conclusion**

First, The need for accelerating yield growth cannot be overemphasized in SSA because farm productivity levels are still very low (Dzanku, 2018). Insufficient modern ***agricultural*** inputs are considered to be a key limiting factor in SSA’s poor ***agricultural*** performance (Adjognon et al., 2017). However, many examples of efficient and sustainable smallholder farming with few external inputs exist throughout the world (from China and Viet Nam, to Costa Rica and Guatemala) (HLPE, 2013). In this paper, we reviewed the traditional ***agriculture*** in East Asia which basically falls into the category of agroecology. Through constant agroecological innovations, the average cereal yield in China reached 1.84–2.75 tons/ha two centuries ago, about 42–112% more than in SSA during 2005–2014. At the same time, what might be the widest systematic study on agroecological systems (involved 12.6 million farmers and a variety of systems and crops in 57 developing countries) to date conducted by Pretty et al. (2006) shows that significant increases in ***agricultural*** productivity are conceived in a relatively short time, say 3–10 years (Altieri et al., 2012; Pretty et al., 2011), by adopting a variety of agroecological practices that include crops diversification, integrated ***nutrient*** management, crop-livestock-tree integration and water harvesting.

Second, solving the looming jobs crisis is critical to achieving the Sustainable Development Goals (e.g. to end extreme poverty and hunger) and to achieving social and political stability across the subcontinent (Page, 2019). The World Bank estimates that Africa’s working-age population will grow by 70% (450 million) between 2015 and 2035. Increasing young people’s opportunities for productive work in rural areas is the most important catalyst for SSA to reap its demographic dividend (Filmer and Fox, 2014). As mentioned above, highly diversified agroecological production is able to meet rising food demand in SSA if it is able to benefit from significant investments and an enabling environment in which to fulfill its full potential. ***Agricultural*** productivity growth will generate strong multiplier effects that expand job opportunities in the downstream stages of the ***agriculture*** and food systems (Yeboah and Jayne, 2016). Also, the development, operation and maintenance of multiple supply chains for a wider variety of food products will create more employment opportunities in rural areas and towns than only staple food production and processing (FAO, 2017a). In addition, SSA is one of the most vulnerable regions to natural disasters and the impact of climate change despite contributing the least to global warming. Over the past three decades, drought in Africa was the most deadly climatological disaster in the world (Beavogui, 2019). Agroecology improves the adaptive capacity of ***agriculture*** systems and reduces vulnerability to natural disasters, climate change impacts, and new and emerging environmental system stresses and shocks.

Furthermore, smallholders form the majority of the farmers in the world and produce 80% of the food supply in developing countries (FAO, 2011b). In Asia and Africa, smallholders use and manage more than 80% of farmland and similar proportions of other natural resources (IFAD, 2011). There will be no truly sustainable development without the involvement and initiative of smallholders (HLPE, 2013). Given very different potentials, needs, constraints and livelihood strategies (Dawson et al., 2016; HLPE, 2019), bottom-up and territorial processes-based agroecology helping to deliver contextualized solutions to local problems is particularly promising for smallholder farmers. However, by adopting agroecology, smallholder farmers will be challenged to take on new perspectives and compile and integrate information from different sources to innovate (Ramesh et al., 2010).

“The future of ***agriculture*** is not input-intensive, but knowledge-intensive”, according to FAO Director-General José Graziano da Silva (FAO, 2017b). Intrinsically, knowledge and information, as productive inputs, are used instead of ***agricultural*** inputs to improve resource efficiency and mitigate negative externalities (Anderson and Feder, 2007), whether agroecology (based on interactions between plants, animals, humans and the environment) in developing countries or precision ***agriculture*** (based on computers, networks, GPS, satellites, sensors and drones) in developed countries. ICT can change how, where and to whom information flows and make information highly targeted and location specific (World Bank, 2017). So the transfer of relevant knowledge could be dramatically increased with better access to ICT in developing countries (Chapman and Slaymaker, 2002). The potential of continuous and new developments in the field of ICT in raising the levels of efficiency and effectiveness is large (FAO, 2014b). Agroecology combined with ICT (e.g. internet access, mobile phones and social media) will probably be smallholders’ own “precision ***agriculture***” (Figure 3) in many developing countries to enhance their food security and livelihood. However, a bottom-up, participatory and collaborative approach to the generation and exchange of knowledge, information and innovations among smallholders and all other stakeholders in the food chain with timely, accurate and convenient flow of information on various cost-effective ICT platforms should be broadly explored in the future.

**Figure 3.**

Agroecology combined with ICT (e.g. Internet access, mobile phone and social media etc.) will probably be smallholders’ own ‘precision ***agriculture***’.

**Notes**

FundingThe author disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Initial Scientific Research Fund supported by Shangrao Normal University (NO.001053).; ORCID iDCheng Wei [*https://orcid.org/0000-0002-4457-3957*](https://orcid.org/0000-0002-4457-3957); 1.Agroecology is a dynamic concept and multiple definitions of agroecology exist (HLPE, 2019).; 2.Information definition: (a) Knowledge obtained from investigation, study, or instruction; (b) intelligence, news; (c) facts, ***data***. Available at: [*https://www.merriam-webster.com/dictionary/information*](https://www.merriam-webster.com/dictionary/information); 3.Calculated by author.

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**Load-Date:** March 29, 2024

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Nature Sustainability

October 2020

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**Section:** Pg. 821-835; Vol. 3; No. 10; ISSN: 2398-9629

**Length:** 11491 words

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**Body**

Main

The global population is projected to reach 9.7 billion people by 2050. This will require a 60% increase in global food production compared with 2005–2007 levels, alongside more equitable access. Additionally, over 815 million people are chronically undernourished, especially in parts of sub-Saharan Africa (SSA) and South Asia, where 22.8% and 14.7% of the overall populations are undernourished, respectively. Postharvest loss (PHL) of food crops, during or after harvest, is a loss of valuable food and of the inputs required to produce and distribute it. Given its substantial scale, reducing PHL will help create more sustainable and resilient food systems, and reduce greenhouse gas emissions. PHL reduction can simultaneously optimize ***agricultural*** productivity and increase the incomes of small-scale food producers and associated value-chain actors, especially women, who are traditionally responsible for many postharvest activities.

The causes of PHL and the stages at which they occur are numerous and varied depending on the supply chain, the location and a variety of other contexts. Damage or loss can occur during all postharvest stages. For example, part of the crop may get left behind unharvested in the field, spilt during transportation or attacked by pests or microbes during storage. All of these can reduce the quantity or quality of food available and the associated income opportunities for small-scale food producers. Many of these are preventable through proper training, the adoption of appropriate tools or technologies, effective handling practices, sound policies and marketing-related improvements.

After the food crises of the 1970s and 2007–2008, PHL reduction received more attention and investment. However, due to factors such as poor coordination, inappropriate scale, a focus predominantly on technologies, short-term time frames and lack of follow-up, the investment impact has been limited. Moreover, the failure to invest in proper support for training, institutionalization and services (for example, financial credit, supply chains and distribution networks, quality standards, and improved infrastructure) has contributed to the lack of progress–.

Targets have been set under Sustainable Development Goal (SDG) 12.3 to reduce losses along the supply chain. African Union Member States have gone even further, pledging to halve postharvest food loss by 2025 under the Malabo Declaration. The reduction of postharvest food loss has wider implications for other SDGs related to food systems, as well as socio-economic and environmental effects related to SDGs 1, 2, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15 and 17. The critical role of PHL reduction to support the attainment of SDG 2 and the need to review existing evidence were recognized during a consultative exercise coordinated by the Global Donor Platform for Rural Development and the Ceres2030 project ([*https://ceres2030.org/*](https://ceres2030.org/)). A synthesis of the expanding body of research and development work on interventions that can help small-scale producers and associated value-chain actors to reduce PHLs is vital for evidence-based decision-making.

Box 1 Overview of methods

Searches. A search strategy was developed in May 2019 and used to sequentially search CAB Abstracts, Web of Science, Scopus and 47 additional electronic database and grey literature sources. The 14,576 records identified were deduplicated, resulting in 12,786 documents for title and abstract screening. A second search was done on 30 October 2019 to ensure that the evidence-base was as current as possible, yielding 121 additional studies.

Study exclusion criteria. Studies were excluded if they:

Did not include a PHL reduction intervention for one of the 22 focal food crops

Did not take place in SSA or South Asia

Were not relevant to PHL reduction by small-scale producers or their associated value-chain actors

Did not include original research and sufficient details on it

Did not report the effect of an intervention on PHL, which required comparison between different interventions, between adopters and non-adopters or between pre- and post-adoption

Did not test an intervention at a meaningful scale at the field level or in a real-world context

Were not written in either English or French

No date restrictions were applied.

Title and abstract screening. The titles and abstracts were auto-coded by semantic machine-learning models and prescreened using filters and a Python script to expedite the exclusion of studies not related to the focal crops or geographies. The title and abstract of each of the 12,907 studies were then screened independently by two of the postharvest researchers.

Full-text article screening. The 1,906 studies included during the title and abstract screening stage were read to determine whether to include them in the evidence-base. A flow chart of the number of studies and exclusion reasons is shown in Extended ***Data*** Fig. , and the included studies are listed in Supplementary Table .

***Data*** extraction and synthesis. ***Data*** from the 334 included studies were extracted into an SQL database version of the coding framework (Supplementary Table ). Meta-analyses were conducted at both the study and the intervention levels to provide an overview of what interventions have been studied by crop, country and postharvest stage, and to compare the efficacy of the different interventions in reducing PHLs. The searchable SQL database was created to facilitate interactive exploration of the ***data*** and is available at [*https://PHCeres2030.net/*](https://PHCeres2030.net/).

The systematic method that we followed aims to capture and rigorously screen all the relevant literature to fully explore, map and compare the existing evidence and to identify gaps and reduce authorial bias. The full details of the methodology are provided in the , and the preregistered protocol is available at [*https://osf.io/6zc92/*](https://osf.io/6zc92/).

Box 2 Policy and investment recommendations

Studies should be conducted to increase the available ***data*** on PHL reduction interventions, particularly for legumes, small grains, root and tuber crops, fruits, and vegetables. Notably effective PHL reduction interventions, along with critical gaps in the evidence-base, are presented in Table .

Future studies should include the non-storage activities in the value chain and the key actors (such as farmers, traders, transporters and wholesalers), because to date the focus has been predominantly on tangible technical interventions to reduce losses during farmer-level storage.

The limited evidence on PHL reduction interventions can be extrapolated to similar crops within each crop group, with participatory field-level studies to confirm and expand the evidence.

The effects of training, finance, policy and infrastructure interventions on PHL reduction need to be studied to guide investments.

More evidence is needed regarding verified socio-economic and environmental outcomes of PHL reduction interventions, because to date the focus has been on their technical efficacy.

More evidence is needed on the efficacy of PHL reduction interventions, particularly when technologies are combined with interventions such as training, changes in handling practices, access to finance and policies.

Future studies would benefit from ***collecting*** a wider array of ***data*** using uniform and more systematic methods to capture the quantitative, qualitative and socio-economic aspects of PHLs.

For improved postharvest management and loss reduction, there is a need for:

Greater efforts to raise the awareness of stakeholders of the ability to reduce losses and the benefits of doing so

Recognition that all technologies have strengths and weaknesses and that due to the heterogeneity between households, agro-ecologies and crops, one-size-fits-all solutions are unlikely to be successful

Technical solutions to be simultaneously promoted alongside good postharvest training and management to build understanding of why losses are occurring, how the technologies can best be used and the local costs and expected benefits of interventions

More study of how national policies, financial access and infrastructure investments affect PHL reduction

Implementation of policies that support quality-sensitive markets to provide incentives for PHL reduction

Multistakeholder postharvest platforms or institutions to promote co-learning and co-innovation, support access to information, and support multilocation and multiseason studies with active participation of stakeholders along the commodity value chains

Targeting of the aforementioned recommendations may be needed depending on limitations of financial resources and information, and whether the main objective for reducing PHLs is improved food security and nutrition or lower environmental impacts.

Results

Only 334 of the 12,907 studies (2.6%) identified for the 22 food crops across 57 countries of SSA and South Asia met the inclusion criteria (Box and Extended ***Data*** Fig. ).

Outline of the evidence

The 334 included studies came from a wide range of sources, with the majority (85.9%) being journal papers. The earliest articles were published in 1971, and 42.2% were published in the past decade (Fig. ). India accounted for 32.2% of the articles, while for 25 countries there were no studies that met the inclusion criteria (Fig. and Extended ***Data*** Fig. ). Studies on maize dominated (24.9%) (Fig. ), and, when aggregated by crop group, legumes were the least studied (7.8%) (Fig. ). When grouped by postharvest activity stages, studies on storage interventions for dry and fresh forms of the crops dominated, each accounting for 42.5% and 40.1% of the studies, respectively (Fig. ). Most of the studies (91.0%) focused on postharvest interventions that small-scale producers could use to reduce losses. Studies of loss-reduction interventions for use by traders, transporters or other food-system actors were limited. On-farm/field trials made up 34.1% of the studies. Surveys accounted for 8.1%, and 57.8% were research station trials. More detailed descriptive ***statistics*** of the evidence can be found in Supplementary Box .

Profile of the 334 PHL reduction intervention studies.

a–e, The number of studies by year (a), country (b), crop (c), crop group (d) and postharvest activity stage (e).

Overview of postharvest interventions studied

Cereals had attracted the most study of PHL reduction interventions (43.3%), particularly maize (25.8%) (Fig. ). Root and tuber crops followed (19.9%), principally potato in India. Next were fruits (19.2%), particularly citrus and mango in India. The vegetable interventions (10.7%) focused on onion or tomato, mainly in India. Legumes had the fewest interventions studied (6.8%).

Number of PHL reduction interventions studied by crop, crop group, country and region.

Derived from the dataset of 334 studies, the numbers in each cell specify the number of interventions studied for each specific crop and country combination. The darkest orange cells identify the crop–country combinations with the most ***data***. The blank cells represent zeroes. The blue rows at the base of the figure show the total numbers and percentages of interventions studied by crop, crop group and region (SSA, South Asia (SAsia) and the geographical regions of SSA (WAfrica, West Africa; EAfrica, East Africa; SAfrica, Southern Africa; CAfrica, Central Africa)).

Geographically, SSA accounted for 55.0% of the interventions studied. The most interventions had been studied in India (34.6%), with a focus on potato, citrus, onion, mango, rice, wheat, banana and tomato. Within SSA, 54.9% of the interventions were on cereals, 19.9% on root and tuber crops, 11.5% on legumes, 7.5% on fruits and 6.2% on vegetables.

The PHL reduction interventions studied were aggregated using a four-tier hierarchical system, with the first tier being the intervention type (technology/tool/equipment, handling practice change, training/extension, finance, policy, markets, support or infrastructure). The second tier was the intervention stage, grouped into typical postharvest stages (such as harvesting, drying and storage), and tier 3 was the specific interventions (such as zero-energy cool chamber or traditional granary plus synthetic chemical; for the full list, see Supplementary Table ). The details of each intervention were provided in tier 4 (for example, the name and application rate of the ***agricultural*** chemical or the size of the box).

The analysis of the 334 studies by intervention type (tier 1) highlights the dominance of studies on tangible technologies, tools or equipment (88.3% of studies, 89.0% of interventions). There were far fewer studies on handling practices (14.1%, 10.5%), training (0.6%, 0.3%) and infrastructure (0.3%, 0.1%). None were on policy, finance, markets or support/organization (Fig. ).

Overview of the number of PHL reduction interventions studied by type (tier 1) and stage (tier 2) and by crop and crop group.

Derived from the dataset of 334 studies, the numbers in each cell specify the number of interventions studied for each specific crop and intervention stage combination. The darkest orange cells identify the crop–intervention stage combinations with the most ***data***. The blank cells represent zeroes. The blue cells at the base of the figure show the total number of interventions studied by crop and crop group, and in the two rightmost columns by intervention type and stage.

Measurement of PHL

PHLs are multidimensional and can be measured in different ways, both quantitatively (physical loss) and qualitatively (for example, increased damage, decay, breakage, contamination with toxins, reduced seed viability and deterioration in the ***nutrient*** content or economic value of a product),. These losses can be assessed using a range of metrics depending on the focus of the research or intended use of the crop. For each intervention studied, ***data*** for one quantitative and one qualitative loss metric were included depending on the evidence presented in the respective study. To support the comparative efficacy analyses, the different loss measurements were aggregated into groups (Supplementary Tables and ).

PHL reduction interventions and their efficacy

Most of the interventions studied were tangible technologies for reducing losses during storage, while a few studies focused on changes in handling practices or training (Fig. ). A comparison of the loss in quantity or quality for the different interventions can provide an overview of their efficacy. Since the studies were conducted in different years, seasons, locations and contexts and using different varieties by different research teams, comparisons beyond those within a single study provide only an indication of the relative efficacy of the different interventions.

Cereals

For cereals, the focus was primarily on storage technology interventions (Fig. ), including pesticides (both synthetic chemicals and botanicals), modified atmospheres, storage containers and combinations of these technologies (Supplementary Table ). Only 11 of the 121 cereal storage studies (9%) targeted traders or other storage service providers. Six of these studied large-scale storage interventions, such as metal silos or hermetic cocoons of seven-tonne capacity or above, or large bag stacks in warehouses.

Studies on changes in handling practices focused on harvest maturity, timing or weather conditions and their combination with other postharvest handling practices. Some studies evaluated the effects of sorting or field-drying methods.

Simple tools or machines for harvesting were compared with manual practices. Drying technologies studied included different structures and heat sources, as well as protecting the crop from contact with the ground during sun-drying versus drying it directly on the ground. Threshing, shelling or de-husking studies compared manual methods, simple tools and mechanized threshing. Only four studies investigated different milling equipment, all on rice in Ghana, India or Bangladesh. Just one study investigated the effect of farmer training, and that was nearly 50 years ago.

Maize

For the analysis of quantity loss for different maize storage interventions (tier 3), percentage weight loss ***data*** were used. For quality loss, the percentage of damaged or discoloured grains was used, although many other quality loss measurements were recorded in the maize studies (Supplementary Table ). As the studies presented loss ***data*** from different storage durations (ranging from 1 to 12 months), the ***data*** for a standardized storage period of six months were used to facilitate comparison. Of the 78 studies on maize storage methods, 74 were from SSA and 4 were from South Asia (India and Nepal). The storage method included details of both the facility in which the crop was stored and the protectant used. The heterogeneity between the studies and the small number of cases (that is, n = 1 or 2) for many of the interventions must be noted.

The aggregated ***data*** indicated that several air-tight/hermetic facilities, the admixture of grain with diatomaceous earth (DE) or cooking oils, and a fumigated and insecticide-sprayed bag stack kept quantity loss below 2% during six months of storage (Fig. ). Quantity losses ranged widely in maize grain and cobs treated with synthetic chemical protectants and stored in different facilities for six months (that is, from <1 to 27% weight loss), although means from a low n value should be interpreted with caution. Differences in the types, efficacy, stability and application rates of synthetic chemicals, varietal susceptibility, environmental conditions and number of occurrences of the interventions help explain the high variability. For example, the most studied intervention, ‘polypropylene bag + synthetic chemical’ (n = 21), had a weight loss of 7.2% ± 11.2% (mean ± s.d.). When the losses in quality between interventions were compared, similar trends to those for the quantity loss ***data*** were observed (Fig. ). Because much of the grain damage was due to insect pest attack in storage, the relationship between quantity and quality loss was expected. For example, 20% storage-insect-damaged maize grain typically equates to 5% weight loss.

Comparative losses in quantity and quality of stored maize.

a,b, Quantity (% weight loss) (a) and quality (% damaged or discoloured grain) (b) loss of maize stored for six months using different storage interventions. The interventions were sorted in order of efficacy. The means, 95% confidence intervals (CIs) and n values (that is, the number of times this intervention was found in the 334 studies) are presented. The loss levels are dependent on numerous factors, including the conditions during the study, which can result in high heterogeneity between studies. The loss levels for each intervention need to be interpreted with caution, particularly where the n value is low. Interventions in which the grain was stored untreated are shown as green bars. The blue bars indicate grain treated with a synthetic chemical. The grey bars indicate grain treated with an alternative method, such as DE.

Two studies found that mass trapping, biological control agents or synthetic chemicals in traditional granaries lowered weight loss by 13.0–57.6 percentage points, compared with the traditional practice or an untreated control (Supplementary Fig. ). Treating fumigated or non-fumigated grain with a residual synthetic chemical dust and storing it in sacks, or storing untreated grain in hermetic bags or metal or plastic silos, lowered weight loss by 1.3–10.1 percentage points and reduced grain damage.

One handling practice study found that selecting cobs with tightly closed husks, as opposed to open husks, reduced insect infestation from 20.0% to 1.0%. Another study found that improved admixing of protectants with grain reduced storage insect damage from 14.0% to 3.2%. Proper crop drying, store hygiene, store disinfestation and regular inspection led to lower losses. Cobs field-dried on plants (as opposed to heaped on the ground) and those harvested at physiological maturity (as opposed to several weeks later) experienced lower weight loss and aflatoxin levels (Supplementary Table ).

Wheat, rice and sorghum

Storage method intervention studies on wheat, rice and sorghum tended to report the percentage of damaged grain (n = 108) rather than grain weight loss (n = 66).

During wheat storage, a range of pesticide treatments were studied, including repeated fumigation and pesticide spraying of bag stacks, which kept weight loss below 2% (Extended ***Data*** Fig. ), as did underground pit storage in India. If products such as industrial filter cake dusts, silicon-rich botanical powder or synthetic chemicals were admixed with grain, or if grain was stored in sealed drums, hermetic bags, concrete bins or improved granaries, weight loss also remained below 2% at six months and grain damage was below 5% (Extended ***Data*** Fig. ). When storage interventions were compared with the traditional practice or untreated control, the admixture of synthetic chemical or filter-cake dust or silicon-rich botanical treatments, or storage in sealed plastic containers or hermetic bags, most effectively prevented grain damage (Supplementary Fig. ). All the wheat storage studies were from South Asia, except one study from Ethiopia.

Less than 2% weight loss and less than 6% damage occurred during six months of storage when paddy rice was sealed untreated in hermetic bags, metal silos or improved granaries, or when it was fumigated and stored inside a metal silo or pesticide-incorporated bag (Extended ***Data*** Fig. ). However, when paddy rice was stored untreated in jute or polypropylene sacks, traditional granaries or heaps on a floor, weight losses between 2.8% and 21.8% and grain damage between 16.4% and 20.3% occurred. When storage interventions were compared with the traditional practice or untreated control, hermetic cocoons, metal silos, traditional granaries with fumigation and rodent control, hermetic bags, and improved granaries lowered weight losses (1.8–5.3 percentage points) and grain damage (12.7–16.4 percentage points) (Supplementary Fig. ).

Sorghum lost less than 2% weight during six months of storage when kept untreated in hermetic bags or improved underground pits, in bags following fumigation and admixture with synthetic chemicals, or in a traditional granary admixed with wood ash. Even without these interventions, weight loss was relatively low (2.1–6.9%) (Extended ***Data*** Fig. ). Less than 5% damage occurred when sorghum was fumigated, treated with synthetic chemicals, and stored in bags; or admixed with wood ash, synthetic chemicals or DE and stored in a traditional granary; or stored untreated in hermetic bags or an improved granary. However, untreated grain stored in bags or traditional granaries with or without botanical preparations sustained between 14.1% and 43.2% damage (Extended ***Data*** Fig. ).

Harvesting rice at the recommended time resulted in lower weight loss (0.6%) and fewer broken grains (9.4%) than either earlier or later harvesting (5.9–20.3% weight loss and 24.0–32.4% broken grains) (Supplementary Table ). Threshing and sun or mechanical drying reduced rice weight loss, breakage and aflatoxin content compared with various field-drying and stacking combinations before threshing.

Legumes

There was considerably less research on legumes than on cereals. The majority of the studies (86.9%) focused on storage methods of dried legumes (Fig. and Supplementary Table ). Cowpea accounted for more than half of the legume storage interventions studied (53.2%). Storage loss was generally higher in legumes than in cereals, despite the shorter standardized storage duration of 4.5 months that was used. For example, when cowpeas or beans were stored in jute or polypropylene bags with no protectant, grain damage ranged from 46% to 70%, and weight loss in cowpeas was 18.9% (Extended ***Data*** Fig. ).

The storage methods investigated included the effect of admixing pesticides (botanicals, synthetic chemicals, DEs or ashes) with grain legumes stored in bags (with and without air-tight liners), clay pots, plastic or metal containers, or traditional granaries.

Most of the legume loss ***data*** were for non-synthetic chemical interventions, such as cowpea storage in hermetic bags (Extended ***Data*** Fig. ). Hermetic bags were clearly more effective in reducing quantity and quality losses in cowpeas, groundnuts and beans, when compared with traditionally used practices or untreated controls (Supplementary Fig. ). Other interventions that kept the grain damage levels at least 20 percentage points lower than the untreated control included mixing synthetic chemicals, botanicals or DEs with cowpeas or beans before storing them in sacks (Supplementary Fig. ). The storage of cowpeas in clay pots, plastic jerry cans or drums reduced storage losses, but not as effectively as hermetic bags or synthetic chemicals. The protective effect of storing unshelled cowpeas was illustrated in one study.

Only three legume studies compared handling practices (Supplementary Table ). Simple handling practice changes, such as weekly sunning or sieving of beans, reduced storage damage to 3.6–4.1%, compared with 37.7% in the untreated control. Careful sorting and drying of groundnuts led to a striking reduction in aflatoxin B1 content (from 55 ppb to 17 ppb), although still beyond the safe limits of most standards. Harvesting groundnuts in the rain and slow drying, as opposed to rapid drying, increased fungal incidence on pods from 19.4–24.5% to 32.5–38.9%.

In a Gambian study, baseline samples of groundnuts had an average aflatoxin B1 content of 112.5 ppb and a median level of 0.49 ppb. After 25 women were trained in sorting and removing any mouldy groundnuts, the resulting weight loss was 1.9%, and the remaining groundnuts had an average aflatoxin B1 concentration of 0.28 ppb.

Roots and tubers

The majority (70.7%) of the root and tuber crop interventions compared storage protectants (hot water dips, irradiation, growth regulators, biological control and pesticides) or structures (shade-providing structures, structures with forced air ventilation, evaporatively cooled and cold stores, and comparisons of traditional structures) (Fig. ). Most of the interventions were on potato or yam; only 6.4% were on cassava.

In roots and tubers, quantity loss was measured as percentage overall loss, loss based on weight loss combined with decay and sprouting, and weight or water loss, except in one study. Quality loss measurements include percentages with decay, damage, infestation and unmarketable product (Supplementary Tables and ). Sprouting was analysed independently from decay because it tended to be inversely related. Storage durations ranged from 5 weeks to 44 weeks.

In potato, quantity and quality losses were less than 15.5% and 8.5%, respectively, when the tubers were stored in improved pits, cold rooms, store rooms, evaporatively cooled or well-ventilated structures, or heaps without the use of chlorpropham (Fig. ). Storage with chlorpropham reduced losses regardless of the storage structure, whereas losses were higher under ambient conditions or in a traditional structure.

Quantity and quality losses associated with storage and packaging of roots and tubers, fruits and vegetables.

a, Storage structures for potato and storage protectants in yam. b, Packaging for citrus and storage protectants in citrus and mango. c, Storage structures for onion and packaging for tomato. The mean percentage quantity loss (blue bars) and quality loss (red bars) and 95% CIs for the different interventions are listed. For each crop and intervention combination, the first n value indicates the number of examples of quantity loss ***data***, while the second n refers to the quality loss ***data***. The loss levels are dependent on numerous factors, including the conditions during the study, which can result in high heterogeneity between studies. The loss levels for each intervention need to be interpreted with caution, particularly where the n value is low. RPC, returnable plastic crates.

The use of botanicals, essential oils, biocontrol, heat or irradiation resulted in less than 20% quantity loss in yams, but not all of these treatments had similar effects on quality losses (Fig. ). When no protectants were used, quantity losses were high (29.0–44.0%). Irradiation reduced both quantity and quality losses, as well as sprouting. When curing was combined with a storage protectant, quality losses were low (10–14%).

Biological control approaches included two studies evaluating Bacillus thuringiensis in potato storage in India and Nepal,, one assessing the performance of the predatory beetle Teretrius (Teretriosoma) nigrescens in protecting dried cassava chunks from attack by the larger grain borer during storage and one on storing yams in termitaria.

Sixteen percent of the interventions studied handling practice changes. These focused on the effect of harvesting from different soil types and moisture contents, piecemeal versus once-off harvesting, and timing of harvest, among others (Supplementary Table ). Harvesting cassava from moist, less compacted soil resulted in lower damage (21.6%) than from dry, compacted soils (44.6%). Soaking cassava chips in water before sun-drying or smoke-drying reduced weight loss to 23.9% after six months of storage compared with 96.4% in unsoaked stored chips. Piecemeal harvesting (11.3%) resulted in lower losses in potato than once-off harvesting (37.1%). Delayed harvesting led to increased insect damage on sweet potato,, while dehaulming lessened decay in roughly handled sweet potato roots. Sorting and storage of undamaged yams led to no decay during 36 weeks of storage compared with 80–100% decay in yams with cuts. In the only study on infrastructure, better road quality reduced losses of potato in Ethiopia.

Fruits

In the fruit crops, quantity loss was measured as percentage overall loss, water loss or weight loss. Quality loss was typically expressed as percentage decayed, damaged or unmarketable. Other measurements reported in the studies were firmness, ***nutrient*** composition changes, assessment of visual quality and ripening stages. Unlike in cereal crop storage, where postharvest quantity loss can be directly correlated to some measures of quality loss, an inverse relationship can exist in fruits and vegetables. For example, if water loss (quantity) is high, then decay (quality) tends to be lower, and vice versa. This, along with the different storage durations and temperature conditions in each study, confounded comparisons.

For fruit crops, storage protectants accounted for 35.5% of the interventions, packaging 22.9%, and storage structures/containers 18.3%. Storage protectants focused on the use of waxes or coatings with or without fungicides, pesticides and heat treatments. Packaging interventions included fibreboard, wooden or plastic boxes with or without liners and padding, modified atmosphere packaging and shrink-wrapping. The storage structure interventions tested included evaporatively cooled structures, insulated rooms equipped with an air-conditioner controller with frost sensor override, and cold rooms. The less commonly evaluated interventions were harvesting tools, harvest maturity, pre-cooling and ripening. Handling practices accounted for 5.6% of the interventions and included combined sets of improvements compared with traditional handling practices.

Most types of packaging reduced quantity loss in citrus, but when liners were used, quality loss was higher. For example, packing in wooden boxes resulted in a 6.6% loss in quality, but when a liner was added, losses increased to 22.6% (Fig. ). This increase in decay was attributed to higher relative humidity. Shrink-wrapping reduced both quantity and quality loss. Storage protectant interventions for citrus were effective. With no protectant, fruits sustained high losses in quantity (34.3%) and quality (33.7%) (Fig. ). The use of waxes alone, with fungicides or with botanicals, reduced losses in both quantity and quality.

For mango, most storage protectant interventions reduced percentage quality loss (usually decay), but this was not always associated with a lower quantity loss (usually water loss) (Fig. ). Heat treatment (specifically hot water) (13.0%) and pesticides (16.6%) were particularly effective in reducing quality loss over 9–14 days of storage, essentially by reducing decay. Mangoes stored without protectants experienced 35.5% quality loss.

Traditional handling of mango (conventional harvest, ***collecting*** in bamboo baskets and rough packaging in wooden crates) resulted in 25% quantity loss and 68.3% damage. Improved handling (careful harvesting with 10–15-cm-long pedicels, desapping in lime solution, washing in water and using the same containers) resulted in only 5% quantity loss and 22.5% damage (Supplementary Table ).

Vegetables

Onions were stored for durations ranging from 7 to 26 weeks, complicating comparisons between the storage structure interventions. The trends indicated higher quantity (22.1–50.5%) and quality (5.5–73.0%) losses in shaded or traditional structures, store rooms and heaps (Fig. ). Lower quantity (6.1–16.6%) and quality (2.9–5.7%) losses occurred in structures with some control of air flow, relative humidity or temperature. Curing onions extended the shelf-life and reduced quantity losses from 47.0% to 31.0%. Improved handling practices (curing, sorting, fungicide use and ventilation during storage) resulted in 32.3–40.3% quantity loss and 8.9% decay compared with 51.7% and 17.4%, respectively, for poor handling practices (Supplementary Table ).

Tomato studies focused on packaging and cool-storage technologies. Traditional packaging, such as wooden boxes or roughly made baskets, tended to cause higher losses in both quantity (23.8–48.3%) and quality (17.0%) (Fig. ). Plastic crates and improved baskets reduced quantity losses (7.9–17.5%) and quality losses (3.2–6.9%). Modified atmosphere packaging showed promise, with low quantity and quality losses (6.2% and 5.7%, respectively).

Social, economic and environmental outcomes

About 13.1% of the studies mentioned economic, social or environmental outcomes of the interventions, either separately or combined. Economic outcomes were reported by 12.5% of the studies, social outcomes by 3.0% and environmental outcomes by 1.2%. Most of the reported economic outcomes were for maize, rice and potato. Nineteen studies reported on theoretical cost–benefit analyses. Nine studies directly mentioned the actual costs and benefits of interventions. Only 11.4% of the studies included information on the costs of the interventions. Costs ranged from less than US$1 for harvesting tools, sacks, baskets, cartons, liners and protective padding to around US$2,000 for cold rooms cooled evaporatively (20 t capacity) or with a modified air-conditioner (8–10 t capacity). The cost was US$4,000 for a 20-t-capacity hermetically sealed cocoon and US$36,000 for a combine harvester (Supplementary Table ).

Some grain storage intervention studies highlighted the links with lower aflatoxin risk and reduced food consumption volatility. Other studies emphasized that while mechanized harvesters, reapers or threshers reduce drudgery, they can also displace labour–. None of the studies reported on gendered outcomes. Just two studies, reported on the economic, social and environmental outcomes simultaneously. These studies showed that the use of improved containers for maize storage reduced chemical use and increased the ability to smooth out consumption and net revenue, as well as increasing the cultivation of high-yielding but storage-pest-susceptible hybrid varieties.

Barriers to and facilitators of adoption

Just five of the articles studied the factors affecting the adoption of PHL reduction interventions. Four were on maize storage, drying or handling in East African countries,,,, and one was on rice threshers in Sri Lanka. The efficacy, lifespan, durability and cost-to-economic-benefit ratio of the technology were positively related to the adoption rate of the interventions. Household size, literacy, land size, use of financial services and off-farm income also had positive relationships with the adoption rate. In contrast, the distance from passable roads and the presence of a female primary decision maker reduced the likelihood of using a metal silo.

Many of the other studies made suggestions regarding barriers and facilitators of the adoption of PHL reduction interventions without supporting ***data***. Suggested barriers to adoption included high initial investment costs, limited availability of distribution channels, lack of participatory development and testing by farmers and value-chain actors, and limited awareness of the scale of the problem. There were also complex trade-offs, such as bulkier packaging or grain protectant methods that reduced seed viability. Lack of credit, subsidies or input markets were also viewed as barriers.

Suggested factors facilitating adoption included cost-effective, time-saving, technically effective and easily maintained interventions; the availability and ease of integration of the interventions with existing practices; quality-sensitive markets; the use of participatory multistakeholder learning-by-doing approaches (such as learning alliances and living labs); and postharvest training and awareness-raising among farmers and value-chain actors.

Discussion

This study investigated PHL reduction interventions for 22 crops across 57 countries of SSA and South Asia from the 1970s to 2019. The identification of just 334 studies highlights the limitations of this evidence-base, particularly as one country, India, accounted for 108 (32%) of these studies. Interventions for cereals (particularly maize) dominated, whereas vegetables and legumes have received much less attention. The increasing trend in the overall number of studies during the past two decades suggests growing recognition of the need for PHL reduction. However, the lack of studies on training, finance, infrastructure, policy and market interventions highlights the need for interventions beyond technology or handling practice changes.

Most of the studies focused on the effect of a technology, tool or piece of equipment during farm-level storage. While interventions to reduce storage losses are crucial, a better understanding of losses during non-storage stages and interventions that can reduce these losses is also needed. PHLs are the cumulative result of a sequence of actions (or inactions) and conditions along the value chain. Given the rapid transformation of food systems in SSA and South Asia—linked to population growth, urbanization, changing dietary choices and climate variability, among other drivers—there is an urgent need for evidence on interventions that support other value-chain actors beyond farmers in reducing PHLs, and not only during the storage stage. For perishable crops, for example, this would require studies that include maturity assessment, harvest method, handling, cooling, packing/packaging, transportation, storage and drying or processing.

Most storage studies included a traditional practice or untreated control as a comparator. In reality, traditional practices may be more dynamic than researchers recognize. As emphasized by Ng’ang’a et al., “farmers, unlike scientists do not wait for 35 weeks to see their storage losses go up to 79.6%”. Additionally, there is limited evidence on common-sense good practices, such as cleaning or disinfesting a store before use and careful handling of perishable crops.

A sound evaluation of postharvest interventions requires a more complete assessment of their efficacy in reducing losses in both quantity and quality. Future research (and evidence syntheses drawing on it) would benefit from employing more systematic and uniform ***collection*** methods of a wider array of ***data***.

It is also worth noting that some postharvest interventions, such as mechanization, save farmers time and drudgery but may increase quality and quantity losses. This highlights just one aspect of the complex trade-offs surrounding PHL reduction.

Drawing robust conclusions on the technical efficacy of many of the interventions is difficult because there are relatively few studies of each intervention for each crop, and they vary in scale, duration, type of loss ***data*** ***collected***, location and context. Many studies were excluded because they used very small quantities of the crops, were conducted only in the laboratory or did not replicate the interventions. Most of the included studies involved only researchers without any participation from farmers or other community members. Their participation could have provided experiential learning opportunities and built ownership. Even if technically effective in researcher-managed trials, such interventions may not be as effective in real life and may not be acceptable to or affordable for farmers. Additionally, more ***data*** on multiseason and multisite testing of interventions are required to provide a critical understanding of their replicability and degree of variation. Loosening the inclusion criteria would increase the number of studies, but it would compromise the value and quality of evidence on which the synthesis was based.

Despite the systematic approach used and the recognition of the four principles (inclusive, rigorous, transparent and accessible) identified by Donnelly et al. for synthesizing evidence for policymakers, the present evidence-base is subject to non-publication bias, as studies of less effective interventions would not have been widely shared. Furthermore, where there is no requirement for PhD or MSc theses or project reports to be registered in public databases, digital search strategies do not always identify these important sources of evidence. Several studies did not acknowledge all the treatment details. For example, the additional cost and effect of prior fumigation on grain storage interventions was rarely recognized. Details of the concentrations and application rates of active ingredients of protectants were not always available, even though they are important for efficacy comparisons, as well as compliance with national product registration and safety regulations. Some grain storage trial durations were very short. The efficacy of the tested interventions may be different during the longer storage durations (six to ten months) required by many small-scale producers to ensure the availability of their staple grains between harvests and in response to increasingly unpredictable climate,,–. Such issues highlight opportunities to support systems to improve PHL reduction research methods, ***data*** analyses and interpretation. Recent initiatives and funders’ forums set up to ensure value in medical research may offer prospects for cross-learning.

Well-designed, multidisciplinary, measured field studies should analyse the links between reductions in different types of loss and their social, economic and environmental outcomes. This will support better understanding for the development, adoption and promotion of PHL reduction interventions in their various forms, such as technologies, policies, training, infrastructure and combinations of these. There is also a need to understand the factors that facilitate or constrain the adoption of interventions. A small body of literature exists on this, although much of it is focused on the adoption of relatively expensive interventions,–. Cost, access, ease of use and reuse, cultural acceptability, one-time subsidies, willingness to pay, scale, awareness and demonstrations, and training are just some of the factors influencing the uptake of PHL reduction interventions along with technical efficacy,,–.

Notwithstanding the limited size of the evidence-base, the efficacy of a number of interventions in reducing PHLs was recognized. A summary of these notable interventions and critical gaps in the evidence-base is presented in Table , followed by a set of policy recommendations (Box ). A deeper analysis of the dataset is available from the authors, and the interactive database at [*https://PHCeres2030.net/*](https://PHCeres2030.net/), which will be updated biannually, provides users with an opportunity to identify relevant studies and better tailor the ***data*** outputs to their specific needs.

Summary of the PHL reduction interventions evidence-base for SSA and South Asia

|  | **Technically effective interventions** | | **Critical gaps in the evidence-base** |
| --- | --- | --- | --- |
| **Technologies, tools and equipment** | **Handling practices** |
| Cereals | Maize storage: in hermetic containers or admixed with some synthetic chemicals or DEsWheat, rice or sorghum storage: in hermetic containers or underground pits, or admixed with some synthetic chemicals, botanicals or DEs | Timely harvesting, protecting crops from direct ground contact while drying | ? Interventions for loss reduction in the non-storage activity stages? Any evaluation of training, policy, infrastructure, finance interventions on loss reduction? Effects of sanitation, grain cleaning and timing of activities on subsequent losses? Verified measured socio-economic or environmental outcomes of the uptake of different PHL reduction interventions at any scale? Factors facilitating and constraining the adoption of PHL reduction interventions? Stakeholder participation in the study of interventions to facilitate co-innovation and co-learning, and the need for more real-world scale on-farm participatory studies? Standardized loss measurement metrics? Consistency of intervention results confirmed through multiseason and multilocation studies |
| Legumes | Storage in hermetic containers or admixed with synthetic chemicals, botanicals, DEs or edible oil | Protecting crops from direct ground contact while drying, sorting to remove mouldy grains |  |
| Roots and tubers | Use of digging tools that reduce harvesting damage, use of improved storage containers, ventilated storage, evaporative cool storage, cold storage, sprout suppressants | Piecemeal harvesting, curing, sorting to remove damaged roots or tubers, avoidance of rough handling, use of maturity indices |  |
| Fruits | Harvesting poles/pickers, use of improved packaging, waxing (alone or with fungicides or botanicals), hot-water treatments, evaporative cool storage, cold storage, ripening treatments | Use of maturity indices, gentle harvesting and handling, sorting to remove damaged fruits |  |
| Vegetables | Use of improved packaging, evaporative cool storage, ventilated storage (onions), cold storage | Gentle handling, curing (onions) |  |

The interventions for which sufficient evidence existed of their efficacy in reducing PHLs are listed for each crop group. These interventions were either of the technologies/tools/equipment type or of the handling practices type, and they predominantly focused on reducing losses during the crop storage stage. Critical gaps identified in the evidence base for all crop groups are listed in the final column.

This evidence-based analysis demonstrates that future PHL reduction research and investments need to be expanded to include a more diverse range of food crops, food systems actors and postharvest activity stages. Future research and investments should also cover combinations of training, finance, infrastructure, policy and market interventions that go beyond tangible technologies and handling practice changes. Besides a more participatory study of the technical efficacy of interventions, there is also a need to explore social, economic and environmental outcomes, and barriers and facilitating factors to adoption to inform policy and guide investments that can drive PHL reduction in food systems at scale.

Methods

Research question

The research was guided by the main question: what are the interventions that small-scale producers and associated value-chain actors in SSA and South Asian countries can adopt or adapt to reduce PHLs along food crop value chains? A secondary research question was: what are the associated barriers and facilitating factors for adoption of the interventions?

This analysis focused on SSA and South Asia, both regions with large populations of small-scale producers dependent on local food systems and where PHLs and the incidence of poverty are relatively high. Interventions applicable to small-scale food producers and/or their associated value-chain actors such as aggregators, packers, operators of driers, threshers, chippers, transporters, processors, traders, and other service providers (for example, training, extension, financial and market information services) were targeted to meet the food demands in these regions. Narrowing the focus to 22 key food crops from five crop groups (cereals—maize, rice, sorghum and wheat; legumes—beans, cowpeas, pigeon peas, chickpeas and groundnuts; roots and tubers—cassava, potato, sweet potato and yam; fruits—plantain, banana, mango, papaya and all citrus fruits including orange, lemon, lime and mandarin; and vegetables—cabbage, onion, tomato and leafy vegetable) allowed for deeper analysis. There were no prior specifications of the types of interventions, as any interventions that apply to PHL reduction in food crop value chains are relevant, including training, information, handling practices, skills, institutional changes, financial interventions, policies, postharvest infrastructure, tangible technologies and any combinations of these.

To measure the effectiveness of the interventions, comparisons included those between different interventions, between adopters and non-adopters, and between pre- and post-adoption of an intervention. The comparisons could be vis-à-vis their technical, economic, environmental or social efficacy and outcomes. Intervention efficacy was evaluated by the level of PHL that occurred as well as the reduction in PHL compared with the traditional practice or untreated control in each study.

To ensure consistency during screening, key terms such as ‘postharvest’, ‘loss’, ‘adopt’, ‘intervention’, ‘field-tested postharvest interventions’, ‘small-scale food producers’ associated value-chain actors’ and ‘food crop value chain’ were defined. The definitions are given in Supplementary Table .

Search strategy

A comprehensive search strategy was developed to identify the relevant published and grey literature. The search terms included variations of the key concepts in the research question: PHLs in quantity or quality, postharvest activity stages, PHL causing factors, focal food crops and focal countries. The search strings used are shown in Supplementary Table . The following online databases of peer-reviewed publications were sequentially searched on 27 May 2019: CAB Abstracts (date coverage, 1973–2019), Web of Science Core ***Collection*** (date coverage, 1900–2019) and Scopus. These searches returned 8,880 records, 3,570 records, and 315 records, respectively, after screening for duplicates using Zotero bibliographic software. The searches were not limited by date or language. However, the search terms were done only in English. The search strategy was pretested and refined, and it used eight benchmark articles to maximize its comprehensiveness (Supplementary Table ). However, three of the eight benchmark articles (a 1991 Acta Horticulturae study and two grey literature reports) were not indexed and were not accessible in any of the databases searched. In addition, 47 electronic database and grey literature sources identified by the postharvest team members were searched by librarians on 24 May 2019 (Supplementary Table ). These grey literature searches involved various combinations of the following terms: ‘post-harvest’, ‘post-harvest loss’, ‘post harvest losses’, ‘post harvest’, ‘postharvest’, ‘value chain’, ‘crops’ and ‘food’. After searching, the results were screened to ensure that ‘postharvest’ and ‘loss’ were found in each report. These searches returned 1,811 records, which were combined with those from the databases to give 14,576 records, which were deduplicated using a Python (v.3.8.0) script. Duplicates were detected using the title, abstract and year of publication, where the year of publication was a match, the title cosine similarity was greater than 85% and the abstract cosine similarity was greater than 80% (or one or both of the abstracts was missing). When this occurred, the duplicate entry was removed. CAB Abstracts was the priority source of record. In contrast to the PHL review in six SSA countries by Affognon et al., where grey literature physically acquired through national teams made up 57.3% of the documents, the current study’s digital search strategy captured relatively few PhD/MSc theses, working papers or project reports.

The bibliographic details for each of the resulting 12,786 peer-reviewed and grey literature documents were exported into MS Excel (v.2002) for machine processing before title and abstract screening by the team. A second search phase of the three online literature databases for the year 2019 was done on 30 October 2019 to ensure that the evidence-base was as current as possible. The search returned 84, 52 and 15 records from CAB Abstracts, Web of Science and Scopus, respectively. After deduplication, 121 additional studies remained for screening.

Study inclusion and exclusion criteria

The following exclusion criteria were applied to the title and abstract and the full-text review stages.

Irrelevant crop: study does not include a PHL reduction intervention for one of the 22 focal food crops.

Irrelevant geographical area: study does not take place in the target geographical area of SSA and South Asia.

Irrelevant target actor: study is not relevant to PHL reduction by small-scale producers or their associated value-chain actors.

Irrelevant study type: study is a review or does not contain any original research or sufficient details on the original research to make an evidence-based decision about the intervention’s efficacy.

Irrelevant ***data*** output: study does not report the effect of an intervention on PHL.

Irrelevant scale of study: study reports the effect of an intervention that was not tested at the field level or in a real-world context. In other words, the intervention was tested only at a small scale in a laboratory or tested in the field or on-station but with a treatment replicate size too small to provide reliable ***data*** on which to base investment decision-making.

In the studies of the durable crops, interventions on maize using less than 50 kg per treatment replicate were excluded, while for sorghum, rice and wheat studies, those with less than 25 kg per treatment replicate were excluded. For the five legume crops, studies with less than 10 kg per treatment replicate were excluded. Additionally, interventions were excluded where stored crops were artificially infested with insects, fungi or bacteria, or where crops were frozen before study to disinfest them. If the study had crops that had been fumigated before the intervention, the study was included. The fumigation aspect was then added to the intervention’s description.

In the studies of the perishable crops, those with less than 20 kg per treatment for roots and tubers and with less than 10 kg per treatment for fruits and vegetables were excluded. For studies where the number of fruits was stated but the weight was not, we used a typical weight for that produce type to determine inclusion or exclusion. Studies that failed to state the size used in the treatments and where the size could not be inferred from the ***data*** were excluded. For some studies, in which the interventions were evaluated on a range of different grades or varieties, the results were averaged to achieve the weight expectations required for inclusion.

Language: studies written in a language other than English or French were excluded.

Date: no date restrictions were applied, but the searches were limited due to the coverage of the individual databases searched.

Title and abstract screening

The titles and abstracts of the search outputs were auto-coded by semantic machine-learning models and then prescreened by six team members in MS Excel using filters and a Python script to expedite the identification and exclusion of studies not related to the focal crops or geographies. The auto-coded fields—topics, countries, plant and animal products, populations, outcomes, interventions (technology, socio-economic, ecosystem, storage and mechanization) and measurements for interventions and for crops—were intended to help derive metadata from the individual citations for later sensitivity analyses and expedite the process of synthesizing the evidence. However, these fields were not found to be sufficiently accurate for this study. For example, the machine could not distinguish between countries mentioned in the title, abstract, bibliographic information or organism names (for example, Rhyzopertha dominica) and the country where the study happened, as it could not understand the context. Further training of the machine in close collaboration with expert researchers would improve the utility of the auto-coded outputs, but the rapid start-up and tight time frame of this study meant that building a more contextual base to train the machine was out of our scope.

The auto-coded search outputs were then imported into the web-based software platform Covidence for screening. Those studies identified for exclusion during the prescreening filtering (that is, wrong crop or wrong country) were then manually excluded on Covidence. For each of the 12,786 studies, the title and abstract were screened independently by two of the postharvest researchers. The eligibility criteria were used to decide which of the studies to include. Where there was uncertainty, the study was assigned to the ‘maybe’ category. If the reviewers’ independent scoring disagreed or if the study was placed in the ‘maybe’ category, a third reviewer screened the title and abstract and made the final decision. To align the scoring, the first 20 disputed studies were discussed by the screening team to develop consistency. In cases where there was insufficient information in the title or abstract to exclude the study, the study was included so that the decision could be made at the full-text-screening stage. Filters in Covidence were used to search for studies on the specific focal crops, and two or three members of the team of five postharvest researchers screened the studies for each crop group. There were many irrelevant studies in the initial library (for example, studies on cocoa or coffee beans, silage or soil; reviews; and studies from other countries and languages), and filters were used to search for and exclude them. The titles and abstracts of the additional 121 studies from 2019 were double-screened using MS Excel, and the reasons for exclusion were recorded. The use of Covidence for the title and abstract screening enabled the records to be double-blind screened and the decision on whether to include them to be captured. However, it did not enable the reasons for exclusion to be recorded.

Full-text article screening

A total of 1,887 studies from the initial search and 19 from the 2019 updated search were selected for full-text article screening. The full texts were sourced by the librarian team members from July to December 2019. They were grouped into six batches on the basis of the timing of their acquisition. The full-text PDFs for each batch were placed in the team’s Google Drive folder, and the MS Excel list of titles and abstracts in each batch was further machine-processed to assist in identifying the perishable and durable crop studies to help divide the articles between the screening members of the team. After reading each assigned article, the screening team members recorded their decisions in their MS Excel sheet. For the excluded studies, the reason for exclusion was recorded. This information was later entered into Covidence to produce the summary ***data*** on inclusion rates and exclusion reasons (Extended ***Data*** Fig. ). If there was uncertainty regarding the inclusion of a study, it was checked and discussed with at least one other member of the team. Fleiss’ kappa score was used to measure the level of agreement between screeners and gave a score of 0.659 for the three main screeners, who screened 83% of the 1,788 available full-text articles, indicating that the level of agreement was substantial (0.61–0.80).

The coding framework was developed and trialled by the researchers using four of the benchmark studies, followed by discussions and amendments before finalizing and registering the protocol on the Open Science Framework at [*https://osf.io/6zc92*](https://osf.io/6zc92)/ (Supplementary Table ). An interactive SQL database and web app were built on the basis of the coding framework for entry of the relevant ***data*** extracted from each of the studies. This database is available for policymakers to explore the results.

Due to uncertainty regarding how many of the 12,786 records from the initial search would be included, a two-part full-text coding approach was initially planned. However, due to the time it took to obtain PDF copies of the 1,887 full texts and the short time frame available for the evidence synthesis, it was not feasible to wait for Part I screening of all the included full-text articles to be done to randomly select a sample of the included studies from across the different postharvest stages, crops and geographies. The Part II ***data*** extraction would have been conducted from this sample. After the full texts of batches 1 and 2 were screened, the inclusion rate was around 20%, so the team decided to do the Part I and II ***data*** extraction on all the included full-text studies after the screening of each batch.

The relevant ***data*** were extracted into the database using drop-down menus based on the coding framework categories. The database structure was finalized in October 2019. In hindsight, the database should have included more options for the quality loss ***data***, as more than one set of measurements was often available (for example, percentage damage, percentage decay, percentage sprouting, percentage germination and aflatoxin content). Each included study was coded by one reviewer for Part I and II ***data*** extraction, and any uncertainties were discussed. Three of the researchers extracted the ***data*** for 88% of the studies. For the 40 studies where ***data*** were extracted by other team members, one of the three main ***data***-extracting researchers then went through them in the database to check and standardize ***data*** capture across the 334 included studies.

In addition to its bibliographic information, the researchers extracted ***data*** for each article using a two-part coding framework (Supplementary Table ). Part I ***data*** comprised the following: geographic locations (country, region and village), focal crops, crop form (fresh, dried, shelled or on the cob), focal postharvest activities (harvesting, handling, field drying, transport to homestead, curing, cooling, further drying, threshing/shelling, milling, packing, storing dry, storing fresh, transport to market and wholesale market), targeted postharvest actors (small-scale producers/point of production; packers and processors; service providers of harvesting, drying, milling, storage and transport; and traders, middlemen or collectors), type of study (field or on-farm trial, on-station trial or survey), study method (quantitative, qualitative, survey or mixed), study design (comparison with traditional practices, other types of intervention, non-adopters or pre- and post-adoption) and funding source. The classification of the interventions was based on a four-tier hierarchical system, with the first tier being the intervention type (technology/tool/equipment, handling practice change, training/extension, finance, policy, markets, support or infrastructure). These were further divided into a second tier, intervention stage, where the interventions were grouped into typical postharvest stages (for example, harvesting, drying and storage). Tier 3 consisted of specific interventions (for example, zero-energy cool chamber and traditional granary plus synthetic chemical) (Supplementary Table ). Detailed descriptions of the intervention were then provided in tier 4 (for example, name and application rate of the ***agricultural*** chemical, size of the box or specific details of the traditional granary). Tier 4 was included for reference but not used in the ***data*** synthesis. In Part II, the following were captured: the PHL measurements of quantity or quality; facilitators and barriers for adoption; study design, duration and scale; intervention cost; and any assessment of any social, economic or environmental outcomes associated with the interventions.

Thanks to programming expertise within the team, machine-scraped sections of the PDF files were placed in special fields in the database to support faster ***data*** extraction. However, the research team found that for accuracy and comprehension, validation still required reading of the paper and manual extraction of the required content. Moreover, the challenge in this body of literature has been that authors often use terms interchangeably, making codifying context difficult. In addition, given that this exercise in assessment is still new, building the knowledge base to train algorithms to function more accurately is a process that takes years. Given the complex and nuanced understanding required, we do not yet have machines that can sufficiently and accurately identify or automatically extract the relevant information from complicated postharvest research studies. But if leveraged correctly, this dataset can be used to build a more effective algorithm.

***Data*** synthesis

The captured ***data*** were downloaded into MS Excel and synthesized using pivot tables. The meta-analysis was conducted at both the study level and the intervention level. A few studies covered multiple crops, multiple countries or multiple postharvest activity stages. Each study reported on at least 2 and as many as 24 interventions. For the meta-analysis, the means of the quantity and quality loss figures for the interventions (tier 3) were pooled. If n > 2, the confidence limits (95%) were calculated for these pooled means, and the ***data*** were presented within the relevant tier 1 and 2 categories. For storage method interventions for durable crops (that is, dried cereals and legumes), the quantity and quality loss ***data*** were adjusted to a standardized storage time of 6 months for cereals and 4.5 months for legumes to facilitate comparisons and represent typical storage durations for these crops in these geographical regions. The ***data*** on storage methods for perishable crops were presented without adjusting for storage time. Temperature is the most important factor affecting the storage life of perishable crops, and its effects are not linear. The wide range in treatment temperatures used in the studies (from <5 °C to >38 °C) made standardization by storage time for perishable crops inappropriate, even for ambient conditions. Multiple comparisons of the mean quantity and quality loss ***data*** for storage interventions of the durable crops were conducted. The Least Significant Difference test function in the R agricolae package, was applied to the output of a one-way analysis of variance using a Holm-corrected least significant difference method to generate groups of means that do not differ significantly at P < 0.05. There were insufficient ***data*** on perishable crop interventions for further analysis.

The searchable SQL database was created to facilitate interactive ***data*** visualization, given the numerous dimensions of the challenge and the scope of the interventions. The database provides a simple way for users to filter the dataset by ***data*** fields such as crop, country and postharvest activity stage for further analysis. Users can also access the bibliographic information and intervention loss datasets for single or multiple studies. The database provides cross-tabulations and a series of graphs.

**Acknowledgements**

This systematic analysis of the evidence-base on PHL reduction interventions was conducted without funding. The research team contributed their time to work together virtually on this study outside their main work roles and responsibilities. The Ceres2030 project (funded through the Bill and Melinda Gates Foundation) identified the need for the synthesis of the evidence on PHL reduction interventions, and we thank J. Porciello of Cornell University for supporting the research team with advice. The Ceres2030 project covered travel and accommodation costs for six of the team members to join an inception meeting in June 2019. We thank the PHL reduction community of researchers and the stakeholders they have worked with for their study of different interventions, which provided the content for this analysis. We also thank the network of libraries for providing the literature.

**Notes**

Extended datais available for this paper at [*https://doi.org/10.1038/s41893-020-00622-1.Supplementary*](https://doi.org/10.1038/s41893-020-00622-1.Supplementary) informationis available for this paper at [*https://doi.org/10.1038/s41893-020-00622-1.Publisher’s*](https://doi.org/10.1038/s41893-020-00622-1.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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[***Council of the European Union: REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS AND THE EUROPEAN INVESTMENT BANK on the implementation of the Commission Communication on a stronger and renewed strategic partnership with the EU's outermost regions PDF documentST 7091 2020 INIT31-03-2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YK3-JHF1-F0YC-N1F0-00000-00&context=1516831)

Impact News Service

April 2, 2020 Thursday

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**Length:** 6934 words

**Body**

Brussels: Council of the European Union has issued the following document:

7091/20 TS/csECOMP.2 ENCouncil of theEuropean UnionBrussels, 31 March 2020(OR. en)7091/20POSEIDOM 1POSEICAN 1POSEIMA 1REGIO 39PECHE 79ENER 97FISC 81EDUC 115PROCIV 17COMPET 134RELEX 253COVER NOTEFrom: Secretary-General of the European Commission,signed by Mr Jordi AYET PUIGARNAU, Directordate of receipt: 23 March 2020To: Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council ofthe European UnionNo. Cion doc.: COM(2020) 104 finalSubject: REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT,THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIALCOMMITTEE, THE COMMITTEE OF THE REGIONS AND THEEUROPEAN INVESTMENT BANK on the implementation of theCommission Communication on a stronger and renewed strategicpartnership with the EU's outermost regionsDelegations will find attached document COM(2020) 104 final.Encl.: COM(2020) 104 finalEN ENEUROPEANCOMMISSIONBrussels, 23.3.2020COM(2020) 104 finalREPORT FROM THE COMMISSIONTO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEANECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONSAND THE EUROPEAN INVESTMENT BANKon the implementation of the Commission Communication on a stronger and renewedstrategic partnership with the EU's outermost regions11. INTRODUCTIONThis report reviews progress made in implementing the Communication “A stronger and renewed strategic partnership with the European Union outermost regions” (the Communication)1.The EU outermost regions - Guadeloupe, French Guiana, Martinique, Mayotte, Reunion Island and Saint-Martin (France), the Azores and Madeira (Portugal) and the Canary Islands (Spain) - face permanent constraints linked to their remoteness, small size, vulnerability to climate change and insularity2, which put a brake on their growth and development. It is in this context that the Treaty on the Functioning of the European Union (Article 349 TFEU), provides for specific measures to support the outermost regions, including tailor-made conditions for the application of EU law in these regions and for access to EU programmes.Scattered across the Atlantic Ocean, the Caribbean basin, Latin America and the Indian Ocean, the outermost regions provide the EU with unique assets: rich biodiversity, strategic location for space and astrophysics activities, extensive maritime economic zones, proximity to other continents.In October 2017, the Commission adopted a Communication strengthening the partnership with the outermost regions and the respective Member States and reinforcing its commitment to supporting these regions on their path to growth. In April 2018, the Council welcomed the Communication and invited the Commission to continue working on specific measures for these regions in accordance with Article 349 TFEU3.This report presents actions undertaken by the Commission, the outermost regions and the respective Member States in the sectors set out in the Communication4; it highlights achievements5; and it suggests to focus efforts on addressing climate change, protecting biodiversity, introducing circular economy and boosting renewable energy. These are key challenges for these regions as recognised in the flagship initiative European Green Deal6 which stresses that the Commission will pay particular attention to the outermost regions taking into account their vulnerability to climate change and natural disasters and their unique assets such as biodiversity and renewable energy sources. The report further highlights the need to strengthen efforts in other key sectors such as the blue economy and connectivity.A new governance based on a strong partnershipSince 2017, as set out in the Communication, the Commission has systematically taken into account the concerns and interests of the outermost regions in policy-making.In 2018, the Commission enshrined the specificities of the outermost regions in 21 proposals for EU programmes 2021-2027 in a wide range of sectors including cohesion, ***agriculture***, fisheries, research, environment, transport and digital connectivity as well as international cooperation. As such, the Commission created new opportunities and secured tailor-made provisions for these regions across most EU programmes.In 2019 the Commission recommended that France, Portugal and Spain invest cohesion policy funds in their outermost regions on key sectors such as the circular economy,1 COM(2017) 623 final.2 The outermost regions are all islands or archipelagos except French Guiana which is situated in Latin America3 Conclusions of the General Affairs Council of April 2018.4 The report covers actions since the adoption of the Communication.5 The Annexes present the actions undertaken by each outermost region and the respective Member State.6 The European Green Deal - Commission Communication COM(2019) 640 final, 11.12.2019 2connectivity, skills and early school leaving in the context of the European Semester country reports. The Council’s country specific recommendations call on these Member States to use cohesion funds taking into account regional disparities and the situation of the outermost regions. The respective 2020 country reports also highlight outermost regions’ specificities.The Commission analysed the possible impact of trade agreements under negotiation on the outermost regions’ key economic sectors7. As a result, the 2019 political agreement on the trade part of the EU-Mercosur Association agreement contains a safeguard clause to protect outermost regions’ local production. The outermost regions’ specificities are being analysed in the on-going review of State aid legislation and of these regions’ special taxation regimes.The Commission consulted the outermost regions on their needs and provided tailor-made support accordingly. For example, the Commission consulted the outermost regions on their climate change adaptation needs and reflected them in the LIFE8 programme’s 2019 call for proposals. It further organised two events to support these regions in shaping blue growth strategies9. The outermost regions have increased efforts to voice their interests by contributing with some 30 responses to public consultations. Finally, the Commission has reached out to the people of the outermost regions through citizens dialogues: in Martinique and the Canary Islands in 2018, in the Azores and Madeira in 2019.EU cohesion, ***agriculture***, fisheries and maritime policy funds have deployed significant means to support local investment strengthening the partnership with the outermost regions and the respective Member States, in particular the competitiveness of small and medium sized enterprises (SMEs), employment and social inclusion, environment and connectivity10. The support from those funds amounts to over €13 billion for 2014-2020.The Commission has set up two task forces dedicated to supporting Reunion Island on energy transition and the Canary Islands on waste management, bringing together Commission services with national and regional stakeholders.The EU ***statistics*** office (***Eurostat***) developed an internet page on outermost regions’ data11. In 2019, the Commission launched a study to improve ***data*** and knowledge for sustainable management of fisheries and conservation of fish stocks in these regions. France’s statistical office is cooperating with Saint-Martin and Sint-Maarten to ***collect*** local ***data***. Portugal’s statistical office is working with Madeira and the Azores on ***agriculture***, sea and transport ***data***; the Azores are improving blue economy ***data*** and the Canary Islands local production ***data***.The Commission enshrined the outermost regions’ concerns in an unprecedented number of EU initiatives and the regions redoubled efforts to provide input to policy-making. There is scope to explore further the potential of task forces. ***Data*** ***collection*** at outermost regions’ level is needed to support policy-making adapted to these regions.7 Council Decision (EU) 2020/13 on the negotiation directives of Economic Partnership Agreements with the African, Caribbean and Pacific countries and regions states that these agreements “provide for specific measures in favour of products from the outermost regions, aimed at their integration into intra-regional trade”.8 L’Instrument Financier pour l’Environnement.9 Outermost Regions Forum for Maritime Affairs and Fisheries in 2018 and 2019.10 [*https://cohesiondata.ec.europa.eu/2014-2020/2014-2020-RUPs-OR-EU-planned-investment/8gwq-ke5u11*](https://cohesiondata.ec.europa.eu/2014-2020/2014-2020-RUPs-OR-EU-planned-investment/8gwq-ke5u11) Regions and cities’ illustrated:   [*https://ec.europa.eu/****eurostat****/cache/RCI/#?vis=outermost.economy&lang=en32*](https://ec.europa.eu/eurostat/cache/RCI/#?vis=outermost.economy&lang=en32). BUILDING ON THE OUTERMOST REGIONS’ ASSETSThe Communication highlights the outermost regions’ assets – including blue economy, biodiversity, renewable energy sources – and puts forward action to develop opportunities in these sectors with a view to supporting growth.Blue economyThe Commission strengthened the legal and financial framework to enhance blue economy in the outermost regions, while ensuring a sustainable management of marine resources and ecosystems. In 2018, the Commission revised the EU State aid guidelines to allow public support for the acquisition of fishing vessels in the outermost regions under a set of conditions aimed at securing sustainable fisheries.The Commission further proposed specific measures for the outermost regions in the European Maritime and Fisheries Fund 2021-2027, including an earmarked budget for these regions both for structural investments and for compensation of additional costs. The Commission further proposed that each Member State develops an action plan to address fisheries and sustainable blue economy-related challenges in their outermost regions.In 2019, the Commission created an Advisory Council for the Outermost Regions to consult stakeholders from these regions on issues related to fisheries and ensured that the EU-Mercosur Association agreement commits the parties to combating illegal fishing. As regards fleet capacity, in 2019 the Commission presented an evaluation of the “Entry/Exit” scheme under the Common Fisheries policy. In Its Green Deal Communication of December 2019, the Commission stressed the central role of blue economy in tackling climate change and announced its intention to propose ways to manage maritime space more sustainably.The Council adopted conclusions on Oceans and Seas stressing the importance of European Maritime and fisheries policies in supporting the outermost regions’ blue economy, and these regions’ vulnerability to climate change affecting their coasts, ecosystems and biodiversity12.The outermost regions are shaping blue economy strategies aimed at achieving a sustainable use of marine resources and preserving biodiversity - progress is uneven and varies in scope and focus. Some regions are improving maritime spatial planning for a better use of oceans in particular the Azores, Madeira, the Canary Islands and Reunion Island with the support of the European Maritime and Fisheries Fund. Many regions have developed support measures such as financial instruments for small-scale operators (Madeira credit line for small enterprises, French Guiana loans to small operators; Mayotte aid for acquisition of vessels), and skills development (Martinique, the Azores, Madeira).The outermost regions are investing further in emerging sectors, such as the monitoring and exploration of maritime spaces (Azores Atlantic Observatory), or marine renewable energy (Canary Islands PLOCAN platform). All outermost regions fostered the sustainable development of fisheries through the ORFISH project; and some are promoting sustainable blue tourism, for example in the Caribbean Sea.To boost blue growth, the regions need tailor-made, comprehensive blue economy strategies encompassing traditional and innovative sectors. Focusing on innovative activities,12 Council conclusions on Oceans and Seas of 19 November 2019.4improving scientific knowledge on fisheries and marine areas and maximising EU and national support are important in this regard.***Agriculture*** and rural developmentThe Commission’s proposal to reform the Common ***Agricultural*** Policy 2021-2027 provides specific conditions and derogations reflecting the outermost regions’ needs. The proposals envisage that national strategic plans take into account the specific circumstances of the outermost regions; and that these regions benefit from the maximum co-financing rates under the European ***Agricultural*** Fund for Rural Development; and from a set of specific favourable conditions.In addition, the Commission proposed to continue the EU ***agricultural*** scheme POSEI for the outermost regions, thus maintaining direct payments to farmers in these regions. In 2017-2019, the POSEI scheme supported ***agricultural*** production and employment in the outermost regions, guaranteed the supply of selected ***agricultural*** products to these regions, and mitigated the additional costs of transporting such products.With the support of their EU co-financed rural development programmes, the outermost regions helped young farmers to grow and market products such as avocado, bananas, sugar cane, and developed agro-environmental measures and LEADER13 initiatives. These measures put strong emphasis on improving the living conditions of the rural population.Several outermost regions have developed quality schemes for ***agricultural*** products in combination with marketing measures. Others invested in new ***agriculture*** technologies, such as growing plants and vegetables without soil in Saint-Martin, using remotely piloted aircrafts in the Azores, and testing the use of organic resources in French Guiana. The French government is also developing risk management tools for example for banana production.***Agriculture*** remains a key sector: ensuring quality and innovation in local production, a fair income to farmers and optimising support tools are key challenges to overcome.BiodiversityTo support the outermost regions in preserving their unique biodiversity, in 2019 the Commission launched a call for projects tailored to the needs and capacity of these regions (Life4BEST). The Commission proposed that the LIFE programme 2021-2027 supports nature and biodiversity in the outermost regions; and provides special regard to these regions in its award criteria. Biodiversity projects are in addition eligible for funding under the Commission proposal for the European Regional Development Fund 2021-2027.The Commission highlighted outermost regions’ unique biodiversity in its Green Deal, which presents climate change as one of the key drivers of biodiversity loss.France has intensified efforts to support biodiversity in its outermost regions with a dedicated action plan (2018). The French agency for biodiversity is supporting over 80 projects in the outermost regions. Portugal financed projects to support biosphere reserves in the Azores and Madeira. French Guiana, Reunion Island, Guadeloupe and Mayotte are setting up regional biodiversity agencies. Martinique launched a programme to preserve and value biodiversity13 Programme LEADER: Liaison entre actions de développement de l'économie rurale.5(2019) while Reunion Island and the Azores are protecting local habitats and endemic species with support from the European Regional Development Fund14 and the LIFE programme.In addition, the outermost regions increased their cooperation on biodiversity with Overseas Countries and Territories or third countries under Interreg programmes.The outermost regions host an important share of EU biodiversity that constitutes one of their major assets. Sustained and coordinated efforts across policies are required to preserve these regions’ biodiversity while exploring its potential.Circular economyThe Commission specifically targeted the outermost regions in the LIFE work programme 2018-2020. Waste management in these regions features amongst the themes of this work programme. Furthermore, upon request of the Canary Islands and with the support of Spain, the Commission has set up a task force to identify obstacles and shape solutions to improve waste ***collection***, reuse, recycling, and traceability on these islands, bringing together European, national, regional and local administrations. The Commission further proposed that the European Regional Development Fund supports transition to circular economy in 2021-2027.In its conclusions of October 2019 on the circular economy, the Council stressed the need to take into account the specific situation of the outermost regions and to ensure a fair and inclusive transition. In addition, in March 2020 the Commission adopted a new Circular Economy action plan covering the entire lifecycle of products and focusing on high intensity sectors, which highlights the specificities of the outermost regions.In 2019, France declared the intention to progress towards “zero waste” in its overseas territories15. The French regions are developing regional plans for preventing and managing waste; the Azores revised its regional waste strategic plan.Most outermost regions are shaping circular economy action plans encompassing sustainable production and consumption as well as waste management. Several regions developed projects to introduce circular economy models, reduce waste and eliminate plastic waste. In 2018-2019, most French outermost regions launched calls for projects to develop circular economy with the support of the French environment and energy agency. For example, Reunion Island implemented 22 circular economy-related projects ranging from design and life duration of products to recycling; Martinique created repair services and organised awareness campaigns on reducing waste.The outermost regions have much to gain from putting in place circular economy models as an essential condition for sustainable growth. It is important to speed up efforts on waste management, in particular on improving circularity in bio-waste management and treatment and in reducing waste through reuse or repair.Climate changeIn its 2018 evaluation of the EU adaptation strategy, the Commission underlined the need to switch from generating knowledge to using it to shape action in the outermost regions. As announced in the Green Deal Communication, the Commission intends to adopt an ambitious EU strategy on adaptation to climate change. The LIFE 2018-2020 work programme14 The European Regional Development Fund allocated over €54 million to biodiversity in the outermost regions in 2014-2020.15 Trajectoire outre-mer 5.0 6specifically sets out projects on preparedness for extreme weather events in the outermost regions. In this context, LIFE is supporting Guadeloupe and French Guiana in restoring their ecosystems to protect their territories against climate change effects such as sea level rise.The Commission further proposed climate change as one of its investment priorities in the European Regional Development Fund 2021-202716. The Commission further deployed €49 million from the European Union Solidarity Fund to support the reconstruction of Saint-Martin and Guadeloupe which were severely hit by hurricanes Irma and Maria in 2017. This fund was also mobilised to support the Azores which were hit by hurricane Lorenzo in October 201917.In 2019, France appointed a delegate to accelerate preventive and adaptation measures in the French outermost regions. The Azores adopted a regional Climate Change programme in September 2019, while the Canary Islands set up an Observatory on Climate Change in 2018.The outermost regions are particularly vulnerable to severe weather events linked to climate change. There is a need for sustained and coordinated action at all levels, across policies, channelling investments to enhancing adaptive capacity, resilience building, prevention and preparedness to climate change.EnergyThe EU adopted legislation to support renewable energy and energy efficiency. For example, the 2018 Renewable energy Directive18 – to be transposed by mid-2021 - acknowledges the role of local communities in the clean energy transition, a role particularly important in isolated territories such as the outermost regions.In the context of the “Clean energy for EU islands” initiative, the Commission is providing advice to Guadeloupe, the Azores and the Canary Islands on how to develop strategies and projects on clean energy, and has promoted outermost regions’ knowledge on renewable energy in the initiative’s annual forum in the Canary Islands in 2018. In addition, in 2019, the Commission put in place a facility19, supported by Horizon 2020, to mobilise at least €100 million in sustainable energy projects in European islands, including the outermost regions, and committed itself in its Green Deal Communication to developing a long-term policy framework to accelerate EU islands’ transition, as supported by Member States.As from 2021, the Connecting Europe Facility (CEF) is due to provide important opportunities for the outermost regions: a preferential rate for energy (and digital and transport) works and special attention in the award criteria. The Commission further proposed to focus the European Regional Development Fund’s investments in 2021-2027 on energy efficiency measures and renewable energy as one of its priorities for a greener Europe.Upon request from Reunion Island, the Commission has set up a task force on energy transition in 2018 with representatives from national and regional services and the private sector, leading to an action plan to improve coordination between different initiatives.16 The total European Regional Development Fund planned support for climate change in all the outermost regions in 2014-2020 is around €1.1 billion.17 An advance on the expected European Union Solidarity Fund assistance was paid in December 2019.18 Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (OJ L 328, 21.12.2018, p. 82).19   [*https://www.nesoi.eu/7In*](https://www.nesoi.eu/7In) 2019, France launched calls to support areas non-connected to the continent: over one third of the €530 million budget is dedicated to deprived populations. Spain supports training and dissemination of knowledge on renewable energy and energy efficiency in the Canary Islands.The outermost regions launched their own strategies to reduce greenhouse gas emissions and increase renewable energy and energy efficiency. They also developed projects with EU or national funding such as solar or biomass based electricity production (Martinique, Guadeloupe, French Guiana) and smart micro grids (Reunion Island). Many outermost regions invested in electric mobility. Since 2017, the Canary Islands have more than doubled the amount of time during which the El Hierro Island is using 100% renewable energy.Given the outermost regions’ dependence on imported fossil fuels, sustained efforts are needed to accelerate energy transition, in particular investing in smart grids and storage, in renewable energy sources, including marine energy, in clean transport solutions and in energy efficiency thus contributing to energy autonomy in these remote regions as well as to carbon neutrality.3. ENABLING GROWTH AND JOB CREATIONThe Communication puts forward action to unlock growth in the outermost regions including investments in research and innovation, entrepreneurship, skills development, as well as digital and transport connexions.Research and innovationTo boost the outermost regions’ research potential, the Commission launched a dedicated call for a coordination and support action under the EU research programme Horizon 2020. This resulted in the FORWARD project bringing together universities, industry, civil society and governments of all outermost regions to map their research capacities, identify fields of excellence, and support their participation in international research projects.In addition, the Commission proposed that the EU programme “Horizon Europe” 2021-2027 extends its “widening participation and spreading excellence” actions to the outermost regions. Furthermore, in 2021-2027, these regions can benefit from the new instrument for interregional innovation investments within European territorial cooperation to participate in global value chains and increase their linkages with other European regions in common areas of smart specialisation.Most outermost regions are evaluating their smart specialisation strategies20 to adapt their innovation ecosystems to the most promising sectors. The Azores, Madeira and the Canary Islands are shaping the Macaronesia trans-regional specialisation strategy. The outermost regions have developed initiatives to foster local actors’ integration in international research networks and to improve their participation in EU-funded research (e.g Azores’ Plan for the Internationalisation of Science and Technology). France has further endeavoured to boost the innovation capacity of its regions with the French Great Investment Plan 2018-2022.The targeted sectors vary according to the regions. Some regions focused on blue economy, for example with the Horizon 2020 project on climate change impacts from maritime transport, tourism, energy and aquaculture involving Macaronesia and Caribbean regions. Others invested in space, for example the Azores and Portugal with the new international20 Putting in place smart specialisation strategies to support regions and Member States in their economic transition is a pre-condition for benefiting from European Structural and Investment Funds in 2014-2020.8spaceport and the Portuguese space agency on the island of Santa Maria. Other regions have invested on energy transition (Reunion Island’s and Canary Islands’ action to decarbonise energy systems), on healthcare (Madeira, Guadeloupe); and on the development of agro-resources or cosmetic products based on natural substances (French Guiana).Developing the outermost regions’ research and innovation potential is key to boost growth in these regions. Increasing their participation in international research networks and global value chains both within Europe and with third countries can help the outermost regions to strengthen their innovation systems and create employment.Employment, education and trainingEU cohesion and ***agriculture*** policy funds are providing substantial support to social development in the outermost regions21.The Commission’s proposal for the European Social Fund Plus 2021-2027 safeguards the highest co-financing rates for the outermost regions, sets up a specific additional allocation to support employment, education and inclusion in these regions, and earmarks 15% of the national strand to support young people in those outermost regions with a significant rate of young people not in employment, education or training.In 2018, the Commission improved access to microfinance in the French outermost regions by increasing the Employment and Social Innovation Programme’s guarantee to an association supporting small entrepreneurs, ADIE. In addition, the Commission further increased the Youth Employment Initiative’s allocation for France, including its outermost regions, as well as the European Social Fund resources for Spain, including the Canary Islands.In the same year, within Erasmus+, the Commission increased the monthly grant for outermost regions’ residents and the travel grants for Mayotte and Reunion Island citizens22. The Commission also extended Erasmus’ specific conditions for outermost regions’ citizens to the European Solidarity Corps. In its proposal for Erasmus 2021-2027, the Commission committed to increasing the outermost regions’ participation in mobility schemes, including with neighbouring countries, and to monitoring this participation.France has revised its legislation23 with a view to developing apprenticeship contracts with neighbouring third countries. Most outermost regions – Martinique, Reunion Island, the Azores, Madeira, the Canary Islands – have developed action plans to improve entrepreneurship within the GROWRUP Interreg project aimed at the unemployed in the blue and green economy sectors. French Guiana created a professional bachelor degree in aerospace; Reunion Island is investing in its regional university; the Azores launched several initiatives to promote young people’s employment.21 The European Regional Development Fund, the European Social Fund and the European ***Agricultural*** Fund for Rural Development together have allocated over €3 billion to support social inclusion, education, vocational training and employment in the outermost regions in 2014-2020.   [*https://cohesiondata.ec.europa.eu/2014-2020/2014-2020-RUPs-OR-EU-planned-investment/8gwq-ke5u22*](https://cohesiondata.ec.europa.eu/2014-2020/2014-2020-RUPs-OR-EU-planned-investment/8gwq-ke5u22) By creating exceptional travel grants for residents travelling from over 8 000 km away.23 “Loi relative à la liberté de choisir son avenir professionnel”, 5.9.2018 9Improving skills, in particular among young people, is essential to match labour market needs and enhance citizens’ employability. Further investment in international mobility would improve cooperation with neighbouring countries and support regional integration.Competitiveness, entrepreneurship and Single marketThe EU cohesion and ***agriculture*** policy provide substantial support to boost SME competitiveness in the outermost regions24.To improve these regions’ access to funding, the European Investment Advisory Hub analysed the situation of each region and proposed ways to maximise financial support, including from the European Fund for Strategic Investments25. The Commission fostered discussions with national and regional authorities and financial institutions on the solutions proposed and encouraged their implementation. In addition, the Commission proposal for the InvestEU programme encourages Member States to address market failures in the outermost regions, using the programme to attract private investment and increase funding leverage.In 2019, the Commission launched a call for proposals under Erasmus for Young Entrepreneurs, encouraging applicants to include entities from the outermost regions. As a result, a first contact point in Martinique is supporting local entrepreneurs. The Commission’s proposal for the Single Market Programme 2021-2027 further stresses the need to better integrate the outermost regions in the internal market. In addition, the Commission proposed that the European Regional Development Fund continues providing a specific allocation to offset the additional costs faced by enterprises located in these regions. Support from the Enterprise Europe Network is available in the Azores, Madeira, the Canary Islands, Martinique, Guadeloupe and Reunion Island.France supported outermost regions' companies with specific fiscal schemes or funding conditions. The Canary Islands and Martinique drew up internationalisation strategies. Some regions intensified trade relations with neighbour third countries. For example, Guadeloupe supported businesses in exporting to the USA; the Reunion Island created a service to support start-ups in Mozambique and financial instruments for SMEs supported by the European Regional Development Fund. Mayotte and Reunion Island are establishing Technopoles.Greater efforts are needed at all levels to improve entrepreneurship and to boost competitiveness on high potential sectors, such as biodiversity and blue economy.Digital accessibilityIn 2017, the Commission launched the EU network of broadband competence offices to support Member States and regions in designing and implementing strategies to bring broadband to areas not served by commercial deployment. The Commission has encouraged outermost regions’ participation in this network, and has recommended that Member States support their involvement. The Commission also approved two major projects for high-speed broadband networks in Reunion Island (2018) and Martinique (2019), to be supported by the European Regional Development Fund. In its proposal for the Digital Europe programme24 The European Regional Development Fund and the European ***Agricultural*** Fund for Rural Development are co-financing projects to support SME competitiveness in the outermost regions worth €1.5 billion in 2014-2020   [*https://cohesiondata.ec.europa.eu/2014-2020/2014-2020-RUPs-OR-EU-planned-investment/8gwq-ke5u25*](https://cohesiondata.ec.europa.eu/2014-2020/2014-2020-RUPs-OR-EU-planned-investment/8gwq-ke5u25)   [*https://ec.europa.eu/regional\_policy/sources/policy/themes/outermost-regions/pdf/rup\_2019/invest\_platform\_feasibillity\_study\_en.pdf102021-2027*](https://ec.europa.eu/regional_policy/sources/policy/themes/outermost-regions/pdf/rup_2019/invest_platform_feasibillity_study_en.pdf102021-2027), the Commission envisaged specific digital entities in the outermost regions and singled out these regions in the award criteria. In addition, under the Connecting Europe Facility 2021-2027, projects supporting new or upgraded backbone networks, including submarine cables between Member States and between the Union and third countries, will be eligible for support. Furthermore, the indicative list of digital connectivity infrastructure projects of common interest accompanying the Connecting Europe Facility proposal26 as modified by the European Parliament and the Council27 includes a new submarine cable linking Madeira, the Azores and Portugal mainland. Digital connectivity projects in the outermost regions can benefit from a higher co-financing rate.France raised digital skills by investing in education centres, while Madeira and the Canary Islands developed new courses. In 2019 Portugal created a working group to prepare the replacement of the submarine cables between its outermost regions and the mainland. In addition, Madeira and French Guiana planned to connect to the submarine cable linking Portugal with Brazil with EU support of €26.5 million.Increasing outermost regions’ digitalisation on the basis of good connectivity to the EU and third countries is important to enable these regions to take advantage of the digital single market and do business internationally. The broadband competence offices network can help the outermost regions in reinforcing their capacity to implement projects in this sector through exchange of good practices and technical support.TransportThe Commission proposed specific provisions for the outermost regions in the Connecting Europe Facility 2021-2027: transport works such as connections to airports, ports, urban nodes in these regions are eligible for funding and can benefit from a higher co-financing rate.Furthermore, the Commission proposed that, as an exception, the outermost regions can use the European Regional Development Fund 2021-2027 to invest in airport infrastructure. In 2019, the Commission also provided the outermost regions with an analysis of their connectivity needs, identifying potential infrastructure and service-related projects.The Commission intends to propose a review of the Trans European Transport Network guidelines in 2021, and to analyse the outermost regions’ specific concerns in this context. Finally, the European Investment Bank invested respectively €100 million and €60 million in the airports of Reunion Island and Guadeloupe with support from the European Fund for Strategic Investments.The outermost regions continued to improve internal road and maritime transport infrastructure with the support of the European Regional Development Fund. This includes improving the safety of road infrastructure and developing public transport in Madeira, French Guiana and Mayotte; and improving the accessibility of various islands in the Azores. In addition, French Guiana is establishing new maritime transport routes with third countries and Guadeloupe a new flight connection with the United States.Sustained efforts at EU, national and regional levels are required to support connectivity in the outermost regions. Shaping a sound pipeline of projects and optimising available support are important in this regard.26 Part V of the Annex to the Proposal for a Regulation of the European Parliament and of the Council establishing the Connecting Europe - COM(2018) 438 final.27 Trilogue on the Regulation establishing the Connecting Europe Facility on 7 March 2019.114. SCALING UP OUTERMOST REGIONS’ COOPERATION WITH THEIR NEIGHBOURHOOD AND BEYONDThe Commission’s proposal for European Territorial Cooperation 2021-27 seeks to facilitate cooperation between the outermost regions and their neighbours with a ring-fenced budget and flexible rules on cooperation aligned with the external funding instrument. In this context, the outermost regions have exchanged good practices to facilitate joint projects in 2019 and have set up common platforms involving external programmes.The EU launched negotiations with the African Caribbean and Pacific States on the post-Cotonou agreement, with a negotiating mandate that enshrines the need to consider the concerns and situation of the outermost regions. This agreement is important in shaping cooperation on global issues such as ocean governance.In 2019, Guadeloupe became a member of the Organisation of Eastern Caribbean States and Saint-Martin requested to become an observer. French Guiana launched a study on the obstacles faced by local companies, while Martinique and Reunion Island supported internationalisation of local enterprises and Reunion Island and Mayotte supported student mobility to third countries. The outermost regions participated in regional cooperation projects with their neighbours on e.g transport, health, blue tourism, skills. The Macaronesia regions strengthened cooperation with Cape Verde, Mauritania and Senegal through the Hexagone project under their territorial cooperation programme. In 2018 and 2019, the Caribbean Sea countries, together with the outermost regions in the area, engaged in a joint exercise to test the Tsunami Early Warning System.Some outermost regions are facing important socio-economic challenges due to migration. In this context, national programmes supported through several EU Funds include a number of dedicated actions. For example, the EU Asylum, Migration and Integration Fund and the Internal Security Fund supported the handling of requests for asylum in French Guiana, the development of the European Border Surveillance system in the Azores and Madeira, and the integration of migrants in society and in the labour market in the Canary Islands. France created services specialised on migration in Mayotte. In Madeira, the cohesion policy funds supported projects to provide healthcare, education, social security and housing to citizens from Venezuela. Concerning mobility with neighbours, the EU reinvigorated relations with Morocco, as confirmed by the EU-Morocco Association Council of June 2019.Building trust in neighbouring countries and developing common practices for sharing resources are key to exploit the new opportunities for cooperation. Platforms involving both European Regional Development Fund and European Development Fund stakeholders could support this purpose. Mobility partnership agreements could ease regional integration.5. CONCLUSIONSThe implementation of the 2017 Communication “A stronger and renewed strategic partnership with the EU outermost regions” is on the right track. In just over two years, the Communication has triggered concrete positive results for the outermost regions.The Commission has delivered on its commitments by creating specific opportunities for the outermost regions in a wide range of EU programmes, by consistently adapting EU legislation, policies and tools to their needs and interests, and by providing tailor-made support to these regions. It is important that the European Parliament and the Council adopt12EU programmes 2021-2027 that provide tailor-made access and specific conditions for the outermost regions as proposed by the Commission.The outermost regions and the respective Member States have played their part by adopting regional and national strategies and developing concrete initiatives to implement the Communication, and by making their voice heard in policy-making.Taking into account progress made, fully implementing the Communication requires speeding up and focusing efforts, at all levels, on key sectors: addressing climate change, protecting biodiversity, introducing circular economy and shifting towards renewable energy. Investment in these sectors is particularly important to secure sustainable growth in these vulnerable, remote and isolated EU regions. This is why the Commission will pay particular attention to the role of the outermost regions in the Green Deal, taking into account their vulnerabilities and assets. The European Regional Development Fund constitutes an important source of funding to invest in these sectors.In addition, there is a need to pursue efforts to continue developing the blue economy, and improving connectivity in the outermost regions. Investing on skills remains a key factor to support job creation and entrepreneurship across sectors.A robust partnership and close cooperation between the European Union, the outermost regions and the respective Member States remains key to developing the potential of these remote regions and to support their transition towards a green economy that puts people first. While the situation of each outermost region varies considerably, there is still a long way to go to bridge inequalities between these regions and the European continent.Reaching out to the outermost regions contributes to building an inclusive European Union that leaves no one behind. In turn, the outermost regions, with their unique assets, can contribute significantly towards a greener, climate neutral and sustainable European Union.

**Load-Date:** April 3, 2020

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[***What’s the talk in Brussels? Leveraging daily news coverage to measure issue attention in the European Union***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6123-8R91-JBMY-H50V-00000-00&context=1516831)

European Union Politics

June 2020

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**Section:** Pg. 204-232; ISSN: 1465-1165, 1741-2757

**Length:** 8148 words

**Body**

**ABSTRACT**

Research on issue attention in the European Union has focused on the prominence of EU integration in domestic politics and media and, at EU level, on the salience of individual issues and legislative files, often in relation to lobbying. Existing EU-level measures of issue saliency, though, are limited in scope and periodicity and tend to reflect the policy priorities of a single institutional actor rather than that of the broader EU elite sphere. We present an alternative measure of issue attention leveraging the quasi-institutional nature of the Agence Europe daily bulletin which provides comprehensive but independent news coverage of EU affairs. We use text-mining techniques, including dynamic topic modelling, in combination with manual classification to map issue prevalence between 1979 and 2018. In addition to reporting validation results, we illustrate how our measure relates to other indicators of EU agenda formation and explain how researchers can make use of our new dataset.

**FULL TEXT**

**Introduction**

What issues receive political attention, or not, is a crucial aspect of politics. Political attention is a scarce and precious good, for which aspiring agenda influencers must compete along with institutionalized agenda-setters. So, since agenda formation affects, either directly or indirectly, virtually all facets of politics, it is not surprising that political scientists have expended considerable efforts on mapping and explaining how policy agendas change (Baumgartner et al., 2006; Baumgartner and Jones, 1993; Princen and Rhinard, 2006), issues and their frames evolve (Carmines and Stimson, 1989; Diez-Medrano, 2004) and how democratic institutions respond to public demands and concerns (Alexandrova et al., 2016; Sorace, 2018).

European Union (EU) studies are no exception to the quest for reliable and comprehensive indicators of issue attention. Much of the literature on agenda formation in the context of EU affairs has concerned itself with the salience of EU integration in domestic politics and media (Adam and Eschner, 2008; Diez-Medrano, 2004; Koopmans and Pfetsch, 2006; Netjes and Binnema, 2007; Peter and De Vreese, 2004; Rauh, 2014; Veen, 2011; Wonka, 2016). Owing to the absence of ‘a genuinely supranational public sphere on the European level’ (Koopmans, 2007; Risse, 2010: 185), measuring the degree of ‘Europeanization’ of domestic politics has been the principal preoccupation of this strand of research. At EU level, meanwhile, researchers have concentrated on the salience of individual issues and legislative files, often in connection with lobbying efforts (Beyers et al., 2018; De Bruycker and Beyers, 2015; Dür and Mateo, 2014; Klüver, 2011). As with agenda research in other contexts, the development of a general measure of issue attention has had to grapple with the difficulty of measuring salience in a comprehensive manner (Wlezien, 2005), either due to prohibitive cost of measurement techniques (surveys, expert interviews, human coding) or the lack of sufficiently comprehensive ***data*** (Warntjen, 2012). Using European Council and European Commission documents, though, researchers have evolved actor-based indicators of agenda formation. Among these is the European Union Policy Agendas Project (Alexandrova et al., 2014), which represents, to date, the most comprehensive attempt to measure issue attention at EU level. The dataset covers a wide range of policies across four decades and constitutes, without any doubt, a major contribution to the study of agenda-setting in the EU context. Still, it exhibits important limitations. First, it is exclusively based on the items appearing in European Council conclusions. Yet, what matters to the European Council may not matter for other EU actors, and vice-versa. Researchers should therefore be wary of using it as more than a measure of Council agenda priority. Second, European Council conclusions emphasize high politics where national governments wish to set general guidelines and objectives for the bloc. Yet, for many research questions, such as the influence of lobby groups on particular policies or the comparative policy responsiveness of EU institutions on specific issues, researchers need a measure that captures both high and low politics and is independent of EU institutions. More broadly, what they need is a measure that captures issue attention in the Brussels-bound, EU elite sphere that encompasses Commissioners, Members of European Parliament (MEPs), EU civil servants, diplomats, policy experts, EU contractors, consultants, pressure groups and non-governmental organizations (NGOs), as well as national government representatives.

In this paper, we undertake to construct such a measure by leveraging text ***data*** from the Agence Europe bulletin (AEB). AEB, we argue, is a ‘quasi-institutional’ news outlet which caters to EU policy wonks, civil servants and lobbyists. Published daily, it covers all policy areas within the remit of EU competences along with broader foreign policy and business news. The broad scope of AEB ensures that it captures low as well as high politics. Analysing the entire universe of English-language AEB from 1979 to 2018, we apply text-mining techniques, including dynamic topic modelling, to construct a detailed classification of the bulletins’ contents. The resulting dataset provides a measure of the proportion of 75 machine-generated topics organized into 19 manually defined meta-categories.1 We validate our indicator using a random sample of human-coded bulletins. Besides showing how our measure of issue attention relates to other measures of EU agenda formation, we provide illustrations of how particular agenda items track international developments and critical junctures in the European integration process.

**Issue attention in the EU**

Issue attention, agenda formation or issue saliency – we use these terms interchangeably2 – can be measured in a variety of ways. A useful distinction is between generic and actor-centred measures (Beyers et al., 2018). Actor-centred indicators approach issue saliency from the viewpoint of aspiring agenda influencers or institutionalized agenda setters. This is the approach adopted by researchers who have constructed measures of issue prevalence from European Council, Council of the European Union and European Commission files (Alexandrova, 2017; Alexandrova et al., 2016, 2014; Carammia et al., 2016; Häge, 2016; Osnabrügge, 2015), European Parliament speeches (Greene and Cross, 2017) or, at the domestic level, from debates in the legislature (Rauh, 2014; Wonka, 2016) or items in party manifestos (Veen, 2011). This approach has the advantage of being both analytically and empirically tractable, in addition to having relevance for various strands of research on EU politics. Each EU institution produces its own line of policy documents and communications which scholars have been able to dissect and interpret as issue attention (Alexandrova et al., 2014; Greene and Cross, 2017; Häge, 2016; Osnabrügge, 2015). The variance in issue attention among different institutions is itself an object of research (Alexandrova, 2017). The same holds for electoral manifestos and legislative debates (Rauh, 2014; Veen, 2011; Wonka, 2016). In contrast to actor-centred measures, generic measures seek to capture issue attention in the broader mediatized public sphere, assuming that this sphere is imperfectly controlled and transcends the priorities of individual agenda-setters. ‘Europeanization’ studies that aim to assess the attention paid to the EU in domestic media (Adam and Eschner, 2008; Diez-Medrano, 2004; Koopmans and Pfetsch, 2006; Peter and De Vreese, 2004) typically follow this line of inquiry.

A comparison of the domestic and EU-level literatures on issue attention reveals an interesting disparity. Whereas research on issue attention at the domestic level features both generic and actor-centred approaches, the EU-level literature has considered only the latter. The underlying reason for this asymmetry may seem obvious. The EU lacks an autonomous public sphere (Koopmans, 2007; Risse, 2010: 185). Therefore, actor-based indicators may seem to adequately capture the items that define the agenda in Brussels. The EU Policy Agendas Project is predicated on the notion that the European Council is the most powerful agenda-setter in the EU context (Alexandrova et al., 2014). Thus, what the EU pays attention to should somehow find its way into European Council conclusions, or alternatively into Commission documents or European Parliament speeches.

We believe, however, that actor-centred measures of agenda formation miss important aspects of the EU-level policy debate. While the EU lacks an autonomous public sphere, Commissioners, MEPs, EU civil servants, diplomats, policy experts, EU contractors, consultants, pressure groups, NGOs, and national government representatives operating in the Brussels-bound ‘EU bubble’(Busby, 2013) form what we may call an ‘elite sphere’. What participants in this sphere debate and discuss goes beyond what a particular EU institution formally puts on its agenda. EU institutions are typically self-focused when articulating their policy priorities, as research comparing the Commission and the European Council has shown (Alexandrova, 2017). Moreover, what they choose to prioritize partly reflects their position in the policy-making process. European Council conclusions set broad goals and articulate general guidelines, which the Commission, the European Parliament and the Council of the European Union then work to implement (Alexandrova et al., 2012). By contrast, while issues debated in the EU elite sphere should be expected to include the items of high politics placed on the European Council’s agenda in the ongoing policy cycle, they should also encompass many low-politics topics and sub-topics.

We seek a generic, EU-level measure of issue attention to cover all these items while minimizing the institutional biases associated with actor-centred measures. In the following sections, we construct and validate such a measure.

**The Agence Europe bulletin**

We propose to construct a generic indicator of issue attention from the AEB. Founded in 1953, originally published in French and from 1979 onward also in English, the AEB specializes in news relating to EU activities and institutions. The AEB sees itself as the leading source of information on European integration: ‘For 66 years now, Agence Europe has been widely considered THE source (some might say the “Bible”) of information on European economic and political integration.’3

Stressing its prominence in the EU elite sphere, some scholars have described the AEB as a ‘quasi-institution’ (Bastin, 2002; Fougier, 2010; Marthoz, 2008). The bulletin is an elite-sphere publication both *for* and *about* EU decision makers. AEB journalists and correspondents are policy specialists, while EU civil servants, Brussels-bound diplomats and EU policy experts constitute the bulk of AEB’s readership (Fougier, 2010). This specialized policy orientation is reflected in the breadth and dry descriptiveness of the bulletins. Aside from institutional and policy developments – which capture change in policy agendas (Peters, 1994; Princen, 2007, 2011; Princen and Rhinard, 2006) – bulletins also carry industry and economic news, in particular those tied to EU affairs. While the AEB along with its leading journalists are associated with a soft-federalist editorial line and EU officials are often their main source of information (Fougier, 2010), AEB is financially and organizationally independent of EU institutions. In early decades, the AEB sometimes re-printed institutional reports which could skew an individual issue towards the frames favoured by its institutional author. Nonetheless, the vast majority of bulletins consist of news items reporting on EU developments without using emotionally charged language, and this largely descriptive tone is consistent over time. We report a minor sentiment analysis exercise in the Online appendix. Opinion pieces (including editorials) represent a very small fraction of the contents of the bulletins.

While political and media attention are, arguably, co-constitutive (Boydstun, 2013), we believe that the AEB provides a comprehensive and relatively objective measure of issue attention. This presumption rests on the small and specialized nature of the AEB’s readership. First, the AEB reports on issues which are not sufficiently newsworthy for mass media but of interests to EU civil servants and policy experts. The resulting breadth of coverage makes the AEB suitable for serving as a basis for a general survey of topic attention. Second, its small, specialized audience makes the AEB unable to shape public opinion. Obviously, the AEB is not a publication for the masses. The AEB’s journalistic style is descriptive rather than investigative (Fougier, 2010). So, political actors at the EU level are relatively safe to ignore its reporting. Even the increased politicization of EU affairs and the emergence of rival outlets, such as Politico, EURACTIV and EUobserver have made little difference to AEB’s descriptive style of reporting (Fougier, 2010). In consequence, it seems reasonable to assume that AEB’s comprehensive coverage of EU affairs is comparatively less distorted by the pressures of electoral and political cycles and the desire to influence voters than transnational mass outlets – such as the Financial Times, the Guardian and the Economist – or, for that matter, national newspapers and broadcasters.

While the EU’s elite sphere has seen the emergence of other news outlets – most notably EUobserver, EURACTIV and Politico – and their degree of overlap with the AEB is a question that future research might deem worth investigating, these outlets do not offer the temporal coverage of the AEB. The English version of the AEB employed in the construction of our measure of issue attention goes back to 1979. By comparison, the old rivals of the AEB, EURACTIV and EUobserver, were launched in, respectively, 1999 and 2000.

***Data* and methodology**

This section explains how digitized versions of the bulletins were obtained; how these texts were pre-processed to facilitate computer-aided analysis and how we combine probabilistic topic modelling and human classification to construct our indicator.

***Data*: AEB, 1979–2018**

Our issue attention measure is derived from the entire universe of bulletins (N = 9546) published in English during the period 1979–2018. By relying on a single type of publication from a single media source, we strive to minimize unwanted heterogeneity and maximize temporal consistency in the underlying text ***data***. Between 1979 and 2000, the textual ***data*** are available in scanned form courtesy of a digitization project conducted by the European University Institute Library. From 2000 onward, the ***data*** were sourced in digital form from the website of Agence Europe ().

The fact that the ***data*** prior to 2000 come from scans of printed publications, as opposed to HTML websites, could introduce unwanted distortion to our measure, as our topic modelling could pick up on technical differences between the two sets of documents. While we acknowledge that the pre-2000 ***data*** do not have the perfect quality of the electronically published documents, we strived to apply the best available optical character recognition (OCR) and image conversion techniques to minimize ***data*** loss. We point out that 19 bulletins from the early period are missing entirely. Depicting the number of words of each document, Figure 1 suggests that the ***data*** retrieval process has not resulted in a systematically biased corpus.

**Figure 1.**

Number of words per document in the raw corpus.

Whereas document length is relatively consistent around the period corresponding to the transition from the scanned to the HTML format (1999/2000), we can see a gradual decline since 2006. We speculate that this reflects editorial decisions driven by readership preferences as a consequence of the changing competitive landscape in the EU-level news market. That said, document length is on the whole remarkably stable, with outliers few and far between. Sentence and character-level measures produce results very similar to the word-level measure. We report the latter because words constitute the unit of analysis in the topic model. Systematic variation can be observed when comparing summer issues (in particular August) with the rest of the year, which mirrors the lighter workload of EU institutions and the less intense news cycle in this period (see also the Online appendix).

**Pre-processing**

As is customary for text-mining applications, our pre-processing steps involve removing white-spaces, punctuation, numbers and stop-words together with stemming while converting all characters to lower case. The goal of pre-processing is to strike the right balance between reducing the inherent complexity of textual ***data*** and preventing the loss of relevant information (Denny and Spirling, 2018; Grimmer, 2010; Lucas et al., 2015). More specifically, Figure 2 illustrates our pre-processing strategy, which breaks down into three main steps: ***data*** ***collection***, cleaning and reduction. As half of our ***data*** consist of scanned documents, we attempted to minimize unwanted distortions in the ***data*** ***collection*** phase by applying a state-of-the-art OCR technique which improves the likelihood of successful text extraction (Smith, 2007). Using recognized words as training ***data***, the OCR algorithm detects the individual component features from which a character is made.

**Figure 2.**

***Data*** pre-processing steps.

The second stage of pre-processing involves the removal of undesirable document-specific (quasi-)words. A substantial number of bulletins feature sentences or paragraphs written in a language other than English (often French). In order to avoid misclassification problems in the topic model, we tokenize all documents at the sentence level and apply a language detection tool to identify non-English sentences, which we then remove from the corpus. Owing to frequent misspelling, typos and similar errors resulting from either incorrect character recognition or the original texts, we employ a dictionary-based spell-checker after tokenizing the sentences at the word level (Ooms, 2017). Erroneous terms are replaced by most likely suggested words or dropped if no suggestion is available, as is the case for garbage tokens. In the last step, we apply four common pre-processing techniques aiming at reducing the number of features in the final document-term matrix: removal of uninformative words and terms shorter than three or longer than 15 characters, reducing words to their stem (stemming), and dropping words appearing in more than 95% and fewer than 5% of all documents.4 During this stage, we also convert frequent – appearing at least 1000 times in the corpus – two-word collocations (bi-grams) into single expressions (for example, ‘cohesion’ followed by ‘policy’ becomes ‘cohesion\_polici’).

While the present paper emphasizes our own indicator, which, we are confident, should meet the needs of many researchers in search of generic EU-level measure of issue attention, the textual corpus enables the construction of alternative indicators, a different set of techniques (e.g. supervised classification, vector embeddings) and/or choosing distinct units of time (week, month) or level of generality. All the ***data*** we ***collected*** and generated – whether the raw and pre-processed corpus or the final EUSSUE indicator – are available on Euthority.eu for researchers to use.

**Dynamic topic modelling and human classification**

With individual bulletins spanning around 13,000 words on average, coding our corpus manually would require an impossibly large amount of resources. For that reason, we rely on automated content analysis techniques to estimate the latent topical structure of our corpus (Catalinac, 2016; Dybowski and Adämmer, 2018; Grimmer, 2010; Grimmer and Stewart, 2013; Kim, 2018; Quinn et al., 2010; Rothschild et al., 2019). Developments in machine learning and natural language processing have led to the emergence of probabilistic topic modelling as a powerful technique to classify large ***collections*** of documents (Blei et al., 2003; Blei and Lafferty, 2006). Originally developed by (Blei et al., 2003), latent Dirichlet allocation (LDA) remains the most popular topic modelling approach. Yet, increasingly sophisticated or specialized topic modelling algorithms have appeared in recent years ranging from non-negative matrix factorization to hierarchical topic models (Blei, 2012; Greene and Cross, 2017; Grimmer, 2010; Rosen-Zvi et al., 2004). All topic models, though, share the same basic assumptions. While reducing texts to bags of words, they model topics as latent probability distributions over words and documents as latent probability distributions over topics.

Although LDA – the plain vanilla approach to topic modelling – is a powerful algorithm for analysing large corpora, it is not well suited for dynamic corpora, where topics may change over time. Dynamic topic modelling addresses this problem by extending the idea of LDA to allow topic representation to evolve over fixed time intervals (Blei and Lafferty, 2006). The multi-purpose structural topic model developed by Roberts et al. (2014) and implemented in the *stm* package for R allows the estimation of a topic model where each topic is represented not by a single distribution over words but, instead, by a sequence of distributions over the time intervals. Building on the Correlated Topic Model (Blei et al., 2007), the *stm* implementation assumes a logistic normal generalized linear model instead of a latent Dirichlet process for topic proportion (Roberts et al., 2014). Here we choose the year as time interval, as it is a common unit of time to track agenda formation dynamics.

Formally, our time interval enters the document-generating process as a covariate interacting with topic prevalence (1)θ1:D|t1:Dγ,Σ ∼ LogisticNormal(μ=t1:Dγ, Σ)where *td* is the year in which document *d* was published; *γ* is a p×(K−1) matrix of coefficients for topic proportion and Σ is a (K−1)×(K−1) covariance matrix. A topic *z* is drawn from the document-specific distribution, conditional on that topic *k*, a word is chosen from the multinomial distribution over words denoted by βd,k(2)βd,k ∞ exp(m+κk)where *m* represents the baseline word frequencies and *κk* the topic deviation per topic *k*. Conditional on the topic selected and token-level distribution zd,n where n∈[1,…,N−d] for each word in the document, the observed word wd,n is drawn from a multinomial distribution (3)wd,n|zd,n,βd,k=zd,k ∼ Multinomial(βd,k=zd,k)

As implemented in the *stm* package, the posterior distribution for this dynamic topic model is computed via variational expectation maximization (Roberts et al., 2019). The number of topics *k* in a topic model is set by the researcher and determines the dimension of the topic space. A larger *k* provides a more detailed picture of the corpus, while a smaller *k* results in a simpler, more general picture. A variety of metrics, such as harmonic mean, perplexity, log-likelihood, semantic exclusivity and coherence, have been proposed to evaluate the quality of the model and to choose the number of topics (Chang et al., 2009; Mimno et al., 2011; Wallach et al., 2009). However, there is no ‘right’ *k*, and the validity of these formal criteria is not well established; perplexity, for one, has been shown to be inversely correlated with human interpretability (Chang et al., 2009). For our main analysis, we ignore these formal metrics. Instead, we set the number of topics on the basis of two criteria. The first is interpretability. There is little point in using topic modelling if the resulting topics, or at least a large number of them, eschew human interpretation. The second criterion is motivated by the aim of our classification exercise: we want a sufficiently large number of topics to provide a relatively fine-grained picture of agenda variation. After iterating several topic models, we settled on *k* = 88 as providing a sufficiently large number of interpretable topics. We found that a higher *k* produces few additional meaningful topics, whereas a lower *k*, though producing interpretable topics, offers a less detailed picture.

Using unsupervised document classification to construct a measure of issue attention has advantages as well as drawbacks. Topic modelling is an inductive, ***data***-driven approach. Whereas supervised classification and manual coding schemes presuppose that the researcher knows the relevant categorizations (Alexandrova et al., 2014), topic modelling lets the ***data*** speak first. The topics do not come from the researcher’s *a priori* definition but emerge from the ***data***. Thus, a topic model may reveal issues the researcher had not thought of. However, to the extent that one has *a priori* knowledge of the items that a measure of issue salience should include or wishes to relate the results to other, human-coded indicators, the topic model may fail to capture the categories of interest to the researcher. Our approach mitigates this problem by adding a layer of human coding to the topic model. We organize the machine-generated topics into more general themes. For this, we follow the coding scheme of the EU Policy Agendas Project (Alexandrova et al., 2014), from which we only deviate with respect to the European Parliament, the Eurozone and EU Treaties.5 This makes our measure easier to relate to existing EU-level indicators.

**EUSSUE: A generic, EU-level measure of issue attention**

Similarly to Quinn et al. (2010), we aim to construct a classification scheme with items that sustain attention over time. We take this to imply that topics must transcend mere events. Nevertheless, as will be seen below, our classification method identifies considerable temporal variation in topic proportion.

The most important output of our dynamic topic model is the topic proportion per document *θ*. We interpret this value as a measure of issue attention in the *k*-dimensional topic space. For topic *i* at time *t*, a larger *θit* indicates greater topic prevalence. Ignoring the temporal dimension for the moment, Table 1 shows an example of the topic proportions in our model (for all 88 topics, see the Online appendix). The table includes also the words most distinctive of each topic, as determined by the word-level parameter *β*.

**Table 1.**

An example of topic proportions and top words for 88-topic model.

| **Topic number** | **Topic proportion (%)** | **Words (?)** | **Topic label** |
| --- | --- | --- | --- |
| 29 | 2.175 | court justic law reason legisl wast infring water fail judg | european\_court\_of\_justice |
| 39 | 2.157 | treati articl provis power common legal legisl charter compet draft | treaty\_reform |
| 80 | 2.140 | law power histori citizen research social cultur legal describ integr | garbage: political\_principles |
| 77 | 1.878 | summit strategi conclus commit prioriti reform framework integr full invit | summits\_organisation |
| 40 | 1.827 | growth deficit rate forecast fall rise economi inflat budgetari figur | economic\_outlook\_european\_economies |
| 5 | 1.812 | brexit vote sourc draft articl law compromis citizen invest mogherini | brexit |
| 17 | 1.784 | price agricultur produc wine farmer milk sugar farm cereal cap | common\_***agricultural***\_policy |
| 7 | 1.782 | maastricht treati summit round debat uruguay republ danish yugoslavia packag | maastricht treaty |
| 48 | 1.757 | vote amend resolut plenari rapporteur debat socialist abstent reject green | EP\_debates |
| 9 | 1.695 | oil price import unit dollar energi convent neuron jenkin start | oil\_price |
| 68 | 1.689 | price export commod import oil deleg start produc energi get | commodity\_prices\_2 |
| 22 | 1.568 | organ summit treati network debat prepar single\_curr social spanish access | procedural\_summits |
| 36 | 1.564 | budget fund budgetari expenditur spend resourc payment commit amount appropri | EU\_budget |
| 61 | 1.553 | turnov debat summit american nice aim stake usd enlarg british | garbage: summit |
| 1 | 1.547 | price import export rate demand agricultur united\_st dollar american firm | commodity\_prices |
| 12 | 1.526 | bank subsidiari share capit firm invest american acquir british turnov | business\_activity |
| 21 | 1.514 | technolog enlarg dollar deleg head united\_st treati summit lead esprit | garbage: trade\_dollar\_mid\_1980s |
| 24 | 1.458 | convent co-oper enlarg candidate\_countri debat summit reform access organis united\_st | convention\_future of\_europe\_and\_enlargement |
| 27 | 1.447 | resourc special deleg financ reduct athen stuttgart summit agricultur german | community\_budget\_summit |
| 20 | 1.422 | constitut lisbon\_strategi debat research citizen solana financial\_perspect get communic prioriti | constitutional\_treaty |

*Note*: All 88 topics can be found in the Online appendix.

In the next step, we proceeded to label all topics and identify those which are not useful for our measurement objectives. The topics were labelled independently by two of the authors with the third one reconciling discrepancies. We use the average cosine similarity to measure inter-coder reliability for topic labelling yielding 0.761. The correlation of assigning the themes of the Policy Agenda project is 0.878. The labels were assigned on the basis of the topic’s most distinctive words (based on *β* value), most distinctive documents (based on *θ* value) and varying proportion over time. As is common in unsupervised document classification, some topics proved, despite the care we put in selecting the model, impossible to interpret. While ‘garbage’ topics may take up a significant proportion of the topic space (Quinn et al., 2010), in our case, this amounts to a tolerable 13.2% of the total. We discarded these topics, thereby bringing the number of topics down to 75.6

As can be readily seen in the full table of topics (reported in the Online appendix), several topics relate to a similar overarching theme such as ***agriculture*** or the euro. As explained above, we organized the topics into 19 themes following a coding scheme largely inspired by the EU Policy Agendas Project.

This task was completed following the same procedure as topic labelling, with two researchers annotating topics independently and a third one reconciling the discrepancies.7 We call the resulting generic, EU-level measure of issue attention ‘EUSSUE’. Table 2 shows an example of the labelled topics and two themes with the attached (overall) proportions (see table in the Online appendix for a complete overview).

**Table 2.**

An example of EUSSUE topics clustered into themes.

| **Theme labels** | **Theme proportion (%)** | **Topic number** | **Topic labels** | **Topic proportion (%)** |
| --- | --- | --- | --- | --- |
| International affairs and foreign aid | 17.109 | 22 | procedural\_summits | 1.743 |
|  |  | 44 | humanitarian\_crises | 1.576 |
|  |  | 81 | yugoslavian\_and\_gulf\_crisis | 1.387 |
|  |  | 38 | german\_reunification | 1.303 |
|  |  | 25 | israel\_palestine\_conflict | 1.268 |
|  |  | 55 | EU\_foreign\_policy\_banking\_crisis | 1.195 |
|  |  | 10 | russia\_ukraine\_crisis\_incl\_gas | 1.05 |
|  |  | 65 | south\_africa\_apartheid | 1.000 |
|  |  | 16 | turkey\_accession\_to\_EU | 0.975 |
|  |  | 66 | EU mediterranean cooperation incl. MENA | 0.892 |
|  |  | 31 | cooperation\_with\_morrocco\_and\_tunisia | 0.891 |
|  |  | 43 | EU\_latin\_america\_cooperation | 0.865 |
|  |  | 83 | balkans | 0.843 |
|  |  | 33 | Cotonou (ACP) agreement | 0.776 |
|  |  | 79 | syrian\_crisis | 0.723 |
|  |  | 63 | EU\_ASEAN\_cooperation | 0.622 |
| EU governance | 12.328 | 29 | european\_court\_of\_justice | 2.351 |
|  |  | 77 | summits\_organization | 2.053 |
|  |  | 5 | brexit | 1.987 |
|  |  | 36 | EU\_budget | 1.74 |
|  |  | 24 | convention\_future of\_europe\_and\_enlargement | 1.633 |
|  |  | 27 | community\_budget\_summit | 1.622 |
|  |  | 74 | eastern\_member\_states | 0.942 |

*Note*: The full list can be found in the Online appendix.

Figure 3 illustrates how issue attention varies over time using the theme level of analysis. Among other things, the plot suggests a decline in the salience of foreign trade but a surge in the salience of immigration around 2015, while ***agriculture*** exhibits remarkable stability.8

**Figure 3.**

EUSSUE theme-proportion over time.

*Note*: The theme ‘Other’ comprises the seven smallest themes in terms of proportion for the sake of visualization. With the exception of themes ‘European Parliament’, ‘Eurozone’ and ‘EU Treaties’, thematic clustering is aligned with the codebook of the Agendas Project (Alexandrova et al., 2014).

**Validation**

Because our classification scheme is, for the largest part, machine-generated, it requires validation (Grimmer and Stewart, 2013). Both the nature of the documents and the relative complexity of our classification scheme presented a validation challenge. The bulletins are lengthy and varied documents, issued in changing economic and geopolitical contexts. Also, because our unsupervised content analysis method models documents as mixtures of topics, a document is assumed to feature all topics, although in proportion varying from large to infinitesimally small. As a consequence, we had reasons to expect that human coders would, at times, lack the historical knowledge or expertise to situate the events described in the bulletins and relate them to the correct topic in our classification scheme. Still, we opted for a simple, conservative validation procedure. We took a random sample of bulletins and then independently asked untrained coders to determine which of the 75 EUSSUE topics they believed to be instantiated in these documents. Each coder had to first read the document and then tick a box in a form listing the 75 topics. The exercise spanned 20 unique documents, for a total of 49 coder-document observations.

Inter-coder reliability was 56%, which is reasonably high for a validation task of such complexity (Hruschka et al., 2004). It bears emphasis, in particular, that, owing to the high number of topics, the probability that coders would agree simply by chance was very small. Cohen’s *κ*, which this probability into account, averages 0.53 across pairwise coder comparisons.

To evaluate how our computer-based measure of topic proportion compares to human coding, we related the documents’ *θ* values from the topic model to the coders’ determination regarding the presence of the corresponding topics. Whether we regress human coding on *θ* (using logistic regression) or *θ* on the coders’ choice (using OLS regression), we find a positive and strongly significant association, as shown in Table 3.

**Table 3.**

Relationship between EUSSUE *θ* and manual coding of a random sample of Agence Europe bulletins.

|  | **Dependent variable\*\*** |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Coders? choice** | **?** | **Coders? choice** | **?** |
| Constant | 0.259\*\*\* (0.053) | 0.010\*\* (0.005) | 0.221\*\*\* (0.007) | 0.011\*\*\* (0.0005) |
| ? | 1.856\*\*\* |  | 1.856\*\*\* |  |
|  | (0.221) |  | (0.219) |  |
| Coder?s choice |  | 0.012\*\*\* (0.002) |  | 0.011\*\*\* (0.002) |
| FE author | Yes | Yes | No | No |
| FE bulletin | Yes | Yes | No | No |
| Observations | 3825 | 3825 | 3825 | 3825 |
| R2 |  | 0.021 |  | 0.021 |
| Adjusted R2 |  | 0.014 |  | 0.021 |
| McFadden pseudo R2 | 0.038 |  | 0.018 |  |
| Log Likelihood | ?2123.067 |  | ?2165.995 |  |
| Akaike Inf. Crit. | 4308.134 |  | \*\*4335.991 |  |
| Residual std. error |  | 0.033 (df?=?3794) |  | 0.033 (df?=?3823) |
| F ***statistic*** |  | 2.758\*\*\* (df?=?30; 3794) |  | 81.532\*\*\* (df?=?1; 3823) |

*Note*: \*p < 0.1; \*\*p < 0.05; \*\*\*p < 0.01. Robust standard errors are given in parentheses.

Table 4 further reports the degree of agreement between human coders and our 19 theme-level categories. Correlation coefficients are mostly positive and often significant. Moreover, even if we group the ***data*** at the theme level, we observe consistently high correlation across all themes (reported in the Online appendix). These results, we believe, support the validity of our measurement method.

**Table 4.**

Correlation between EUSSUE theme proportions and human coding at bulletin level.

|  | **Pearson** | **Spearman** | **Number of coders** |
| --- | --- | --- | --- |
| BNo\_04921 | 0.849\*\*\* (0.849; 0.849) | 0.738\*\*\* (0.738; 0.738) | 5 |
| BNo\_10929 | 0.837\*\*\* (0.837; 0.837) | 0.586\*\*\* (0.153; 1.019) | 5 |
| BNo\_11656 | 0.641\*\*\* (0.218; 1.064) | 0.338 (?0.13; 0.806) | 5 |
| BNo\_02687 | 0.562\*\* (0.123; 1.001) | 0.441\* (?0.018; 0.900) | 2 |
| BNo\_02720 | 0.501\*\* (0.051; 0.951) | 0.820\*\*\* (0.820; 0.820) | 2 |
| BNo\_03257 | 0.546\*\* (0.101; 0.991) | 0.818\*\*\* (0.818; 0.818) | 2 |
| BNo\_04900 | 0.815\*\*\* (0.815; 0.815) | 0.416\* (?0.046; 0.878) | 2 |
| BNo\_05078 | 0.592\*\*\* (0.155; 1.029) | 0.468\*\* (0.014; 0.922) | 2 |
| BNo\_05151 | 0.577\*\*\* (0.138; 1.016) | 0.625\*\*\* (0.200; 1.050) | 2 |
| BNo\_05231 | 0.641\*\*\* (0.218; 1.064) | 0.320 (?0.148; 0.788) | 2 |
| BNo\_05361 | 0.452\* (?0.005; 0.909) | 0.273 (?0.198; 0.744) | 2 |
| BNo\_05541 | 0.664\*\*\* (0.244; 1.084) | 0.576\*\*\* (0.138; 1.014) | 2 |
| BNo\_06710 | 0.625\*\*\* (0.200; 1.050) | 0.690\*\*\* (0.281; 1.099) | 2 |
| BNo\_07664 | 0.643\*\*\* (0.219; 1.067) | 0.362 (?0.104; 0.828) | 2 |
| BNo\_09499 | 0.371 (?0.094; 0.836) | 0.609\*\*\* (0.175; 1.043) | 2 |
| BNo\_10072 | 0.297 (?0.174; 0.768) | 0.343 (?0.124; 0.810) | 2 |
| BNo\_10185 | 0.282 (?0.189; 0.753) | 0.403 (?0.059; 0.865) | 2 |
| BNo\_10331 | 0.180 (?0.289; 0.649) | 0.125 (?0.338; 0.588) | 2 |
| BNo\_10858 | 0.330 (?0.137; 0.797) | 0.448\* (?0.01; 0.906) | 2 |
| BNo\_11713 | 0.328 (?0.14; 0.796) | 0.187 (?0.283; 0.657) | 2 |

*Note*: \*\*\*p < 0.01; \*\*p < 0.05; \*p < 0.1; 95% confidence intervals are given in parentheses. A random sample of Agence Europe bulletins has been selected for the validation.

**Relation to European Council agenda items**

While manual topic validation demonstrates that our method is effective at extracting agenda items from the AEB documents, comparing EUSSUE with an existing measure of EU agenda formation is useful to understand how a generic indicator differs from actor-centred ones. The European Union Policy Agendas Project offers the only quantitative measure comparable to the EUSSUE measure proposed here (Alexandrova et al., 2014). As highlighted above, EUSSUE and the Agendas Project differ in two important respects. First, one is based on European Council conclusions, which are essentially outcomes of political negotiations, whereas the other is built on journalistic reporting. Second, the two measures also diverge in the way they capture the time dimension. AEB is published on average five times a week, while European Council summits have traditionally had biannual recurrence. In sum, the two indicators are designed to measure different things. So, while a degree of overlap is to be expected – European Council conclusions are normally reported in the AEB – they should also exhibit a fair amount of divergence.

Generally speaking, our measure attributes greater saliency to items relating to EU institutions (notably European Parliament debates), the Eurozone and EU Treaties than the European Council conclusions coded in the Agendas Project. This is the reason why we created specific themes for these items, thereby deviating from the meta-classification employed in the Agendas Project. For the purpose of comparing the EUSSUE with the Agendas Project, we collapse the Eurozone topic under ‘macroeconomics’ and European Parliament and EU Treaties under ‘EU governance’. For each theme, we computed the annual theme proportion for the period 1979–2014 shared by both indicators.9 Figure 4 shows the correlations between the two measures with ***data*** aggregated by theme and year. Because the ***data*** are a mixture of normal and skewed distributions, we report three correlation methods. Coefficients are r¯=0.28;ρ¯=0.24;τ¯=0.17 for, respectively, Pearson, Spearman and Kendall correlation.

**Figure 4.**

Pearson’s, Spearman’s and Kendall’s correlation between paired theme-year observations in the EUSSUE and Agenda Project datasets.

Given the underlying differences in measurement design and approach, it should not come as a surprise that the correlations oscillate, for the most part, between low and medium. It is also understandable that rank correlation is overall lower than linear correlation, since issue attention frequently surges considerably in response to crises with the scale of such a phenomenon co-occurring in both measures captured to a larger extent by a linear function. The greatest difference between linear and rank correlation is found for the theme ‘energy’ (r=0.75;ρ=0.18;τ=0.10). A visual inspection of the ***data*** (see Figure 5) demonstrates that both measures share important similarities, in particular for the period of the 1979 oil crisis and in the mid-2000s. Themes which consist of merely one topic – such as health, civil rights, space and science – in the EUSSUE measure tend to be weakly correlated with the corresponding items in the Agendas Projects. Also, whereas ***agriculture*** seems to enjoy sustained saliency in AEB, it is much less present in European Council conclusions, which may reflect the fact that this policy has been, in large measure, delegated to the European Commission (Alexandrova, 2017). Overall, these results are consistent with our expectation that while partly overlapping, EUSSUE and the Agendas Project represent distinct measures of issue attention.

**Figure 5.**

Comparison of EUSSUE and Agendas Project ***data*** on attention paid to theme ‘energy’ between 1979 and 2014.

**Events and temporal patterns**

Finally, we relate the EUSSUE to a selected set of exogenous events. While not strictly equivalent to a validation exercise, this helps shore up our assumption that AEB provides a generic and relatively neutral measure of issue attention. If this assumption is correct, then we should expect topic and theme proportion to correlate with major events, such as armed conflicts and economic crises, where these topics are central. Simultaneously, this exercise helps illustrate how our indicator can be used in research on EU affairs. As a first illustration, we consider the topic ‘CO2\_emissions’. At the most basic level, we should expect this topic to reflect the rising political and social salience of climate questions since the 1980s and, more recently, the intense diplomatic efforts to bring countries together to cap and reduce greenhouse gases globally. Because the EU has been a key player in this international political effort, we expect the EUSSUE to reflect this. The sizeable literature on the EU’s role in the international climate change regime highlights the 2009 Copenhagen summit as a salient juncture, exposing the failure of European leadership (Bäckstrand and Elgström, 2013; Dimitrov, 2010; Groen and Niemann, 2013; Haug and Berkhout, 2010; Oberthür, 2011).

In Figure 6, we can see that the 2009 Copenhagen summit coincides with one of the peaks of the ‘CO2\_emissions’ EUSSUE topic. The *θ* value for this topic, though, reaches its peak in 2016, which corresponds to the signature of the Paris Agreement. Our measure therefore behaves consistently with basic expectations about climate change issue attention in the EU: we observe decade-on-decade increases while peaks correspond to salient junctures.

**Figure 6.**

EUSSUE topic ‘CO2\_emissions’ and notable UN climate change summits.

The impact of climate change summits on issue attention can also be analyzed at a more granular level using days rather than years as unit of time. Summits usually take place at the tail-end of calendar years and might otherwise go undetected when issue attention is aggregated at the year or semester level. Figure 7 reports the document-level *θ* of the ‘CO2\_emissions’ topic around the time of the 2009 Copenhagen summit.10

**Figure 7.**

Document-level *θ* of EUSSUE topic ‘CO2\_emissions’ around the time of the 2009 Copenhagen climate change conference.

*Note*: The time-series window spans 1 September 2009–1 March 2010.

Figure 7 illustrates how the occurrence of significant events may affect issue coverage outside the strict window when they take place. This makes intuitive sense: in the case of a planned event such as the Copenhagen climate summit, actors prepare and can signal positions in the build-up to the event. The outcome of the event – failure of climate diplomacy and EU leadership – is subsequently discussed in its aftermath. As a result, the period around the Copenhagen summit has a higher θ¯ than the average for 2009, 2010 or overall.

Events and crises whose intensity can be credibly tracked using continuous indicators instead of individual time-moments provide another illustration of how AEB items respond to these events. Assuming again (imperfect) parallelism between issue attention and real-world developments intuitively recognized as economically or politically salient, we first use Greek bond yields as a proxy for the intensity of the Eurozone crisis. Bond yields capture a combination of risk factors which are sensitive to financial and sovereign debt conditions in a country (Arghyrou and Kontonikas, 2012; Manganelli and Wolswijk, 2009). As the situation in Greece was the most critical to the survival of the Eurozone during the European sovereign debt crisis, the country’s bond yields summarize well the evolution of the crisis. Next, we consider the number of asylum applications as a proxy for the ‘European migrant crisis’. While asylum-seekers are only one group of migrants, they were at the centre of the European migrant crisis when Germany opened its borders to Syrian refugees in 2015. Last, the Syria conflict is itself the subject of one of our EUSSUE topics. Here, for the comparison with issue attention in the EU, we take battle-related deaths as a relatively objective measure of the conflict’s intensity. The association between these proxies and topics is depicted in Figure 8.

**Figure 8.**

Temporal patterns of four EUSSUE topics and related external measures. (a) Eurozone crisis, (b) migrant crisis and (c) Syria crisis.

*Note*: Greek bond yields and the number of asylum application are sourced from ***Eurostat*** and battle-related deaths in Syria from the World Bank. On the left, vertical axis is the estimated proportion of a given topic θs^ where s∈[1,75], while the external indicator is measured on the right vertical axis.

The temporal patterns of external measures largely overlap with EUSSUE topics. The trends support the plausible assumption that issue attention varies for the most part in step with crisis intensity. Crises tend to generate and subsequently lose EU-level attention rapidly.

To assess the statistical strength of these relationships, Table 5 presents the results of several linear regressions, taking the EUSSUE topic proportions as the dependent variable and the external indicators as predictors. The table reports effect sizes and 95% confidence intervals with bootstrap standard errors. The normality assumption in the regression analysis is likely to be violated and bootstrapping permits to relax this assumption by producing robust standard errors. The estimates of the external measures are positive and significant at α=5%.

**Table 5.**

Relationship between three EUSSUE topics and thematically connected real-world quantities.

|  | **Estimated topic proportion ( ?s^)** |  |  |
| --- | --- | --- | --- |
|  | **Eurozone crisis** | **Migrant crisis** | **Syria crisis** |
| Constant | 0.003 (?0.008, 0.013) | ?0.030 (?0.058, ?0.001) | 0.015\*\* (0.011, 0.019) |
| Greek long-term bond yields | 0.297\*\*(0.178, 0.417) |  |  |
| Asylum applications |  | 0.135\*\* (0.094, 0.176) |  |
| Battle-related deaths |  |  | 0.137\* (0.042, 0.232) |
| Observations | 18 | 11 | 7 |
| R2 | 0.598 | 0.821 | 0.613 |
| Adjusted R2 | 0.573 | 0.801 | 0.536 |
| Residual Std. error | 0.012 (df?=?16) | 0.026 (df?=?9) | 0.003 (df?=?5) |
| F ***Statistic*** | 23.849\*\*\* (df?=?1; 16) | 41.201\*\*\* (df?=?1; 9) | 7.930\*\* (df?=?1; 5) |

*Note*: \*p < 0.05; \*\*p < 0.01; Number of bootstrap iterations is 10,000.

**Conclusion**

In this paper, we presented a new measure of issue attention at the EU level, EUSSUE. Constructed from Agence Europe's daily bulletins using a combination of human and computerized text-classification methods, EUSSUE provides a generic EU-level measure of issue prevalence across 75 topics organized in 19 policy themes. Our validation exercise shows that it constitutes a reliable measure of the issues discussed in the entire universe of AEB published in English in the period 1979–2018. EUSSUE should be seen as a complement rather than a substitute to existing, actor-based indicators of agenda priority like the Agendas Project.

We believe that our measure of issue attention should be of broad interest to the EU studies research community. How the Brussels bubble reacts to world events and major crises is just one illustration. The generic nature of the EUSSUE dataset opens the possibility for researchers to deploy it – in entirety or in part – in different ways and contexts to investigate items of both low and high politics. Our indicator can be used as a dependent variable to explain variation in issue attention; as an independent variable to explain other phenomena; or as a control variable to remove the effect of varying issue saliency on a causal relationship of interest. Alternatively, researchers may also decide to use the underlying textual corpus or the pre-processed ***data*** in order to, for example, remodel the topic space in a way tailored to specific research objectives or to apply supervised classification techniques.

**Supplemental Material**

**EUP902530 Supplemental Material1 - Supplemental material for What’s the talk in Brussels? Leveraging daily news coverage to measure issue attention in the European Union**

Supplemental material, EUP902530 Supplemental Material1 for What’s the talk in Brussels? Leveraging daily news coverage to measure issue attention in the European Union by Michal Ovádek, Nicolas Lampach and Arthur Dyevre in European Union Politics

**Supplemental Material**

**EUP902530 Supplemental Material2 - Supplemental material for What’s the talk in Brussels? Leveraging daily news coverage to measure issue attention in the European Union**

Supplemental material, EUP902530 Supplemental Material2 for What’s the talk in Brussels? Leveraging daily news coverage to measure issue attention in the European Union by Michal Ovádek, Nicolas Lampach and Arthur Dyevre in European Union Politics

**Notes**

1 The textual corpora (.RData) and time-series ***data*** (.csv and.RData) of the EUSSUE measure are available in the Online appendix; 2 For a conceptual elaboration of these notions, see Beyers et al. (2018) and Netjes and Binnema (2007).; 3 See website ; 4 See the Online appendix for a comparison with an alternative pre-processing strategy. Custom words removed are also listed in the Online appendix.; 5 The deviation rests in the fact that we code these three issues at the theme level rather than as part of the ‘EU Governance’ theme. The issues receive sufficient attention in the AEB to warrant this more granular approach compared to the EU Policy Agendas project. If complete comparability is desired, these additional themes can be collapsed by researchers into the ‘EU Governance’ theme.; 6 This step also involved merging two topics dealing with commodity prices into one after adjudging that they captured the same issue.; 7 Results based on more formal clustering metrics are reported in the Online appendix.; 8 The ***data*** can be explored online at ; 9 We add zeros to the Agendas Project ***data*** for years where no sentence is coded as belonging to a given topic and convert the counts into proportions, taking into account the length of European Council conclusions in each year.; 10 In order to use document-level values, we must remove the effect of the year-covariate present in the EUSSUE measure otherwise. This does not lead, however, to a large discrepancy. For the topic ‘CO2\_emissions’, the average effect is 0.00004. Documents were annotated with their date of publication to construct the time-series.

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STUDYEPRS European Parliamentary Research ServiceAuthor: Ron KorverEx-Post Evaluation UnitPE 642.827 – April 2020 ENFramework for national Roma integration strategies up to 2020European Implementation Assessment

EPRS European Parliamentary Research ServiceFramework for National Roma Integration Strategies up to 2020European Implementation AssessmentThis study provides a review of the EU Framework for national Roma integration strategies (NRIS) up to 2020. It was produced at the request of the European Parliament's Committee for Civil Liberties, Justice and Home Affairs (LIBE) and Committee for Employment and Social Affairs (EMPL) to feed into the discussions regarding the post-2020 framework.The study provides a synthesis of evaluations and opinions of the EU Framework for NRIS, focusing both on the architecture of this instrument and on the national policy measures that have been put in place in the main policy areas under the framework. It furthermore provides an appreciation of the coordination, consultation and monitoring structures under the framework and the way they work in practice. It also looks at the framework's interplay with other EU legal, funding and policy instruments. It then reviews the main policy objectives and the effect the framework has had on anti-discrimination and anti-gypsyism.AUTHOR(S)Ron Korver, Ex-Post Evaluation UnitThis paper has been drawn up by the Ex-Post Evaluation Unit of the Directorate for Impact Assessment and European Added Value, within the Directorate-General for Parliamentary Research Services (EPRS) of the Secretariat of the European Parliament.To contact the authors, please email: [*EPRS-ExPostEvaluation@ep.europa.euLINGUISTIC*](mailto:EPRS-ExPostEvaluation@ep.europa.euLINGUISTIC) VERSIONSOriginal: ENManuscript completed in April 2020.DISCLAIMER AND COPYRIGHTThis document is prepared for, and addressed to, the Members and staff of the European Parliament as background material to assist them in their parliamentary work. The content of the document is the sole responsibility of its author(s) and any opinions expressed herein should not be taken to represent an official position of the Parliament.Reproduction and translation for non-commercial purposes are authorised, provided the source is acknowledged and the European Parliament is given prior notice and sent a copy.Brussels © European Union, 2020.PE 642.827ISBN: 978-92-846-6517-4DOI: 10.2861/96941CAT: [*QA-01-20-232-EN-Neprs@ep.europa.eu*](mailto:QA-01-20-232-EN-Neprs@ep.europa.eu)[*http://www.eprs.ep.parl.union.eu*](http://www.eprs.ep.parl.union.eu) (intranet)   [*http://www.europarl.europa.eu/thinktank*](http://www.europarl.europa.eu/thinktank) (internet)   [*http://epthinktank.eu*](http://epthinktank.eu) (blog)Framework for National Roma Integration Strategies up to 2020IConclusionsThis study provides a synthesis of evaluations and opinions of the EU Framework for national Roma integration strategies (NRIS) up to 2020. It describes the framework as such, as well as the main policy areas that it targets, namely (Roma access to) education, employment, health, housing, as well as anti-discrimination and anti-gypsyism.The EU Framework for NRIS is an evolving instrument. Considered by many an achievement in itself, its establishment was a turning point for Roma communities in Europe. It put the social integration of people with a Romani background high on the European policy agenda and put pressure on Member States to develop relevant national strategies.Nonetheless, the framework is often criticised for its non-binding character. As a soft policy tool, it provides a reference point for policy coordination, consultation and monitoring, and targeted policy recommendations for national Roma integration strategies. It is then up to national, regional and local governments to decide if and how they translate the recommendations into administrative capacities and specific policy actions.National Roma integration strategies (NRIS) are often associated with the creation of documents and structures at EU level, rather than with the development of new policies, the implementation of actions and the monitoring of their results, as these depend on the political priorities of the respective national line ministries rather than on Roma-specific strategies.1Despite diverse public administration models and degrees of decentralisation, the actual implementation of both the NRIS and the national Roma integration policies is often more strongly dependent on the political will and priorities of local government leadership than on those of the national leadership.The NRIS are usually not part of the agendas of the EU Member States' national parliaments, a consequence being that executives are not sufficiently accountable to these parliaments as regards the NRIS and report on them directly to the European Commission.'Explicit but not exclusive targeting' of the Roma is considered essential for inclusion policy initiatives addressed at them2. This implies focusing on the Roma as a target group, but not on the exclusion of other people who share similar socio-economic circumstances with them. This approach does not separate Roma-focused interventions from broader policy initiatives. However, it also engenders the risk that Member States in which a genuine political will is absent and results are not sufficiently monitored would implement actions that have no actual impact on the Roma communities, yet justify the use of funding under the NRIS commitments.Furthermore, Member States with big Roma populations largely rely on EU funding to implement their NRIS, yet do not publicly declare what portion of their national budgets is allocated for NRIS implementation. In this context, it is difficult to monitor the extent of their commitment.A key role at the national level is assigned to the national Roma contact points (NRCPs) that are appointed by the national governments; some are of Romani background, but the majority are not. Their resources, roles and responsibilities vary significantly, as some of them are assigned to interior ministries and others to ministries managing EU funding. Some are well staffed and are given coordinating functions, while others are not. NRCPs rarely have a say as regards the content of Roma1 Roma civil monitor pilot project, A synthesis report on implementation of national Roma integration strategies in Bulgaria, Czech Republic, Hungary, Romania and Slovakia, European Commission, March 2018, p. 7.2 See for example ‘Report on the implementation of the EU Framework for National Roma Integration Strategies 2015’, European Commission, June 2015EPRS European Parliamentary Research ServiceIIintegration policies or measures to promote the implementation of the NRIS. Their role is mostly one of communication and reporting to the Commission, something that further shifts the debate to Brussels rather than to the respective capitals.In the context of the above criticism, the NRIS risk becoming a parallel reality in which national accountability is replaced by a rather loose reporting obligation to the Commission; this could create greater complacency among national politicians when it comes to NRIS implementation.It would be good to foster national debates on the implementation of the NRIS, also because in order to be effective, Roma policy measures often require complex approaches and close coordination.That said, it should be noted that there has been some progress in the policy areas covered by the EU framework for NRIS. For instance, early school-leaving has been reduced by 19 %, participation in early childhood education has increased by 6 % and the experience of hunger has decreased by 11 % from 2011 to 2016. Also, the experience of discrimination has decreased and acceptance of the Roma by the general public has increased. Nonetheless, there is a feeling of disappointment among the Roma in local settlements, who feel there has been little or no improvement in their socio-economic situation over the past decade.In the way it correlates with other policy, legal and funding instruments, the EU framework can be considered an addition. Whereas the country-specific recommendations (CSRs) under the European Semester aim at providing mainstream policy guidance, the Race Equality Directive provides a legal tool with sanctioning possibility and the European structural and investment funds (ESIF) provide funding. The EU framework, on the other hand, provides targeted guidance for Roma integration.To see the detailed conclusions that have been drawn about the different policy areas under the EU framework, please refer to the final paragraphs under the respective sections.Framework for National Roma Integration Strategies up to 2020IIIAcronyms and abbreviationsCSO civil society organisationCSR country-specific recommendationECEC early childhood education and careEIA European implementation assessmentEMPL European Parliament's Committee for Employment and Social AffairsEP European ParliamentEPSCO Employment, Social Policy, Health and Consumer Affairs CouncilESIF European Structural and Investment FundsFRA EU Fundamental Rights AgencyLIBE European Parliament's Committee for Civil Liberties, Justice and Home AffairsMFF multiannual financial frameworkNEET not in employment, education or trainingNRCP national Roma contact pointNRIS national Roma integration strategyEPRS European Parliamentary Research ServiceIVTable of contents1. 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Framework for National Roma Integration Strategies up to 202011. Research, scope and methodologyThis study looks at the EU Framework for National Roma Integration Strategies (NRIS) over the period up to 2020.3 It was produced at the request of the European Parliament's Committee for Civil Liberties. Justice and Home Affairs (LIBE) and Committee for Employment and Social Affairs (EMPL).The EU Framework for NRIS (the EU framework) was adopted in 2011 and its main objectives were to contribute to the reduction of poverty, social exclusion and discrimination of the Roma by promoting their equal access to education, employment, health and housing both in the EU and in enlargement countries.4This study focuses both on the architecture of the EU framework as such and on the policy measures that were put in place to achieve the said objectives. It describes the coordination, consultation and monitoring structures under the EU framework and the way they work in practice. It also looks at the way the EU framework interacts with other EU legal, funding and policy instruments. It then reviews the main policy objectives and the effect the EU framework has had on anti-discrimination and anti-gypsyism.Not all Member States have an NRIS. While, for instance, Malta does not have one at all, other Member States have adopted 'integrated sets of measures within their broader inclusion policies' in the place of an NRIS. The Member States were given this option by the Employment, Social Policy, Health and Consumer Affairs Council (EPSCO) in its 2011 conclusions endorsing the EU framework.The extent to which one can accurately assess the effects of national strategies is limited, given that each of these strategies combines different measures under different sectoral policy areas targeting the Roma. Furthermore, governments do not generally ***collect*** official ***statistics*** on the Roma. A number of Member States oppose the ***collection*** of ethnically disaggregated ***data*** for ethical, political or legal reasons. The lack of such ***data*** makes it difficult to establish a clear baseline situation of the levels of social exclusion or discrimination, the number of Roma benefiting from inclusion measures, the funds allocated for Roma inclusion measures, or the effects of such measures.Another limiting circumstance is that financial ***data*** are often unavailable, unverifiable or incomparable. This is partly due to the lack of ethnically disaggregated ***data***, but also to the fact that Roma inclusion policies are often part of mainstream measures that do not single the Roma out as a specific target group.This study is based on desk research, relying primarily on institutional sources, such as the European Commission (Directorate General for Justice and Consumers (DG JUST) and the Joint Research Centre), the European Court of Auditors (ECA), the EU Agency for Fundamental Rights (FRA) and relevant publications from think tanks, civil society organisations and Roma interest groups.Publications based on primary ***data*** ***collection*** that were also used in this briefing include the Commission's Report on the implementation of national Roma strategies5 and its Mid-term3 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on an EU Framework for National Roma Integration Strategies up to 20204 The Roma consist of various groups that are labelled with different ethnonyms, such as Sinti, Kale, Gypsies, Manouches, Romanichels, Boyash, Ashkali, Egyptians, Yenish, Dom, Lom, Rom, Abdal Arlije, Calé, Gurbet, Kale, Kalderaš, Lovara, Manuš, Sepečides, Ursari or travellers. Some of these ethnonyms are self-designated while others are externally designated. Many groups also use the self-designation Roma. Throughout this paper, the term 'Roma' is used in line with the terminology of European institutions and international organisations, to refer to all these different groups, without denying the unique features and varieties of lifestyles and situations of these groups.5 Report on the implementation of national Roma integration strategies, European Commission, 2019.EPRS European Parliamentary Research Service2evaluation of the EU Framework for National Roma Integration Strategies up to 2020,6 as well aspublications by the FRA, inter alia its Second European Union Minorities and Discrimination Surveyon Roma (EU-MIDIS II)7 and the ECA's Special report on EU policy initiatives and financial support forRoma integration.86 Mid-term evaluation of the EU Framework for national Roma integration strategies up to 2020, European Commission,1 November 2019.7 Second European Union Minorities and Discrimination Survey, Roma, Selected findings, EU Fundamental RightsAgency, 2018.8 Special report no 14/2016: EU policy initiatives and financial support for Roma integration, European Court ofAuditors, June 2016.Framework for National Roma Integration Strategies up to 202032. An EU framework for national Roma integration strategiesSince its establishment, the EU framework has been the subject of many evaluations and criticalanalyses. This section first describes the context in which the framework came into being, its maindesign and policy features and how it evolved over time. It then provides an overview of both theresults and challenges that have been abstracted from different available evaluations and aboutwhich there seems to be consensus.2.1 Background, design and objectivesThe Roma are Europe's largest ethnic minority. Out of an estimated total of 10-12 million in Europe,some 6 million live in the EU, and most of them are citizens of an EU country.9 The estimated shareof the Roma in EU countries in 2012 ranges from 10.3 % in Bulgaria, 9.1 % in Slovakia, 8.3 % inRomania, 7 % in Hungary, 2.5 % in Greece, 2 % in Czechia and 1.6 % in Spain, to less than 1 % in mostof the other countries.A significant part of the Roma in Europe live in very poor socio-economic conditions, whether inrural or urban areas. The discrimination, social exclusion and segregation they face are mutuallyreinforcing. Their limited access to high-quality education and difficulty of integrating into thelabour market translate into low income levels and poor health, which in turn result in highermortality rates and lower life expectancy, compared with non-Roma populations.10In 2016, some 80 % of the Roma lived below their country's poverty threshold; every third Romalived in housing without tap water; every third Roma child lived in a household where someonewent to bed hungry at least once in the previous month; and 50 % of the Roma aged 6-24 did notattend school. Against this background, one can only conclude that the Roma face discriminationand unequal access to public services.11The EU has long stressed the need for better Roma integration. Already in the second half of the1990s, the Commission called for national measures in accession countries with large Romapopulations to further the social integration of the Roma and, later, to transpose and put into effectthe Race Equality Directive.12In 2011, the Commission called for the adoption of national Roma integration strategies (NRIS). Toensure that effective policies are in place in the Member States, the Commission proposed that NRISwere designed, or, where they already existed, were adapted to meet EU Roma integration goals,through targeted actions and adequate funding (national, EU and other) to deliver them. Itproposed solutions to address the existing barriers to a more effective use of EU funds and laid thefoundations of a monitoring mechanism.The EU framework for NRIS encouraged Member States and enlargement countries to adopt acomprehensive approach to Roma integration and socio-economic inclusion, to mainstream Romainclusion, using policy, legal and funding instruments, to adopt NRIS and to set up coordination,consultation, and monitoring mechanisms.9 European Commission website: Who are the Roma?.10 Roma Education in Europe, Practices, policies and politics, Maja Miskovic (editor), 2013.11 Second European Union Minorities and Discrimination Survey Roma – Selected findings, EU Agency for FundamentalRights, 2016.12 Council Directive 2000/43/EC of 29 June 2000 implementing the principle of equal treatment between personsirrespective of racial or ethnic originEPRS European Parliamentary Research Service4The overall objective of the EU framework is to promote the equal treatment of the Roma and their social and economic integration in EU societies. It also establishes specific integration goals for the Roma, linked to their access to education, employment, healthcare and housing, which Member States were invited to endorse. More specifically, Member States were called upon to: ensure that all Roma children complete primary school; close the gaps between the Roma and the non-Roma in respect to employment, health, housing and public utilities (water, electricity).At the EU level, the Commission set up coordination and consultation structures and mechanisms, mobilised funding, and undertook activities to monitor the implementation of the objectives of the EU framework. The Commission enhanced its dialogue with the Member States on Roma integration, in particular by establishing the network of National Contact Points for Roma integration (NRCPs) in October 2012, to discuss solutions to the challenges at hand.In 2013, the EU framework was strengthened by a Council recommendation on effective Roma integration measures.13 This document placed a stronger focus on two horizontal areas: anti-discrimination and poverty reduction. It also introduced, as of 2016, an annual reporting obligation for Member States, contributing to the development of an EU system of monitoring. The December 2016 Council conclusions on accelerating the process of Roma integration confirmed the Member States' commitment.2.2 General considerations concerning the frameworkMost stakeholders consider the very existence of the EU framework for NRIS an achievement.14 There seems to be broad consensus that the framework has helped place Roma inclusion higher on the European and national political agendas and created a political commitment to specific, large-scale, long-term integrated action.The EU framework has triggered the development, implementation and monitoring of national strategies and integration measures. A main weakness however, is its non-binding character, resulting from a treaty-based distribution of competences. The framework is a soft policy tool that relies on political will at all levels of government in Member States for putting national strategies into effect, including the administrative capacities and budgets.The structures that the EU framework put in place represent a system of permanent cooperation that has the potential to lead to better alignment of initiatives, increased knowledge-sharing and concentration of economic resources.Annual monitoring and reporting from the Commission, targeted policy guidance for Member States, ***data*** ***collection*** and, since 2016, a reporting obligation for Member States are all considered crucial for keeping the social integration of Roma on the policy agenda and for improving knowledge and evidence-based policy-making.The EU framework gives Member States the flexibility to adapt its objectives to their specific national contexts. While this has allowed Member States to apply a tailored approach, some suggest that it has also led to fragmented implementation, reduced effectiveness and limited progress towards EU Roma integration goals.13 Council Recommendation of 9 December 2013 on effective Roma integration measures in the Member States14 Revisiting the EU Roma Framework: Assessing the European Dimension for the Post-2020 Future, Open Society Institute, Anna Mirga-Kruszelnicka, March 2017.Framework for National Roma Integration Strategies up to 20205A point of criticism is the use of the term 'Roma' as a common denominator. While the framework highlighted the importance of diversity by using this broad umbrella term, it failed to recognise the diversity within the population of people with a Romani background.Some stakeholders say that the framework should have explicitly mentioned thematic areas, such as Roma political participation, Roma arts and culture, and Roma history, as complementary measures to the four main priority areas of education, employment, housing and healthcare.15As regards the scope of the EU framework and the NRIS, some criticise the fact that the focus is extensively on marginalised Roma and recommend increasing investment in, and empowerment of, Roma youth, women and children, and paying more attention to the intra-EU mobility of the Roma.The initial absence of a response to anti-gypsyism in the EU framework resulted in the Member States' reluctance to include explicit measures targeting anti-discrimination and specifically anti-gypsyism in their national strategies, and has been criticised. Following the adoption of the EU framework, the Commission has taken a series of measures to fight Roma discrimination. It has reinforced its monitoring of how Member States implement the anti-discrimination and anti-racism and xenophobia legislation.The original goals of the EU framework were not SMART, meaning they were neither specific nor time bound and therefore not measurable; furthermore, some were rather unambitious, others were not realistic.In a special report, the ECA identified a number of remaining shortcomings as regards the NRIS.16 For instance, it found that monitoring the progress made by Roma integration projects has been difficult, mainly because of shortcomings in relation to the availability and quality of ***data*** on Roma participants. The lack of comprehensive and robust ***data*** is a problem not only in relation to projects, but also to policy-making at EU and national level. The ECA special report also found that: the national strategies do not indicate what level of funding is needed to carry out the proposed measures for Roma inclusion. Furthermore, they do not indicate what funds have been made available for such measures from the national budget and, through the European Regional Development Fund (ERDF) and the European Social Fund (ESF), from the EU budget; anti‑discrimination and anti‑gypsyism were not given enough attention in the early years of the existence of the framework; the selected Member States have not always taken into account the need to actively involve civil society organisations, in particular those representing the Roma community itself, when drafting their NRIS; the role of the NRCPs set up to coordinate the development and implementation of the NRIS has sometimes been undermined by a mismatch of resources and responsibilities.15 Ibid., Revisiting the EU Roma Framework, Open Society Institute, Anna Mirga-Kruszelnicka, p. 5.16 Special report no 14/2016: EU policy initiatives and financial support for Roma integration, European Court of Auditors, June 2016.EPRS European Parliamentary Research Service62.3 Coordination, consultation and monitoring structuresThis section looks at coordination at EU and national level, and at cooperation and consultation with the stakeholders. It provides an overview of the different structures that are in place, looks at the extent to which they are considered effective, and makes recommendations for improvement.2.3.1 Coordination at EU levelSeveral coordination mechanisms supporting the EU framework have been set up at EU level,17 namely: the Commission's Roma Team in DG JUST's Non-Discrimination and Roma Coordination Unit coordinates the implementation of the EU framework; the Roma Task Force, created in 2010, is made up of different Commission DGs, including JUST, Employment Social Affairs and Inclusion (EMPL), Education, Youth, Sport and Culture (EAC), Health and Food Safety (SANTE), Neighbourhood and Enlargement Negotiations (NEAR), Migration and Home Affairs (HOME), Regional and Urban Policy (REGIO) and ***Agriculture*** and Rural Development (AGRI). The FRA is also part of it; the Network of NRCPs, created in 2012, is a mechanism for coordination both among the Member States' contact points, and among them and the Commission. It meets twice a year; the European Network on Social Inclusion and Roma under the Structural Funds (EU Roma Network) is a 'learning network' focused on the use of European Structural and Investment Funds (ESIF) to facilitate Roma inclusion. It is made up of the NRCPs and ESIF management authorities. the European Platform for Roma Inclusion, which brings together representatives of the national and local governments, the EU, international organisations and civil society on an annual basis. It aims to encourage cooperation and the exchange of successful Roma inclusion practices; the EU Roma summit; the Member States' annual report to the Commission on the implementation of their NRIS; consultation meetings with civil society and international organisations: the Commission regularly organises meetings bringing together civil society, international institutions and organisations (Council of Europe, UN agencies, the OSCE), EU level and umbrella organisations. The local governments network Eurocities is part of it.2.3.2 Coordination at national levelAt the national level, the following structures have been put in place: the national Roma contact points, the main coordinators with regard to the development and implementation of the NRIS; the national Roma platforms established in most Member States (and all enlargement countries), whose aim it is to ensure inclusive involvement of and coordination with all relevant stakeholders (such as civil society, public authorities,17 Communication from the Commission to the European Parliament and the Council on the Midterm review of the EU framework for national Roma integration strategies, European Commission, August 2017.Framework for National Roma Integration Strategies up to 20207and Roma and non-Roma communities). Regrettably, the business sector is hardly present in such platforms.2.3.3 Stakeholder consultationsAt the EU level, consultations are held with stakeholders such as the Council of Europe, the Economic and Social Committee, EU agencies such as the FRA, UN agencies, the Organisation for Security and Cooperation in Europe (OSCE), the EEA and Norway Grants, the World Bank, civil society associations and foundations, representatives of municipalities, thematic umbrella organisations and others.18The EU framework gave an impetus to national-level consultations with stakeholders (Roma community representatives and civil society). New mechanisms include: national Roma platforms; annual national progress reports that are shared with stakeholders; dedicated advisory committees; projects to further strengthen cooperation with Roma NGOs; regular consultation meetings with Roma representatives and other stakeholders (e.g municipalities); expert groups including both government and NGO representatives.2.3.4 ConclusionsThe development of European and national coordination structures that have fostered the creation of platforms for Roma participation and cooperation among stakeholders is an effect attributed to the EU framework for NRIS.The designation of NRCPs to coordinate NRIS development, cross-sectoral implementation and monitoring, and their increasing involvement in planning the use of the ESIF and mainstream policies, are considered positive.The creation of the European Platform for Roma inclusion in 2009 and the national platforms for Roma inclusion in 2015, and the role of equality bodies in the fight against discrimination, are other strong points mentioned in evaluations.Member States have developed national consultation processes, convened and managed by the NRCPs. However, important obstacles persist, such as lack of capacity and sustainable funding, not sufficiently transparent or inclusive involvement of civil society, and limited administrative capacity of local governments to implement sustainable integrated measures.Many of the NRCPs interviewed during the Commission's mid-term evaluation said they have sufficient administrative capacity to effectively coordinate NRIS implementation. Nonetheless, the Commission evaluation report concludes that the NRCPs' mandate and powers are sometimes weak and that they have limited influence on the design and implementation of mainstream policies and, more generally, on policies implemented by other institutions at the national and local level. The report concludes that coordination is not yet well integrated into the national policy cycles of planning, budgeting, implementation, monitoring and evaluation.The Commission report further concludes that the NRCPs have become increasingly involved in matters involving coordination and have been contributing to policy-making and the use of18 Commission Staff Working Document, Evaluation of the EU Framework for National Roma Integration Strategies up to 2020, 4 December 2018.EPRS European Parliamentary Research Service8national and EU funds 19. However, in its more recent implementation report on the NRIS, itconcludes that 'NRISs are not well known, even in some cases by key administrative departments inthe government. NRCPs have limited power to influence decision-making processes across policies,which is a major obstacle before their coordination capacity with regard to the NRIS’20.In its Synthesis report on implementation of national Roma integration strategies, the Roma civilmonitor project concluded that implementation of measures in different policy fields depends onthe political priorities of the respective line ministries rather than on strategic planning andcoordination at the level of the government (across ministries). The content of the Roma integrationpolicies and the tools for reinforcing the implementation of the measures planned in the NRIS areseldom in the hands of the NRCPs, which mostly play a role in communication and reporting to theCommission. The actual position and influence of the NRCPs differ across countries; for instance,some NRCPs are dissociated from the government agency that acts as the main driving force,coordinator or expert body for Roma integration or social inclusion. In some cases, insufficientcoordination seems to stem from a lack of commitment by ministries, from the political context orfrom the lack of participation at local and regional level.The NRCP network is considered a good opportunity for NRCPs to establish contact with colleaguesin other Member States dealing with similar situations and to exchange practices.The Roma Task Force is considered to play an important role in the mainstreaming of Roma inclusioninto different policy fields.There is room for improvement with regard to the coordination between the national Romaplatforms and the European Roma platform.Despite efforts, weaknesses have been identified with regard to the involvement of civil society inthe practical implementation, monitoring and evaluation of the NRIS.2.4 Mobilising EU legal, policy and funding instrumentsSince the launch of the EU framework, legal, policy and financial support instruments have beenmobilised and aligned to promote Roma inclusion. This section looks at the way the different policyoptions are being coordinated.2.4.1 Legal instrumentsMember States' efforts to fulfil their commitments with regard to the EU framework should not bebased solely on the socio-economic inclusion approach; they should also target compliance withhuman rights standards. Mainstream EU legislation prohibits discrimination, hate speech and hatecrime targeting the Roma. The best-known pieces of legislation in this field – Directive 2000/43/EC(the Race Equality Directive),21 and Directive 2008/913/JHA (the Framework Decision oncombating racism and xenophobia)22 – were already in existence at the time when the EUframework was adopted.19 Midterm review of the EU framework for national Roma integration strategies, European Commission, August 2017,p. 1320 Report on the evaluation of the EU Framework for National Roma Integration Strategies up to 2020, EuropeanCommission, December 2018, p.2821 Council Directive 2000/43/EC of 29 June 2000 implementing the principle of equal treatment between personsirrespective of racial or ethnic origin22 Ibid., Revisiting the EU Roma Framework, Open Society Institute, Anna Mirga-Kruszelnicka, p. 12.Framework for National Roma Integration Strategies up to 20209The Race Equality Directive prohibits discrimination on grounds of race and ethnic origin and covers: employment and occupation; vocational training; membership of employer and employee organisations; social protection, including social security and health care; education; access to goods and services which are available to the public, including housing.Under this directive, all Member States must establish a specialised body for the promotion of equal treatment on grounds of race and ethnic origin. The legislation sets out minimum requirements.The purpose of the Framework Decision on combatting racism and xenophobia23 is to ensure that certain serious manifestations of racism and xenophobia are punishable by effective, proportionate and dissuasive criminal penalties throughout the EU. Furthermore, it aims to improve and encourage judicial cooperation in this field. Roma and pro-Roma NGOs are involved in the process of monitoring online hate speech.Since 2016, the Commission has been authorised to launch infringement proceedings against Member States that breach this framework; this is considered a potential tool to combat discrimination against Roma. Nonetheless, civil society organisations are not well aware of this tool and it needs to be promoted among Roma activists, who could bring the necessary evidence to the Commission whenever violations of this section of the EU Roma Framework legislation occur.2.4.2 Policy guidanceThe European Semester provides a framework for the coordination of economic policies across the European Union. It allows EU countries to discuss their economic and budget plans and to monitor progress at specific times throughout the year.Through the European Semester exercise, the Commission steers and monitors Member States' actions aimed at mainstreaming Roma inclusion policies. Since 2012, the five Member States with the largest Roma communities and most acute challenges24 have received country-specific recommendations (CSRs) on Roma inclusion. These have increasingly focused on education, calling for systemic measures to promote Roma children's participation in quality inclusive mainstream education. The CSRs steered the funding priorities in the 2014-2020 programming period.252.4.3 Financial supportThe bulk of EU financial support for social inclusion measures in general, including measures promoting Roma inclusion, is provided through the ERDF and the ESF.The ECA, in its special report on EU policy initiatives and financial support for Roma integration, concluded that the Commission has made significant progress in setting out EU policy initiatives promoting Roma integration, and that most Member States had developed an NRIS by 2012, but that this had come too late to have an impact on the design of ERDF and ESF operational programmes (OPs) and the selection of projects during the 2007‑2013 programme period.23 Council Framework Decision 2008/913/JHA of 28 November 2008 on combating certain forms and expressions of racism and xenophobia by means of criminal law.24 Czechia, Slovakia, Hungary, Romania and Bulgaria.25 Communication from the Commission to the European Parliament and the Council, Midterm review of the EU framework for national Roma integration strategies, August 2017, p. 4.EPRS European Parliamentary Research Service10In relation to the 2014‑2020 period, the ECA noted a number of improvements. For example, Roma integration was explicitly referred to in the ESIF Regulation; furthermore, specific funding priority was introduced in the ESIF in this regard. Moreover, Member States with country‑specific recommendations related to Roma integration became obliged to devote funds its promotion. The ECA considers, however, that additional efforts are required at both Commission and Member State level to make sure that these changes will result in projects that better contribute to Roma integration on the ground.The amount of funding channelled specifically to Roma integration initiatives is not recorded. However, Member States' planning documents suggest that around €1.5 billion has been earmarked for the socio-economic integration of marginalised communities, such as the Roma, during the 2014‑2020 programme period.26Most of the national public funding is allocated for investment in education and housing and infrastructure, whereas the lion share of EU funding is spent on employment measures. Much less funding goes for health or for horizontal and structural measures. According to the ECA, measures to address anti-gypsyism received less attention, a criticism that was strongly supported by Roma civil society and later on taken over in the Council recommendation on effective Roma integration measures in 2013.Furthermore, Roma civil society organisations stress that financial investment seldom reaches its beneficiaries: a significant percentage of expenditure covers salaries and staff and considerable sums are consumed by mediating institutions.272.4.4 ConclusionsIn the way it correlates to other policy, legal and funding instruments, the EU Framework for NRIS can be considered an addition. Whereas the CSRs under the European Semester aim at providing mainstream policy guidance, the EU framework can provide targeted guidance for Roma integration measures.'Explicit but not exclusive targeting' of the Roma is considered an essential principle with regard to policy initiatives on inclusion.28 It implies focusing on the Roma as a target group, without excluding others in similar socio-economic circumstances from the focus of these policy initiatives. This approach does not separate Roma-focused interventions from broader policy initiatives. However, it also bears the risk that Member States in which a genuine political will is absent and where results are not sufficiently monitored, would implement actions that have no impact on the Roma communities, yet justify the use of funding under the NRIS commitments. At the same time, Member States strongly rely on EU funding in the implementation of their NRIS, but do not publicly declare what amounts from their national budgets are available to this end. In this context, it is difficult to monitor national investment.There are calls to target the Roma more explicitly under EU and national programmes, such as the Youth Guarantee and Erasmus+. Many point to possible further improvements in the use of the ESIF and call for NGOs and local governments to be given direct access to funds.At the financial level, EU added value has been created through the establishment of a close link between the European Semester, the ESIF in their 2014-2020 programming period, and the NRIS. In26 Special report no 14/2016: EU policy initiatives and financial support for Roma integration, European Court of Auditors, June 2016.27 Ibid., Revisiting the EU Roma Framework, Open Society Institute, Anna Mirga-Kruszelnicka, p. 17.28 How to mainstream Roma inclusion in general programmes, projects and interventions, ESF Learning Network.Framework for National Roma Integration Strategies up to 202011many countries, much of the funding for Roma integration comes from ESIF/Instrument for Pre-Accession (IPA)) funding, while there seems to be more reluctance to invest domestic money for thispurpose, at least beyond the national co-funding required under the ESIF. However, this is difficultto assess due to the limitations pointed out above. In many cases, the ESIF have helped scale upexisting projects, intensify actions and improve the quality of interventions.29The ESIF remain the most important source of funding for local interventions in Roma integration inthe countries with the largest Roma populations. Effective use of the ESIF requires skills that manylocal governments do not necessarily possess. Moreover, the ESIF are planned in a top-downmanner and often do not meet local needs.The Commission has launched infringement procedures against Hungary, Slovakia and Czechia overthe discrimination against Roma children in education. While these procedures have been generallywelcomed as a positive development, CSOs have reported that nevertheless, unlawful practices ofdiscrimination against Roma children in education continue.The CSRs under the European Semester give Member States general policy guidelines to help themidentify funding priorities with regard to Roma integration in general, but also with regard to Romaeducation, improved living standards and employment. The introduction of ex ante conditionalitieshas been the main innovation. It requires Member States to have a policy framework in place tobecome eligible to use the ESIF for Roma inclusion measures under the dedicated investmentpriority.As regards the planning and implementation of the ESIF, it is suggested that the degree and qualityof stakeholder participation varies across countries, and in many cases the mechanisms andprocesses for such participation are weak or limited to specific phases of the policy cycle.The European Semester is non-binding, but there is a common acceptance of the need to worktowards common, quantified EU targets. This approach may also be appropriate for the post-2020EU Framework for NRIS.29 Evaluation of the EU Framework for National Roma Integration Strategies up to 2020, European Commission StaffWorking Document, December 2018, p. 51.EPRS European Parliamentary Research Service123. Policy areas under the frameworkThis section looks at the five policy areas under the framework, namely education, employment, health, housing and anti-discrimination, and anti-gypsyism. It describes the background and objectives in each policy area, the measures taken, results achieved and priorities to be addressed.3.1 Education3.1.1 BackgroundThe EU Framework for NRIS recognises access to education as a key priority. It recommends that Member States take effective measures to ensure equal treatment and full access to quality and mainstream education for Roma boys and girls, and to ensure that all Roma pupils complete at least compulsory education.The EU framework also called on Member States to improve access to education through the following specific measures: widen Roma children's access to quality early childhood education and care (ECEC); support Roma pupils' primary school completion; prevent discrimination and/or segregation of Roma children; reduce Roma pupils' dropout rates; encourage young Roma to participate in secondary and tertiary education; and improve the intercultural competences of teachers.The subsequent Council recommendation of 9 December 2013 on effective Roma integration measures in the Member States called for: eliminating any school segregation; putting an end to any inappropriate placement of Roma pupils in special needs schools; reducing early school leaving throughout all levels of education, including at secondary level and vocational training; increasing the access to, and quality of, early childhood education and care, including targeted support, as necessary; considering the needs of individual pupils and addressing those accordingly, in close cooperation with their families; using inclusive and tailor-made teaching and learning methods, including learning support for struggling learners and measures to fight illiteracy, and promoting the availability and use of extracurricular activities; encouraging greater parental involvement and improving teacher training, where relevant; encouraging Roma participation in and completion of secondary and tertiary education; widening access to second-chance education and adult learning, and providing support for the transition between educational levels and support for the acquisition of skills that are adapted to the needs of the labour market.Framework for National Roma Integration Strategies up to 2020133.1.2 MeasuresThe following information was ***collected*** by the Commission from the NRCPs, who were asked about measures implemented under their countries' NRIS:30Most Member States invest in measures to reduce early school-leaving.The next most frequently used measures include: considering the needs of individual pupils in cooperation with their families; increasing access to, and quality of, early childhood education and care; encouraging Roma participation in – and completion of – secondary and tertiary education.Efforts are also made to: fight school segregation; use inclusive teaching methods; develop skills adapted to labour market needs.The NRCPs consider the following thematic areas important, ranking them in terms of their relevance as follows:31 fight early school-leaving; consider the needs of individual pupils; encourage Roma participation in – and completion of – secondary and tertiary education; increase access to and quality of early childhood education and care; eliminate school segregation; use inclusive chance education and adult learning; fight illiteracy; prevent and tailor-made teaching and learning methods; support the acquisition of skills adapted to labour market needs; support transition between educational levels; encourage parental involvement; improve teacher training; promote extracurricular activities; widen access to second-inappropriate placement of Roma in special needs schools.3.1.3 ResultsData ***collected*** by the FRA32 show that, while in some Member States Roma children's participation in education has improved over time, the gap in educational achievement between Roma and non-Roma children remains high, especially beyond compulsory education.The ***data*** show that Roma pupils are leaving school early and access universities and other tertiary education establishments and training institutions at very low rates.30 Report on the implementation of National Roma Integration Strategies, European Commission, 2019, p. 7,31 NRCPs' reporting on Roma integration measures implemented in 2017.32 A persisting concern: anti-gypsyism as a barrier to Roma inclusion, EU Agency for Fundamental Rights, 2018.EPRS European Parliamentary Research Service14Between 2011 and 2016, participation in early childhood education increased,33 but still laggedbehind the general population average. While Roma children's participation in compulsoryeducation improved, it remained below the general population average in most countries, asmentioned above. The Europe 2020 early school leavers target is 10 %. The number of Roma pupilswho left education between 2011 and 2016 at the level of secondary school on average decreasedfrom 87 % in 2011 to 68 % in 2016. The proportion of Roma early school leavers compared to earlyschool leavers in the general population across all countries surveyed remained very high.34Inrespect of school segregation, the share of Roma attending classes where 'all classmates are Roma'on average increased from 10 % in 2011 to 15 % in 2016.In 2019, 68 % of Roma children left education early. In addition, only 18 % of Roma children transitedto higher levels of education and the absenteeism and early-school-leaving rates among the Romawere significantly higher than for other categories of pupils.35Roma enrolment rates in compulsory education in most Member States, for which ***data*** are available,have reached similar levels as for the rest of the population.36 With respect to early leavers fromsecondary or vocational training education, the gap between Roma and non-Roma has shrunk from74 % to 57 %, but with an average 68 % drop-out rate among the Roma, much progress is stillneeded.The most widespread achievement mentioned by the NRCPs in the area of education is mediation.Other achievements include: development of kindergarten capacities; improved support to fighting and monitoring early school-leaving; incorporating Roma inclusion and non-discrimination-related topics in teachertraining or national curricula.The most significant challenges highlighted by the NRCPs include: school participation, absenteeism and early school-leaving; the transition from primary to secondary education and the completion of secondaryeducation.Other challenges include: fighting segregation; ensuring and developing human capacities; cooperation among stakeholders; promoting early childhood education; care; adult learning and second-chance education; ***data*** availability.33 In six out of the nine countries surveyed by the FRA. In Romania and Portugal, by contrast, it went down.34 A persisting concern: anti-gypsyism as a barrier to Roma inclusion, EU Agency for Fundamental Rights, 2018, p. 28.35 Report on National Roma Integration Strategies: Key Conclusions, European Commission, September 2019.36 Significant gaps remain in Greece and Romania.Framework for National Roma Integration Strategies up to 2020153.1.4 RecommendationsSome of the important policy lessons37 in this area include: early intervention and prevention are important; the participation and empowerment of Roma parents (as a key element of supporting children in each stage of education) need to be ensured; extracurricular activities play a role in strengthening Roma children's identity and social networks; continuous complex support measures (tutoring combined with scholarship and removal of other cost barriers) need to be applied with a view to promoting the transition between educational levels and to employment; although affirmative action has helped to improve Roma participation in education), it is important to avoid dedicating specific slots for Roma who would have qualified for regular admittance.In its communication to the Parliament and the Council38, the Commission concludes that especially in Member States with a high share of Roma pupils, a systematic, complex and long-term approach is needed to fight school and class segregation, which remains a pressing problem undermining the success of other inclusion measures.Key elements of this approach include: providing early and free access to quality inclusive early-childhood education and care in integrated settings (both to prepare Roma children, to overcome prejudice between Roma and non-Roma children and parents in order to prevent later segregation); supporting Roma parents in choosing a school for their children; gradual closing of segregated schools by the educational authorities; distributing Roma children across several schools (through the reorganisation of school catchment areas).These active desegregation measures should be accompanied by additional financial and professional support to promote the social and academic integration of Roma children in mainstream schools, such as: covering transportation costs; school materials; meals, extracurricular activities; supplementary classes; training pre-school staff and teachers in new teaching methods in integrated school settings (including overcoming stereotypes); facilitating communication between parents and schools; informing parents of the benefits of integrated education; student mentoring; after-school support for Roma children; employment of teacher assistants;37 The recommendations under Section 3 are not the author's, but were abstracted from the different studies and position papers that were consulted.38 Report on the implementation of national Roma integration strategies, European Commission, August 2019, p.3 EPRS European Parliamentary Research Service16 measures to sensitise the general public on the importance of educational inclusion and intercultural education for community relations via campaigns and media channels.Priorities to be addressed require to:39 support home parenting and early-childhood learning as part of comprehensive early intervention and prevention programmes; introduce or further extend quality, inclusive, free and obligatory pre-school education and remove financial and non-financial barriers to access; promote quality, inclusiveness and results in education through incentives (funding and reform of teacher training), attracting the best teachers to disadvantaged schools/regions; systematically monitor and fight school and class segregation with long-term comprehensive, preparatory and accompanying measures supporting Roma families; ensure public support and cooperation of all stakeholders to complement explicit active desegregation measures; combine scholarships, tutoring and extracurricular activities to prevent early-school-leaving and promote the transition to the next stage of education; target Roma girls, their parents and teachers to fight gender stereotypes and reduce early school-leaving; promote transition to – and completion of – upper secondary and further education including by career guidance for Roma students and their families.;3.2 Employment3.2.1 BackgroundThe adoption of the EU Framework for NRIS in 2011 took place in a period when the EU had to develop effective measures to respond to Europe's economic crisis. The employment and social dimensions of this crisis were among the essential elements of the Europe 2020 strategy, adopted in 2010. In line with the headline target of the Europe 2020 strategy to ensure that 75 % of the EU population aged 20-64 will have been employed by 2020, the EU Framework for NRIS set the goal to ensure better access to employment for Roma people and to narrow the employment gap between the Roma and the rest of the population.The framework calls on Member States to: grant access to vocational training, to the job market and to self-employment tools and initiatives in a non-discriminatory way; encourage access to micro-credit; give due attention to qualified Roma civil servants in the public sector; ensure that public employment services reach out the Roma and provide personalised services and mediation.The subsequent 2013 Council recommendation called for the following specific measures: support for first work experience, vocational training, on-the-job training, lifelong learning and skills development; support for self-employment and entrepreneurship;39 Report on the National Roma integration strategies, European Commission, 2019, p. 9.Framework for National Roma Integration Strategies up to 202017 provision of equal access to mainstream public employment services, alongside services to support individual job-seekers, focusing on personalised guidance and individual action planning and, where appropriate, promoting employment opportunities within the civil service; elimination of barriers, including discrimination, to (re)entry into the labour market.3.2.2 MeasuresAt the time of the adoption of the EU framework, some Member States and enlargement countries were implementing a host of initiatives aimed at increasing Roma labour market participation under various initiatives such as the Decade of Roma Inclusion 2005-2015 and social inclusion action plans. To address the Roma, the majority of approaches were focused on promoting Roma employment and Roma entry into the formal labour market, especially in the context of the ESF programmes. However, there is little evidence of measures to tackle anti-gypsyism in the labour market.The following information was ***collected*** by the Commission from the NRCPs, who were asked about measures implemented under the NRIS.40The two largest groups of measures implemented by most Member States aim at: removing barriers to the labour market; Individualised support for job-seekers.Fewer, but still significant number of countries invest in: vocational training, lifelong learning and skill development self-employment and entrepreneurship.The NRCPs highlight the following actions as important, ranking them in the following order of relevance: eliminate labour market barriers, including discrimination; provide personalised guidance to individual job-seekers; support vocational training; support lifelong learning and skills development; support self-employment and entrepreneurship; support first work experience; support on-the-job training; provide equal access to mainstream public employment services; promote employment opportunities within the civil service.3.2.3 ResultsIn 2011, the Roma employment rate was much lower than that for the general population in most EU Member States, especially in respect of women and youth. According to ***data*** published in a 2011 FRA survey,41 the employment gap between the Roma and the general population was 42.6 %. The share of Roma whose self-declared main activity status was 'paid work', including full-time, part-time, ad hoc jobs and self-employment, was 26 %, while the EU-28 average employment rate was 68.6 % (***Eurostat***).40 Report on the implementation of National Roma Integration Strategies, European Commission, 2019, p. 10,41 The situation of Roma in 11 EU Member States, EU Agency for Fundamental Rights, 2012.EPRS European Parliamentary Research Service18With respect to employment, the gap between Roma and non-Roma was significant, including forthe category of youth who are not in employment, education or training (NEET). Roma employmentrates were about 40 % in most Member States, while Roma NEET on average increased from 56 % to63 % between 2011 and 2016.42Data ***collected*** by the FRA43 show no change, between 2011 and2016, in the proportion of Roma who indicated that their main activity was 'paid work'; yet there wasan important gender gap.This difference could partly be attributed to the impact of anti-gypsyism alongside other factorsrelated to persisting social exclusion, such as poor functional literacy, inadequate qualifications orpoor social skills, as well as traditional gender roles still common in Roma communities. The rates ofexperiences involving discrimination due to one's Roma background when looking for work andwhile at work remain, on average, very high. Many Roma across the EU engage in entrepreneurialactivities, but the employment potential of this entrepreneurial activity is not utilised in full.In their reporting on integration measures implemented in 2017, several NRCPs referred to thepositive impact of economic growth on the Roma's prospects for employment.44 Even more NRCPsreferred to targeted measures, such as: regional employment programmes; career-counselling; vocational or on-the-job training; job matching tailored to Roma or vulnerable job-seekers.The above listed measures are considered more effective when the Roma are involved in thecapacity of mediators, social workers, or other service providers.NRCPs point out three main types of challenges: capacity of implementing structures; discrimination against the Roma; attitudes and trust of the Roma for other Roma.3.2.4 RecommendationsAccording to the Commission evaluation, the most critical points in employment appear to be: ensuring an effective transition from education to the open labour market; tackling discrimination by employers; matching labour demand with labour supply (especially among Roma youth not ineducation, employment or training). The growing rates of Roma youth not in education, employment or training wouldrequire even more efforts in supporting a first work experience.Two other areas that should be prioritised are: safeguards and personalised services to ensure that mainstream public employmentservices effectively reach out to disadvantaged Roma job-seekers; positive action to promote Roma employment in the civil service.42 Report on the National Roma integration strategies: key conclusions, European Commission, 2019, p. 3.43 Second European Union Minorities and Discrimination Survey - Roma - Selected findings, EU Agency for FundamentalRights, 2018, p. 22.44 Report on the National Roma integration strategies: key conclusions, European Commission, 2019, p. 10.Framework for National Roma Integration Strategies up to 202019In order to reduce the gender gap in employment and the rate of Roma youth not in education, employment or training, it is considered essential to incentivise and cooperate closely with private employers and to explicitly target Roma youth and women in mainstream policies (rather than creating parallel employment structures). Improving Roma employability should also include development of IT and foreign language skills. To ensure employment, however, other barriers also need to be addressed, in particular: discrimination by employers; limited social network of Roma job-seekers; traditional gender roles in Roma communities.A combination of training, supported internships and anti-discrimination measures targeting employers can play an important role.According to the NRCPs, priority action should be taken to:45 enable mainstream public employment services to effectively support Roma job-seekers' integration in the primary labour market; (continue to) train and employ Roma as youth mentors and mediators to support transitions in education and to the labour market; target Roma (youth and women) more explicitly with active labour market policies, including the Youth Guarantee; sensitise and incentivise employers to employ Roma; systematically monitor and fight discrimination with regard to labour market access and at the workplace; combine job placement support (internship) with IT- and language training and work with employers; prioritise (re)integration in the primary labour market through parallel systems (e.g public or informal work); work on integrated solutions to tackle the vulnerable situation of undocumented mobile Roma, including by transnational cooperation.3.3 Health3.3.1 BackgroundBetter access to healthcare is a right in itself (Article 35 of the EU Charter of Fundamental Rights). Improved health among children in general is linked with better educational outcomes and better socio-economic conditions. Better access to healthcare, including health promotion and disease prevention, and also actions resulting in an improved health status among adults in general, is related to the universal health system and positively influences productivity and economic output. Poor housing conditions may affect one's health status, while poor access to housing may limit one's access to healthcare. The low health status of the Roma is mainly due to the social determinants of health that affect the members of all vulnerable groups. Relevant factors include not only access to healthcare, but also access to education and housing. The EU Framework for NRIS mentions that the life expectancy at birth in the EU is 76 years for men and 82 years for women. For the Roma, it is estimated to be 10 years less. In addition, while the infant mortality rate in the EU is 4.3 per one thousand live births, there is evidence that the rate is much higher among Roma communities. This45 Report on the implementation of national Roma integration strategies: key conclusions, European Commission, 2019, p. 11.EPRS European Parliamentary Research Service20disparity reflects the overall gap in health between Roma and non-Roma. This difference is, inter alia, linked to: the poor living conditions of the Roma; the lack of a targeted information campaign on a healthy lifestyle; limited access to quality healthcare; exposure to higher health risks.In a 2009 FRA survey,46 discrimination by healthcare personnel also emerged as a particular problem for the Roma: 17 % indicated they had experienced discrimination in this area in the previous 12 months. Use of prevention services among the Roma population is low and, according to some studies, over 25 % of Roma children are not fully vaccinated.47The EU Framework for NRIS states that Member States should provide access to quality healthcare especially for Roma children and women, as well as access to preventive care and social services for the Roma as a whole at a similar level and under the same conditions as to the rest of the population.48 Where possible, qualified Roma should be involved in healthcare programmes targeting their communities.The 2013 Council recommendation calls for effective measures to ensure equal treatment of the Roma in their access to universally available healthcare services on the basis of general eligibility criteria. This goal was to be attained, among other things, by: removing barriers to access to the general healthcare system; improving access to medical check-ups, prenatal and postnatal care and family planning, as well as sexual and reproductive healthcare, generally provided by national healthcare services; improving access to free vaccination programmes targeting children and vaccination programmes targeting, in particular, groups most at risk and/or those living in marginalised and/or remote areas; promoting awareness of health and healthcare issues.3.3.2 MeasuresNRCPs reported to the Commission that a number of measures had been implemented in 2017.49 The two most significant measures reported by a majority of NRCPs involved: removing general barriers to healthcare and promoting health awareness; representing a balance between supply and demand-side interventions.Other relevant measures included: targeted vaccination programmes; access to specialised health services.46 European Union Minorities and Discrimination Survey, Main Results Report, EU Agency for Fundamental Rights, 2009.47 An EU Framework for National Roma Integration Strategies up to 2020, Communication from the Commission to the European Parliament and the Council, 2011, p. 7.48 Member States are already required to give the Roma (as any other EU citizens) non-discriminatory access to education, employment, vocational training, healthcare, social protection and housing under Directive 2000/43/EC.49 Report on the implementation of the National Roma Integration Strategies, European Commission, 2019, p. 12.Framework for National Roma Integration Strategies up to 202021NRCPs highlighted a number of actions as important, ranking them according to their relevance as follows: remove barriers to healthcare; promote health awareness; improve access to free vaccination programmes targeting children and groups most at risk; improve access to medical check-ups, prenatal and postnatal care and family planning.According to the Commission, there was a notable lack of reference to efforts to address discrimination, improve the hygiene at home and enhance access to healthy food.503.3.3 ResultsIn its midterm review of the EU Framework for NRIS, the Commission concludes that in general, the self-perceived health status of the Roma has improved,51 which points to some success resulting from other health measures, such as those promoting health awareness, access to vaccination, medical check-ups, pre- and post-natal care and family planning. Improved perceptions of health could also be linked to the declining rate of Roma suffering from hunger on a regular basis in most countries.Nonetheless, differences in the share of Roma covered by national health insurance between 2011 and 2016 are relatively small. At 76 %, this share is significantly lower than among the non-Roma. The share of Roma assessing their health status as 'good' or 'very good' is 68 %. More than a quarter of Roma feel they are restricted in their activities due to poor health and 22 % have a longstanding illness or health problems.There is still concern about low vaccination rates among the Roma, which in some countries are reported to contribute to higher premature mortality and mortality rates. Roma participation and empowerment in healthcare initiatives is considered a challenge, also due to low literacy and language barriers.The Roma population is also disproportionately affected by communicable diseases. Persistently poor living conditions often result in a higher probability of serious illnesses and chronic diseases, even when access to healthcare is provided. Furthermore, little progress has been made with regard to preventive healthcare, as the Roma continue to have consistently lower child vaccination rates compared to the non-Roma.The achievements most often mentioned by the NRCPs are: vaccination campaigns and other prevention and detection programmes; improved hygiene, health conditions and access to healthcare; raised awareness; health mediation; multi-stakeholder cooperation involving national and local governments and civil society.50 Report on the implementation of national Roma integration strategies, European Commission, 2019, p. 7.51 With the biggest increases in Romania, Bulgaria, Hungary, Portugal and Greece.EPRS European Parliamentary Research Service22Challenges reported include: lack of coordination and effective communication between the national and local levels; difficulties in maintaining appropriate (national or EU) funding or staffing; lack of self-consciousness on health matters; lack of health insurance coverage among the Roma; insufficient knowledge of health professionals on Roma issues.3.3.4 RecommendationsThe most broadly used promising practices focus on: prevention via vaccination campaigns; training and employment of Roma health mediators.It is important, however, for targeted support services to actively seek to improve health awareness, change behaviours and foster among the Roma the capacity for long-term self-reliance and an ability to engage with mainstream institutions, as a way to help diminish their dependence on permanent intermediaries and long-term parallel structures. Anti-discrimination measures targeting healthcare professionals should be prioritised.Priorities require actions to:52 increase health insurance coverage, fill gaps in primary and specialised care provision, including reproductive and sexual health in disadvantaged areas; step up efforts to prevent and fight drug addiction, smoking, HIV, hepatitis, tuberculosis, cardio-vascular diseases and premature birth; monitor and fight discrimination in access to health and sensitise health professionals to the needs of the Roma; ensure that targeted Roma health mediators help build long-term self-reliance among the Roma; improve nutrition and fight unhealthy living conditions targeting Roma women and families with children.3.4 Housing3.4.1 BackgroundPoor access to housing and public utilities has a negative impact on education, employment and health outcomes and adversely affects social inclusion overall. In addition, residential segregation, the lack of availability of suitable halting sites for non-sedentary Roma, and forced evictions have been key issues contributing to an unequal housing situation of the Roma.The Racial Equality Directive (2000/43/EC) provides protection and guarantees for equal treatment in access to and supply of goods and services, including housing. Access to secure housing with basic infrastructure is a core aspect of social inclusion. The provision of affordable, adequate and social housing is primarily within the responsibility of national and regional policies.52 Report on the implementation of national Roma integration strategies, European Commission, 2019, p. 13.Framework for National Roma Integration Strategies up to 202023The EU Framework for NRIS called on Member States to close the housing and essential services gap between the Roma and the rest of the population by: promoting non-discriminatory access to housing, including social housing; ensuring that actions addressing housing needs are a part of an integrated approach including, in particular, education, health, social affairs, employment and security, and desegregation measures; addressing the particular needs of non-sedentary Roma (e.g providing access to suitable halting sites for non-sedentary Roma); and actively intervening with targeted programmes involving regional and local authorities.The 2013 Council recommendation called on Member States to take effective measures to ensure equal treatment of the Roma in access to housing by means of measures aimed, among other things, at: eliminating any spatial segregation and promoting desegregation; promoting non-discriminatory access to social housing; providing halting sites for non-sedentary Roma, in proportion to local needs; ensuring access to public utilities (such as water, electricity and gas) and infrastructure for housing in compliance with national legal requirements.3.4.2 MeasuresThe measures most commonly reported by the NRCPs to the Commission as being implemented under the NRIS involve:53 ensuring access to public utilities (water, electricity, gas) and infrastructure for housing; supporting desegregation; promoting non-discriminatory access to social housing.Only a minority of Member States invest in integrated housing interventions targeting marginalised communities in the framework of local urban regeneration projects or use the ESIF for community-led local development or integrated territorial investments.NRCPs highlight the following thematic areas as important, ranking them in terms of their relevance as follows: ensuring access to public utilities and infrastructure for housing; eliminating spatial segregation and promoting desegregation; promoting non-discriminatory access to social housing; ensuring that urban regeneration projects include integrated housing interventions for marginalised communities; promoting community-led local development and/or integrated territorial investments supported by the ESIF; providing halting sites for non-sedentary Roma.53 Report on the implementation of National Roma Integration Strategies, European Commission, 2019, p. 14.EPRS European Parliamentary Research Service243.4.3 ResultsThe Roma often live in areas where most neighbours are Roma too. A third of Roma households do not have tap water, just over half have an indoor flush toilet or shower and 78 % of the Roma live in overcrowded households.54In its Second European Union Minorities and Discrimination Survey Roma (MIDIS II), the FRA concludes that:55 as far as access to electricity is concerned, there is a slight improvement compared with the results of its 2011 Roma survey; the situation is worse with regard to access to clean drinking water through a connection to a water supply system with public access. The share of Roma living in households without tap water inside their dwelling is much higher than for the general population; looking at the various housing quality indicators as a whole, a substantial proportion of Roma live in households without access to needed public utilities and basic housing amenities. This puts them at risk of severe housing deprivation; while many Roma live in households without tap water inside the dwelling across the nine examined EU Member States, an even higher percentage live in households without a toilet and shower or bathroom inside their homes; a considerable number of Roma feel that pollution, grime and other environmental problems – such as smoke, dust and unpleasant smells or polluted water – are a problem.The mid-term evaluation of the EU Framework for NRIS56 concluded that housing disparities continue to be significant, with about 30 % of Roma still living without water within their dwellings and 36 % without toilet, shower, or bathroom. The gap between the Roma and the rest of the population in terms of access to electricity has been insignificant (96 % of Roma have access to electricity). The authors conclude that there has been a lack of major policy initiatives in Member States that could have contributed to shifting the housing conditions of the Roma. The open public consultation that was carried out as part of the above-mentioned mid-term review confirms the lack of progress between 2011 and 2016, with more than half (57.3 %) of respondents indicating that the housing situation had worsened due to higher levels of housing discrimination.Member States' policy measures most often focus on: maintenance, provision and repair of municipal and social housing; infrastructure in Roma settlements; legislative measures, construction permits or legalisation of informal housing.Explicit active desegregation, including the removal of slums, as well as integrated territorial measures or social/infrastructural support for the homeless is much less common as a central focus of investment.54 Report on National Roma Integration Strategies: Key Conclusions, European Commission, 2019, p. 5.55 Second European Union Minorities and Discrimination Survey Roma – Selected findings, European Agency for Fundamental Rights, 2018, p. 33-35.56 Mid-term evaluation of the EU Framework for National Roma Integration Strategies up to 2020, final report, European Commission, 2018, p. 41.Framework for National Roma Integration Strategies up to 202025NRCPs reported that the most significant achievements were in: the provision of access to social housing; the elimination of slums and spatial segregation; the provision of halting sites; the provision of access to public utilities (such as water, electricity and gas); the provision of infrastructure for housing; the legalisation of housing; urban regeneration.Reported challenges include: spatial segregation; barriers before the Roma's access to housing in the private sector; public support for and legislation on access to social housing.There is no evidence of actual or intended policy interventions to overcome residential segregation, and some countries are even witnessing a growth in the number and size of localities with concentrated, socially-excluded populations, often living in appalling conditions that lack basic infrastructure and access to basic public services.573.4.4 RecommendationsAccording to the Commission, housing is the policy with the fewest examples of promising approaches common to several countries. It is also the area where a long-term, integrated and comprehensive approach has been found to be especially critical, including: complementing provision of housing with accompanying support combining elements of employment, education, and health and community development; embedding interventions in broader national policy and legislation on land and social housing.Promoting spatial desegregation requires a targeted, coordinated and participatory process: engaging Roma beneficiaries in the design and implementation of community and individual housing options; combining infrastructural and human investments; and raising awareness to reduce ethnic tensions and overcome resistance from the majority in society.Other areas that need to be prioritised include: developing the social housing stock to ensure improved access for the Roma; preventing forced evictions as part of a multi-stakeholder, broad housing approach; providing sufficient and culturally appropriate halting sites for non-sedentary Roma.Priorities to be addressed include steps to: invest in affordable and appropriate social housing stock in integrated areas, and ensure that eligibility criteria are accessible to the Roma; provide housing assistance targeting the most vulnerable; legalise housing and prevent forced evictions;57 A synthesis report on implementation of national Roma integration strategies, Roma civil monitor pilot project, European Commission, March 2018.EPRS European Parliamentary Research Service26 combine comprehensive long-term desegregation with preparatory and accompanying measures building public support and inter-ethnic community relations, and ensure the participation of communities in design and implementation; ensure access to clean water, basic amenities and essential public services for all, with explicit safeguards for the Roma; fight discrimination in access to (social and private) housing; ensure the provision of sufficient, properly serviced and culturally appropriate halting sites for Travellers.3.5 Anti-discrimination and anti-gypsyism3.5.1 BackgroundThe Racial Equality Directive (Council Directive 2000/43/EC) lays down a framework for combating discrimination on the grounds of racial or ethnic origin throughout the EU in relation to employment and training, education, social protection (including social security and healthcare), social advantages and access to, and supply of, goods and services, including housing.The Council recommendation of 9 December 2013 on effective Roma integration measures in the Member States called on them to continue their efforts to ensure the effective practical enforcement of Directive 2000/43/EC, in particular by: ensuring that their national, regional and local administrative regulations are not discriminatory and do not result in segregation practices. The relevant case-law of the European Court of Human Rights should serve as a point of reference for the human rights compatibility of provisions and practices in this context; Implement, where relevant, desegregation measures concerning the Roma both regionally and locally. Policies and measures to combat segregation should be accompanied by appropriate training and information programmes, including training and information on human rights protection, addressed to local civil servants and representatives of civil society and the Roma themselves; ensure that forced evictions are in full compliance with EU law and other international human rights obligations, such as those under the European Convention on Human Rights.Member States were also called on to implement measures to combat discrimination and prejudice against Roma, sometimes referred to as anti-gypsyism, in all areas of society. Such measures could include: raising awareness about the benefits of Roma integration both in Roma communities and among the general public; raising the general public's awareness of the diverse nature of societies, and sensitising public opinion to the inclusion problems Roma face, including, where relevant, by addressing those aspects in public education curricula and teaching materials; taking effective measures to combat anti-Roma rhetoric and hate speech, and addressing racist, stereotyping or otherwise stigmatising language or other behaviours that could constitute incitement to discrimination against the Roma.Framework for National Roma Integration Strategies up to 2020273.5.2 MeasuresAnti-discrimination measures most reported by Member States include: fighting anti-gypsyism by raising awareness on the benefits of Roma inclusion; awareness raising about diversity; combatting anti-Roma rhetoric and hate speech.Few Member States invest in measures that seek to protect Roma women and children by fighting multiple discrimination, (domestic) violence, or underage and forced marriages. Only four Member States report investing in measures to ensure the effective enforcement of the Racial Equality Directive (2000/43/EC). Even fewer refer to local or regional desegregation measures or to measures aimed at fighting trafficking in human beings. Only one Member State reports measures to prevent unlawful evictions or child begging; and to promote cross-border cooperation.Member States most often invest in: promoting Roma culture and heritage as a way to raise awareness and fight anti-gypsyism indirectly among the general public; awareness-raising to directly fight discrimination and intolerance.Other measures focus on: capacity development of institutions; Roma civil society; human rights monitoring mechanisms.Key areas that received lesser focus were the provision of legal support and the empowerment of Roma women and desegregation. Only a few of the reported antidiscrimination measures targeted explicitly Roma youth or Roma women.The NRCPs reported to the Commission on the implementation of the following measures in 2017: fighting anti-gypsyism by raising awareness about the benefits of Roma integration fighting anti-gypsyism by raising awareness on diversity fighting anti-gypsyism by combatting anti-Roma rhetoric and hate speech fighting violence, including domestic violence, against women and girls fighting (multiple) discrimination faced by children and women involving all relevant stakeholders fighting underage and forced marriages ensuring the effective practical enforcement of Directive 2000/43/EC fighting trafficking in human beings implementing desegregation measures regionally and locally ensuring that eviction are in full compliance with EU law and international human rights obligations fighting begging involving children, through the enforcement of the relevant legislation promoting cooperation among Member States in situations with a cross-border dimension.EPRS European Parliamentary Research Service283.5.3 ResultsThe Roma are still discriminated against across the EU: for instance, 43 % of them experience discrimination when trying to buy or rent housing. Furthermore, they are not sufficiently aware of their rights in terms of equality and need to develop greater trust in the law enforcement bodies.58The available ***data*** on Roma perceptions across the EU59 show that 61 % of EU citizens believe that discrimination against the Roma is widespread in their country.Compared to 2015, 64 % of Europeans (up 10 %) would feel comfortable about having daily contact with a Roma colleague and 49 % (up 9 %) would feel comfortable if one of their children was in a love relationship with a Roma. Over 60 % of EU citizens agree that society could benefit from improved integration of the Roma, which represents an increase by 8 % as compared to 2012. However, only 19 % think their country's efforts to integrate its Roma population are effective and 28 % think these efforts are moderately effective. This percentage is higher among people who identify themselves as Roma (29 %).Available evidence shows that in 2011 the Roma were subject to a significant discrimination across the EU. On average, 46 % of the Roma people surveyed by the FRA in 2011 reported having been subject to discrimination because of their Roma ethnicity in the past 12 months – ranging from around 60 % in Italy, Czechia and Poland, to around 30 % in Romania, Bulgaria and Spain.Eurobarometer surveys from 2012 also provide insights into the prevalence and nature of discrimination faced by the Roma. In 2012, 34 % thought that citizens in their country would feel uncomfortable if their children had Roma schoolmates, (28 % thought citizens would feel fairly comfortable and 31 % thought they would feel comfortable). The level of being uncomfortable with the Roma varied between the countries, with Slovakia and Czechia taking the lead in this respect.The achievements most often mentioned by the NRCPs were: improving the conditions of Roma women and children; combating anti-gypsyism by breaking stereotypes or promoting Roma culture and heritage; and involving all relevant players (public authorities, civil society and Roma communities) in efforts to promote anti-discrimination.Several NRCPs referred to challenges in improving access to legal protection and rights awareness, as well as difficulties in fighting against stereotypes and improving the situation of Roma women and children. The mere fact that several Member States – including some with large Roma communities and several with very high rates of perceived discrimination among Roma – did not report any anti-discrimination measures underlines the gravity of the challenges in this area.Notwithstanding the fact that EU legislation has been fully incorporated into the domestic law of all five countries, discrimination against the Roma remains widespread and goes effectively unchallenged. Low independence, few resources and the limited mandate of the official bodies responsible for combating discrimination, a low level of rights awareness among many marginalised Roma communities, and widespread scepticism concerning enforcement of justice, as well as the lack of ethnically disaggregated ***data***, are among the main causes of this persisting problem.60Despite the existing legal prohibition on the segregation of Roma children in special schools or in ethnically homogeneous settings, as well as rulings from national courts and European Court of58 Report on National Roma Integration Strategies: Key Conclusions, European Commission, 2019.59 Special Eurobarometer 493, 'Discrimination in the European Union', Fieldwork, May 2019.60 A synthesis report on implementation of national Roma integration strategies, Roma civil monitor pilot project, European Commission, March 2018.Framework for National Roma Integration Strategies up to 202029Human Rights judgments, the reports confirm that Roma children are still denied access to quality integrated education. Separate facilities are still being built with public funds and existing opportunities for active desegregation are not used. The infringement procedures against three Member States seem to have had little discernible impact on school segregation so far.3.5.4 RecommendationsExperience with Roma inclusion actions shows that long-term change in any of the policy areas requires tackling anti-gypsyism and discrimination towards Roma, and building trust between Roma and non-Roma communities.To succeed, Roma inclusion actions in all policy areas must be linked to common values and include awareness raising among the general public.The fight against stereotypes, hate speech and hate crime requires building positive narratives on Roma among mainstream society and strengthening Roma identity, via specific targeted measures to fight anti-gypsyism and promote recognition for Roma history (including the Holocaust).The most successful actions do not just align with, but rather transform mainstream structures and policies by fighting prejudices and stereotypes and building a positive image of Roma among policy-makers and other stakeholders.The discrimination the Roma faced across Europe in 2011 was multi-faceted and affected their access to education, employment, housing and health, while also generating more, broader-ranging forms of social exclusion and poverty. The specific manifestations of discrimination in respect to these different policy areas are discussed further down.Priorities to be addressed require actions to: develop ethnically disaggregated (anonymised) ***data*** ***collection*** to monitor anti-gypsyism, discrimination and the impact of public policies on Roma; develop actions to fight, raise awareness about, monitor and sanction anti-gypsyism, hate crime and hate speech (linked to broader anti-racism strategies) with Roma civil involvement targeting society as a whole; ensure the enforcement of equality legislation and tackle discriminatory treatment by law enforcement and other public bodies through thorough investigation, dissuasive sanctions, sensitisation and antidiscrimination training; support Roma access to justice with a focus on victims of multiple discrimination (women, LGBTI, non-citizen Roma), and reinforce the capacity of equality bodies to deal with discrimination against the Roma; set up Roma-led truth and reconciliation processes to explore, document and raise awareness about past abuses against Roma, and promote trust and reconciliation; empower the Roma to participate fully in political, cultural and social life and all stages of the policy process; follow a holistic, gender and child sensitive approach; fight child abuse, early marriages, begging involving children (through the enforcement of legislation protecting children rights), violence, including trafficking in human beings; alleviate the social costs of begging and maintain human dignity.

This study provides a review of the EU Framework for national Roma integration strategies (NRIS) up to 2020. It was produced at the request of the European Parliament's Committee for Civil Liberties, Justice and Home Affairs (LIBE) and Committee for Employment and Social Affairs (EMPL) to feed into the discussions regarding the post-2020 framework.The study provides a synthesis of evaluations and opinions of the EU Framework for NRIS, focusing both on the architecture of this instrument and on the national policy measures that have been put in place in the main policy areas under the framework. It furthermore provides an appreciation of the coordination, consultation and monitoring structures under the framework and the way they work in practice. It also looks at the framework's interplay with other EU legal, funding and policy instruments. It then reviews the main policy objectives and the effect the framework has had on anti-discrimination and anti-gypsyism.This is a publication of the Ex-Post Evaluation UnitEPRS European Parliamentary Research ServiceThis document is prepared for, and addressed to, the Members and staff of the European Parliament as background material to assist them in their parliamentary work. The content of the document is the sole responsibility of its author(s) and any opinions expressed herein should not be taken to represent an official position of the Parliament.ISBN 978-92-846-6517-4doi:10.2861/96941QA-01-20-232-EN-NQA-01-20-232-EN-N

**Load-Date:** April 28, 2020

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[***Flagellin of Bacillus amyloliquefaciens works as a resistance inducer against groundnut bud necrosis virus in chilli (Capsicum annuum L.)***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693N-XPG1-JDK8-021G-00000-00&context=1516831)

Archives Virology

May 2020

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**Section:** Pg. 1585-1597; Vol. 165; No. 7; ISSN: 0304-8608,1432-8798

**Length:** 7464 words

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**Body**

Introduction

Chilli (Capsicum annuum L.) a genus in the family Solanaceae known as red pepper, is an important condiment and vegetable crop in India. Capsicum is native to Central and South America, consisting of thirty species, however only five of these, including Capsicum annuum, have commercial importance. As per the latest ***statistics***, India produces around 800,000 tonnes of dry chilli from an area of 930,000 hectares. The major chilli-producing states of India are Maharashtra, Karnataka Andhra Pradesh, and Tamil Nadu. Chilli is susceptible to infection by at least 10 viruses, which pose a serious threat to commercial cultivation of chilli and reduce its yield []. The viral disease complex of chilli can cause a 100 percent yield reduction during early stage of infection and often has social consequences [, ]. A recent outbreak of necrosis disease in chilli caused by groundnut bud necrosis virus (GBNV) has become as a major impediment to chilli production [–]. GBNV, a member of the genus Tospovirus, causes necrosis disease of vegetables in India and is an important crop pathogen in many countries, causing major economic losses in chilli cultivation and other vegetable crops [, ]. Necrosis disease caused by GBNV results in a variety of symptoms, including circular chlorotic and necrotic spots on leaves and stunting with misshapen leaves.

Transmission of GBNV usually occurs through different species of thrips [, ]. In India, commercial cultivars are susceptible to viral pathogens whose biological diversity can lead to a breakdown of resistance. Microbe-associated molecular pattern (MAMP)-triggered immunity via bacterial endophytes involves a combination of specific enzymes and defense-related genes. Inducible plant defense responses suppress the multiplication of a wide variety of plant viruses, by producing antiviral compounds.

In recent years, plant-growth-promoting rhizobacteria (PGPR) have been exploited to manage fungal and bacterial diseases, but their effect on viral diseases has not been extensively studied. PGPR promote plant growth and induce host defense, and they have been shown to induce an induced systemic resistance (ISR) against tomato leaf curl virus (ToLCV) []. However, the role of MAMP molecules of PGPR in triggered immunity and their interactions with the signalling pathway mediated by the NPR1 are not well understood. MAMP molecules such as iturin, bacilysin, surfactin, bacillomycin, fengycin, mersacidin and mycosubtilin from Bacillus species have been reported to exhibit antiviral activity against tobacco streak virus infecting cotton []. Likewise, MAMP-triggered immunity enables the plants to acquire broad-spectrum antiviral capacity, including against viruses propagated by physical wounding and aphids. Plants treated with MAMP molecules have been shown to develop resistance to several viruses without much of a negative effect on plant growth. Flagellin, a major protein component of flagella in members of the genus Bacillus, is known to be a general elicitor that is recognized by plants and induces MAMP-triggered immunity. It is believed to activate signalling cascades, resulting in coordinated expression of a specific set of genes involved in plant defense. Regardless of the inherent mechanism of disease resistance, after exposure to PGPR, plants initiate expression of genes involved in plant defense mechanisms []. The levels of transcripts for a large complex of structurally diverse gene products called pathogenesis-related (PR) proteins, increase following exposure to PGPR and contribute to an overall defensive condition in plants []. In this study, exogenous application of B. amyloliquefaciens CRN9 to chilli seedlings was demonstrated to elicit a defense response. Triggered immunity was analysed by measuring the levels of transcripts of different systemic acquired resistance (SAR) and ISR genes and expression of defense-related compounds. Using this information, investigations were carried out to document the presence of GBNV in chilli and to increase our knowledge about the role of B. amyloliquefaciens CRN9 in triggering innate immunity involved in the suppression of GBNV in chilli.

Materials and methods

Plant material and virus isolate

Chilli pepper cultivar Syngenta Bullet plants showing susceptibility to the virus were used in this study. The plants were grown on a sterilized mixture of cocopeat, vermiculite, and perlite (3:1:1 ratio vol/vol/vol ratio) in an insect-proof controlled environment at 28 ± 2 °C with a photoperiod of 16 h day/8 h night. The virus isolate ***collected*** from infected plants showing characteristic symptoms of GBNV was used for inoculation and used for subsequent studies.

Inoculum preparation

A standard protocol for mechanical sap inoculation was applied for virus inoculation []. The virus extract was prepared by macerating infected chilli plant tissue in 0.1 M sodium phosphate buffer, pH 7.0, containing 0.1% β-mercaptoethanol, using an ice tray. Inoculation was carried out by gentle rubbing with inoculum, using the broad end of a pestle, on the young leaves of one-month old chilli plants that had been dusted with 600-mesh carborundum powder. Three replications with 15 plants in each replication were performed, and post-inoculation observations were recorded according to Widana Gamage et al. []. Chilli plants showing characteristic symptoms of necrosis disease were tested by direct antigen coating-ELISA (DAC-ELISA) using a polyclonal antibody specific for GBNV as described by Hobbs et al. [].

Amplification of the coat protein gene of GBNV

Total RNA was extracted from 100 mg of leaves of infected chilli using a TRIzol Plant Extraction Kit (Sigma Chemicals, USA) according to the manufacturer’s protocol and resuspended in 50 μl of nuclease-free water. The total RNA isolated from virus-infected field chilli samples were subjected to PCR in a 50-µl reaction volume containing cDNA, 2 units of enzyme mix with primers specific for GBNV (CPF—ATGTCTAACGTYAAGCAGCTC; CPR—TTACAACTCTAGCGAAGGAC), to amplify the complete coding region of the CP gene. The PCR conditions included 35 cycles of denaturation at 94 °C for 2 min, annealing at 52 °C for 30 s, and extension at 72 °C for 1 min, followed by a final extension at 72 °C for 10 min. The PCR reaction was carried out in an Eppendorf Mastercycler Gradient ES. The amplified products were analyzed in a 1% agarose gel, stained with ethidium bromide, and photographed using a UV gel documentation system (AlphaImager).

Isolation and molecular characterization of the bacterial antagonist

Bacterial endophytes were isolated from chilli plants following a protocol described earlier []. In order to characterize the bacterial antagonist, a standard cetyl trimethyl ammonium bromide (CTAB) method was used to extract the genomic DNA from bacterial endophytes, and amplification of 16S rRNA gene was performed using the universal primers 799F (AACMGGATTAGATACCCKG) and 1193R (ACGTCATCCCCACCTTCC) to obtain an product size of approximately 1500 bp []. The PCR reaction was carried out in a total volume of 50 µl in an Eppendorf Master Cycler (Germany). The amplified products were resolved on a 2% agarose gel at 50 V, stained with ethidium bromide (0.5 µg/ml), photographed and analyzed using a gel documentation system (Alpha Innotech Corporation, San Leandro, California). DNA sequencing was performed at M/s Chromous Biotec Pvt. Ltd., Bangalore, India.

Screening and selection of bacterial endophytes against GBNV

To test the antiviral activity of bacterial endophytes, individual bacterial isolates were inoculated into a 250-ml conical flask containing 100 ml of ***nutrient*** broth and incubated at room temperature (28 ± 2 °C) in an orbital shaker at 150 rpm for 48 h. Then, fully grown bacterial culture was mixed with 1% Tween 20 (10 ml), 1% glycerol (10 ml), and 1% polyvinylpyrrolidone (10 g). To ensure uniform mixing, the mixture was incubated in an orbital shaker at 200 rpm for 5 min. The concentration of the suspension was adjusted to a minimum of 2.5 × 1010 colony-forming units (CFU)/ml []. The inoculum of GBNV was multiplied in cowpea (CO7) plants maintained in the glasshouse under insect-proof conditions. A virus extract was prepared by macerating GBNV-infected leaves of cowpea plants in 0.1 M sodium phosphate buffer, pH 7.0, using an ice tray. In order to screen the bacterial endophytes, cowpea plants were treated separately with a 1% bacterial suspension of each isolate as a foliar spray following a standard protocol. After 24 h, the cowpea plants were challenge inoculated with the freshly prepared GBNV inoculum and incubated at 28 ± 2 °C in a glasshouse. The experiment was repeated three times with three plants per replication. A buffer-inoculated control and an uninoculated control were also included. The number of lesions was recorded to assess the antiviral activity of the bacterial endophytes.

Construction of pBIN-flg for transient expression

The binary vector pBIN-GFP was used to clone the gene encoding flagellin, a general elicitor of plant defense. The full-length flagellin gene was amplified from the effective isolate B. amyloliquefaciens CRN9 using the self-designed specific primers F (ATGAGAATCAACCACAATATC) and R (TTAACCTTTAAGCAATTGAAG). The PCR product contained restriction sites for XbaI and BSP to facilitate cloning into the vector pBIN-GFP. The amplified PCR products were separated in 1.2% agarose gels, purified, and cloned into pGEM-T Easy Vector (Promega). Subsequently, the products were excised from the pGEM-T Easy Vector and cloned to the pBIN-GFP vector. The positive clones with recombinant plasmid pBIN-flg containing the flagellin expression cassette were identified by restriction endonuclease digestion with XbaI and BSP. The expression cassette from plasmid pBIN-flg was mobilized into Agrobacterium tumefaciens strain LBA4404 via triparental mating using pRK2013 as a helper strain [, ] for use in agrodrenching for transient expression in chilli plants.

Agrodrenching of chilli plants for the transient expression of flagellin

Agrobacterium tumefaciens LBA4404 containing recombinant vector pBin-flg were cultured overnight to an optical density (OD) of 1 in 20 mL of LB broth containing 10 μg of rifampicin and 50 μg of kanamycin per mL. The overnight cultures were inoculated into 100 ml of fresh LB broth containing 10 μg of rifampicin and 50 μg of kanamycin per mL for 24 h. The culture was centrifuged at 4,000 rpm for 10 min to pellet the Agrobacterium cells, which were then resuspended in 100 ml of Murashige and Skoog (MS) basal medium without hormones. The suspension was mixed with 10 mM 2-(N-morpholino)-ethanesulfonic acid (MES) and 100 μM acetosyringone, adjusted to an OD of 1 and kept at room temperature for at least 3 h. This cell suspension was used to inoculate the roots of chilli plants for transient expression of the flagellin gene. For agrodrenching, one-month-old chilli seedlings were grown in a sterilized mixture of coir pith, vermiculite and perlite (3:1:1) and maintained in glasshouse under insect-proof conditions. The collar region of each chilli plant was drenched with 5 ml of Agrobacterium strain containing pBIN-flg following the protocol described by Ryu et al. []. The transcripts of the flagellin gene in the freshly grown leaves were detected at different time points 0 to 9 days after inoculation, using the gene-specific primers.

Bacillus, BTH treatment and virus inoculation

Our isolate of B. amyloliquefaciens CRN9 showing antiviral activity was inoculated into a 250-ml conical flask containing 100 ml of ***nutrient*** broth and incubated at room temperature (28 ± 2 °C) for 48 h in an orbital shaker at 150 rpm to a final OD of 1. The bacterial suspension was then mixed with 1% Tween 20 (10 ml), 1% polyvinylpyrrolidone (10 g), and 1% glycerol (10 ml) and incubated in an orbital shaker at 200 rpm for 10 min to obtain a homogenous mixture. Afterward, the mixture was adjusted to a concentration of 2.5 × 1010 CFU ml−1. The prepared suspension was applied as foliar spray onto chilli seedlings until runoff with a maximum of 15 ml of suspension per seedling []. For hormonal treatment, chilli seedings were sprayed with 300 mM BTH in distilled water. Control plants were treated with sterile distilled water. The first applications of both Bacillus and BTH were carried out 24 h prior to virus inoculation, and later, the seedlings were challenged with the GBNV inoculum []. After 24 h of inoculation, seedlings were given a second application of Bacillus or BTH according to the treatment schedule. All experiments were conducted in a growth chamber, with three replicates, each with 30 plants. The control and treated samples were harvested at 0, 1, 3, 5, 7 and 9 days after treatment, frozen immediately in liquid nitrogen and preserved at -80 °C until use.

RNA isolation and cDNA synthesis

Total RNA was extracted from the ***collected*** frozen samples using TRIzol Reagent (Sigma Chemicals, USA) from 100 mg leaves, resuspended in 50 μl of nuclease-free water and treated with DNase I (Sigma Chemicals, USA). The purified RNA, with a 260/280 nm absorbance ratio ranging from 2.0 to 2.1, determined using a NanoDrop spectrophotometer (BioDrop, Germany), was used for cDNA synthesis. For cDNA synthesis, 1 µg of total RNA was annealed with 0.3 µM random primer at 70 °C for 10 min, after which 1 µl of RNase inhibitor (20 U), 2 µl of dNTPs (10 mM) and 4 µl of 5 × reverse transcriptase buffer (250 mM Tris–HCl, 250 mM KCl, 20 mM MgCl2, 50 mM dithiothreitol [DTT]) were added to the reaction mixture. The reaction mixture was incubated at 37 °C for 10 min, 40 U of M-MuLV reverse transcriptase was added, and the mixture was incubated at 45 °C for 60 min. The reaction mixture was heated at 70 °C for 10 min to stop the reaction. The reaction was performed in Eppendorf Mastercycler Gradient ES.

Quantitative real-time polymerase chain reaction (qRT-PCR)

A tenfold dilution of the first-strand cDNA was used as a template for qRT-PCR as described by Mishra et al. []. The qRT-PCR analysis was carried out using the specific primers corresponding to defense-related genes (Table ). The specificity of the primers was verified by RT-PCR and analysis of the amplified PCR products on an agarose gel. A total volume of 10 μl of reaction mixture was prepared for qPCR analysis, and the reaction mixture consisted of 5 μl of FAST-SYBR Green PCR mix (Sigma Chemicals, USA), 1 μl each of the forward and reverse primers (5 μM), 1 μl of template cDNA, and 2 μl of nuclease-free water. qPCR was performed on a real-time PCR system (Bio-Rad company, Germany) with a temperature plan consisting of 95 °C for 30 s (initial denaturation) followed by 40 cycles of 95 °C for 30 s and 60 °C for 30 s. A melt curve from 65 to 95 °C was performed by using a cycle of 65 °C for 15 s. To check the PCR product specificity, the temperature was increased slowly to 95 °C at a rate of 0.2 °C/s. Ct values were calculated from three biological replicates for each sample with two technical replicates. Gene expression was normalized against the constitutively expressed, ubiquitin gene from C. annuum. The level of gene expression in the control sample was set to 1, and the relative repression of gene expression was determined using the comparative 2−∆∆Ct method [].

Sequences of gene-specific primers used for quantitative qPCR experiments

| **Gene** | **Forward and reverse primers** |
| --- | --- |
| 5-epi-aritolochene synthase gene (*EAS1*) | F-TGGCAGACTAAAGGAGTCTCTTG |
| R-GTGGAGAAAGCGAGTGCATCTTC |  |
| WRKY33 | F-GTCCTACCGGTGGCAATAGC |
| R-TGCTTTGAAGCTTGGATCTTTG |  |
| NPR1 | F-CTTTACCTTCCAGATCTCTGA |
| R-GCAATCTCTCACATGCTTTAC |  |
| Lypoxygenase | F-TGGTGATCCTGCGAATGGTT |
| R-CGTCCCAATCAAACGTGACA |  |
| Peroxidase | F-ACACGTCTGATTTGCCAGGCT |
| R-GCTGAGGTCCCAATTGTGTGC |  |
| Phenylalanine ammonia lyase | F-AAGTCATTCGCGCTGCAACT |
| R-CCACCGTGTAAGGCCTTGTT |  |
| Plant defensin 1.2 (PDF) | F-TCAATCCTTCAGGACCAACCA |
| R-CCACCGGTAGGACTAGCACTCT |  |
| SAR 8.2 | F-TGAGACTAAGAAAGTTGGAC |
| R-ACCTCTATGGATTTCTGATC |  |
| Ubiquitin 3 (UBI3) | F-TCAAGCCTCCAAAGGTTGCT |
| R- GGACTCCACTGCTCCTTGAGA |  |

Viral resistance assay in flagellin-, Bacillus- and BTH-treated plants

The progression of viral disease was assessed by visual observation of symptom development in flagellin, Bacillus- and BTH-treated plants. The symptom severity grade was assessed 10 days after challenge inoculation with GBNV, where 0 = no symptoms, 1 = mild symptoms, 2 = moderate symptoms, 3 = severe symptoms and 4 = very severe symptoms []. The number of plants with symptoms and the percent reduction in disease relative to the inoculated control were recorded. The results were analysed statistically to ascertain the significance of the results and compared. Further, the virus titre was assessed by DAC-ELISA using a polyclonal antiserum specific for GBNV []. The samples were ***collected*** 10 days after challenge with GBNV and were considered positive if the absorbance at 450 nm was more than three times the average of three healthy control samples. Subsequently, the abundance of GBNV in chilli plants was tested by quantitative PCR using a real-time PCR system (Bio-Rad, Germany). Sampling, standard curve preparation, and quantification of samples were performed using a standard protocol []. The normalized Ct values of unknown samples were compared to a standard curve. The threshold cycles were determined for the CP gene of GBNV from different treatments of chilli plants at 10 dpi and the number of copies per gram of plant tissue was calculated and compared.

Statistical analysis

The statistical significance of the results was analyzed by two-way analysis of variance (ANOVA). Multiple comparisons were done using the uncorrected Fischer's LSD test. Differences between mean values were considered statistically significant at p < 0.05.

Results

Virus isolate, coat protein (CP) gene characterization

Chilli showing characteristic symptoms of virus infection ***collected*** from a field was subjected to DAC-ELISA. The results revealed a strong positive reaction with an approximately fourfold increase in absorbance values compared to healthy samples against a polyclonal antiserum specific for GBNV. The positive samples were inoculated onto a local-lesion host, cowpea cv. C152, and the plants expressed characteristic circular lesions 4–5 days after inoculation. Subsequently, the inoculated cotyledonary leaves exhibited chlorotic and necrotic lesions with systemic veinal necrosis. cDNA derived from the extracted RNA of the chilli samples was amplified by PCR to produce an amplicon of approximately 840 bp, which was excised from a gel and cloned into pGEM-T Easy Vector. Independent clones were selected and confirmed by restriction analysis using EcoRI. The clones were sequenced in both directions using universal M13 primers and edited using BioEdit software to obtain the full-length nucleotide sequence of the CP gene. NCBI BLAST analysis showed that this sequence shared 99% nucleotide sequence identity to a sequence available in the NCBI database, confirming its identity as GBNV. The CP gene sequence of GBNV isolates were submitted to the NCBI GenBank database under accession no. MK424873.

Identification of potential antagonistic bacteria and screening against GBNV

A total of 50 bacterial isolates were isolated from the endosphere of chilli plants to test their antiviral activity against GBNV. Out of 50 bacterial endophytes, 10 isolates were tentatively identified as Bacillus spp. by biochemical tests, viz., Gram staining, KOH test, citrate utilization test, catalase test, and gelatin hydrolysis. In order to identify the bacterial antagonist as Bacillus spp., a PCR reaction was performed to amplify its 16S rRNA. All ten isolates were positive by PCR, with a product size of ~ 1500 bp corresponding to 16S rRNA, and sequences of the amplified products were determined. BLAST searches of sequences against the NCBI database revealed that three out of the 10 antagonists were Bacillus megaterium (MK863555; MK875983 and MK876002), four were Bacillus subtilis (MK863567; MK863568; MK863569 and MK863570), two were Bacillus amyloliquefaciens (MK863573 and MK863574), and one was Bacillus licheniformis (MK863566), respectively. Screening of the 10 isolates of Bacillus spp. against GBNV reflected that B. amyloliquefaciens CRN9 effectively reduced the number of lesions from 32.00 lesions per leaf in the virus-inoculated control to 4.00 lesions per leaf. This was followed by B. licheniformis CRN3 and B. megaterium CRN2, which were effective in reducing the number of lesions to 6.67 and 7.67 lesions per leaf, respectively. The number of lesions in the other bacterial endophytes treated cowpea plants ranged from 8.00 to 13.67 lesions per leaf. (Fig. ).

In vitro efficacy of endophytic Bacillus spp. for the reduction of symptom expression upon artificial inoculation of GBNV. Error bars represent the standard deviation of the mean from three independent biological experiments. Different letters indicate significant differences between treatments

Amplification and cloning of the flagellin gene

Flagellin gene fragments were amplified with an amplicon size of 1.19 kb with restriction sites for XbaI and BSP. They were then cloned into pGEM-T Easy Vector and their sequence determined. In a BLAST similarity search, the flagellin clone showed more than 99% identity to a sequence from B. amyloliquefaciens, and the sequence was submitted to the GenBank database with the accession number MK947369. The resultant construct, pGEM-T (flg), was digested with the restriction enzymes XbaI and BSP, producing a 1.19-kb fragment containing the flg gene, which was subcloned into pBIN-GFP. The resulting plasmid, pBIN-flg, was digested with XbaI and BSP to produce a 1.19-kb fragment containing the flagellin gene. This gene construct was then mobilized into Agrobacterium tumefaciens strain LBA4404 via a triparental mating approach using pRK2013 as a helper strain (Fig. S1).

Transient expression of flagellin with consecutive defense gene analysis

The expression of flagellin and its ability to elicit the expression of MAMP-associated genes in chilli were investigated after agrodrenching with A. tumefaciens containing pBIN-flg versus challenge inoculation of GBNV. The results indicated a high level of expression of flg, with a strong band being visible from days 0 to 5 post-inoculation (dpi). The intensity of the band became very faint after 7 dpi. RT-qPCR ***data*** further revealed that the level of transcripts increased at 3 dpi and decreased at 7 dpi compared to the host reference gene UBI (Fig. ). Meanwhile, the expression of MAMP-associated genes categorized as chemically induced, defense-responsive, pathogenesis-related (PR), and transcription factors was studied in chilli cv. Syngenta Bullet infected with GBNV at 0, 1, 3, 5, 7 and 9 dpi.

Transient expression of flagellin in chilli plants. The chilli plants were agrodrenched with A. tumefaciens LBA4404 containing pBIN:flagellin. RT-qPCR was performed to determine gene expression of the flagellin at different times after inoculation filtration, and the samples were normalized against UBI3. The normalized fold expression of the flagellin (flg) gene in the healthy plant at time 0 was set equal to 1.0. Error bars represent the standard deviation of the mean from three independent biological experiments. Different letters indicate significant differences between treatments

Differential expression of chemically induced and defense responsive genes

A relative expression analysis was performed to determine the transcript levels of seven defense-related genes that were induced in response to different signaling pathways. In plants treated with flagellin, the phytoalexin precursor gene EAS1 was strongly upregulated as early as 3 dpi (1.38-fold), and reached a peak at 3 dpi (1.64- and 1.56-fold) in plants treated with Bacillus and BTH, respectively which was significantly higher than in the GBNV-inoculated control. Subsequently, the expression declined from 5 dpi. In correspondence with pathogen inoculation, inoculated control plants showed a 2.29-fold increase in gene expression at 1 dpi. Subsequently, the expression declined in all treatment groups at 5 dpi, except in agro and IC chilli plants at 9 dpi (Fig. a). P-values for all comparisons are provided in Supplementary Table S1.

Expression pattern of the a) EAS1, b) WRKY33, c) NPR1 and d) PAL genes after treatment (transient expression of flagellin, application of Bacillus and BTH) and challenge with GBNV inoculation. The expression level of genes was calculated relative to healthy control (HC) plants. The ubiquitin (UBI3) gene was used as an internal reference. The normalized fold expression of the genes at various intervals was set equal to 1.0 against HC. Error bars represent the standard deviation of the mean from three independent biological experiments

Differential expression of transcription factor and non-expressor of pathogenesis-related protein 1 (NPR1)

A relative expression analysis of transcription factor WRKY33 gene revealed that the WRKY33 gene was upregulated as early as 1 dpi (0.45-fold) in plants treated with flagellin and reached a peak at 7 dpi (0.61-fold) in plants treated with Bacillus. Significant upregulation was also observed in all treatment groups at 7 dpi. Subsequently, the expression declined in all treatment groups at 9 dpi (Fig. b). The transcript accumulation for the NPR1 gene in flg-treated plants reached a peak at 3 dpi (2.5-fold) and a decreasing trend was observed from 5 dpi (0.23-fold). However, strong upregulation was observed in all treatment groups except the inoculated control as early as 0 dpi (Fig. c). Subsequently, downregulation of gene transcripts was observed in plants treated with Bacillus or BTH and in the inoculated control at 9 dpi.

Differential expression of salicylic acid (SA)-mediated defense responsive genes

The PAL gene plays a major role in priming defense-related genes in the SAR pathway. A transcript analysis revealed an increase in PAL gene transcript irrespective of treatment. The transcript level increased (1.10-fold) at 1 dpi and reached a maximum (1.35-fold) at 3 dpi in plants treated with the flg gene. The increase in the transcript level of PAL was very high in Bacillus-and BTH-treated plants (1.82- and 1.84-fold, respectively). Similarly, a high transcript level was observed in the inoculated control (2.39-fold) at 1 dpi, but it dropped to 0.9-fold after 5 dpi (Fig. d). For PO, the transcript levels increased by 1.73-fold in flg-treated plants as early as 1 dpi. A maximum peak of 2.39- and 2.25-fold was observed in Bacillus- and BTH-treated plants, respectively, at 1 dpi. However, irrespective of the treatment, the transcript level of PO in all cases decreased to 1.43-fold at 3 dpi, but it was significantly higher than the inoculated control (Fig. a). The transcript level of basic protein family (SAR 8.2), increased from 1.93-fold at 0 dpi to 2.0-fold after 3 dpi. It subsequently decreased to 0.61-fold after 3 dpi in flg-treated plants. However, downregulation of gene transcripts was observed at 0 dpi in plants treated with BTH and an increase was observed from 1 to 3 dpi. Compared to all the other transcripts, the level of SAR 8.2 in Bacillus-treated plants increased only marginally. In contrast, the transcript accumulation of the SAR 8.2 gene was constitutively higher in the inoculated control at 0 dpi (2.32-fold), and thereafter the expression declined from 1 dpi (Fig. b).

Expression pattern of the a) PO, b) SAR8.2, c) LOX and d) PDF1.2 genes after treatment (transient expression of flagellin, application of Bacillus and BTH) and challenge with GBNV inoculation. The expression level of genes was calculated relative to healthy control (HC) plants. The ubiquitin (UBI3) gene was used as an internal reference. The normalized fold expression of the genes at various intervals was set equal to 1.0 against HC. Error bars represent the standard deviation of the mean from three independent biological experiments

Differential expression of jasmonate (JA)-mediated defense-responsive genes

Application of agroinfectious clones of flagellin and Bacillus onto chilli plants increased the expression of lipoxygenase 3 (LOX3) and plant defensin 1.2 (PDF1.2) genes associated with JA biosynthesis. Agrodrenching with the flg gene increased the transcript of the LOX3 gene to 0.96-fold at 1 dpi. The transcript levels decreased from 3 to 5 dpi. The maximum level of transcript (2.07-fold) was observed in plants treated with Bacillus, and a strong downregulation of the transcript of the LOX3 gene (-0.08- and -0.97-fold) was observed at 3 dpi (Fig. c). Similarly, the plant defensin 1.2 (PDF1.2) gene transcript was strongly upregulated and reached a peak (1.16-fold) at 0 dpi immediately after the application of flagellin. A decreased level of transcripts was observed from 5 dpi onwards. Plants treated with Bacillus and Agrobacterium alone expressed higher levels of transcripts (1.75- and 1.71-fold) at 0 dpi. However, significant down regulation of transcripts level (-0.94-fold) was observed in plants treated with BTH at 0 dpi, a 1.2 fold increase in plant defensin was observed when flagellin and Bacillus were applied (Fig. d).

Virus titer and disease assessment

To investigate the level of resistance against GBNV, plants responding to the applied treatments were selected and inoculated mechanically with GBNV at the four-leaf stage. The results revealed that transient expression of the flagellin gene and treatment with Bacillus effectively reduced the disease severity grade to 0.33 and 0.25, respectively, after 10 days of challenge inoculation with GBNV. Application of BTH was the most effective, reducing the disease severity grade to 0.39, whereas the inoculated control plant had a severity grade of 3.50 (Fig. ). Characteristic symptoms of GBNV were observed in all of the virus-inoculated plants control group (12/12). The presence of virus was confirmed by DAC-ELISA, which showed a high virus titre at 405 nm. GBNV was detected in only two out of 12 plants that were agrodrenched with flagellin. Likewise, only one plant out of 12 treated with B. amyloliquefaciens CRN9 was observed to be infected with GBNV, and none of the BTH-treated plants gave a positive reaction for GBNV (Fig. ; Table S2). qPCR was used to examine virus accumulation in parallel to expression of defense-related genes (Table ). The lower concentration of target correlated with a higher Ct value. The qPCR results revealed a reduced accumulation of GBNV in chilli plants transiently expressing flagellin, with a minimum GBNV concentration of 1.42 × 105 copies when compared to virus-inoculated control at 9 dpi. Similarly, reduced copy numbers of GBNV (0.253 × 105 and 0.308 × 105) were observed in treated applied with B. amyloliquefaciens CRN9 and BTH, respectively, compared to the inoculated control, which had a copy number of 8.34 × 109.

Suppression of symptom expression in plants treated with flagellin, Bacillus, BTH and challenged with GBNV. Error bars represents the standard error of the mean. Different letters indicate significant differences between treatments

Representative symptoms of GBNV in inoculated control plants (a) in contrast to the majority of the flagellin, BTH, and Bacillus-treated plants (b), which were symptomless

Copy numbers of GBNV coat protein genes in plants treated with flagellin, Bacillus, or BTH and challenge inoculated with GBNV

| **Treatment** | **Transcript copy number(CP gene of GBNV)** |
| --- | --- |
| Flagellin gene (transient expression) | 1.42 × 105 |
| *Agrobacterium* alone | 1.26 × 108 |
| *B. amyloliquefaciens* CRN9 | 0.253 × 105 |
| BTH | 0.308 × 105 |
| Inoculated control | 8.34 × 109 |

A lower concentration of target resulted in an increased Ct value. The unknown sample Ct values were correlated with a standard curve (R2 = 0.92; y = -2.7206x + 44.45), which refers to a 10-fold dilution of a known concentration of the CP gene of GBNV

Discussion

Tospoviruses causing necrotic diseases are evolving as major viral pathogens in chilli and other vegetable crops under protected and field conditions in Tamil Nadu, India. GBNV is artificially transmitted through mechanical sap inoculation and is transmitted by insect vectors under field conditions. The major symptoms of necrosis disease include the presence of circular chlorotic and necrotic patches, necrotic streaks on the stem, stunting of plants, and failure to produce flowers if infection occurs in the early stages of the crop. We identified the cause of the necrosis disease to be a member of the genus tospovirus using an inoculation test on cowpea and testing samples using a polyclonal antiserum specific to GBNV. Our results are in agreement with those of Jain et al. [], who made the GBNV-specific antiserum and detected the virus in infected chilli under field condition. Similarly, Gopal et al. [] surveyed for GBNV infection in chilli under field condition and confirmed the infection using DAC-ELISA. Recently, Sharma and Kulshrestha [] also detected GBNV infection in bell pepper plants in Himachal Pradesh, using DAC-ELISA and DAS-ELISA with a polyclonal antiserum specific for GBNV. The pathogen was confirmed as GBNV by PCR, which produced an amplicon of 832 bp corresponding to coat protein gene of GBNV. Sequence analysis showed that this virus was similar to existing isolates from chili and tomato. Similar results were also obtained by Kunkaliker et al. [], who characterized the CP gene of GBNV from chilli and tomato plants. Management of virus disease in crop plants can be achieved by PGPR, which has broad-spectrum of antimicrobial activity and promotes growth []. However, the defense mechanism triggered by the PGPR against virus disease remains unknown. In our study, endophytic bacteria were isolated from chilli and identified as Bacillus spp. based on the sequence of the 16S rRNA region. An isolate of B. amyloliquefaciens CRN9 inhibited the symptom expression in a local lesion host up to 87.50% compared to an untreated control. Similarly, Vinodkumar et al. [] reported that Bacillus spp. had antiviral activity against necrosis disease of cotton caused by tobacco streak virus. PGPR and Enterobacter asburiae BQ9 reduced the severity of disease caused by tomato yellow leaf curl virus (TYLCV) under protected conditions, up to 52% promoted tomato plant growth, and induced resistance to TYLCV []. The MAMP molecules of PGPR act as elicitors, activating the first line of defense by interaction with pattern-recognising receptors at the plasma membrane, activating a signalling cascade that leads to the induction of immunity.

To study GBNV resistance in chilli, we investigated the priming effect of the B. amyloliquefaciens CRN9 and the role of flagellin against GBNV through the expression of defense-related genes in a susceptible cultivar due to lack of resistant commercial cultivars. In the present study, Bacillus induced the transcription of flagellin and other defense-signaling genes in chilli plants challenged with GBNV. Flagellin, a monomeric component of the flagellum, is the MAMP molecule involved in elicitation of a defense response in plants. The plant detects a specific epitope of flagellin known as flg22 during the host-microbe interactions, which is recognized by the plant receptor-like kinase (RLK) FLS2 [, ]. Flagellin binding leads to a cascade of signalling events triggering defense gene expression and production of reactive oxygen species []. Plant immunity induced by flagellin is associated with elevated levels of cytosolic Ca2+ and Ca2+-dependent immune signalling that occurs as a result of interaction between the epitope-containing peptide flg22 and the FLS2 receptor. This is mainly dependent on influx of extracellular Ca2+ into the cytosol through the plasma membrane []. Recently, it was reported that transient expression of flagellin-derived PAMPs (flg22 and flgII-28) in tomato resulted in transcriptional reprogramming and enhanced defense gene expression.[], suggesting that flagellin may interact with the FLS2 receptor in chilli plants, inducing the signalling pathway for SAR- and ISR- mediated resistance against invading GBNV.

The plant defense is not a constitutive and requires the accumulation gene transcripts in the infected plant to counter the risk posed by the invading pathogens. In the present study, the gene transcript of the epi-aristolochene synthase gene (EAS1) accumulated to a significantly higher level in plants treated with flagellin and Bacillus than in virus-inoculated control plants. The plant challenged with virus alone produced a higher accumulation of EAS1 at 1 dpi, and a reduced level of accumulation was observed in the ensuing days, indicating the antiviral activity of phytoalexin capsidiol. 5-epi-aristolochene synthase catalyzes the formation of 5-epi-aristolochene, which is an immediate precursor of the bicyclic phytoalexin capsidiol and later on produces the bicyclic sesquiterpenic phytoalexin capsidiol []. Resistant genotypes of chilli produced more EAS1 gene transcripts upon inoculation with capsicum chlorosis virus [], suggesting that induction of EAS1 gene expression in chilli plants might represent a part of the induced resistance mechanism, which can directly affect the degree of resistance against the pathogen.

Plant defense reactions against pathogen infection in plants can be triggered by the recognition of MAMPs, elicitors, exogenous application of plant hormone, and biotic or abiotic stresses. These hormonal induced defense responses in plants are mediated by SA or JA. In the present study, chilli plants treated with flagellin and challenged with GBNV showed a maximum accumulation of WRKY33 transcripts at 1 dpi when compared to the control. This was in line with the observations of Jingyuan et al. [], who found that chilli plants sprayed with 5 mM SA, produced high levels of CaWRKY30 transcripts, which accumulated 2 h after treatment and reached a level that was 19-fold higher than in compared to the control. CaWRKY is a positive regulator of PR gene expression, a component of the L-mediated resistance response to tobacco mosaic virus in hot pepper []. Moreover, treatment with Bacillus or BTH induced the NPR1 expression, the basic component of plant defense against virus infection. Consistent with previous reports, Bacillus treatment resulted in increased transcription of NPR1, indicating a primed state or induction of SAR []. In our study, plants treated with flagellin and challenged with virus had higher level of transcript accumulation at 1 dpi and 3 dpi when compared to virus-inoculated untreated plants. However, the levels decreased at 5 dpi, which indicated that up-regulation was more pronounced (2.20-fold) in flagellin-treated plants than in Bacillus- and BTH-treated plants.

In marker expression with NPR1, the PAL gene was significantly upregulated and peaked at 3 dpi in flagellin-treated plants. Interestingly, a higher level of transcript accumulation was observed at 1 dpi in plants treated with Bacillus and BTH. A similar trend was observed for the transcripts of the PO, PPO, SAR 8.2 genes, which accumulated significantly. The significant upregulation of the PR genes in plants treated with flagellin, Bacillus and BTH indicated the induction of resistance through SA in chilli. The basal expression of PAL and PO genes, whose gene products belong to the family of PR-proteins, has been strongly associated with resistance against pathogens []. Likewise, a basic protein family called SAR 8.2 was induced locally and systemically in pepper and tobacco plants upon pathogen infection and salicylic acid treatment during the onset of SAR [, ]. Overexpression of the SAR 8.2 gene in Arabidopsis results in increased defense activity against Fusarium oxysporum f. sp. matthiolae, Botrytis cinerea, Pseudomonas syringae pv. tomato and abiotic stress. Transgenic lines of Arabidopsis plants overexpressing CaSAR82A exhibit high levels of expression of PR genes associated with high levels of transcripts in CaSAR8.2. The induction profile of CaSAR8.2 resembles that of PR proteins, and it is considered to be a member of a novel PR protein family [, ]. This suggests that MAMPs-triggered expression of PR genes is a prerequisite for initial suppression of the viral pathogen through the activation of the SAR pathway.

The lipoxygenase (LOX) pathway is crucial for lipid peroxidation and lead to the formation of JA from linolenic acid, which is a marker for JA-dependent signalling and induced systemic resistance against biotrophic pathogens [, ]. In our study, LOX gene expression was induced in plants treated with flagellin, Bacillus and BTH. Likewise, defensins, members of the PR-protein family (PR-12), contribute to defense signaling and serve as effectors of JA signaling and resistance in several plant species after infection by necrotrophic pathogens. In the present study, the PDF 1.2 gene was upregulated in plants treated with flagellin, Bacillus and BTH. The antiviral activity of defensins has been reported by Kachroo et al. [], who found that inoculated leaves of Arabidopsis (Col-0) plants inoculated with turnip crinkle virus (TVV) exhibited enhanced basal-level expression of the defensin (PDF 1.2) gene and activation of both the MeJA and ethylene pathways, which are required for the expression of PR12 (PDF1.2). On the other hand, coexpression of the PR-1 and PDF1.2 genes in wild-type Arabidopsis Col-0 through the application of B. amyloliquefaciens EXTN-1, indicated that B. amyloliquefaciens EXTN-1 induces systemic resistance through the salicylic-acid- and jasmonic-acid-dependent pathways and leads to a counterattack against the invading viral pathogen []. It is manifested that there is a combined pathway leading to resistance against virus through specific communication with host components.

The results presented in this report show that exogenous application of Bacillus reduces the severity of necrosis disease caused by GBNV in chilli. Similar results have been reported by several workers investigating the reduction of the viral symptoms in crop plants though the application of several bioagents [, ]. Hongwei et al. [] reported that Enterobacter asburiae BQ9 significantly reduced the severity of disease caused by tomato yellow leaf curl virus (TYLCV) under greenhouse conditions by up to 52% and promoted tomato plant growth. Similarly, foliar application of leaf-colonizing B. amyloliquefaciens has been shown to protect N. benthamiana and pepper plants against cucumber mosaic virus under field conditions []. Furthermore, while all the untreated control plants were positive when tested using a polyclonal antiserum specific for GBNV, only a few plants treated with Bacillus were positive for viral infection by DAC-ELISA, indicated the enhanced antiviral resistance of susceptible plants after treatment. Interestingly, agrodrenching with flagellin and Bacillus resulted in reduced virus accumulation at the early stages of infection and delayed virus detection in apical leaves, similar to treatment by exogenous application of BTH. This was confirmed by qPCR, which clearly showed a reduced accumulation of GBNV in agrodrench experiments with flagellin and Bacillus spp. This is in agreement with the observations of Beris et al. [], who demonstrated that tomato plants treated with B. amyloliquefaciens strain MBI600 and SA had reduced virus titres, indicating enhanced antiviral activity against TSWV and PVY. Similarly, Vanthana et al. [] found that tomato plants treated with B. amyloliquefaciens VB7 showed significantly reduced disease severity and GBNV titer. They also suggested a role of flagellin and elongation factor of B. amyloliquefaciens VB7 as inducers of MAMP-triggered immunity in tomato through expression of PR1, NPR1, MAPK and WRKY33. In our study, the flagellin gene of B. amyloliquefaciens CRN9, a native isolate from chilli, triggered the ISR-mediated defense mechanism of disease resistance through the activation of both salicylic acid and ethylene mediated pathways against necrosis of chilli caused by GBNV. Our results also showed that foliar application of B. amyloliquefaciens CRN9 during the early stages of crop growth regulated MAMP-triggered immunity against GBNV, which implies that it can be used for the biological control of necrosis disease in chilli and can play an important role in sustainable ***agriculture***.

**Acknowledgements**

The authors are grateful for the financial support provided under “Dr. A.P.J. Abdul Kalam Fellowship” sponsored by School of Post Graduate Studies, Tamil Nadu ***Agricultural*** University, Coimbatore-641 003 for accomplishing this work. The authors also acknowledge DST-FIST, Department of Science and Technology, Government of India, New Delhi, for the infrastructure facilities for conducting the experiments.

**Notes**

Publisher's NoteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 8, 2023

**End of Document**



[***Industrial dynamics in the context of a region’s international competitiveness***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6BNK-C111-DY41-73V4-00000-00&context=1516831)

Local Economy: The Journal of the Local Economy Policy Unit

May 2020

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**Section:** Pg. 209-229; Vol.35; No.3; ISSN: 0269-0942, 1470-9325

**Length:** 8130 words

**Byline:** Celeste Varum

Carmen Guimarães

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**Body**

**ABSTRACT**

This article attempts to explain the resilience and international competitiveness of a micro-region in Portugal, based on three intertwined levels – firm, industrial structure and region. The study covers the period 2006–2014 and is based upon a rich micro-level dataset of all firms established in Portugal. The findings reveal the dynamics of the industrial base of this region and how its enterprises managed to remain competitive over time, reinventing themselves through innovation and related diversification, conveying knowledge and expertise from incumbent businesses to new ones with higher value added. Proximity between firms played an important role in learning processes, and knowledge creation was promoted by shared knowledge. Competitiveness requires ongoing replacement of resources and rejuvenation of structures and institutions, turning regional capabilities into valuable assets.

**FULL TEXT**

**Introduction**

Continuous technological change in an environment marked by increasing worldwide competition and globalisation, along with major crises in demand, has shifted the core of industrial competitiveness and benefits firms and regions that are able to renovate and innovate faster. This article attempts to explain the resilience and international competitiveness of a micro-region in Portugal, based on three intertwined levels – firm, industrial structure and region.

The paper shows the role of firms’ flexibility, of related diversification and of spatial proximity in promoting industrial competitiveness in the Portuguese micro-region, Aveiro North, which is integrated in the NUT III Metropolitan Area of Porto. We show that, to some extent, firms have been influenced by the economic and social characteristics of the region, particularly by its strong, export-oriented industrial base (Beira, 2007; Mesquita, 1995). We found evidence for the role of localised learning, suggested by Maskell and Malmberg (1999), for international comparative advantage, largely reflected in relationships of subcontracting and in a process of related diversification. A dense network of family-based firms is revealed to be highly flexible, shrinking in size in times of austerity and relying on subcontracting relationships between them. Firms have shown the ability to create knowledge by interacting with one another and with entities of the scientific and technological system that developed locally or close by. This type of pattern is more likely to occur within relations of trust and cooperation that develop over time (Moulaert and Sekia, 2003). These network of agents and embedded knowledge, coupled with the traditional export orientation of many sectors in the region, helped to create new sources of comparative advantage and to reinforce existing ones, as reflected by export competitiveness indicators (Balassa index) (Balassa, 1965) and related diversification measures (Krugman specialisation index) (Krugman, 1991), discussed in the “Export competitiveness indicators” and “Related diversification” sections. Firms and sectors which are more internationally active seem to have been constantly supported by regional characteristics in maintaining their international competitiveness. Indeed, the Aveiro North region registers an average export intensity of almost 40%, higher than the national average.1 Altogether, these characteristics and international orientation are likely to have helped the region to resurge in the aftermath of the economic crisis. Here, we must recall Saboniene (2009), who argues that export is even more essential for growth and vitality.

Our case is also a good example of resilience in the sense of the ability of a region and its firms to adapt to external shocks (CCDRN, 2017; EU, 2009). By doing this, we reveal that the resilience of industries and regions is path dependent, depending on its track record and the legacy of the past (Rigby and Essletzbichler, 1997; Martin and Sunley, 2006, 2010; Neffke et al., 2011), hence the need for studies that take a historical perspective (Boschma, 2015).

The study covers a reasonable period, 2006–2014, and enables follow-up of the dynamics of the region over the recent macroeconomic crisis.2 Regional and national results for 193 sectors (at NACE 3-digit level) were computed from a rich and comprehensive firm-level database, the nationwide Integrated Business Accounts System (SCIE), which gathers general, financial and economic information from all the non-financial private firms in Portugal. Secondary and quantitative ***data*** are complemented by primary and qualitative information, gathered within the context of focused workshops with local managers. To our knowledge, this is one of the few studies conducted with such an extensive database and deep level of geographic disaggregation and is highly innovative in this regard.

This is an important area of neglect in the literature because the existence of widespread regional disparities in economic activity and increasing tendencies of economic activities to become agglomerated and clustered (Porter, 1998) suggest that serious considerations should be directed to the sub-national analysis of export activities. In addition, economic and policy discussion on exports in small economies, like Portugal, have been largely observed through the prism of national exports, rather than the sub-national origin of such exports. The neglect of the sub-national analysis of exports has been a glaring omission in the existing literature on Portugal, despite evidence of the insurmountable contribution which exports have had towards strengthening the Portuguese economy (Felke and Eide, 2014; Lains, 1994). In Portugal, the attention of policymakers and academics towards export activity has been largely directed to national export performance, often with a firm or sectoral approach (Amador, 2017; Amador et al, 2007a, 2007b; Crespo and Fontoura, 2004). What is little known is what routes industries and firms in different regions have taken in face of the growing phenomenon of internationalisation. An exception is the contribution from Teixeira and Barros (2014), who analysed local municipalities’ involvement in promoting the internationalisation of small and medium enterprises (SMEs).

Deeper understanding of economic and social developments at the regional level can support the design of improved policy to spur regional and enterprise competitiveness. The accurate understanding of industrial comparative advantages helps in understanding the growth prospects of the region and design of policy programmes and tailoring them more effectively to the needs of firms (Janger et al., 2011; Peneder, 2003). While national policies have an important role to play in promoting national exports, regional policies that spur and support local firms to internationalise can also contribute to achieving the global objective (Teixeira and Barros, 2014). Having this framework in mind, as mentioned earlier, this article addresses the international competitiveness of a micro-region in Portugal, based on three intertwined levels – firm, industrial structure and region.

The paper is organised as follows. The next section provides a brief theoretical background. Then the context is set up and the ***data*** are discussed. This is followed by a presentation of the results of our empirical study. Finally, we derive the main conclusions.

**Theoretical background**

The resilience and international competitiveness of regions has attracted the attention of politicians and academics alike (Faggian et al., 2018; Martin et al., 2015; Simmie and Martin, 2010). Aligned with a path-dependent approach,3 it has been argued that the way regions evolve depends on their track record; it is a legacy of the past (Martin and Sunley, 2006, 2010; Neffke et al., 2011; Rigby and Essletzbichler, 1997). Gernot Grabher’s (1993) work is often referred to as one of the first studies to implement path dependence in a regional level. Since then, regional path-dependence research has developed along diverse lines (Boschma and Frenken, 2006; Boschma and Martin, 2010). In the context of path-dependent development of regional economies, path dependence can be used to explain why changes take a certain direction. It can be seen like a process that defines opportunities and limits for change. Hence, on the one hand, path dependency may lead to lock-in effects, which may hinder the adoption of more efficient technologies. Empirical studies on regional path-dependence attribute the lack of change to lock-in at various levels of regional agents (firms, industries and institutions). The regional lock-in effect derived from path dependence can be observed by the continuity and preservation of production methods, especially when there is already newer technology available that allows the same task to be performed, but that involves change, adaptation and possibly even training by the workforce.

As stated by Martin and Sunley (2010: 395) “some regional economies become locked into development paths that lose dynamism, whilst other regional economies seem able to avoid this danger and in effect are able to ‘reinvent’ themselves through successive new paths or phases of development”.

Martin and Sunley (2006) suggest five scenarios to escape from regional lock-in situations: indigenous creation (of new paths), heterogeneity and diversity, transplantation from elsewhere, diversification into (technologically) related industries and the upgrading of existing industries. Diversification can also be thought of as an evolutionary dividing process in which new paths develop from existing related paths (Boschma and Frenken, 2011). Indeed, “the delocking of a local industrial path may arise endogenously […] if local firms switch to a different, perhaps related, sector of activity on a new path that is perceived as affording more profitable opportunities” (Martin, 2010: 6–7). Frenken and Boschma (2007) further suggest that regional path dependence can be viewed as a branching process, particularly in the form of diversification from old to newer industries (Neffke et al., 2011), often related to the old path (Boschma and Frenken, 2011; Nooteboom, 2000). Related industries often benefit from using the same skills, knowledge and, sometimes, the same technology. Thus, the creation of a new company is often based on existing knowledge, tradition or existing resources, rather than on creating something different and radically innovative (Neffke et al., 2011). Hence, the legacy of the past can be a critical asset to potentiate the future (Boschma, 2015).

Moreover, in certain regions, the development over time of specialised companies in different stages of the productive process, and of other specialised ones in business services, facilitates and promotes the accumulation and creation of knowledge, based upon relations of trust and cooperation (Moulaert and Sekia, 2003).

Geographic proximity, equality of values, language, culture and context facilitate face-to-face interaction among the various actors, subcontracting relationships as well as the diffusion of management practices and technological innovations, through imitation or worker mobility between companies. Firms develop common ways of designing, producing and assembling products and providing services (Pinch et al., 2003), and together with the support of innovation, organisations can join forces to innovate and increase their competitiveness (Cooke, 2001).

These settings create opportunity for high levels of flexibility and related diversification (Henry and Pinch, 2000; Karim and Mitchell, 2000). Knowledge and expertise from original businesses can be transposed to launch and manage new ones with higher value added. Boschma and Wenting (2007) provide a practical example of this relationship by studying the spatial evolution of the automobile sector in Britain between 1895 and 1968. Later, Boschma and Iammarino (2009) found strong evidence that related variety joined with extra-regional knowledge from related sectors contribute to economic growth in Italy. In the same line, and according to Asheim et al. (2011), regional specialisation in related variety is more likely to promote innovation and learning. In spite of the advantages, related diversification should not be extremely high, because of the risk of a shock on demand, which could have a negative domino effect upon the whole regional economy (Boschma and Iammarino, 2009; Frenken et al., 2007).

Hence, entrepreneurs may turn path dependency into a path-breaking phenomenon if they combine embedded, accumulated knowledge in the region, which is difficult to transfer or to replicate elsewhere, with external knowledge in order to create value (Bathelt et al., 2004). This translates into comparative advantage and promotes international competitiveness (Asheim, 1996). This idea underlines the definition of smart specialisation policy, involving the discovery of the region’s area of expertise and what makes local knowledge original and unique, and can help to promote the diversity of the region’s knowledge and experience areas, making the economy more able to benefit from agglomeration economies and less vulnerable to market shocks (Foray et al., 2009, 2011).

This paper applies this framework to explain the resilience and industrial competitiveness of the industrial region under analysis, in line with the view of the region as a knowledge-intensive system.

**Methodology**

**The region**

The study is conducted in an industrial Portuguese micro-region, Aveiro North, integrated into the NUT III Metropolitan Area of Porto. The Aveiro North region gathers five counties: “Arouca”, “Oliveira de Azeméis”, “Santa Maria da Feira”, “São João da Madeira” and “Vale de Cambra” (Figure 1). This region covers 859 km2 and 274,856 habitants (Census 2011, conducted by Instituto Nacional de Estatística (INE)).

**Table 1.**

GDP and GDP per capita of the Aveiro North region and Portugal.

|  | **2006** | **2009** | **2012** | **2013** |
| --- | --- | --- | --- | --- |
| GDP (M €) |  |  |  |  |
| Aveiro North | 3516 | 3589 | 3675 | 3685 |
| Portugal | 166,249 | 175,448 | 169,668 | 171,211 |
| GDP per capita (€) |  |  |  |  |
| Aveiro North | 12,642 | 12,975 | 13,369 | 13,450 |
| Portugal | 15,800 | 16,601 | 16,136 | 16,372 |

Source: INE.

**Figure 1.**

Aveiro North region. Source: Own elaboration.

During the period under review, the GDP of Aveiro North accompanied the national trend (see Table 1), registering an increase in GDP per capita, converging slightly towards the national average (from 78.16% (in 2009) to 82.15% (in 2013), Portugal = 100%).

**Methodology and *data***

In this study, we combine quantitative analysis with rich qualitative ***data*** ***collected*** through qualitative research methodologies. This combination allows some of the limitations of both methods to be minimised: qualitative interview results can help to identify unobservable heterogeneity present in quantitative ***data*** and help to explain variables and statistical results that until then seemed unexplained; qualitative research may also help to discover the lack of validity of quantitative measures and instruments; and quantitative studies can help to corroborate the results provided by the qualitative methods (Starr, 2014). Combining these two types of methods allows us to meet complementary purposes, giving robustness to the results obtained.

The quantitative study covers the period 2006–2014 and it is based upon an extremely vast and rich micro-level dataset of all firms established in Portugal, kept by Banco de Portugal Microdata Research Laboratory (BPLIM) from the Bank of Portugal. Our micro-dataset for Portugal includes 3,306,206 observations, an unbalanced panel of around 370,000 firms per year. Aveiro North accounts for 1.9% of all firms in the dataset (Table 2).

**Table 2.**

***Data*** set.

| **# of enterprises in the dataset** | **2012–2014** |
| --- | --- |
| Aveiro North | 61,777 |
| Portugal | 3,306,208 |

In addition, in-depth qualitative ***data*** were gathered from 86 CEOs and local managers organised in 29 focus groups, during 2017 and 2018. Each focus group included two or three companies from different sectors, allowing managers to speak more freely. We followed an open-ended approach, promoting interactive and oriented sessions about the evolution of the industry in the region and the relationships between the industrial sectors as well the nature of the linkages between the different stakeholders of the region. Through an interactive and repetitive process, which allowed information to be cross-validated, managers were directly involved into the processes of producing economic knowledge (Starr, 2014).

***Data*** ***collected*** through this process were used to enrich the interpretation of the quantitative ***data***. This is dealt with in the “Related diversification” section.

**Industrial dynamics in the context of a region’s international competitiveness**

**Productive and export structure**

The region comprises a business structure made up mainly of small firms (Table 3), which are highly flexible, establishing strong relationships of outsourcing and subcontracting between them. Despite the increase in the number of firms, we find a reduction in the number of employees and in the average size of firms. The Aveiro North region was strongly affected by the recession that hit the country (2008–2011) and was among the five regions registering the highest increases in unemployment rate (QREN Technical Coordination Commission, 2012). The crisis was also felt on turnover, but the recovery was relatively quick in this region (Figure 2).

**Table 3.**

Aveiro North region and Portugal – business activity.

| **Variables** | **2006–2008** | **2009–2011** | **2012–2014** |
| --- | --- | --- | --- |
| Number of companies |  |  |  |
| Aveiro North | 19,898 | 20,721 | 21,158 |
| Portugal | 1,070,394 | 1,112,786 | 1,123,028 |
| Employees |  |  |  |
| Aveiro North | 62,081 | 60,869 | 58,560 |
| Portugal | 2,768,782 | 2,786,185 | 2,557,459 |
| Average Size (employees) |  |  |  |
| Aveiro North | 3.12 | 2.93 | 2.76 |
| Portugal | 2.58 | 2.5 | 2.28 |

Source: Own elaboration based upon the SCIE database.

**Figure 2.**

Turnover evolution (billions of euros). Source: Own elaboration based upon the SCIE database.

Over the period analysed, the sectoral composition of the region in terms of turnover remained relatively stable (Table 4).

**Table 4.**

Sectoral composition (sectors with more than 3% on regional turnover) – Aveiro North – NACE Rev. 2.a

| **NACE Rev. 2** | **2006–2008** | **2009–2011** | **2012–2014** |
| --- | --- | --- | --- |
| Manufacture of footwear (15.2) | 9.66% | 9.50% | 11.40% |
| Manufacture of parts and accessories for motor vehicles (29.3) | 9.25% | 10.91% | 10.53% |
| Other specialised wholesale (46.7) | 7.36% | 5.72% | 3.91% |
| Manufacture of other fabricated metal products n.e.c. (25.9) | 5.54% | 5.26% | 5.45% |
| Manufacture of plastic products (22.2) | 3.99% | 3.67% | 3.96% |
| Manufacture of products of wood, cork, straw and plaiting materials (16.2) | 3.66% | 3.12% | 3.52% |
| Manufacture of cutlery, tools and general hardware (25.7) | 3.51% | 3.39% | 4.30% |
| Wholesale of food, beverages and tobacco (46.3) | 3.37% | 3.46% | 3.81% |
| Wholesale of household goods (46.4) | 3.09% | 3.25% | 3.03% |
| Manufacture of tubes, pipes, hollow profiles and related fittings, of steel (24.2) | 2.96% | 2.59% | 3.03% |

aFor more details, please see Table A1, Appendix 3, included in the supplementary material for this article.

Source: Own elaboration based upon the SCIE database.

Different sectoral taxonomies are useful to characterise the industrial structure of the region: first, according to the level of technological content (***Eurostat***, 2017): high, medium-high, medium-low and low technology;second, according to the intensity of innovation (Peneder, 2010): high (creative sectors focused on product innovation and R&D), medium-high (intermediate creative sectors, mainly involved in process innovation; frequently using patents by appropriation), medium-low (sectors with adaptive behaviour that acquire new technology) and low (sectors that don’t realise innovative activities or acquire innovations);third, manufacturing industries are divided into five groups considering the main factor of competitiveness (OECD): natural resources, product differentiation, labour, scale economies, and R&D (see Borbèly, 2004);fourth, manufacturing industries are classified according to the main factor input (Peneder, 2002): labour-intensive; capital-intensive; marketing-driven; technology-driven; and when it is not possible identify the factor input – mainstream manufacturing;Aiginger (2000) classified manufacturing industries according to competitive mode, or to the main driver of the industry’s success: price or quality. If the prices are important for one industry, firms with high prices sell low quantities and firms with low prices sell more. On the contrary, in other industries, even when charging high prices, firms sell high quantities – quality, design, service or reliability of the product creates a willingness to pay;Peneder (2002) classifies manufacturing industries according to labour skills, based on the distinction between occupations, from low-skilled (machinery operators or other elementary occupations) and medium-skilled white-collar industries (e.g. skilled ***agricultural*** and fishery workers, clerks or service workers) to high labour skills (e.g. legislators or managers);Peneder (2007) classifies the sectors according to educational intensity: low (people without any formal degree or with basic degrees), medium (mechanical engineering, retailing, chemicals, electrical machinery and air transport) and high (people with a university degree).

The region holds a long tradition in the footwear industry and Aveiro North accounts for nearly 30% of national turnover of footwear industry (Table 5). Within the region, after a slight fall in the turnover in the period 2009–2011, it bounced back from 2012 onwards, accounting for over 11% of regional business turnover (Table 4). This industry is a low-tech sector, with low innovation, highly dependent on unskilled labour, labour being its main factor of competitiveness. However, it is nowadays a marketing-driven industry, with competition based on quality and design.

**Table 5.**

Aveiro North region turnover over national turnover (%) – NACE Rev. 2.a

| **%** | **NACE Rev. 2** | **2006–2008** | **2009–2011** | **2012–2014** |
| --- | --- | --- | --- | --- |
| gthan16% | Manufacture of tubes, pipes, hollow profiles and related fittings, of steel (24.2) | 83.95% | 79.85% | 79.55% |
| Manufacture of footwear (15.2) | 30.45% | 27.37% | 26.50% |  |
| Manufacture of other fabricated metal products n.e.c. (25.9) | 23.65% | 23.29% | 24.82% |  |
| Manufacture of cutlery, tools and general hardware (25.7) | 20.11% | 20.13% | 19.65% |  |
| Manufacture of tanks, reservoirs and containers of metal (25.2) | 17.37% | 15.98% | 20.76% |  |
| Manufacture of other special-purpose machinery (28.9) | 17.20% | 16.18% | 18.96% |  |
| Manufacture of parts and accessories for motor vehicles (29.3) | 15.21% | 16.61% | 14.32% |  |
| Manufacture of ***agricultural*** and forestry machinery (28.3) | 14.44% | 16.74% | 16.69% |  |
| Manufacture of transport equipment n.e.c. (30.9) | 14.33% | 17.06% | 13.52% |  |

aFor more details, please see Table A2, Appendix 3, included in the supplementary material of this article.

Source: Own elaboration based upon the SCIE database.

“Manufacture of parts and accessories for motor vehicles”, which accounts for 10.5% of regional business (Table 4) is, by contrast, a medium-to-high-tech sector that uses medium-skilled workers, is capital intensive and its success depends on economies of scale. However, in terms of competition, it also focusses on quality, design and reliability. Manufacture of other fabricated metal products not elsewhere classified (n.e.c.) and manufacture of cutlery, tools and general hardware account for 5.45% and 4.30%, respectively. Both sectors have medium-to-low technological intensity, medium intensity of innovation, and rely on product differentiation. While other metal products are classified as mainstream manufacturing industry, cutlery, tools and general hardware is a marketing-driven industry. Both are characterised by low educational intensity, predominantly using medium-skilled workers. Competition relies mainly on price, especially for metal products.

All economic activity sectors in this region are highly involved in export activities, contributing about 3% to national exports. This contribution remained almost constant over the period under review. In Table 6, we show that the contribution of several sectors to national exports is well over 20%. The export intensity of the region is significantly higher than the overall economy. The average export intensity in Aveiro North firms rose over the period analysed, reaching almost 40% in the period from 2012 to 2014 (Table 7), and, as shown in Table 8, several sectors reveal an export intensity over 50% in all periods analysed.

**Table 6.**

Aveiro North region’s contribution to national exports (%).a

| **%** | **NACE Rev. 2** | **2006–2008** | **2009–2011** | **2012–2014** |
| --- | --- | --- | --- | --- |
| ≥20 | Manufacture of tubes, pipes, hollow profiles and related fittings, of steel (24.2) | 93.17% | 95.67% | 93.64% |
| Waste ***collection*** (38.1) | 34.12% | 14.15% | 4.18% |  |
| Manufacture of communication equipment (26.3) | 29.70% | 10.44% | 10.65% |  |
| Manufacture of other fabricated metal products (25.9) | 27.36% | 24.78% | 27.70% |  |
| Manufacture of footwear (15.2) | 27.11% | 24.71% | 23.89% |  |
| Manufacture of cutlery, tools and general hardware (25.7) | 26.29% | 25.85% | 24.45% |  |
| Manufacture of ***agricultural*** and forestry machinery (28.3) | 24.44% | 32.93% | 27.83% |  |
| Manufacture of other special-purpose machinery (28.9) | 20.35% | 17.71% | 14.52% |  |
| Manufacture of transport equipment n.e.c. (30.9) | 18.75% | 21.84% | 18.82% |  |
| Logging (2.2) | 9.49% | 11.60% | 21.33% |  |
| Manufacture of grain mill products, starches and starch products (10.6) | 7.29% | 8.12% | 23.72% |  |

aFor more details, please see Table A5, Appendix 3, included in the supplementary material for this article.

Source: Own elaboration based upon the SCIE database.

**Table 7.**

Aveiro North region and Portugal – business activity.

| **Variables** | **2006–2008** | **2009–2011** | **2012–2014** |
| --- | --- | --- | --- |
| Exports (M €) |  |  |  |
| Aveiro North | 5,591,648 | 5,525,718 | 6,006,848 |
| Portugal | 180,186,647 | 186,803,318 | 201,482,275 |
| Export intensity (exp/turnover) |  |  |  |
| Aveiro North | 0.34 | 0.35 | 0.39 |
| Portugal | 0.18 | 0.19 | 0.22 |

Source: Own elaboration based upon the SCIE database.

**Table 8.**

Aveiro North sectors with an export intensity ≥50% in all periods analysed – NACE Rev. 2.a

| **NACE Rev. 2** | **2006–2008** | **2009–2011** | **2012–2014** |
| --- | --- | --- | --- |
| Manufacture of transport equipment n.e.c. (30.9) | 83.60% | 84.81% | 77.92% |
| Manufacture of parts and accessories for motor vehicles (29.3) | 82.56% | 79.64% | 79.17% |
| Manufacture of communication equipment (26.3) | 74.07% | 70.37% | 80.12% |
| Manufacture of cutlery, tools and general hardware (25.7) | 67.43% | 68.57% | 70.46% |
| Manufacture of general – purpose machinery (28.1) | 65.76% | 59.95% | 81.18% |
| Manufacture of products of wood, cork, straw and plaiting materials (16.2) | 59.77% | 63.55% | 64.39% |
| Manufacture of footwear (152) | 57.77% | 58.58% | 57.16% |
| Manufacture of other textiles (13.9) | 56.72% | 58.09% | 61.69% |
| Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations (20.4) | 52.68% | 94.11% | 100.00% |

aFor more details, please see Table A3, Appendix 3, included in the supplementary material for this article.

Source: Own elaboration based upon the SCIE database.

Over the crisis period, the region’s structure of exports remained relatively stable (Table 9). During this period, the sectors which contributed most to regional exports were the “manufacture of parts and accessories for motor vehicles” – about 20% – and the “manufacture of footwear” – 16%. Excluding services, the export structure is in line with the productive structure.4

**Table 9.**

Sectoral structure of exports – Aveiro North (%) – NACE Rev. 2.a

| **%** | **NACE Rev. 2** | **2006–2008** | **2009–2011** | **2012–2014** |
| --- | --- | --- | --- | --- |
| ≥5% in all periods | Manufacture of parts and accessories for motor vehicles (29.3) | 22.32% | 24.81% | 21.23% |
| Manufacture of footwear (15.2) | 16.31% | 15.89% | 16.59% |  |
| Manufacture of other fabricated metal products (25.9) | 8.42% | 7.14% | 7.11% |  |
| Manufacture of cutlery, tools and general hardware (25.7) | 6.91% | 6.64% | 7.72% |  |
| Manufacture of products of wood, cork, straw and plaiting materials (16.2) | 6.39% | 5.67% | 5.78% |  |

aFor more details, please see Table A4 in Appendix 3, included in the supplementary material for this article.

Source: Own elaboration based upon the SCIE database.

**Export competitiveness indicators**

Next, we turn to the computation of sectoral regional comparative advantage (RCA).5 The results confirm that the sectoral competitiveness of the Aveiro North region relies strongly in manufacturing (Table 10).

**Table 10.**

Balassa index for the Aveiro North region (sectors with RCA ≥2) – NACE Rev. 2.a

| **Manufacturing industries NACE Rev. 2** | **RCA** |  |  |
| --- | --- | --- | --- |
| **2006–2008** | **2009–2011** | **2012–2014** |  |
| Manufacture of tubes, pipes, hollow profiles and related fittings of steel (24.2) | 30.0186 | 32.3416 | 31.4057 |
| Manufacture of communication equipment (26.3) | 9.5713 | 3.5288 | 3.5718 |
| Manufacture of other fabricated metal products (25.9) | 8.8167 | 8.3782 | 9.2904 |
| Manufacture of footwear (15.2) | 8.7345 | 8.3522 | 8.0122 |
| Manufacture of cutlery, tools and general hardware (25.7) | 8.4726 | 8.7410 | 8.2015 |
| Manufacture of ***agricultural*** and forestry machinery (28.3) | 7.8752 | 11.1327 | 9.3362 |
| Manufacture of other special-purpose machinery (28.9) | 6.5590 | 5.9899 | 4.8698 |
| Manufacture of transport equipment n.e.c. (30.9) | 6.0411 | 7.3856 | 6.3130 |
| Manufacture of parts and accessories for motor vehicles (29.3) | 5.7948 | 6.4588 | 5.0743 |
| Manufacture of tanks, reservoirs and containers of metal (25.2) | 5.4300 | 5.5723 | 4.6610 |
| Manufacture of vegetable and animal oils and fats (10.4) | 4.5340 | 2.6548 | 1.7875 |
| Manufacture of plastics products (22.2) | 4.0111 | 3.2253 | 2.6735 |
| Manufacture of furniture (31.0) | 3.1936 | 2.3900 | 2.1012 |
| Manufacture of products of wood, cork, straw and plaiting materials (16.2) | 3.0173 | 3.2057 | 3.1305 |
| Manufacture of grain mill products, starches and starch products (10.6) | 2.3503 | 2.7443 | 7.9580 |
| Manufacture of other textiles (13.9) | 2.0243 | 2.3657 | 2.3318 |

aFor more details, please see Table A6 in Appendix 3, included in the supplementary material for this article.

Source: Own elaboration based upon the SCIE database. RCA: regional comparative advantage.

The sector with the highest RCA is the “manufacture of tubes, pipes, hollow profiles, and related fittings, of steel”. This is a medium-low technology sector, with medium-high intensity of innovation and with product differentiation as a main factor of competitiveness. In fact, these companies have a strong engineering and time-to-market capability and great internationalisation experience for very demanding and diversified markets. Nevertheless, the sector practices low prices and uses low labour skills.

The sector with the next highest RCA is the “manufacturing of communication equipment”. Despite its good result in the first period, this sector registered a reduction in the Balassa index during the period of 2009–2011, which remained in the period 2012–2014. This reduction is mainly due to the high growth of exports in this sector at the national level. The sector is high-tech, with high intensity of innovation and medium labour skills, and is committed to R&D and quality.

The sectors of “manufacture of other fabricated metal products” and “manufacture of cutlery, tools and general hardware” also present a good, consistent level of RCA. There is also the sector of “manufacture of footwear” with an equal value in terms of RCA.

This region holds a comparative advantage in several medium-high technology intensity sectors, namely, “manufacture of ***agricultural*** and forestry machinery”, “manufacture of other special-purpose machinery”, “manufacture of transport equipment n.e.c.” and “manufacture of parts and accessories for motor vehicles”. The first two sectors present high intensity of innovation, high labour skills and their main factor of competitiveness is product differentiation. In turn, the other two present medium-high intensity of innovation, and medium-low labour skills and the main factor of competitiveness is scale economies. These sectors rely on quality, which is why their RCA levels remained the same or even increased during the crisis. The only exception was the manufacture of other special-purpose machinery, which registered a reduction in the periods 2009–2011 and 2012–2014.

Other sectors that register a relevant index are “manufacture of tanks, reservoirs, and containers of metal”, “manufacture of plastic products” and “manufacture of vegetable and animal oils and fats”. The two first sectors have medium-low technological content, although the former use low labour skills and the second use medium labour skills. The third sector has a low technological content, low labour skills and medium-low intensity of innovation.

Finally, the comparative advantage in “manufacture of furniture”, “manufacture of products of wood, cork, straw and plaiting materials (16.2)”, “manufacture of grain mill products, starches and starch products (10.6)” and “manufacture of other textiles” should be highlighted. All these sectors have low technological content and low or medium labour skills and educational intensity. The sector of “manufacture of grain mill products, starches and starch products” is dependent on the natural resources and tries to establish a good relation between quality and price. For all the remaining sectors, the main factor of competitiveness is labour.

We find that the northern region of Aveiro relies largely on two groupings, one of low and medium-low technology sectors and another of medium-high technology sectors. There seems to be a growing commitment to the production of more complex products, with a greater involvement of technology. As for the competitive factors, what seems to have most prevalent in this region is product differentiation, although availability of labour and economies of scale also have a significant weight.

**Related diversification**

The results for the Krugman specialisation index (Table 11) show that the Aveiro North region export structure is similar to the national exports structure and presents a low level of specialisation.6

**Table 11.**

Krugman specialisation index of the Aveiro North region.

|  | **2006–2008** | **2009–2011** | **2012–2014** |
| --- | --- | --- | --- |
| EDV | 0.24 | 0.21 | 0.24 |

Source: Own elaboration. EDV: Entre Douro e Vouga.

According to Boschma et al. (2012), regions tend to diversify into new industries that make use of similar capabilities to those already used in existing companies.

In our case, it is possible to identify three examples of this type of diversification: the metal industry (Figure 3), the motor vehicle industry (Figure 4) and the footwear industry (Figure 5).

**Figure 3.**

Metal-related business activities with comparative advantage in the Aveiro North region. Source: Own elaboration.

**Figure 4.**

Automobile-related business activities with comparative advantage in the Aveiro North region. Source: Own elaboration.

**Figure 5.**

Footwear-related business activities with comparative advantage in the Aveiro North region. Source: Own elaboration.

**The metal industry**

The metal sector is the pillar for the economic development of the Aveiro North region. Benefiting from an intense demand for equipment and a favourable legislative framework, this sector registered remarkable evolution and growth after the Second World War up to 1975 (Coelho, 2002). ***Agriculture*** and farming activities stimulated the local demand for machinery which, along with the availability of labour, led to a significant increase in investment and the creation of new businesses in metal industry (Santos, 2001).

As an example, we refer to a flagship company of the region, ARSOPI, created in 1942, as a small mechanical metalworking company. Over the years, it developed several areas of activity, from the repair of automobiles and machines used by dairy companies to the commercialisation of fuels (1940s) and the manufacture of machinery for the industry of dairy products (1950), always trying to adapt to the circumstances and the needs of the region (Beira, 2007). At the end of the 1960s, ARSOPI began its internationalisation and in 1972 it already had its own foundry area. As a result of this work and its high capacity for innovation and adaptation, in the mid-1990s the company was already exporting to 63 countries. Currently, the ARSOPI group focuses on the dairy, wine and beverage, chemical, petrochemical and casting markets (ARSOPI, 2017).

Another outstanding company is COLEP, a packaging company, founded in 1965 (Faria and Mendes, 2011). Its production began with the use of tinplate; however, production diversified through vertical integration, technological modernisation and international contacts. This company benefited from the introduction of single dose products, widely accepted in Europe in the 1950s. In 1975, the company already produced packaging for a wide variety of markets (food, paints, glues, deodorants, etc.) (COLEP, 2014).

In recent decades, the metal industry has developed new capabilities, increasingly focusing on the manufacture of products with high added value, such as technical parts sold to the automotive, aeronautics and nuclear industry, thus achieving very positive results in terms of exports. There is a local spillover effect between firms, stimulating the introduction and development of new technologies, contributing to raising the added value of products and services and leveraging other economic activities. This can be explained by the existence of a regional innovation system, where innovation is a creative process resulting of the interaction between firms, associations and research centres, and the orientation to “problem-solving” (Moulaert and Sekia, 2003), leading to a net of interrelated diversification.

The big challenges of this industry are to replace part of the imports of raw materials and to try to produce machinery and equipment in sufficient numbers to satisfy domestic demand.

**Suppliers of automotive industry**

The automotive industry in the Aveiro North region appears directly related to the plastic mould industry and textiles.

In the 1920s, three men from Marinha Grande, who worked at the same plant of moulds for glass, began to experiment with moulds for pressing plastic materials. Attracted by the opportunities provided by the north glass centre, they were attracted to Oliveira de Azeméis and one of them created a mould-making plant (Beira, 2007). In 1945, there were already three companies of moulds for plastic in the region.

In the late 1940s, due to the necessity of glass moulds, the Vulcano centre was created inside the north glass centre, becoming a driver for the diffusion of new technologies within the moulds for glass and plastic (Beira, 2007). In 1955, Moldoplásticos was founded, and in 1959, one of its partners left the company to establish Simoldes Aços.

At the same time, the automobile industry began to develop at the national level, mainly due to the country’s economic needs (AICEP, 2016). In fact, in 1959, the commercial deficit, in part created by the increasing imports of automobiles, prompted investment in this industry. Domestic demand had to be met internally, a challenge to which the largest automobile assembly companies responded by opening factories in Portugal.

Thus, in the early 1960s, the mould-making business developed significantly, also driven by the professionals of the glass centre and the Vulcano centre and by the examples of Moldoplásticos, Simoldes, and Metaloura, founded in the meantime (Beira, 2007).

In 1963, a group of Portuguese businessmen set up Gametal, S.A., in Oliveira de Azeméis, which was dedicated to the production of tools and moulds mainly for the automobile industry (AFIA, 2015). In the 1980s, this company was acquired by the French group Bertrand Faure – currently Faurecia – and its areas of activity were expanded. In 1993, the company was sold to Kirchhoff Automotive and it developed rapidly.

The plastic mould industry in the region and the presence of direct suppliers of major automotive brands such as Faurecia and Kirchhoff Automotive determined the development of the automotive industry (Marques, 1997). Currently, Oliveira de Azeméis is one of the main centres for mould production, for automotive, electronics and home appliance industries, at an international level.

Another strong sector in the region was the textile manufacturing sector, including prestigious companies which, realising the interest in the manufacturing of automotive components, decided to specialise in the production of automobile textiles, as is the case of ERT (2017).

Nowadays, automobile suppliers face enormous challenges associated with the introduction of industry 4.0, the need to develop new materials, the electric revolution, and the emergence of autonomous vehicles. This sector needs to overcome the resistance to change or the likely lock-in effect caused by path dependence (Boschma and Frenken, 2011; Nooteboom, 2000).

**The footwear industry**

The footwear industry has a strong presence in the municipality of São João da Madeira and is one of the leading export industries in Portugal.

The beginning of the manufacture of footwear in this region dates back to 1483 with the first craftsmen (Museu do Calçado, 2017). Around 1833, the first footwear plant was founded, in 1905 another plant emerged, and in 1910 there were already four plants in the counties of Oliveira de Azeméis and São João da Madeira.

The high demand for leather prompted the development of tanning plants. As early as 1808, a company dedicated to the manufacturing of leather supplies was created in Santa Maria da Feira (Mesquita, 1995). The growing need to produce on a larger scale promoted the adoption of new tools and machines, laying the ground for the manufacture of tools and machines for the shoe industry.

Over the 20th century, the footwear industry grew significantly, reflecting the upsurge of direct foreign investment, internationalisation and the continuous upgrading of production plants. Companies were driven into foreign markets, first in the 1960s with the loss of the colonial market, and again in the mid-1980s with the accession to the EEC. The importance of the cluster in the region prompted the establishment of the Portugal’s Technical Shoe Centre in 1981 to give technical support and training to companies within the footwear value chain. Design and production skills improved, leading to increased productivity, improved quality and greater diversification. The hundreds of footwear factories that developed in Oliveira de Azeméis and São João da Madeira remained small and flexible, relying on local subcontracting to satisfy demand fluctuations. All firms benefitted from a skilled workforce pool that moved easily from firm to firm, which resembles Henry and Pinch’s (2000) concept of the “knowledge community”.

Over time, new materials, such as glues, textiles and plastics have been introduced into the manufacturing process. Textiles have become a very valuable material in this industry, even allowing the creation of companies in the region that are dedicated to the manufacture of textiles for this specific use. Plastic is also a widely used material, not only in the manufacture of heels but also in the manufacture of soles and other components, benefiting from the region’s experience in the manufacture of plastic injection moulds.

With increasing competition from Eastern and Asian countries, both in terms of price and quality, several companies closed in the first decade of the 21st century. In order to compete, firms had to reinvent themselves, invest in new equipment and technologies and innovate in design and materials as well as in distribution channels. The growth in e-commerce and well as sustainability are, currently, big challenges. Another major challenge regards human resources. There is a lack of supply of qualified personnel mainly because over time this industry has lost its capacity to attract young workers. The increase in compulsory schooling, and the overvaluation of university courses vis-a-vis professional courses, makes jobs related to the industry less sought after and less attractive in the eyes of young people.

Hence, over time we have been witness to the emergence and development of a highly supportive productive system for knowledge sharing. Firms and innovation support organisations have come to realise the need for new and detailed internal empirical research to understand the nature and extent to which businesses and organisations cooperate in the market and to what extent they contribute to greater innovation and competitiveness (Cooke, 2001). Firms also benefited from the proximity to the universities of Aveiro and Porto. Geographical proximity and clustering facilitated the diffusion of knowledge and learning and thus enhanced the firms’ absorptive capacities; it also made inter-firm collaboration easier.

**Discussion and implications**

This paper examines the industrial dynamics of a region with a long manufacturing tradition. The region has a competitive and resilient economy, with a high capacity for adaptation (CCDRN, 2013).

The paper shows that, so far, the industrial business sector has proved to be capable of resisting, renovating and recovering in a context marked by strong economic and financial recession, increasing competition and globalisation. Likewise, over time, many firms have shown a capacity to respond to technological challenges. Accordingly, for managers, instead of pure threats, these factors opened “windows of opportunity” for local manufacturing – several kept their international clients and even strengthened the relationship, while others diversified into new markets with higher value added, and/or widened their role within the value chain.

At the firm level, there is an overwhelming dominance of small and medium enterprises with a high productive flexibility, which have overcome the usual difficulties associated with a small size by forming business groups and by collaborating with each other and with entities of the scientific and technological system.

Some firms in specialised activities evolved from followers, just copying or imitating, turning into technology leaders, upgrading their products and processes and creating new ones. A few conduct R&D in-house, but most do it in collaboration with international clients and technological centres specialised in new materials, mechanisation and automation of production. Geographical proximity and clustering facilitated the diffusion of knowledge and learning and thus enhanced the firms’ absorptive capacities; it also made inter-firm collaboration easier, similar to that referred to by Pinch et al. (2003). However, overall, the region continues to have a low degree of specialisation and its focus continues to be on sectors with low technological content.

Locally embedded knowledge, coupled with skilled human resources capabilities and access to external coded information, drives and facilitates innovation and value creation (Bathelt et al., 2004). Thus, further efforts should be made to promote a system which is supportive of innovation and augmentation of human capital. It is necessary to mobilise institutions and companies to invest in human capital, innovation and R&D, to reinforce the existing comparative advantages and develop new ones. While EU cohesion policy has enabled the modernisation of key infrastructures, improvement in education, support for business and innovation and the implementation of European-wide territorial cooperation agreements, there is still room for improvement (Medeiros, 2014). Regional policies should combine the objectives of regional development with national policy objectives. Thus, the Northern Coordination and Regional Development Commission defined the need to focus on a regional strategy of intelligent specialisation, based on culture, creation and fashion – largely applied by the footwear sector – on mobility – fundamental to the metallurgical industry – and on broadband technologies, aligned with the definition of a smart specialisation policy based upon original and unique assets (Foray et al., 2009, 2011).

In line with what has been suggested by Teixeira and Barros (2014), given the challenges and speciﬁcities at the regional and local levels, a “multiscalar nature of governance within economies regarding SMEs export promotion might be advisable”. Future research should look at the local dimension or the decentralisation of the support provided to the internationalisation of ﬁrms. Furthermore, the region would benefit from a more proactive support system that, as proposed by Sivaev (2013), “engages with businesses that are not making the most of growth opportunities and addresses the ‘long tail’ of underperforming business”. It will also benefit from a regional innovation system (Moulaert and Sekia, 2003). Even if most support services should be delivered at a national level to ensure greater efficiency and better coordination, the local level should focus on adjusting national schemes to local needs and proactively engaging with the local business base to help it identify potential for growth.

**Supplemental Material**

**sj-pdf-1-lec-10.1177\_0269094220922823 - Supplemental material for Industrial dynamics in the context of a region’s international competitiveness**

Supplemental material, sj-pdf-1-lec-10.1177\_0269094220922823 for Industrial dynamics in the context of a region’s international competitiveness by Celeste Varum, Carmen Guimarães, José Martinho Oliveira and Ana Martins in Local Economy: The Journal of the Local Economy Policy Unit

**Notes**

1We present more details in the “The region” section.; 2After a massive slump in domestic demand from 2008/2009 onwards, Portugal’s three-year economic adjustment programme ended in May 2014.; 3The seminal works by Paul David (1985) and Brian Arthur (1989) are regarded as landmark studies on path dependence, highly influential in what has become a major and distinct research field today.; 4Comparing the sectors shown in Tables 5 and 6, the “manufacture of tubes, pipes, hollow profiles, and related fittings, of steel” should be highlighted as the sector that contributes most to exports and turnover.; 5For more details, please see Appendix 1, included in the supplementary material for this article.; 6For more details, please see Appendix 2, included in the supplementary material for this article.

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[***Genome-Wide Identification of Copper Stress-Regulated and Novel MicroRNAs in Mulberry Leaf***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H7S1-JDK8-000P-00000-00&context=1516831)

Biochemical Genetics

January 2021

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**Section:** Pg. 589-603; Vol. 59; No. 2; ISSN: 0006-2928,1573-4927

**Length:** 4233 words

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**Body**

Introduction

Copper (Cu) is an essential ***nutrient*** for plant growth. In animals, plants, and microorganisms, it is usually found in the form of copper ion or cuprein. It is a component of a variety of enzymes, which are widely involved in photosynthesis, respiration electron transport chain, reactive oxygen metabolism, ethylene sensation, nitrogen metabolism, cytoderm lignification, pollen formation, and other metabolic processes (Ku et al. ; Min et al. ; Yruela ). Lack of copper can lead to bluish-green, necrotic leaves, wrinkled or deformed leaves, short plants, slow growth, and reduced yield (Vinit-Dunand et al.

). However, with the extensive use of copper-containing fertilizers and fungicides, the copper content always exceeds the required amount by plants, which results in plant toxicity, interferes with plant metabolism, and destroys the structure and function of cells (Lombardi and Sebastiani ; Ouzounidou ). After the absorption of excessive copper, the membrane system and various organelles are vulnerable to damage. For example, protoplasts of maize root tip cells are destroyed by the excessive presence of copper (Ouzounidou et al. ). Excessive copper induces the rapid synthesis of plant cells, oxide anion (O2ˉ), hydroxyl radical (OH), hydrogen peroxide (H2O2), singlet oxygen (1O2), and reactive oxygen species. This decreases the strength of cell membrane, leading to the toxic effect of Cu2+ infiltration into the cell (Strange and Macnair ). The effects of excessive copper further affect the structure and function of the organelle and cause the leakage and deletion of other ions in the cell (Clijsters and Van Assche ).

Among them, intracellular K+ exudation is the most obvious. Besides, excessive copper inactivates chloroplast enzyme activity, accelerates chloroplast decomposition, inhibits the synthesis of chlorophyll, or damages the chlorophyll in plant cells quickly composite (Mittler ), which affect the photosynthesis of plants. However, copper poisoning is not common in plants under different environmental conditions of copper stress, so it is believed that the regulatory system changed during plant evolution to maintain the average growth and development process.

MicroRNAs (miRNAs) are groups of small (19–24 nucleotides in length), endogenous, evolutionarily conserved RNAs that function as posttranscriptional regulators of gene expression (Brodersen et al. ; Chen ; Fujii et al. ; Phillips et al. ), regulating plant physiological and biochemical processes, signal transduction, and biological and abiotic stress response (Budak et al. ; Luo et al. ). It is reported that miRNA to be identified was the first lin-4 (Lee et al. ) in Caenorhabditis elegans, regulating postembryonic development. Subsequently, Reinhart et al. () found the second heterochronous switching gene let-7 in nematode worms and its homologous in human cells. Since then, several research groups have identified hundreds of miRNAs (Llave et al. ; Reinhart et al. ) from various species, including humans, fruit flies, and plants. With the continuous innovation of research methods, a multitude of plant miRNAs have been identified and proved to play a crucial regulatory role in growth and development, hormone regulation, resistance to disease, and other aspects (Li et al. , ; Wang et al. ; Zhang et al. ). Studies have shown that during the regulation of copper ion stress, multiple miRNAs in plants, such as miR395, miR397, miR398, miR408, miR857 (Burkhead et al., ), and miR1444 (Shi et al. ), maintain internal environment stability by regulating copper-containing proteins with different functions (Wang et al. ). Jiu et al. () identified Cu stress-responsive grapevine microRNAs and their target genes by high-throughput sequencing, 100 known and 47 novel miRNAs were identified as differentially expressed under Cu stress.

Mulberry is an essential perennial economic tree. The comprehensive utilization of mulberry resources and the mulberry industry's development are getting a multitude of attention (Liu and Willison ). Simultaneously, mulberry has significant ecological and economic value, and its leaf is the primary food of silkworm. The root, stem, leaf, and fruit of mulberry have medicinal value (Subramoniam ). Mulberry trees can be used in paper making. Mulberry has a developed rooting system and strong adaptability to the harsh natural environment, with drought, salt and alkali, cold tolerance, and heavy metal ion absorption in soil (Sarkar et al. ). At present, research on abiotic stress responses in mulberry mainly focuses on the identification of resistant germplasm resources and cloning of resistant genes, while studies on the resistance function of miRNAs and the regulation of stress response genes are rare (Wu et al. ). It is reported that miR398 and miR408 (Lu et al. , ) play a crucial role in the copper stress response of Populus trichocarpa, but this role has not been determined in mulberry. In this study, two small RNA libraries were constructed using mulberry leaf tissue. Through RNA-seq and screening, a total of 65 known miRNAs and 78 predicted novel mature miRNAs were identified, among which a total of 40 miRNAs were differentially expressed under copper stress, including 27 miRNAs up-regulated genes and 13 miRNAs down-regulated genes. PCR is used in validating RNA sequencing results. Real-time fluorescent quantitative PCR (qPCR) and 5′ RLM-RACE were used to verify the expression patterns of 14 miRNA and the shear sites of miR156a target gene XM\_010090955.1, respectively. Our findings will provide the fundamentals for further study on the molecular mechanism of copper stress regulation in mulberry.

Materials and Methods

Plant Materials and Copper Treatment

The Mulberry (M. atropurpurea R.) variety was provided by the Sericulture research institute of the Chinese Academy of ***Agricultural*** Sciences. It was planted at the national germplasm resources greenhouse of Zhenjiang, Jiangsu, China. When the new shoots were about 20 cm long, mulberry seedlings with the same growth status were randomly divided into two groups. The control group (without Copper treatment) and the experimental group were treated with 200 mg/kg CuSO4 for 1 day, 3 days, 5 days, 10 days, 15 days, and 20 days to induce copper stress. To reduce the differences between individuals, three biological replications were conducted for each treatment, and 1–3 leaf positions of young leaves were ***collected*** at the same time point at different treatment times, which were immediately frozen in liquid nitrogen and stored at -80℃ for subsequent RNA extraction.

Construction and Sequencing of Small RNA Libraries

The total RNA was isolated from frozen samples using the reagent RNAiso Plus (Takara, China). A NanoDrop 1000 spectrophotometer was used to determine the RNA concentration and purity; RNA integrity was also checked using an Agilent 2100 Bioanalyzer (Agilent Technologies, Palo Alto, CA, US). Based on the pre-test results, the RNA extracted from the 5th day of the experiment and the control group was selected for the construction of a small RNA (sRNA) library at Novo Gene Biotechnology Company (China) in Beijing. The two sRNA libraries use the second-generation sequencing method to sort according to the manufacturer's protocol.

Analysis of Known miRNAs in Mulberry Leaves and Prediction of Novel miRNAs

Raw reads obtained from sequencing contained low-quality reads with adaptor. To ensure the quality of information analysis, raw reads were processed to obtain clean reads (Sunkar et al. ). Different clean reads in the samples were screened out, sRNAs with a length range of 18–30 nt were selected, and the sRNA after length screening was mapped to the reference sequence by bowtie (Langmead et al. ), and then compared with the sequence in the specified range in miRBase ([*http://www.mirbase.org/*](http://www.mirbase.org/)). Mirdeep2 software (Friedländer et al. ) and sRNA tools were used to obtain known miRNA and secondary structure. The signature hairpin structure of miRNA precursors was used to predict new miRNA. Using the software mirdeep2 (Friedländer et al. ) and miREvo (Wen et al. ), new miRNAs were predicted by the minimum free energy of secondary structures, Dicer cleavage sites, and small RNA markers (Wang et al. ).

Prediction of miRNAs Target Genes

Online software psRNATarget ([*http://plantgrn.noble.org/psRNATarget/*](http://plantgrn.noble.org/psRNATarget/)) was used to predict the target genes of miRNAs in combination with setting default parameters. According to the correspondence between miRNA and its target gene, The Gene Ontology (GO, [*http://www.geneontology*](http://www.geneontology)) and Kyoto Encyclopedia of Genes and Genomes (KEGG, [*http://www.genome.jp/kegg/database*](http://www.genome.jp/kegg/database)) were used to predict differentially expressed the function of the miRNA target gene, which mainly involved the determination of biochemical metabolism and signal transduction pathways.

Quantitative Analysis of miRNAs

Specific miRNA stem–loop reverse transcription primers were designed based on previous literature (Chen et al. ). Additionally, 6–8 bases of target miRNA 3′reverse complement were added to the 3′end of the universal stem–loop structure sequence (5′-GTCGTATCCAGTGCAGGGTCCGAGGTATTCGCACTGGATACGAC-3′).

The primers of the internal reference genes designed in the same way; using miRNA stem–loop reverse transcription primers, refer to the M-MLV reverse transcription kit (TaKaRa) to reverse transcribe cDNA. The forward primer of real-time fluorescent quantitative PCR was the first 13–14 bases of the target miRNA and 6 nt was added to maintain the Tm value at about 62 °C; the reverse primer, a universal primer (5′-CAGTGCAGGGTCCGAGGTAT-3′). The reaction was performed using SYBR qPCR SuperMix Plus (Novoprotein, China) master mix, using β-actin as the internal reference gene, with the following programs 95 °C, 1 min, 95 °C, 20 s, 40 cycles, 60 °C, 1 min program, in ABI Quant Studio 6 Flex (USA)). The reaction's result was three independent repeated experiments, and the relative quantitative method (2−△△Ct) was used to evaluate the relative expression differences of genes. All primers are shown in Supplemental Table S1.

Validation of Targets by 5′ RLM-RACE

The ability to connect to 5′ monophosphate RNA using a unique 5′ adapter, but not to 5′ splice containing a cap structure. With total RNA as the template, target gene fragments were cloned by referring to the FirstChoice RLM-Race Kit (Ambion) instructions using the corresponding general primers and specific primers. Sequence analysis software MEGA 6.0 was used to compare the sequencing results with the known sequences of target genes and verify the accuracy of the target genes' degradation sites obtained by sequencing.

Results

Statistical Analysis of Small RNA Libraries

Through high-throughput sequencing, total raw reads of 15,388,613 and 11,926,909 were obtained from the small RNA libraries constructed by the control group and copper stress, respectively. To ensure the quality of information analysis, the ***data*** were processed, and low-quality reads were removed (more than 30% of the total reads had a base value of sQ ≤ 20). The number of clean reads and their proportions in the total number of raw reads was 14,483,482 (94.11%) and 11,598,984 (97.25%). ***Data*** processing and its percentage in the total number of raw reads are shown in Table . The length interval of the sRNA was 18-35nt. The length distribution peak was used to determine the type of sRNA, clean reads of each sample were screened, and sRNA within a specific length range was used for subsequent analysis. The types (unique) and quantities (total) of sRNA are shown in Tables and , and the length distribution ***statistics*** are shown in Fig. S1.

***Data*** filtering in two small RNA libraries

| **Group** | **Total reads** | **N% > 10%** | **Low quality** | **5 adapter contamine** | **3 adapter null or insert null** | **With polyA/T/G/C** | **Clean reads** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Control | 15,388,613 (100.00%) | 156 (0.00%) | 239,773 (1.56%) | 12,304 (0.08%) | 640,641 (4.18%) | 12,257 (0.08%) | 14,483,482 (94.11%) |
| Copper stress | 11,926,909 (100.00%) | 119 (0.00%) | 175,001 (1.47%) | 13,837 (0.12%) | 109,987 (0.92%) | 28,980 (0.24%) | 11,598,984 (97.25%) |

The type and quantity of small RNAs in control and copper stress

| **Group** | **Total reads** | **Total bases (bp)** | **Uniq reads** | **Uniq bases (bp)** |
| --- | --- | --- | --- | --- |
| Control | 11,107,607 | 277,476,021 | 1,673,677 | 41,508,155 |
| Copper stress | 10,185,006 | 259,717,194 | 2,618,900 | 64,056,005 |

Analysis results of miRNAs in mulberry leaves in small RNA libraries

| **Group** | **Conserved** | **Novel** |
| --- | --- | --- |
| Mature | 65 | 78 |
| Hairpin | 73 | 95 |
| Uniq sRNA | 1545 | 2737 |
| Total sRNA | 379,697 | 711,436 |

MiRNA Expression Profile Analysis

miRNA development from precursor to mature body was done by Dicer enzyme cutting. The specificity of enzyme cutting points makes the first base of its mature body sequence to have a strong bias. To study the conservative miRNA in mulberry leaves under Copper stress, the screened sRNA was compared with the specified range sequence in miRBase.

To obtain the sequence length, number of appearances, and the secondary structure of known miRNA on each sample match, and through the secondary structure of RNA, Enzyme cut points and energy characteristics were analyzed to predict novel miRNA in the sample. Sixty-five (65) known miRNAs were identified in two small sRNA libraries belonging to 29 miRNA families, including 73 hairpin structures (Supplemental Table S2). Also, 78 novel miRNAs and 95 novel hairpins were predicted in the library (Supplemental Table 3). The vast majority of known miRNA families, such as miR156, miR159, and miR398 (Guo et al. ; Pokoo et al. ), are highly conserved in most plant species. The number of miRNAs in different families was significantly different, with the most significant family being miR159 with 13 members, followed by miR171\_1 with seven members. However, the miR319, miR828, miR171\_2, miR394, miR169\_1, miR395, miR393, miR6476, miR2111, miR162\_1, miR162\_2, miR408, and miR168 families were the smallest, each containing only one miRNA member. Furthermore, among known miRNAs, there were significant differences in the quantity and abundance of miR396a in the control and copper-treated libraries, which reflects the differences in its potential function in the response of mulberry trees to Copper (Supplemental Tables S2, S3).

Verification of Novel miRNAs in Mulberry Leaves

By analyzing the secondary structure of sequence as and Dicer enzyme cutting site information and other characteristics, novel miRNAs in samples were predicted. To the predicted novel miRNAs, nine miRNAs were selected to verify the analysis results. RT-PCR results showed that all nine miRNAs could be detected in mulberry leaf samples (Fig. S2). The stem ring reverse transcription primers used in the experiment are shown in Supplemental Table 1

Predictive Analysis of miRNA Target Genes

Online software psRNATarget was used to predict miRNA target genes in the samples. A total of 8318 target genes were predicted from 65 conserved miRNA (Supplemental Table S4). Of the 19 differentially expressed miRNAs, including 13 up-regulated miRNAs and 6 down-regulated miRNAs, were 2490 predicted target genes. After the significant miRNAs expression in different groups were obtained, Gene Ontology (Young et al. ) and KEGG (Kanehisa et al. ) enrichment analyses were conducted for the ***collection*** of target genes with different miRNA expression in each group according to the corresponding relationship between miRNA and target genes. These predicted target genes were mainly involved in the macromolecule metabolic process, organic substance metabolic process, primary metabolic process, and protein metabolic process (Fig. ).

Analysis results on the prediction of target gene GO enrichment of copper stress-regulated miRNA in mulberry leaves. The x-coordinate is three GO categories, and the y-coordinate is the number of candidate target genes, as well as the ratio between the number of labeled candidate genes and the total number of labeled candidate genes. These three different classifications represent the three main classifications of Go terminology (from left to right, biological processes, cellular components, and molecular functions)

The essential biochemical metabolic pathways and signal transduction pathways that predict target genes' involvement were identified through KEGG analysis. Rich factor, q value measured KEGG enrichment, and the number of genes enriched in this pathway. The Rich factor is the ratio of the number of genes in the pathway entry in the differentially expressed genes to the total number of genes in the pathway entry in all the annotated genes. The larger the Rich factor is, the higher the enrichment degree. q value is p value after multiple hypothesis testing and correction. The range of q value is [0,1], closer to zero, indicating enrichment of the more significant. Top 20 enriched pathway items were selected and are shown in Fig. .

KEGG enrichment result of predicted target genes. The vertical axis represents the pathway name, the horizontal axis represents the Rich factor, the dots' size represents the number of candidate target genes in the pathway, and the dots' color corresponds to different q value ranges

Identification of miRNA Regulated by Copper Stress

Differential expression analysis of two groups was performed to identify the Copper stress-regulated miRNAs in mulberry leaves using the DESeq R package (1.8.3) (Anders and Huber ). The p values were adjusted using the Benjamini–Hochberg method.

The corrected p value of 0.05 was set as the threshold for significantly differential expression by default. Forty differentially expressed miRNAs were obtained, including 19 conserved miRNAs, consisting of 13 up-regulated miRNAs and 6 down-regulated miRNAs. There were 21 novel miRNAs, including 14 up-regulated miRNAs and 7 down-regulated miRNAs (Table ).

Copper stress-regulated miRNAs identified in mulberry by deep sequencing

| **MiRNA** | **Sequence (5??3?)** | **Length** | **Copper stress vs. control** | | |
| --- | --- | --- | --- | --- | --- |
| ***p*-value** | **Padj** | **Mark** |
| Novel-2 | TTTGGATTGAAGGGAGCTCTG | 21 | 4.60 × 10?59 | 5.98 × 10?57 | Up |
| Novel-3 | TTTGTAGTTGAATTTGAAGACA | 22 | 8.70 × 10?5 | 4.04 × 10?4 | Down |
| Novel-5 | TTTTCCCAACACCTCCCATACC | 22 | 3.49 × 10?3 | 1.30 × 10?2 | Up |
| Novel-6 | TCTTGCCGAGACCTCCCATACC | 22 | 6.04 × 10?7 | 4.91 × 10?6 | Up |
| Novel-12 | TATTGGCCTGGTTCACTCAGA | 21 | 1.23 × 10?50 | 5.32 × 10?49 | Down |
| Novel-16 | ACTCTCCCCCTTAAGGCTTCCA | 22 | 1.80 × 10?16 | 2.60 × 10?15 | Up |
| Novel-18 | TTCATCTCTCCTCGACTGAAG | 21 | 6.16 × 10?27 | 1.34 × 10?25 | Up |
| Novel-19 | GGAATGGGCTGTTTGGGAAGA | 21 | 4.51 × 10?12 | 4.88 × 10?11 | Up |
| Novel-23 | TGCCAAGAGGAGTTGCCCTGT | 21 | 1.88 × 10?10 | 1.88 × 10?9 | Up |
| Novel-24 | ATCGGATCATGTGGTAGCTTCACC | 24 | 5.52 × 10?33 | 1.44 × 10?31 | Down |
| Novel-35 | TGCCAAAGGAGAGTTGCCCTC | 21 | 1.18 × 10?5 | 6.65 × 10?5 | Up |
| Novel-38 | TGAAGTGTTTGGGGGAACTCT | 21 | 1.04 × 10?4 | 4.66 × 10?4 | Up |
| Novel-40 | AGAAGAGAGAGAGTACAGCTT | 21 | 7.98 × 10?3 | 2.88 × 10?2 | Down |
| Novel-42 | TTGACAGAAGAGAGTGAGCAC | 21 | 2.87 × 10?5 | 1.49 × 10?4 | Up |
| Novel-45 | AGGATCTGTTTAGTTTATTAATTC | 24 | 9.80 × 10?3 | 3.35 × 10?2 | Down |
| Novel-56 | TGACAGAAGAGAGTGAGCACC | 21 | 1.17 × 10?2 | 3.79 × 10?2 | Up |
| Novel-60 | CGTGATATTGATTCGGCTCATA | 22 | 1.27 × 10?4 | 5.51 × 10?4 | Up |
| Novel-90 | TTGGACTGAAGGGAGCTCCTC | 21 | 2.05 × 10?22 | 3.81 × 10?21 | Down |
| Novel-114 | TTAGATTCACCCACAAACTCG | 21 | 4.29 × 10?4 | 1.74 × 10?3 | Up |
| Novel-115 | ATTGGAGTGAAGGGAGCTTCT | 21 | 2.12 × 10?3 | 8.09 × 10?3 | Up |
| Novel-128 | TACGCAGGAGAGATGACGCTGT | 22 | 4.74 × 10?5 | 2.28 × 10?4 | Up |
| MiR156a | TGACAGAAGAGAGTGAGCAC | 20 | 1.31 × 10?8 | 1.22 × 10?7 | Up |
| MiR159a | TTTGGATTGAAGGGAGCTCTA | 21 | 8.45 × 10?3 | 2.97 × 10?2 | Up |
| MiR162a | TCGATAAACCTCTGCATCCAG | 21 | 9.51 × 10?4 | 3.75 × 10?3 | Down |
| MiR164a | TGGAGAAGCAGGGCACGTGCA | 21 | 1.80 × 10?4 | 7.57 × 10?4 | Down |
| MiR166n | TCGGACCAGGCTTCATTCCTT | 21 | 8.27 × 10?39 | 2.69 × 10?37 | Up |
| MiR166p | TCGGACCAGGCTCCATTCCTT | 21 | 1.63 × 10?13 | 1.92 × 10?12 | Up |
| MiR167e | TGAAGCTGCCAGCATGATCTG | 21 | 2.30 × 10?5 | 1.25 × 10?4 | Up |
| MiR168a-3p | CCCGCCTTGCATCAACTGAAT | 21 | 5.00 × 10?6 | 3.34 × 10?5 | Up |
| MiR168a-5p | TCGCTTGGTGCAGGTCGGGAA | 21 | 4.52 × 10?6 | 3.26 × 10?5 | Up |
| MiR171a-3p | TTGAGCCGTGCCAATATCACG | 21 | 2.47 × 10?8 | 2.14 × 10?7 | Down |
| MiR171e | TGATTGAGCCGTGCCAATATC | 21 | 4.54 × 10?14 | 5.90 × 10?13 | Down |
| MiR172a | AGAATCTTGATGATGCTGCAT | 21 | 5.14 × 10?6 | 3.34 × 10?5 | Down |
| MiR395b | CTGAAGTGTTTGGGGGAACTC | 21 | 6.99 × 10?6 | 4.13 × 10?5 | Up |
| MiR396a | TTCCACAGCTTTCTTGAACTG | 21 | 8.92 × 10?51 | 5.32 × 10?49 | Up |
| MiR396c | TTCCACAGCTTTCTTGAACTT | 21 | 1.69 × 10?6 | 1.29 × 10?5 | Up |
| MiR396f | TTCCACGGCTTTCTTGAACTG | 21 | 6.64 × 10?6 | 4.11 × 10?5 | Up |
| MiR398b | TGTGTTCTCAGGTCGCCCCTG | 21 | 1.20 × 10?17 | 1.95 × 10?16 | Down |
| MiR399f | TGCCAAAGGAGAATTGCCCTG | 21 | 1.05 × 10?2 | 3.50 × 10?2 | Up |
| MiR408-3p | ATGCACTGCCTCTTCCCTGGC | 21 | 3.75 × 10?5 | 1.88 × 10?4 | Down |

To verify the sequencing results, special stem-ring RT-PCR primers were designed, and 14 differentially expressed miRNAs were selected for qPCR (Fig. ), with β-actin as the internal reference gene. Among them, the expressions of novel-2, novel-18, novel-23, novel-24, miR156a, miR166n, miR168a-3p, miR171e, miR396a, miR398b, and miR399f were identified as significantly differential expressions both by solexa sequencing and qPCR.

qPCR results of copper stress-regulated miRNAs in mulberry leaf. qPCR validation of differential expression of miRNA under copper stress. Error bars represent standard deviation. qPCR reactions were run in triplicates with three biological replicates

Identification of Target Cleavage Sites for miR156a

With the discovery of a multitude of miRNA, the identification of miRNA target genes has become the key to study the biological functions of miRNA. Target genes can be successfully verified by detecting the cleavage products and sites of target mRNA. We established a 5 'RCM-RACE experiment to verify the properties of potential miRNA targets and predict the regulation of miR156a on its target genes. The results showed that the predicted target gene XM\_010090955.1 cleavage sites of miRNAs were between 12 and 13 nt from the 5′ of miR156a (Fig. ). Only the cloned sequences that matched the correct gene and had 5′ ends within a 100 nt window centered on the miRNA validation were included. The partial mRNA sequences from the target genes were aligned with the miRNAs. The numbers indicate the fraction of cloned PCR products terminating at different positions. The primers of the 5′RLM-RACE experiment are listed in the supplementary electronic material (Supplemental Table S1).

Verification of target genes for miRNAs by 5′ RLM-RACE. The top strand depicts a miRNA-complementary site in the target mRNA, and the bottom strand depicts the miRNA. The arrows indicate the 5′ termini of mRNA fragments isolated from mulberry leaf, as identified by cloned RLM-RACE products, with the frequency of clones shown

Discussion

In this study, we identified 65 known miRNAs and 78 predicted novel mature miRNAs using high-throughput sequencing, of which 19 known and 21 novel miRNAs were identified as differentially expressed under copper stress. Although many miRNAs are associated with plant growth and development and stress resistance, they have different response patterns in different plants. According to studies, the expression level of MiR397a in western Balsam poplar changes with a change of copper concentration, the target gene of miRNA, copper-assisted laccase (LAC), is also regulated by MiR397a (Lu et al. , ). However, the differential expression of miR397a copper was not significant in mulberry. MiR398 plays multiple roles in biotic and abiotic stresses in several plants. For example, miR398 was identified as oxidative stress-responsive (Sunkar et al. ) and down-regulated in Medicago sativa and Medicago truncatula treated with toxic mercury, cadmium, or aluminum concentrations (Zeng et al. ; Zhou et al. ). MiR398 was up-regulated in the nitrogen-deficient (Liang et al. ). Loreto Naya et al. () proved that in bean plants under Cu toxicity, miR398b was decreased, and its target gene Nod19 and CSD1 were up-regulated. Besides, the down-regulation of miR398b was found in bean leaves infected with Sclerotinia scleortio-rum fungal pathogen. Our study observed the down-regulation of miR398b in mulberry leaves under Copper stress by high-throughput sequencing and qPCR. Similar results were also detected in rice seeds treated with Copper (Lu et al. ). Our results suggest that miR398 may be associated with abiotic stress regulation in mulberry leaves. Also, the primary function of miR408 in plants is to participate in abiotic stress response and maintain intracellular Copper ion content stability. The target gene of MiR408 encodes the copper-containing plasmidine in the photosynthetic electron transport chain, and the lase involved in lignin oxidation polymerization (Schuetz et al. ). In this study, miR408-3p in mulberry was down-regulated under copper stress, which was similar to the result analysis of arabidopsis thaliana under copper treatment, suggesting that it might be related to the Copper regulatory response of mulberry leaves.

In summary, by studying the expression profiles of miRNAs in mulberry leaves under copper stress, we can understand the Copper metabolism pathway of mulberry trees. The findings also provide an essential molecular basis for elucidating the molecular mechanism of plant absorption and Copper cultivation and cultivating new varieties of copper-efficient utilization plants. Further experiments on predicted target genes validation and function identification are necessary to explore the potential mechanism of copper stress regulation in mulberry.

**Acknowledgements**

This work was supported by Sericulture Industry Technology in China ***Agriculture*** Research System (CARS-18-ZJ0207), Guangxi innovation-driven development project (AA19182012-2), Open Program of Key Laboratory of Silkworm and Mulberry Genetic Improvement Ministry of ***Agriculture***, China (KL201906), The Crop Germplasm Resources Protection Project of the ***Agriculture*** Ministry (111721301354052026), and National Infrastructure for Crop Germplasm Resources (NICGR-43).

**Notes**

Publisher's NoteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

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[***Public sector organizations and agricultural catch-up dilemma in emerging markets: The orchestrating role of Embrapa in Brazil***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2V1-F0C0-33S6-00000-00&context=1516831)

Journal of International Business Studies

April 2020

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**Section:** Pg. 646-670; Vol. 52; No. 4; ISSN: 0047-2506,1478-6990

**Length:** 15205 words

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**Body**

INTRODUCTION

Catch-up is the process by which productivity growth has occurred and converged over time across countries through the modernization of technology embodied in their respective capital stocks (Abramovitz, ). The more laggard a country, the more its potential to improve rapidly through such modernization. Over time, laggards may not only catch up with leaders by utilizing advanced technology but also potentially leapfrog and displace them by proceeding to generate new knowledge. Many studies have explored how countries and firms have “caught up” through industrialization or in specific industries such as automobiles or high-technology fields (e.g., Amsden, ; Awate, Larsen, & Mudambi, ; Brandt & Thun, ; Chu, ; Hung & Chu, ; Kumaraswamy, Mudambi, Saranga, & Tripathy, ; Mathews, ; McDermott & Corredoira, ).

Far fewer studies, however, have explored catch-up in the ***agricultural*** sector (e.g., Andersen et al., ; Bisang & Gutman, ; Giuliani, Morrison, & Rabellotti, ; McDermott, Corredoira, & Kruse, ). This is surprising because the sector is a significant source of gross domestic product (GDP) and a driver of economic development in developing and emerging economies1 (Mazzoleni & Nelson, ). With the growing global demand for food and feedstock, the ***agricultural*** sector’s capital and knowledge intensities, and its interactions with other sectors considered high technology have increased. So has the sector’s global scope. Moreover, catch-up in the ***agricultural*** sector also has critical implications for national and, more widely, global food safety and security, health and social welfare, and environmental sustainability (Hirsch-Kreinsen, ; Hirsch-Kreinsen, Jacobson, Laestadius, & Smith, ).

Extant studies on catch-up in the ***agricultural*** sector have noted several requirements and dynamics similar to those observed in the case of catch-up in the industrial sector. For instance, catch-up in the ***agricultural*** sector also requires effective public policies and institutional mechanisms to jump-start the process. Moreover, diverse interorganizational linkages (private–private, public–private, and public–public) enable the sustenance of catch-up efforts over the long term (e.g., Bisang & Gutman, ; Giuliani et al., ; Hall, Matos, Silvestre, & Martin, ; McDermott et al., ). Despite these similarities, catch-up in the ***agricultural*** sector exhibits several challenges that are different in nature and scope from catch-up in the industrial sector.

First, despite the ***agricultural*** sector being characterized as either low or medium in terms of technological intensity and scope, even traditional crossbreeding techniques to develop new cultivars2 require significant tacit knowledge and intensive effort by specialized teams of researchers over long periods (Andersen et al., ). The recent application of modern biotechnology to develop new cultivars has increased technological intensity and complexity, with seeds becoming complex “assemblies” of desirable features made possible by genetic engineering (Andersen et al., ; Hirsch-Kreinsen, ; Marin, Stubrin, & van Zwanenberg, ; von Tunzelmann & Acha, ). Increasingly, the refinement and adaptation of new cultivars to different soil and climatic conditions involve a mindful combination of modern biotechnology and traditional crossbreeding techniques to improve commercial viability and value. While these advances have enabled rapid development of new cultivars with a wide range of desirable features, they also require a significant degree of technological sophistication and tacit knowledge, hence the need to build absorptive capacity (Cohen & Levinthal, ) to acquire, learn, and apply existing products and technologies, and innovation capabilities (Bell and Pavitt, ) to develop new cultivars and associated technologies appropriate for specific climatic and soil conditions.

Second, while catch-up in the industrial sector is typically “spearheaded by a few ‘leading’ (large or small) firms that adapt their strategies and make appropriate investments in upgrading their capabilities, diverging away from laggard firms” (Kumaraswamy et al., : 369), catch-up in the ***agricultural*** sector requires a substantial and sustained investment of resources and the creation of a pervasive ecosystem of diverse organizations to facilitate both innovation and diffusion (Griliches, ; ; Hayami and Ruttan, ; Rogers, ; ). For instance, Rogers (, ) found that the development and diffusion of new technologies in the U.S. ***agricultural*** sector was due to the development of a two-part innovation ecosystem: a research subsystem constituted by research universities and supported by government agencies to develop new applied knowledge and technologies, and a much wider extension subsystem of universities, government agencies, nongovernmental organizations, and private sector organizations at various levels (federal, state, and county) to facilitate the widespread diffusion and adoption of new knowledge and technologies by farmers and other end users. Griliches’ () seminal work further demonstrates the value of ***collective*** participation by tracing the use of collaborative experimental stations in hybrid corn, which “played a major role in the comparative analysis of practice, and in spreading the news regarding best practice to farmers” (Mazzoleni & Nelson, : 1517). Thus, catch-up in the ***agricultural*** sector requires the ***collective*** participation of diverse organizations in innovation and significant and sustained investments to build an ecosystem to facilitate the generation and widespread dissemination of new technologies to farmers and other end users.

A third challenge pertains to the evolution of the seeds sector and agribusiness from isolated national markets to one that is global in scope. Beginning in the early 1980s, the application of modern biotechnology gave rise to complementarities and economies of scope between the development of agrochemicals (e.g., fertilizers, pesticides) and the development of cultivars adapted or tolerant to these chemicals (Carvalho & Pessanha, ). Simultaneously, the emergence of global frameworks for the protection of intellectual property also afforded protection for new varieties of plants and seeds through patents and the less-effective certificate of plant variety protection (Yamamura, ). This made it attractive for multinational companies from developed countries to invest in innovation and international trade in new and improved cultivars. A wave of mergers and acquisitions among companies in the pharmaceutical, agrochemical, and seeds sectors led to the emergence of an oligopoly of global agribusinesses (e.g., BASF, Bayer, Dow, Dupont, Monsanto, and Syngenta) collectively known as the Gene Giants. These Gene Giants possessed global reach, expertise in biotechnology and genetic engineering, and formidable capital, technological, and marketing resources to achieve market dominance. This meant that any catch-up investments and initiatives – especially by emerging economies with large growth markets – inevitably will face competition from these global, well-endowed agribusinesses and struggle to maintain salience to effectively safeguard national interests.

Taken together, these challenges make catch-up in the ***agricultural*** sector a formidable undertaking – one that goes beyond problems posed by the need for significant resources and scale – for emerging economies such as those in Latin America, which have faced decades of dysfunctional economic, political, and social dynamics, institutional fragmentation, fiscal uncertainty, and the lack of adequate capital, technological, and human resources (Haggard & Webb, ; Willis, da Cunha Bueno Garman, & Haggard, ; Haggard & Kaufman, ; Marin & Stubrin, ; Schneider, , ). Moreover, these economies are beset by systems that limit the ability of their governments to develop effective policies or institutional mechanisms to safeguard national interests while pursuing technological progress (Haggard & Kaufman, ).

How, then, can such emerging economies catch up technologically in the ***agricultural*** sector? More specifically, how can these economies first develop the absorptive capacity and innovation capabilities to jump-start the catch-up process and then build an ecosystem to facilitate the continual generation and dissemination of innovations? Equally important, how can they maintain the viability and salience of their catch-up investments and initiatives subsequent to the entry and dominance of well-endowed multinational companies (i.e., the Gene Giants)?

To answer our research question(s), we chose to study a successful instance of catch-up in the soy seeds sector in Brazil, a Latin American country subject to the complex challenges that we noted earlier. Starting nearly from scratch in the early 1970s when small quantities of soybeans were grown only in the southern states with favorable climatic and soil conditions, Brazil reclaimed barren lands deemed unfit for cultivation, developed new varieties of soy seeds suitable for cultivation in diverse climatic and soil conditions in its different regions, and eventually become the second-largest producer and exporter of soy seeds worldwide, accounting for approximately 30% of global production and 40% of global exports by 2015.

To offer a brief preview, our study demonstrates an innovative role for public sector organizations in accomplishing catch-up in the ***agricultural*** sector in an emerging economy context. Specifically, it provides a step-by-step processual account of how Embrapa, a public sector organization chartered by the Brazilian government, accomplished catch-up in the country’s soy seeds sector by first developing critical capabilities and then building an innovation-diffusion ecosystem of public and private organizations. Equally important, our study calls into question the prevalent notion of technological catch-up as a rush to reach the technological frontier at any cost, without regard for safeguarding national interests and environmental sustainability (also see Figueiredo, ; Perez-Aleman, ) – especially in (though not limited to) the ***agricultural*** sector.

In the sections that follow, we first present the core catch-up dilemma confronted by emerging economies such as those in Latin America. Subsequently, we describe our study’s methodology and offer a case narrative of how Embrapa built needed capabilities and a pervasive ecosystem of diverse organizations to address catch-up challenges and then maintained its salient role even after the entry and domination of Brazil’s soy seeds sector by global agribusinesses. We conclude by discussing the insights and implications of our study.

CATCH-UP DILEMMA IN EMERGING ECONOMIES

The requirements imposed by catch-up in the ***agricultural*** sector – the development of absorptive capacity and innovation capabilities and the subsequent building of an ecosystem to continually generate and diffuse innovations, the sustained investment of resources, and eventual competition from well-endowed global agribusinesses – poses a core and seemingly intractable dilemma as to who should drive catch-up and how these efforts should be implemented and sustained over the long term (Marin, Navas-Aleman, & Perez, ).

Prior research suggests that governments can facilitate the development of technological knowledge (Montalbano, Nenci, & Pietrobelli, ), particularly through the implementation of new regulations and standards (Perez-Aleman, ). As we have seen in the cases of industrial catch-up and leapfrogging in Japan and Korea, government initiatives and policies can influence access to knowledge, labor, and technological inputs as well as increase the motivation of the private sector to engage in innovation (Casper, Lehrer, & Soskice, ; Rogers, ). However, each country has its own economic and social endowments, and governments exhibit inherent differences in their ability to restructure entire sectors (Safford, ).

Historically, emerging economies, such as those in Latin America, have suffered decades of institutional fragmentation, fiscal uncertainty, and the stagnation of local markets (Haggard & Webb, ; Willis et al., ). Furthermore, governments in these economies face demands from numerous constituents with diverse and conflicting interests. So, they may find it difficult financially and politically to marshal the considerable resources needed to spur technological upgrading and innovation and to set up the far-flung ecosystem to facilitate widespread diffusion of the fruits of such progress (Lazzarini, ; Schneider ). Even when conditions are favorable, governments often find it difficult to formulate cohesive policies. Or they introduce excessive regulation and bureaucracy that make local actors reluctant to support government initiatives (Casaburi, ). Therefore, it is not surprising that formal, centralized attempts by governments in these fragmented and conflict-ridden systems to plan or coordinate technological catch-up have been ineffective or short-lived (Limoeiro & Schneider, ). Indeed, as Mahmood and Rufin () have proposed, economic and political centralization may enable governments to play more fruitful roles in facilitating technology development and innovation, especially when economies are located far from the technological frontier.

While these constraints make it challenging for governments to drive technological progress and change, they also have circumscribed the emergence of a dynamic private sector with the ability to engage in catch-up (Schneider, , ; Marin & Stubrin, ; Perez-Aleman, ). The private sector that does exist may not possess the scale, resources, or incentive to first develop absorptive capacity and innovative capabilities and then forge diffusion capabilities (potentially a public good). Partly, as we discussed earlier, this is due to the ineffectiveness of governments in these economies to formulate policies and institutional mechanisms that reward and protect investments and innovation by the private sector. Moreover, private sector firms possess heterogeneous interests and sets of resources that make it difficult for them to engage in ***collective*** action or learning critical for catch-up in the ***agricultural*** sector (Perez-Aleman, , ; Rogers, ). The likelihood of collaboration among private firms may also vary due to the nature of firm clusters and their relational social structures, resulting in the emergence of dysfunctional networks that do not generate value (Granovetter, ; Knoke, ).

When the domestic private sector is not capable of engaging in catch-up, one possibility for governments of large and growing economies is to open their markets and invite the entry of technologically well-endowed multinational companies. However, the entry of multinational companies can be a double-edged sword. On the one hand, their entry may lead to productivity increases and technological catch-up by local organizations due to potential spillovers or sharing/transfer of technology through the development of local supply chains. On the other hand, any such benefits are contingent on the country’s stage of economic development as well as the awareness, capability, and motivation of local organizations to respond effectively to multinational entry (Blomström & Kokko, ; Meyer & Sinani, ).

Inevitably, multinational companies dominate the markets they enter and relegate local firms to peripheral status within sectoral value chains (e.g., Humphrey & Salerno, ; McDermott & Corredoira, ). Once they become indispensable to the host-country’s economy, the bargaining power of multinational companies may increase, especially in technologically dynamic and global sectors (Kobrin, ). With the increasing technological and capital intensities, the global scope of the ***agricultural*** sector, and the salience of global intellectual property regimes (e.g., The Agreement on Trade-Related Aspects of Intellectual Property Rights or TRIPS) governing ***agricultural*** products such as genetically engineered seeds, host governments may possess even less power to “entice” multinational entrants to act or invest in the host-country’s interests, as opposed to making proprietary investments to fully appropriate the value of their intellectual property. Although considerations such as sustainability are becoming central to firm- and country-level strategies (Brandl, Darendeli, & Mudambi, ; Parente et al., ), multinational companies may not adequately consider environmental sustainability or other host-country priorities (Lipsey & Sjöholm, ), and host governments may prefer not to push back and alienate them.

When neither the government nor the private sector (domestic or multinational) has the ability or the willingness to make appropriate investments, it is not clear how emerging economies can accomplish technological catch-up in the ***agricultural*** sector. As an answer to this dilemma, scholars have suggested a potential role for public sector organizations or state-owned enterprises (e.g., McDermott et al., ; McDermott & Corredoira, ; Perez-Aleman, ; Schneider, ). These organizations are established by and, hence, extensions of their governments. However, they have specific and limited mandates and therefore may be insulated from the myriad dysfunctional pressures and conflicts that beset governments.

Indeed, as Schneider () pointed out in the case of Brazil, the handful of successful organizations or “pockets of efficiency” in its industrial sectors (e.g., Embraer, Oi/Telemar, Gerdau) had their origins as state-owned enterprises, that is, public sector organizations. Drawing inspiration, we decided to explore the case of successful catch-up in Brazil’s soy seeds sector, which indeed was orchestrated by a public sector organization (that is, Embrapa). Embrapa operated with some degree of autonomy and overcame institutional voids (Jackson & Deeg, ) and myriad constraints to become a pocket of efficiency (Evans, ; Schneider, ).

***DATA*** AND METHODS: BRAZIL’S SOY SEEDS SECTOR

Our research setting is the soy seeds sector in Brazil from 1973 to 2015. Geographically, Brazil stretches on both sides of the equator, with significant diversity in both climatic and soil conditions. After declaring independence from Portuguese rule, Brazil politically alternated between autocratic rule by the military and democratic governments until an enduring federal democracy was established in the mid-1980s. Brazil’s economy experienced periods of industrialization and growth driven by government attempts at industrial planning and investments, and economic liberalization, but the country was beset with debt crises, inflationary pressures, and inconsistent policies. Indeed, by the beginning of our study period (i.e., the early 1970s), as with other Latin American countries, Brazil’s political economy had undergone cycles of dysfunctional dynamics that were not conducive to promoting sustained growth throughout the vast nation. Whereas the southern states had enjoyed industrial and ***agricultural*** growth, other parts of the country lagged behind significantly.

Specifically, with respect to soybeans, during the early 1970s, relatively small quantities were cultivated in the southern states where the climate was more temperate and soil conditions were favorable. However, several events in the early 1970s were instrumental in the significant growth of global soybean demand and its emergence as a valuable source of export earnings in addition to fulfilling increasing domestic demand for food and feedstock. One such event was the U.S. government’s soybean export restriction of the early 1970s and the consequent increase in global soybean prices and Japan’s efforts to find new sources of soybeans (Japan was then the largest consumer and importer of soybeans in the world). A second was the emergence of China as a significant soybean importer beginning in the mid-1990s. These events, in turn, prompted emerging economies like Brazil to invest resources and land in soybean cultivation. While increasing market demand clearly drove investment in soybean cultivation, the fact remains that Brazil had to make significant and sustained investments to first absorb and internalize highly tacit knowledge pertaining to soybean crossbreeding and cultivation in varied climatic conditions and then forge technological and infrastructural capabilities to catch up with the United States, which was the dominant soybean producer and exporter. These are the things that motivated us to study the investments and initiatives that made possible technological catch-up in Brazil’s soy seeds sector.

We utilized a longitudinal case-study approach (Davis & Eisenhardt, ; McDermott et al., ; Pettigrew , ; Yin, ) to understand the process of catch-up in the Brazilian soy seeds sector over a period of about four decades (1973 to 2015). Our study’s focal actor was the Brazilian ***Agricultural*** Research Corporation (Embrapa), the public sector organization set up by the Brazilian government in 1973 to initiate and orchestrate catch-up in Brazil’s ***agricultural*** sector and to commercialize the new seeds and associated technologies developed through such catch-up. Embrapa was responsible for coordinating research in ***agricultural*** sciences undertaken by the National ***Agricultural*** Research System (NARS) comprising 122 organizations such as federal public institutions, state universities, and domestic private foundations and companies.

Though it was tasked with technological catch-up and the commercialization and diffusion of newly developed seeds within Brazil, Embrapa’s objectives also encompassed the safeguarding of Brazil’s ***agricultural*** interests and its environment. Accordingly, we decided to focus not only on technological and commercial dimensions of the catch-up process but also on the wider relational-, institutional-, and sustainability-related outcomes. Therefore, we studied Embrapa’s initiatives, the institutional, market, and technological contexts within which such actions occurred, the evolving relationships between Embrapa and other actors (public and private, international and national), and the outcomes of these actions and relationships that, in turn, became the context for subsequent initiatives and events.

Such rich details on events and their context as well as the explication of the underlying drivers enabled us to identify patterns and propose potentially causal explanations of these patterns (e.g., antecedents and consequences) (see Pentland, ; Van de Ven & Poole, ). In addition, rich details create verisimilitude by offering a transparent window into the complexities and dynamics of our research setting, thereby enabling readers and interested scholars to assess the credibility of our interpretations compared to potential alternative explanations (Creswell & Miller, ; Lincoln & Guba, ). Equally important, they offer similarly placed actors (e.g., other agribusiness-dependent countries and associated organizations) to abstract and transfer insights that are relevant and appropriate (i.e., generalizable) to their own specific settings (Langley, ).

We ***collected*** ***data*** from multiple sources using multiple methods. During 2015, we conducted 41 personal interviews with directors, managers, and technical experts within Embrapa, professionals from various agribusiness organizations (from both the public and private sectors) that constitute the Brazilian soy seeds sector ecosystem, and industry experts from universities and trade associations. These interviews, which lasted 30 to 90 min each, were recorded and then transcribed to generate 488 pages of primary source materials and notes. We shared respective interview transcripts and notes with each informant so they could check the accuracy of our interpretations (Lincoln & Guba, ). When we noticed any inconsistencies in specific events or issues across our interviews, we contacted informants to obtain clarification and additional information. In addition, we engaged with the phenomenon in depth by conducting technical visits to key research organizations to gain an appreciation of the technological initiatives and advances related to the catch-up process.

To complement our fieldwork and primary ***data***, we ***collected*** ***data*** from Embrapa’s archival records, published commentaries, business and trade publication articles, news releases, reports published by industry and trade associations, and annual technical reports from national and international research organizations. In addition, we gathered secondary ***data*** on soybean production and exports from a variety of databases. We performed content analysis of relevant research publications from two databases – National Institute of Industrial Property (INPI) and Derwent Innovations Index (DII) – to identify various organizations with which Embrapa collaborated over time. By examining the rich ***data*** obtained from multiple sources and by using multiple methods, we were able to triangulate, cross-check, and ensure the validity of our ***data*** and inferences. Table  provides details on our key ***data*** sources.

***Data*** sources.

| **Sources** | **Details** |
| --- | --- |
| Interviews and technical visits | 41 personal interviews (30 to 90 min long; recorded and transcribed) with Embrapa directors, managers, and technical experts, as well as executives, professionals, and experts at public-sector, private-sector, and other organizations (such as foundations and associations)Technical visits, including Embrapa?s soybean Germplasm Bank |
| Published retrospectives, articles, and commentaries | Published retrospectives of EmbrapaArticles and comments/commentaries published in the popular business press and specialized/trade journalsAnnual technical reports of the National Center for Soy ResearchArticles and commentaries identified through extensive Google searches |
| Websites of organizations and other online sources | Reports, ***data***, news, and general publications available from the websites of Embrapa (headquarters), Embrapa Soja, and Embrapa CerradosOther online sources of industry news, reports, and ***data*** such as the websites of the U.S. Department of ***Agriculture*** (USDA); International Union for the Protection of New Varieties of Plants (UPOV); World Trade Organization (WTO); World Intellectual Property Organization (WIPO); Food and ***Agriculture*** Organization of the United Nations (OECD-FAO); International Seeds Federation (ISF); JICA Research Institute; Brazilian Agribusiness Foreign Trade ***Statistics*** (Agrostat); Ministry of ***Agriculture***, Livestock, and Supply (MAPA); Ministry of Environment (MMA); and Ministry of Development, Industry, and Commerce (MDIC) |
| Company and industry directories | Histories on key industry actors from directories such as the U.S. Department of ***Agriculture*** (USDA), National Supply Company (Conab), Secretariat of Foreign Trade (Secex) of Ministry of Development, Industry, and Commerce (MDIC) |
| Industry association news releases and reports | News releases and reports published by industry associations (e.g., Brazilian Association of Seeds and Seedlings (ABRASEM) and Brazilian Association of Soybean Producers (ABRASS)) |
| Databases | National Service of Protection of Cultivars (SNPC) databaseU.S. Patent and Trademarks Office databaseNational Institute of Industrial Property (INPI) and Derwent Innovations Index (DII) patent applications from 1973 to 2015SciELO Citation Index and Web of Science databases for joint publications on hybrid or genetically modified soybean seeds between Embrapa and various partners from 1973 to 2015 |

Next, we generated a detailed chronology of events in the Brazilian soy seeds sector from 1973 to 2015. Using this detailed chronology as the foundation, we created numerous tables and diagrams to better understand links between context, actors, events, and outcomes and to identify potential patterns and explanations at and across time. As suggested by Miles and Huberman (), we coded our ***data*** for thematic content by abstracting quotes, text, and quantitative information from our interview transcripts and various archival sources. In particular, we sought to understand Embrapa’s initiatives and interactions with other actors in its efforts to drive catch-up within the sector; the technological, institutional, and market contexts within which these efforts were made; the enablers and constraints in force; the outcomes of these efforts at various points in time; and the resultant evolution of the sector itself over time.

As we engaged with the ***data*** more deeply and iterated between ***data*** and existing theory, several insights began to emerge. We noticed similarities between the catch-up process orchestrated by Embrapa and findings of studies (Griliches, ; McDermott et al., ; McDermott & Pietrobelli, ; Perez-Aleman, ; Rogers, ) on technological progress and catch-up in the ***agricultural*** sector. However, our fieldwork and qualitative ***data*** suggest that the catch-up process orchestrated by Embrapa progressed relatively quickly, from building absorptive capacity during the 1970s to a nearly simultaneous emphasis during the 1980s on increasing productivity (in the limited area in the southern states with favorable climatic and soil conditions) and developing innovation capabilities (to reclaim barren lands and enable soybean cultivation in the remaining parts of Brazil that had unfavorable conditions). In addition, we noted the especially critical roles played by universities, government agencies, and public organizations (apart from Embrapa) and public–private partnerships in the catch-up process. We also realized that the very nature of catch-up in the ***agricultural*** sector may be different from that in the industrial sector and may need to be reconceptualized not just as a race to the technology frontier, but as a more mindful process of innovation seeking to establish a balance between technological progress and environmental sustainability.3

During our analysis, we noticed a significant lag between the adoption of intellectual property regimes applicable to plant and other organic materials at the global level and within Brazil. We also noted that our informants repeatedly mentioned the critical enabling and constraining role played by the intellectual property regime applicable to plant material within Brazil. For instance, Brazil began to offer some intellectual property protection to crossbred seeds only after the institution of the Plant Varieties Protection Law (PVPL) in 1997 that prompted further involvement in the development and diffusion of new seeds by private companies. The mid- to late-1990s saw the emergence of genetically modified or transgenic soy seeds and increasing interest of multinational agribusinesses in entering Brazil and neighboring Argentina. However, Brazil continued to ban the cultivation of transgenic seeds and did not allow patenting of seeds or other organisms found in nature. Eventually, this ban resulted in the smuggling of transgenic seeds from Argentina and, despite the ban, quick adoption by Brazilian soy farmers who thought these seeds offered benefits over traditionally crossbred seeds. Only in 2005 did the Brazilian government finally adopt the Biosafety Law (first proposed in 1995), making their use legal. This set the stage for multinational agribusiness firms to legally introduce transgenic seeds into Brazil and gain dominance.

Given the discontinuities introduced by the adoption of the PVPL in 1997 and the Biosafety Law in 2005, we decided to temporally bracket (Langley, ) our study time frame (1973–2015) into three periods: 1973–1996, 1997–2005, and 2006–2015.4 Our strategy to temporally bracket using changes in the intellectual property protection regime within Brazil is consistent with the recommendations offered by scholars (e.g., Lee & Malerba, ; Pettigrew, ) to identify major market demand, technological or institutional discontinuities, or milestones to guide ***data*** analysis. Indeed, as Lee and Malerba () noted, the long-run evolution of a sectoral system is determined by changes in demand, changes in knowledge and technology, and changes in institutions and public policy, with responses/strategies to these changes determining leadership changes and catch-up by latecomers.

Continuing with our earlier effort to understand in more detail context, events, patterns, dynamics, and outcomes within each period, we created tables that allowed us to revisit and refine our thematic coding and illustrate how we induced insights from our comprehensive ***data*** (see Table  for a summary).

Context, events, and outcomes in the Brazilian soy seed sector, by period.

|  |
| --- |
| *Period 1 (1973?1996)* |
| Market/demand: 1973 U.S. Embargo - soybean price increase/1990s transgenic seeds; China as major importer |
| **Institutional:** 1978 Protection of New Varieties (UPOV) convention/1980 U.S. Supreme Court allows patenting of living organisms/1990 Brazilian market opening/1991 Revision of UPOV convention/1993 Biological Diversity (CBD) convention/1994 Agreement of Trade Related Aspects of Intellectual Property Rights (TRIPS)/1995 Brazil member of WTO and TRIPS; Biosafety Law introduced/1996 Brazil enacted Law on Industrial Property |
| **Embrapa related:** 1973?1975 Creation of Embrapa, Embrapa Soja & Embrapa Cerrado; Development of POLOCENTRO/1979 Japanese-Brazilian cooperation (PRODECER) |
| **Embrapa collaborations:** 1973?1980 Collaboration and education/training in U.S. universities and federal agencies; international organizations and multilateral/bilateral cooperation with more than 16 countries/1981?1996 Collaboration with public universities, national and state research institutes, and private associations within Brazil |
| **Catch-up outcomes:** 1973?1980 Technological capabilities accumulation/1980s Development of biological nitrogen fixation/1981?1996 Expansion of ***agricultural*** frontier to other Brazilian regions; crossbreeding, technologies for soil management, cultivars with different growth cycles and disease resistance; creation of a germplasm bank/Growth from 1980 to 1997: Land-area cultivated 8500 ha to 11,800 ha; production 15,200 tons to 27,300 tons; yield from 1.8 tons/ha to 2.3 tons/ha; exports from 1800 tons to 8400 tons |
| *Period 2 (1997?2005)* |
| **Market/demand:** 1990s Monsanto introduces transgenic seeds in Argentina/2001?2003 Smuggled transgenic seeds to Brazil/2001?2005 Rapid diffusion of smuggled seeds in Brazil |
| **Institutional:** 1997 Plant Varieties Protection Law (PVPL)/1998 Law of Access to Genetic Resources/1999 Brazil signatory of 1978 UPOV convention/2003 Revision of PVPL (1977) enhancing protection and promoting investment in innovation/1997?2004 Transgenic seeds ban/2005 Revision of Biosafety Law (1995) |
| **Embrapa related:** 1997?2005 Ban on transgenic seeds discouraging investment in biotechnology; misuse of farmer?s privilege, resulting in piracy/1998 Budget decline/2000?2001 Gene Giants entry; introduction of transgenic seeds in South of Brazil/2003 Smallest Embrapa budget since 1975/2005 Gene Giants competition led to decline in adoption rate of Embrapa?s cultivars to 39% (from 51% in 2001) |
| **Embrapa collaborations:** Increase in number partnerships; collaboration with national private companies (foundations and associations of small- and medium-sized private seed companies); research projects and technological/financial support/2000s partnerships with Gene Giants, especially Monsanto and BASF |
| **Catch-up outcomes:** Largest seed bank in LA and one of the largest worldwide; innovation in advanced techniques such as molecular biology and genomics; focus on environment preservation; expansion of ***agricultural*** borders/Growth from 1997 to 2005: Land-area cultivated 11,800 ha to 22,200 ha; production 27,300 tons to 57,000 tons; yield 2.3 tons/ha to 2.6 tons/ha; exports from 8400 tons to 25,900 tons |
| *Period 3 (2006?2015)* |
| **Market/demand:** Growing interest in GM seeds, with only niches interested in non-GM seeds/Rapid adoption of transgenic seeds/Increasing dominance of the Gene Giants |
| **Institutional:** 2015 Revision of the Law of Access to Genetic Resources in Brazil |
| **Embrapa related: N**etworks to increase agility in launching differentiated products, intensification of agribusiness, better management skills/Constraints due to lack of funding, overly restrictive Brazilian law of access to genetic resources/Inability to keep up with Gene Giants in proprietary marketing/distribution channels and offering of packages (seeds plus agrochemicals), financing, and amenities to farmers that build loyalty/Reduction in adoption rate of Embrapa?s cultivars from 39% in 2005 to 6% in 2014/Preserving sovereignty of the country in sourcing and in supplying high-quality genetics; conserving environment and development of sustainable technologies through systemic innovations in crop-livestock-culture integration/Investments in biological functions such as drought tolerance, resistance to diseases, and nematodes |
| **Embrapa collaborations:** Increase in partnerships, especially with Gene Giants for development of transgenic seeds/Intensifying partnerships with international biotech organizations, national universities, research centers, and national private companies/Partnerships with national private firms; focus on niche market for non-GM soy seeds |
| **Catch-up outcomes:** Development and launch of first transgenic cultivar: technology CULTIVANCE® (Embrapa and BASF)/New soybean varieties INTACTA RR2 PRO with glyphosate tolerance and insect resistance/Prospection of biological functions of interest with seeds with drought tolerance/Growth from 2006 to 2015: Land-area cultivated 22,200 ha to 33,300 ha; production 57,000 tons to 96,500 tons; yield 2.6 tons/ha to 2.9 tons/ha; exports from 25,900 tons to 54,400 tons |

During our analysis of the ***data***, for each of the three periods, we gathered detailed information on the collaborative relationships between Embrapa and partner organizations. To do this, we tracked Embrapa’s collaborative research publications with partner organizations on hybrid and genetically modified soy seeds from 1989 to 2015 using keyword searches of two databases – the SciELO Citation Index and the Web of Science – to generate a list of 1895 publications between Embrapa and its partner organizations.5 After discarding articles that did not fit our study’s focus or scope or were authored solely by Embrapa, our list had a final tally of 224 collaborative publications. As Embrapa’s collaborative publications were available in the SciELO Citation Index database only from 1989, we also used our informants and other archival sources to identify Embrapa’s partners during the 1973–1989 period. Comparisons of Embrapa’s collaboration networks across the three periods enabled us to trace how Embrapa adjusted and augmented its knowledge, resources, and technological capabilities over time. These analyses also helped us understand how Embrapa utilized an evolving set of partnerships over time to forge the soy seeds sector ecosystem – one similar in scope and function to the research and ***agricultural*** extension system described by Rogers (, ) – stretching from soy seeds R&D to soy farmers and other end users.

The ultimate outcome of all the above analyses was a rich, longitudinal case on Embrapa’s orchestration of catch-up within Brazil’s soy seeds sector. We shared our detailed case narrative and underlying analysis (including key tables, figures, and network diagrams) with our informants at Embrapa and other organizations to confirm the accuracy of our ***data*** as well as the validity of our analysis and interpretations. In the next section, we present an abbreviated version of this case narrative.

EMBRAPA’S ORCHESTRATION OF CATCH-UP

In 1973, the emergence of soybeans as an attractive cash crop and as the means to satisfy the growing domestic demand for food prompted the Brazilian government to consider the possibility of transforming barren land (e.g., the Cerrado) into productive land suitable for ***agriculture***. Embrapa was created in 1973 to explore this possibility, and along with it came the Cooperative System for ***Agricultural*** Research (CSAR), a consortium of federal and state agencies, universities, and the private sector. Embrapa and the CSAR aimed to contribute to the modernization of Brazilian ***agriculture*** as a whole by increasing the productivity of land through intensive farming. In 1975, the National Center for Soybean Research (NCSR) – also known as Embrapa Soybean – was created to focus on the soy seeds sector.

Period 1 (1973–1996): Developing Capabilities and Building the Ecosystem

Innovation in seeds involves high knowledge and capital intensities, tacit knowledge on the complex process of crossbreeding, complementary innovations such as soil and crop management techniques, and the development of an elaborate ecosystem of diverse organizations to enable diffusion of new seeds and associated technologies to farmers and other end users. In Brazil, there were additional challenges due to significant diversity in climatic and soil conditions. One challenge was the need to develop innovations to transform vast expanses of barren land into cultivable land and adapting soy seeds to grow in such land. Additionally, soy seeds that were native to temperate climates had to be adapted for cultivation in more tropical climates. Accordingly, Embrapa had to drive catch-up on multiple fronts.

In the beginning, Embrapa sought help from American universities, the ***Agricultural*** Research Service (ARS) of the U.S. Department of ***Agriculture*** (USDA), and other international organizations primarily to introduce the soybean crop in the most economical way within Brazil. These partners helped Embrapa adapt selected cultivars (primarily from the United States) to Brazilian conditions and promote appropriate soil and crop management practices for soybean cultivation. Consequently, until almost 1980, the soybean varieties that existed in Brazil were American varieties developed for latitudes above 35°N. Embrapa and other Brazilian seed companies were involved just in multiplying and adapting seeds, in the so-called “following-path” trajectory of extending the soybean-producing regions in Brazil to other southern, southeastern, and midwestern states with similar soil and climatic conditions (Embrapa, ). Despite such progress, much of the land in Brazil remained unproductive, especially the entire regions of north and northeastern Brazil.

However, Embrapa had a clear vision about the catch-up possibilities that could arise from collaborative partnerships with countries and international organizations that were at the technological frontier (Alves, ). Consistent with this vision, Embrapa invested significantly in knowledge and capability building by sending its staff for training as researchers at partner institutions abroad such as Mississippi State University, which then was considered the mecca of seed technology. International organizations such as the Instituto Interamericano de Cooperación para la Agricultura (IICA) and the Food and ***Agriculture*** Organization of the United Nations (FAO) also helped Embrapa upgrade its knowledge and capabilities. By 1980, the graduate program of Embrapa, supported by the International Bank for Reconstruction and Development (BIRD), the Interamerican Development Bank (BID), and Financier of Studies and Projects (Finep), had benefited 1835 Embrapa researchers, including 518 of its professionals stationed in regional units across Brazil. In addition, Embrapa had established multilateral cooperation and bilateral relations with nearly 16 developed countries and the so-called Third World countries across the globe (Alves, ).

After adapting American cultivars to the soil and climatic conditions in southern Brazil, Embrapa began initiatives to develop new cultivars on its own. While such efforts resulted in the consolidation of the soybean crop in Brazil, an equally important innovation during this period was the “conquest of the Cerrado.” As an article in The Economist () noted:

When Embrapa started, the ‘Cerrado’ was regarded as unfit for farming. Norman Borlaug, an American plant scientist often called the father of the Green Revolution, told The New York Times that “nobody thought these soils were ever going to be productive.” They seemed too acidic and too poor in ***nutrients***.

The Brazilian government initiated special programs to develop and modernize ***agriculture*** in the Midwestern and Western states and to exploit the Cerrado (Roessing & Guedes, ). Also key were the contributions of Embrapa’s Cerrado ***Agricultural*** Research Center (“Embrapa Cerrado”) and the Japanese-Brazilian cooperation for the development and exploitation of the Cerrado (Hosono, da Rocha, & Hongo, ). Through these efforts, Embrapa and its collaborators developed the significant innovation of biological nitrogen fixation, which enabled soybean cultivation not only in the Cerrado, but also in other areas thought unfit for such a purpose. During this process of expansion, Embrapa not only had to develop soy varieties appropriate for cultivation in these regions, but also a package of technologies for soil management. This progressive conquest of the Cerrado transformed vast tracts of barren land into productive ***agricultural*** assets (Delfim Netto, ) and set Brazil on the path to becoming a major soybean producer and exporter.

Beginning in the early 1980s, plant health-related problems (especially in the context of exports and international trade) became a major concern for soybean researchers in Brazil. Accordingly, a significant emphasis on the soy seeds breeding programs of Embrapa from 1981 to 1997 was the development of new cultivars resistant to dangerous diseases caused by numerous pathogens such as fungus, bacteria, and nematodes. Embrapa’s other goals included: (1) adapting cultivars to various ecological regions (for latitudes of up to 22° N), soil types, and production systems; (2) obtaining high-quality seeds for use in planting and for food; (3) developing an Active Germplasm Bank (BAG)6; and (4) developing a methodology for soybean selection and breeding (Embrapa, ).

Simultaneously, in partnership with national or state universities and research institutes (which constituted the National System ***Agricultural*** Research (NSAR)) and other national state agencies (Ematers), Embrapa forged the national research and diffusion system for the development of region-specific innovations and the diffusion of these innovations to farmers and other end users. While state research institutes participated actively alongside Embrapa in the development of new cultivars, the state agencies offered technical assistance to farmers and identified critical challenges afflicting farmers to be addressed through research projects. Embrapa and CSAR also began engaging the domestic private sector through collaborative research projects and the provision of custom research services, with private companies primarily provided financial support for research (Alves, ).

Cooperatives also emerged to facilitate the diffusion of the new cultivars and associated technologies. Embrapa relied on a wide range of cooperatives such as Associação dos Produtores de Soja do Brasil (Aprosoja Brasil) and Cooperativa Agropecuária do Médio Oeste do Paraná (Agropar), primarily in the south. The partnerships between the NSAR and national universities also strengthened to include training of technicians and the initiation of projects (especially using students) to investigate and solve critical problems (Alves, ). The Brazilian System for Technical Assistance and Rural Extension (SIBRATER), which was coordinated by the Brazilian Technical Assistance and Rural Extension (EMBRATER), handled the dissemination of research results and the transfer of technology to farmers.

In sum, during its first two decades (i.e., from 1973 to 1996), Embrapa built its absorptive capacity and innovation capabilities through partnerships with international organizations. Then it began applying its growing innovation capabilities both to reclaim barren land for cultivation and to adapt or develop soy cultivars appropriate for various regions of Brazil. Simultaneously, it forged an ecosystem of public organizations, universities and, in a more limited capacity, the private sector to continually generate and diffuse innovations. In addition, Embrapa took initiatives to create critical complementary knowledge and technological assets (e.g., BAG).

The outcome of such catch-up efforts was that Embrapa’s research staff grew to nearly 2100 researchers by 1997 (Alves & de Oliveira, ). Also, from 1981 to 1997, Brazil’s soybean crop registered an annual growth rate of approximately 9%; that is, production increased approximately 2.4 times. The cultivated area also increased (accompanied by a gradual increase in average yields), reaching 2384 kg/ha in 1997, an increase of 55.21% when compared to the yield in 1981 (see Table ). In addition, Brazil’s soybean exports and its share of the global market grew consistently and significantly during this period.

(a) Production and exports of soybean – Brazil and the world – 1973–2015. (b) Evolution of production, planted area, and yield of soybean in Brazil – 1980–2015

| **Year** | **Production (million tons)** | | | **Exports (million tons)** | | |
| --- | --- | --- | --- | --- | --- | --- |
| **Brazil** | **World** | **Share (%)** | **Brazil** | **World** | **Share (%)** |
| (a) |  |  |  |  |  |  |
| 1973/1974 | n.a. | 54.0 | n.a. | n.a. | 15.2 | n.a. |
| 1980/1981 | 15.2 | 80.9 | 18.8 | 1.8 | 25.3 | 7.1 |
| 1996/1997 | 27.3 | 131.9 | 20.7 | 8.4 | 36.4 | 23.1 |
| 2005/2006 | 57.0 | 220.8 | 25.8 | 25.9 | 63.6 | 40.7 |
| 2015/2016 | 96.5 | 316.6 | 30.5 | 54.4 | 132.5 | 41.1 |

| **Year** | **Production of grain (million tons)** | **Planted area (thousand hectares)** | **Average yield (tons/hectare)** |
| --- | --- | --- | --- |
| (b) |  |  |  |
| 1980/1981 | 15.2 | 8.5 | 1.8 |
| 1996/1997 | 27.3 | 11.8 | 2.3 |
| 2005/2006 | 57.0 | 22.2 | 2.6 |
| 2015/2016 | 96.5 | 33.3 | 2.9 |

Sources: USDA (2015); Authors’ estimates based on ***data*** from Conab and IBGE (Annual Technical Report of the National Soybean Research Center – 1973, 1974, and 1975), accessed 30 October 2015.

Period 2 (1997–2005): Strengthening the Ecosystem Through Public–Private Partnerships

In 1997, a key change occurred in the intellectual property regime governing innovation in plant and seed varieties, with the institution of the first Plant Varieties Protection Law. As recommended in Article 2 of the PVPL, certificates protect new varieties of seeds – whether they are genetically modified or not – by guaranteeing rights to the breeder and preventing others from selling the variety, offering it for sale, importing or exporting it, conditioning it, storing it, or using it in the production of a hybrid variety or a different form of it. In Brazil, patents are used to protect only new genes or new genetic constructs, but not life forms and/or genomes (genes) found in nature.7 With the PVPL enabling some appropriation of investments in innovation, important changes were observed in the Brazilian market. These changes included increasing market segmentation and specialization and the application of modern biotechnology to seed development.

Embrapa sought to develop new interorganizational arrangements to continue sharing the results of its plant-breeding programs within this new institutional framework. These arrangements resulted in more than 20 technical or financial cooperation agreements with state research organizations, foundations that support research, a consortium of companies, and seed-producer associations within Brazil. These arrangements and partnerships were developed primarily to expand the breeding capacity, testing, and multiplication of new cultivars, especially at a time when public agencies such as the State Institutes for Rural Extension (e.g., Ematers) in some Brazilian states exited agribusiness to focus only on family farming.

During this period, the national private sector (e.g., foundations and associations of small- and medium-sized private seed companies) began to participate more actively in the soy seeds sector. One example of a public–private partnership was with Tropical Breeding & Genetics (TMG), a company dedicated to the development of cultivars and technology; its professionals worked to improve seeds that came from Embrapa. While TMG was dedicated to the breeding phase, a partnership with the Meridional Foundation – made up of 61 seed producers in the southern states and accounting for 95% of soybeans produced in the region – focused on downstream activities. This group participated in selecting soybean lineages, testing to identify appropriate varieties, and introducing them to the market, thereby supplementing the efforts of state companies that were hampered by significant financial difficulty (including Embrapa, which faced budget cuts beginning in 1998). However, as one of our interviewees mentioned, most private firms typically did not possess the capacity or scale to develop research programs generating new cultivars, and they assisted primarily with downstream commercialization:

Most of the time, Embrapa will be working with products that are not ready yet from the point of view of the end user of the technology. So Embrapa needs partners like private companies or foundations to provide financial resources and to help with validating these products from the point of view of the market and introducing them commercially. In return, for a certain period of time, they earn exclusivity to commercially exploit that product.

In 2000, the Gene Giants began showing a keen interest in entering the growing agribusiness market in Brazil. By the mid-1990s, Monsanto already had introduced its genetically modified (i.e., transgenic) soy seeds, initially even without patent protection, into Argentina, where climatic conditions were favorable; the company captured a dominant position there. However, in Brazil, Monsanto and other multinational agribusinesses faced two challenges: the Brazilian government’s ban on transgenic seeds and the pervasive presence and positive image enjoyed by Embrapa, whose traditionally crossbred soy cultivars had been adopted by more than 50% of the Brazilian market. Moreover, Embrapa had significant knowledge in genetics, expertise in adapting, developing, and testing seeds, complementary technologies appropriate for diverse Brazilian soil and climatic conditions, and a growing soybean germplasm bank. Given Embrapa’s considerable strengths and expertise, the Gene Giants (especially BASF and Monsanto) initially were intent on forming partnerships with Embrapa to adapt their transgenic seeds to Brazilian conditions. However, once they entered and consolidated their positions in the Brazilian market, the scope of their partnerships with Embrapa changed. As an informant explained:

The goals of the multinational companies have changed over time. At the beginning, since Embrapa had credibility in the country, a partnership with us would help them enter…They came here and said, “Could you test it for me?” We did a partnership to test it, and the result was good. Then they opened up the market…Over time, they found out that Embrapa had knowledge that they could use to develop products together…

Over time, Embrapa’s efforts enlarged the ***agricultural*** borders within Brazil. Indeed, soybean production in the northeast more than doubled from 1609.8 million tons in 1998–1999 to 3560.9 million tons in 2005–2006, while soybean production in the north increased from 123.2 million tons to 1255.2 million tons during the same period. Accordingly, a number of new partners from northeastern and northern states began to play preeminent roles within the national ecosystem. With Embrapa continuing to maintain strong relationships with its traditional partners (international organizations, universities, and state agencies from the southern and southeastern states of Brazil), its total number of partnerships increased significantly during this period (see Table  for a conservative estimate).

Number of Embrapa partners, by period

|  | **Phase 1 (1973?1996)** | **Period 2 (1997?2005)** | **Period 3 (2006?2016)** |
| --- | --- | --- | --- |
| Number of partners | National universities/research centers: **3**International universities/research centers: **1** | National universities/research centers: **17**International universities/research centers: **10** | National universities/research centers: **48**International universities/research centers: **28** |
|  | International agencies: **3**National agencies: **2** | International agencies: **13**National agencies: **12** |  |
|  | International private companies: **1** | International private companies: **6**National private companies: **6** |  |
| Cumulative outcomes of partnerships | Accumulation of absorptive capacity and training of researchers in crossbreeding techniques and the adaptation of seeds acquired from the United States.Development of innovation capabilities that led to innovations such as biological nitrogen fixation and technologies for soil management that enabled the productive use of barren lands of the Cerrado.Development of own cultivars (with primary emphasis on disease resistance). | Creation of the largest seed bank in Latin America and among the largest worldwide.Innovations related to advanced techniques (e.g., molecular biology and genomics), within constraints imposed by prevailing Brazilian law and ban on transgenic seeds.Systemic innovation emphasizing environment preservation and sustainability (livestock, farming, and forest integration). | Development of new cultivars (with primary emphasis on drought tolerance).Innovations related to advanced techniques (e.g., molecular biology and genomics) enabling development of transgenic seeds.Development and commercialization of first transgenic cultivar, and new transgenic soybean varieties.Increasing emphasis on environment preservation and sustainability, especially given dominance of transgenic soybean varieties. |

Note: Key partners were determined based on co-authored publications between Embrapa and other organizations during each period. Note, however, that this method of determining the number of Embrapa’s partners is very conservative because it does not include the many national and international organizations (both public and private) that partnered with Embrapa and played key roles within its innovation and diffusion ecosystem but did not collaborate on research leading to publications.

A significant benefit of these diverse partnerships and the expanding ecosystem was the growth in the number of researchers accessible to Embrapa – 2214 by 2005 (Alves & de Oliveira, ). In addition, Brazilian soybean production, yields, and exports increased significantly from 1998 to 2006 (see Figs. 3a and 3b). While in 1998–1999 Brazilian soybean production represented 19.58% of world production, in 2005–2006, it accounted for 25.81%. While the global growth rate in yield from 1998 to 2006 was 38.19%, it was 82.11% in Brazil. The numbers are more impressive when we consider exports, with the growth rate of Brazilian exports being 190.09% compared to the global growth rate of 68.35%.

However, over time, the adoption of Embrapa’s traditionally crossbred soy cultivars within Brazil declined significantly, from 51% in 2001 to 39% in 2005 and eventually to 6% by 2014. One reason for this precipitous decline was the smuggling of Monsanto’s transgenic seeds from Argentina into Brazil beginning in the early 2000s. Brazilian soy farmers perceived the smuggled transgenic seeds as offering more benefits than traditionally crossbred seeds available from Embrapa and other domestic seed companies. Not surprisingly, transgenic seeds were adopted rapidly in Brazil despite their ban.

A second reason for the decline was the slow pace with which the Brazilian government revised or adopted laws to maintain the competitiveness of the country’s seeds sector, despite several important laws coming into force during this period. For instance, the ban on transgenic seeds had oriented Embrapa away from investing more aggressively in modern biotechnology and the development of genetically modified seeds, even though the organization possessed technical expertise in these fields. Consequently, the rapid diffusion of smuggled transgenic seeds in the Brazilian market placed Embrapa at a technology disadvantage of at least 3–4 years, necessitating another round of catch-up. Adding to Embrapa’s challenges, Brazilian laws (based on the UPOV Convention of 1978) allowed the so-called “farmer’s privilege,” whereby farmers could save a certain quantity of seeds for their own use in the following year without receiving permission or paying royalties to the developer or breeder of the seeds. However, according to some of our interviewees, this privilege was misused by farmers who saved more seeds than allowed by law and, in addition, supplied seeds from their stock to other farmers, thereby resulting in significant piracy. By comparison, in the case of transgenic seeds, seeds delivered for export were tested by exporting firms (e.g., Bunge, Cargill, DM) for genetic modification, and, absent proof of initial purchase, the farmer was required to pay a 7% royalty to the patent holder (Monsanto, primarily).

A final reason for the decline was the Brazilian government’s progressive reduction of investment in Embrapa. Alves & de Oliveira () estimated that the government’s investment in Embrapa had been declining from more than 1% of GDP in the early 1990s to approximately 0.55% of GDP in 2003, even though its investment in industrial sectors increased during this period. This further constrained Embrapa’s efforts to stay abreast of evolving technological and market trends in the soy seeds sector.

In sum, during the 1997 to 2005 period, Embrapa expanded and strengthened the soy seeds sector ecosystem into new regions of Brazil where soybeans were now being cultivated. Equally important, Embrapa resorted increasingly to public–private partnerships to augment declining government funding for innovation and to help hasten commercialization and diffusion of such innovation to farmers and other end users. Even for the multinational Gene Giants with significant expertise in transgenic seeds, Embrapa’s technological capabilities and its deep tacit knowledge of breeding cultivars appropriate for Brazilian soil and climatic conditions made it a sought-after partner to first facilitate their entry into and then consolidate their dominance within Brazil’s soy seeds sector. However, the Brazilian government’s ban on transgenic seeds and its reluctance to make timely changes to intellectual property laws resulted in Embrapa falling behind in the development of transgenic soy seeds.

Period 3 (2006–2015): Balancing Technological Progress and Environmental Sustainability

According to interviewees, the rapid adoption of transgenic seeds and the growing dominance of the Gene Giants, especially after the passage of the revised Biosafety Law in 2005, required Embrapa to make adjustments such as the articulation of networks of economic interests, agility in launching differentiated products, technological intensification of agribusiness, and better management skills. Embrapa continued forging a number of partnerships to accomplish these adjustments, making the soy seeds sector a complex and fully interconnected network of myriad organizations. Although many of Embrapa’s partnerships were still with universities and research centers (especially national ones), this period also saw the intensification of partnerships with international organizations (such as USDA/ARS and JIRCAS), other biotech organizations (such as Ctr Estudios Fotosintet & Bioquim (CEFOB), LABEX USA Plant Biotechnol, and COODETEC), private organizations within Brazil, and the multinational Gene Giants. In other words, Embrapa began relying even more heavily on public–private partnerships, driven by the complexity of engineering transgenic seeds and the high level of financial investment required for patenting and then complying with regulatory biosafety requirements.

Indeed, these costs could reach levels up to ten times the cost of developing new transgenic seeds (Andersen et al., ). This effectively shut out small- and medium-sized companies from the so-called “traits” segment of the sector. As a result, the Brazilian soy seeds sector ecosystem became increasingly stratified and specialized (Fig. ), with upstream companies that develop new cultivars through traditional crossbreeding or modern biotechnology techniques (the innovators like Embrapa and the multinational Gene Giants) interacting with more specialized downstream organizations such as multipliers of seeds (seed producers), farmers (planters of seeds and harvesters of grain), distributors (commercialization agents), and end users (soybean consumers).

The soy seeds sector ecosystem in Brazil in 2015.

Embrapa tried to minimize financial problems, especially with its shrinking budget allocations from the Brazilian government, by resorting to both the traditional purely “technical partnerships” and “technical and financial partnerships,” wherein private companies contributed a significant portion of financial resources. Partnerships with private companies also were indispensable for the mutual sharing of complementary knowledge, with both Embrapa and its private partners seeking to identify in each other a set of complementary skills in which each did not intend to invest. In the words of an interviewee:

We have a clear perception that companies (national and multinational ones) do not have interest in having all these capabilities. We have corporate partnerships with 102 companies and, consistently, companies arrive here wanting to partner with Embrapa…because they identify a set of national skills which they do not intend to invest in. Likewise, we too choose to partner with companies that have skills that we don’t want to invest in.

With respect to transgenic seeds, Embrapa intensified its partnerships with several Gene Giants, primarily for the development of transgenic soy seeds (Contini & Andrade, ). For instance, in collaboration with BASF, Embrapa developed and launched “Cultivance,” its first transgenic cultivar. Embrapa also entered into a cooperative agreement with Monsanto of Brazil to develop and test new transgenic soy varieties with glyphosate tolerance and insect resistance. However, given the paucity of funds and an overly restrictive Biosafety Law (on access to genetic resources) that hampered research efforts,8 Embrapa knew it would not be able to match the Gene Giants in developing and diffusing its own transgenic seeds, despite its increasing knowledge of advanced molecular biology and genomics (Nass, ). Indeed, the Gene Giants, beyond investing significantly in proprietary marketing/distribution channels and offering a “package” (i.e., seeds plus agrochemicals) to the farmer, also financed the crop, obtained a percentage of the harvest, and offered a range of amenities to build loyalty to their respective products.

More important, Embrapa’s priority was not just in increasing productivity through transgenic seeds but also in preserving the sovereignty of the country in sourcing and in supplying high-quality genetics competitively in case of high prices or a very high level of verticalization. According to interviewees, this was driven by Embrapa’s long-term concern for the Brazilian soy seeds sector due to its dual role as a public sector organization driving new technological developments and as the supplier of last resort to Brazilian farmers. Guarding against diseases was another concern because, as one interviewee stated, “Diseases that affect the soybean crop can cause annual production losses ranging from 10% to 70%, depending on the pathogen that caused the disease, region, climate conditions, and management strategies chosen by the producers.” Embrapa also prioritized biological functions of interest, such as drought tolerance and resistance to diseases and nematodes. Especially of concern in this regard, according to interviewees, was the reemergence of diseases afflicting soybean crops that had been eradicated in Brazil.

In addition, Embrapa sought to conserve the environment and focus on sustainable technologies, especially through systemic innovations in livestock, farming, and forest integration (crop-livestock-culture integration). One interviewee offered an example of Embrapa’s efforts to control the Helicoverpa nematode infestation:

When we had the problem of Helicoverpa, everyone hurried to import insecticides from all over the world on an emergency basis and apply these to solve the problem. We began researching and found that natural enemies controlled the Helicoverpa caterpillar. Using insecticides for controlling the caterpillar also killed the natural enemies and, counterintuitively, led to an increase in the population of Helicoverpa. Then we started recommending not to apply insecticides. Despite initial reluctance to believe our recommendation, they came to our experimental areas to see for themselves and then began to take our advice seriously.

Indeed, to reduce risks for the sector, Embrapa even trained professionals from private companies, including the Gene Giants. One interviewee described Embrapa’s attitude thus:

The ultimate function of Embrapa is to ensure quality soy for producers. The staff working for these companies that are our “competitors” – Syngenta, Pioneer, Bayer, BASF, Monsanto – are already here, and we do not close our doors to them. The training we give here…since the ’80 s until today, exactly 1798 people were trained in techniques of analysis and seed production at Embrapa Soybean. And the work we do here is not only for Embrapa, but we also have trained professionals from Bayer, Syngenta, and other companies.

Such a benevolent attitude resulted in a high degree of confidence in Embrapa’s capabilities, with interviewees mentioning that Embrapa was contacted even when there were problems with other companies’ cultivars. Despite the declining adoption of its cultivars, Embrapa had key complementary assets and know-how pertaining to the adaptation of cultivars to Brazilian conditions; it also had strong links with different segments of the soy seeds sector ecosystem. Thereby, the Gene Giants found Embrapa a knowledgeable and valuable partner even after they achieved market dominance in Brazil.

In sum, during the 2006–2015 period, Embrapa relied heavily on public–private partnerships to strengthen the soy seeds sector ecosystem as well as to secure technical and financial support for its initiatives. While its significant know-how and capabilities enabled Embrapa to continue innovating in partnership with the Gene Giants, its focus also turned toward striking a balance between productivity and technological innovation on the one hand and environmental sustainability and national interests on the other. These initiatives enabled it to maintain its salient role even after the Gene Giants began dominating the Brazilian soy seeds sector.

The critical role Embrapa played through the years was highlighted by The Economist () in an article “The miracle of the Cerrado.” The article mentions numerous technological innovations Embrapa developed and its role in making Brazil the first tropical food giant in the world with only minimal government subsidy. As per The Economist article, ***data*** from the Organisation for Economic Co-operation and Development (OECD) indicated that state support accounted for only 5.7% of total farm income in Brazil from 2005 to 2007, compared to 12% in the U.S., 26% average for the OECD, and 29% in the European Union. Despite this, soybean production, planted area, and yields continued to improve during this period, with exports becoming higher than domestic consumption (see Table ). Brazil is expected to become the world’s largest exporter, with a 46% share by 2024–2025.

DISCUSSION

We asked how an emerging economy can catch up technologically in the ***agricultural*** sector – more specifically, how it can develop absorptive capacity and innovation capabilities, then build a pervasive ecosystem to facilitate the continual generation and dissemination of innovations. We then explored a second, related question of how these economies can later maintain the viability and salience of their catch-up investments and initiatives after the inevitable entry and market dominance of well-endowed multinational agribusinesses. Our case study of Embrapa and the public–private networks that it forged over time offers an innovative institutional solution to these questions by demonstrating how a public sector organization can play a crucial role to orchestrate catch-up efforts and then maintain its salience (after multinational entry and dominance) by emphasizing initiatives to balance technological progress on the one hand and environmental sustainability and national interests on the other. In the remainder of this section, we use insights from the Embrapa case to theorize on the crucial role that a public sector organization can play in an emerging economy context.

Role of the Public Sector in Orchestrating Catch-up

A public sector organization may be better placed than either the government or the private sector to jump-start and then sustain large-scale, long-term projects with both economic and social welfare implications (Mazzoleni & Nelson, ), especially in an emerging economy context. On the one hand, public sector organizations are extensions of the government and may possess more legitimacy than profit-driven private firms in the eyes of the general public and the diverse domestic and international organizations whose assistance or support they seek (Nwankwo, Phillips, & Tracey, ). Moreover, since their mandates are infused with a social welfare imperative (Brammer & Walker, ), they may not face the challenges pertaining to ***collective*** action and appropriability that private firms typically confront while undertaking initiatives whose benefits are available to all comers and, thereby, approximate public goods. Still, public sector organizations are similar to private firms because they have specific and narrower objectives, which insulates them from the wider dysfunctional dynamics besetting governments even while conferring on them what Evans () calls “embedded autonomy.” Consequently, in contrast to governments that are not consistently effective in undertaking formal, centralized attempts to jump-start and sustain innovation (Haggard & Kaufman, ; Limoeiro & Schneider, ), public sector organizations may be more successful in leveraging scarce resources and producing desired outcomes. Given a degree of autonomy and political support to follow their assigned mandates, public sector organizations have the potential to become pockets of efficiency (Evans, ; Schneider, ), driving change and subsequent adjustment.

During the initial phase of catch-up, a public sector organization can leverage its legitimacy to seek and source knowledge or other resources from governments and associated agencies in leading countries. Even in a substantially resource-constrained and potentially dysfunctional environment characteristic of an emerging economy, a public sector organization may find it possible to mobilize technological, financial, and human resources from a number of sources, both domestic and international (such as universities and federal and state governments), and other resource providers (such as private foundations and firms). Indeed, Embrapa’s primary accomplishments during the early stages of catch-up (1973–1996) were the accumulation of human capital and absorptive capacity and the development of tacit knowledge on diverse local environments (e.g., climatic and soil conditions) within Brazil. This served as the foundation for Embrapa’s development of innovation capabilities by recombining knowledge gained from different sources to adapt imported soy cultivars from the U.S., reclaim the barren lands of the Cerrado for productive use, and eventually develop its own new cultivars along with a package of complementary technologies to make adoption economically viable for Brazilian farmers and other end users.

Another critical role for a public sector organization is the building of diffusion capabilities through the initiation and sustenance of an innovation and diffusion ecosystem within which organizations share knowledge and resources to develop and disseminate systemic innovations (Adner, ; Adner & Kapoor, ; Nambisan, Zahra & Luo, ). While academic, professional, public, and private networks may already exist and engage in ***collective*** knowledge generation at the regional or local levels, they most often are fragmented (Haggard & Webb, ) and face diverse resource requirements and heterogeneous socioeconomic environments; thus, they may be in a position to address only local needs (Corredoira & McDermott, ; Gittelman, ; Perez-Aleman, ; Safford, ). By contrast, a public-sector organization with national scope, a systemic perspective, long-term orientation, and growing knowledge of local needs and conditions can serve as a bridge linking these dispersed networks to reconcile and set appropriate priorities to guide ***collective*** innovation, to garner and invest scarce resources optimally, and to progressively forge a national ecosystem to foster locally salient innovations and their rapid diffusion. Such a national ecosystem reduces the pressure on any given actor, instead allowing numerous actors to provide complementary assets and services (Adner, ).

The value added by the public sector organization in this regard, however, depends on its ability to engage and incentivize the active participation of and partnership with the private sector (Montalbano et al., ). One way, although particularly difficult in dysfunctional emerging economies, would be to champion the adoption of institutional mechanisms such as strong intellectual property protection to incentivize investments in innovation and/or diffusion by the private sector. While this may prompt domestic private firms to participate in catch-up efforts to the extent their capabilities permit, it also may lead to the entry of well-endowed multinational firms by making the growing market and intellectual property protection attractive to them. Once they enter, their sophisticated technological, marketing, and managerial capabilities soon lead to their dominance of the local market and, as studies on catch-up (e.g., McDermott & Corredoira, ) have demonstrated, the relegation of domestic actors to peripheral roles.

We saw this happen in Embrapa’s case, too, with the Gene Giants’ transgenic seeds dominating Brazil’s soy seeds sector and relegating Embrapa’s traditionally crossbred cultivars to niche markets for non-genetically modified soy seeds. In this case, the entry by multinational agribusinesses, specifically, Monsanto, occurred through the “back door.” with transgenic seeds smuggled across the border from Argentina despite the Brazilian government’s ban on the cultivation of such seeds. Once the smuggled seeds gained widespread acceptance, the Brazilian government made pro-market changes to its regulatory regime to allow their domestic cultivation without evaluating potential consequences. Instead of bargaining power potentially shifting back to the host country government over time as posited by the obsolescing bargaining model (Vernon, , ), multinational corporations became further entrenched and gained more power due to widespread demand for their protected transgenic seeds. The Brazilian government was unable to push back to safeguard national interests and priorities. In addition, the decade-long delay in the adoption of the Biosafety Law – first proposed in 1995 and formally adopted only in 2005 – placed Embrapa at a technological disadvantage in the development of transgenic seeds, further worsening the power imbalance and potentially compelling Embrapa to partner with the Gene Giants to catch up.

How then can the public sector orchestrator (as well as the emerging national ecosystem) survive and maintain salience even after multinational entry and dominance? Our case study of Embrapa offers a possible answer. First, in line with the work of Turkina and Van Assche (), the public sector orchestrator can continue to engage in technology development efforts and learn even after the entry of multinational corporations. For instance, as in Embrapa’s case, deep knowledge of local needs and climatic/soil conditions and the know-how to adapt cultivars to local contexts offer a pathway for the organization to partner with multinational corporations whose global operations and scale make the development of such competencies in localization noncore and economically unviable. Likewise, complementary assets accumulated over time (e.g., the germplasm bank in Embrapa’s case) may be invaluable and inimitable, offering another pathway to partnerships and learning opportunities. Furthermore, public–private partnerships make the national ecosystem robust to evolving technological, market, and institutional environments and augment its capacity to engage in recombination and diffusion of knowledge most pertinent to local needs (Arundel, Casali, & Hollanders, ).

The increasing reliance on public–private partnerships, however, poses a challenge for the public sector orchestrator whose mandate includes promoting social welfare and safeguarding national interests (e.g., environmental sustainability). Driven by a profit motive, private sector partners may seek to fully appropriate the value of their intellectual property and attain market dominance and power, without regard to the host government’s priorities and interests (Banalieva, Cuervo-Cazurra & Sarathy, ; Cuervo-Cazurra, Gaur & Singh, ; Giuliani, ). In such a situation, the public sector orchestrator can become the supplier of last resort and potentially the sole source of environmentally sustainable technologies and best practices (Maksimov, Wang & Yan, ). As Embrapa’s experiences demonstrated, such actions are consistent with the public sector orchestrator’s mandate and, in addition, help mitigate unanticipated disruptions due to market dynamics, natural disasters, or excessive rent-seeking by dominant multinational companies. All these initiatives progressively transform the role of the public sector organization from primarily being a “direct provider” of technology and innovation (McDermott et al., ) to also becoming a “coordinator” offering services and programs to various constituents – including multinational companies – of the national innovation and diffusion ecosystem (Gittelman, ; McDermott & Pietrobelli, ).

In sum, its deep knowledge and its orchestrating role in forging the national ecosystem enables the public sector organization to gain access to copious and useful information on needs, challenges, and outcomes, thereby enabling continual adjustments in policy, behavior, and, equally important, optimal evolution of the ecosystem itself to best reflect emerging priorities. Unlike governments that conduct industrial policy by handing out subsidies but do not have the mechanisms to monitor outcomes and demand adequate value for proffered public subsidies, the public sector orchestrator is able to fulfill all preconditions that scholars (e.g., Schneider, ) have identified as being essential to the success of developmental initiatives in emerging economies. Figure  distills our discussion into a conceptual model of catch-up in the ***agricultural*** sector, as viewed from the perspective of the public sector organization.

Conceptual process model of catch-up in the ***agricultural*** sector.

Nature and Scope of Catch-up

Clearly, as our case shows, catch-up in the soy seeds sector has been successful, with Brazil’s ascendance as the second-largest producer and exporter of soy seeds by 2015. Brazil’s soy farmers now have access to transgenic cultivars, the products of advanced biotechnology that are at the technology frontier in seeds innovation. The process and outcomes are consistent with the traditional notion of catch-up, which is conceptualized as a process by which productivity growth occurs through modernization – first through the adoption and utilization of sophisticated new technologies and later through the development of new knowledge (e.g., Abramovitz, ). Such conceptualization emphasizes building innovation capabilities as well as the institutional mechanisms to progress as rapidly as possible to the technology frontier.

However, the tremendous growth in soybean cultivation in Brazil also has had negative consequences, especially for the environment (e.g., Fearnside, ). Our study’s findings (for example, the reemergence of diseases thought to have been eradicated) also point to other unanticipated consequences of catch-up and the need to actively safeguard environmental sustainability. Equally important, Brazil’s soy seeds sector is now dominated by the Gene Giants, whose primary interests are in appropriating the full value of their patented products and technologies, not the domestic priorities or interests within Brazil. With the government lacking the mechanisms (or being unwilling) to enforce national interests, it has fallen on Embrapa and isolated efforts by the private sector such as the Soy Moratorium (Gibbs et al., ; Koning, Mertens & Roosenboom, ) to safeguard the environment through sustainable practices and development. Hence, it is unclear whether technological catch-up in the ***agricultural*** sector should imply the achievement of rapid increases in productivity by rushing to reach the technological frontier, regardless of costs or consequences.

Past research has shown that progress in the ***agricultural*** sector appears to be most effective when innovation is systemic (Stokke, ) and creates value for the nation by safeguarding and sustainably marshaling technology and critical resources (Figueiredo, ; McDermott et al., ; Perez-Aleman, ). While it may take longer to reach the technological frontier, this process protects national interests and, more broadly, global food and environmental safety. Indeed, as Marin et al. (, ) have proposed, it may not have been biotechnology that transformed the seeds sector, but a mindful process of systemic changes based on conventional technologies and practices most salient to environmentally sustainable growth. Accordingly, we suggest a more mindful process of catch-up that balances technological progress with safeguarding social welfare and national interests such as environmental sustainability and food safety. In other words, catch-up ought not be a single-minded rush to reach the technological frontier at any cost, but a well-articulated process that improves technological productivity and capabilities without compromising national interests throughout the process (Awate et al., ).

CONCLUSION

Our study makes two key contributions. First, it demonstrates innovative roles for public sector organizations in technological catch-up in the ***agricultural*** sector in an emerging economy context. Second, it questions the prevalent notion of catch-up, especially in the ***agricultural*** sector and proposes a more mindful process that seeks to balance productivity growth and innovation with environmental sustainability and national interests.

In addition, our study reinforces insights from existing studies (e.g., Andersen et al., ; Bisang & Gutman, ; Giuliani et al., ; McDermott et al., ) on the key roles played by a diversity of actors – the state and its institutions, the public sector, and public–private partnerships – in sustaining a national innovation and diffusion ecosystem that facilitates technological catch-up in the ***agricultural*** sector. By emphasizing the crucial roles played by these actors and institutional mechanisms, especially in an emerging economy context, we add to insights contributed by studies on the emergence and sustenance of innovation ecosystems (e.g., Adner, ; Adner & Kapoor, ; Adner, ).

In sum, it is our hope that our study, along with others that offer a processual account of catch-up (e.g., McDermott, ; McDermott et al., ; McDermott & Pietrobelli, ), can serve as a potential template for catch-up efforts in the ***agricultural*** sector in developing and emerging economies in Africa, Latin America, and Asia. Accordingly, we conclude by quoting what The Economist () wrote about Brazil’s (and Embrapa’s) achievement in the soy seeds sector:

So if you were asked to describe the sort of food producer that will matter most in the next 40 years, you would probably say something like this: one that has boosted output a lot and looks capable of continuing to do so; one with land and water in reserve; one able to sustain a large cattle herd (it does not necessarily have to be efficient, but capable of improvement); one that is productive without massive state subsidies; and maybe one with lots of savannah, since the biggest single ***agricultural*** failure in the world during past decades has been tropical Africa, and anything that might help Africans grow more food would be especially valuable. In other words, you would describe Brazil.

Notes

In the remainder of the paper, we use the term “emerging economy” to refer to both emerging economies, which have begun industrializing in earnest, and developing economies, in which industrialization is much less advanced and ***agriculture*** predominantly constitutes GDP.

According to the International Code of Nomenclature for Cultivated Plants (2009: 6, [*https://www.actahort.org/chronica/pdf/sh\_10.pdf*](https://www.actahort.org/chronica/pdf/sh_10.pdf), accessed on November 22, 2019), a cultivar “is an assemblage of plants that (a) has been selected for a particular character or combination of characters, (b) is distinct, uniform, and stable in these characters, and (c) when propagated by appropriate means, retains those characters.”

We thank an anonymous reviewer for encouraging us to explore and reconceptualize the very notion of catch-up in the ***agricultural*** sector.

As noted earlier, the U.S. soybean export restrictions in the early 1970s curtailed supply and resulted in a significant increase in global soybean prices. A second discontinuity occurred in the mid- to late-1990s when China became a significant importer of soybeans, resulting in a relatively rapid and significant increase in global soybean demand. This discontinuity is consistent with our definition of our second period, beginning in 1997. This fits in well with the temporal boundaries of our first period (1973–1996).

Co-authorship has been used to track collaboration networks and the emergence, evolution, and overlapping of research communities in the past (e.g., Palla, Barabási, & Vicsek, ; Tuertscher, Garud, & Kumaraswamy, ).

As the germplasm contains the genetic information of plants, germplasm banks are the main source of raw material for breeding researchers and act as insurance against the extinction of species in their natural habitat. The objectives of the Active Germplasm Bank, established in 1975–1976, included the ***collection***, characterization, evaluation, and conservation of soybean genotypes, which represent wide genetic variability.

This is in contrast to a U.S. Supreme Court decision in the Diamond vs. Chakrabarty case allowing the patenting of living organisms (or at least certain parts, such as the genetic construction) found in nature.

This law was revised after review in 2015, but interviewees still perceived it as being very restrictive and hampering innovation when compared to laws in other countries.

**Notes**

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**Load-Date:** May 3, 2023

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chemical substances used as nuclear fission materials; fuel for nuclear reactors; fused quartz in various forms, such as disks, ingots, rods and tubes for general use in the industrial arts; adhesives substances for industrial purposes; polycrystalline alumina ceramic for general use in the industrial arts; brazing and soldering fluxes and products; thermoplastic and thermosetting adhesives; chemicals, biochemicals and reagents for use in industry, science and research; chemical preparations for cell separation and culture; chemical preparations for the purification of nucleic acid, nucleotides, florescent nucleotides, oligonucleotides, peptides, proteins, amino acids, organic molecules and markers for DNA/RNA synthesis; reagents for luminescence; reagents for gene expression quantification; reagents for polymerase chain reaction processes; reagents for rolling circle amplification processes; reagents for DNA cloning and vectors, enzymes for modification and restriction; reagents for labeling, sequencing and fragment analysis of nucleic acids and proteins and customized synthesis; reagents for recombinant protein expression and purification; chromatography media; reagents for electrophoresis, biocomputing, spectrophotometry and fluorometry; radiochemical products for scientific research; reagents for scintillation proximity assay; test kits and products for high ***data*** rate analysis for producing medicines; reagents for high-resolution laser microscopy, fluoroscopic microscopy and confocal microscopy; specialized chemicals for use in industry, science and research; gases and gas mixtures for use in industry, research and science; chemical products and substances for the manufacture of pharmaceutical products, diagnostic products and substances; chemical testing reagents, saline solution and paper coated with reagents, all for scientific use and for use in laboratories; fissile chemicals for scientific research; radioactive elements and isotopes for use in industry, science and research; radioactive norms and sources for radiographic technology; radioactive sources for non-destructive sterilization, purification and testing, technology; radionuclides for scientific research; chemical compounds and chemicals for use in the treatment of water supply systems; chemical compounds and chemicals for use in the treatment of wastewater treatment systems; chemical compounds and chemicals for use in the treatment of cooling water circuits; chemical compounds and chemicals for use in the treatment of boiler water and steam generating systems; chemical compounds and chemicals for use in the treatment of boiler condensate systems; chemical compounds and chemicals for use in the treatment of liquid separation systems; chemical compounds and chemicals for use in the treatment of systems for water purification and dehydration in aqueous systems; chemical compounds and chemicals for use in the treatment of conditioning systems; chemical compounds and chemicals for use in the treatment of gas purification systems; chemical compounds and chemicals for use in the treatment of industrial process systems; chemical compounds and chemicals for use in the treatment of fuel treatment systems; chemical compounds and chemicals for use in the treatment of hydrocarbon and gas treatment systems; chemical compounds and chemicals for use in the treatment of petrochemical systems and oil and gas treatment systems; chemical compounds and chemicals for use in the treatment of paper and pulp making systems; chemical compounds and chemicals for use in the treatment of plastic and metal coating systems; chemical compounds and chemicals for use in the treatment of metal processing systems; chemicals, namely chemical additives for gasoline, additives for heating oil and additives for improving the efficiency of turbine engine fuel; chemically-treated bagged water-absorbing granular materials for placement into fuel tanks; testing kit comprising reagents for determining the presence of algae and active organic organisms in diesel fuel; bacterial cultures and ***nutrients*** for sludge and wastewater treatment; polymeric chemicals for dispersing particles in steam generating equipment; chemicals and chemical compounds used as anti-fouling and demulsifying agents in operations for producing coke by-product operations of steel industries; chemicals, catalysts, plastic semi-processed goods used as materials, filtering materials for removing acid gases, unprocessed plastics, crystal whiskers and zinc oxide; radiopharmaceuticals for scientific use and for research; polymeric membrane materials for liquid separation.Class 3Non-medicated cosmetics and toiletry preparations; non-medicated dentifrices; perfumery, essential oils; bleaching preparations and other substances for laundry use; cleaning, polishing, scouring and abrasive preparations; cleaning preparations containing chemicals and chemical compounds for cleaning steel, aluminium, galvanized and mixed metal surfaces for general industrial use in the manufacture of metal products; cleaning agents containing chemicals and chemical compounds for industrial use for removing contaminants in industrial process systems; paint stripping preparations containing chemicals and chemical compounds for removing paint from equipment surfaces in spray-painting booth operations.Class 4Industrial oils and greases, wax; lubricants; dust absorbing, wetting and binding compositions; fuels and illuminants; candles and wicks for lighting.Class 5Pharmaceuticals, medical and veterinary preparations; sanitary preparations for medical purposes; dietetic food and substances adapted for medical or veterinary use, food for babies; dietary supplements for humans and animals; plasters, materials for dressings; material for stopping teeth, dental wax; disinfectants; preparations for destroying vermins; fungicides, herbicides; pharmaceutical preparations for diagnosis; veterinary pharmaceutical preparations for diagnosis; pharmaceutical and veterinary substances for medical use; diagnostic reagents and preparations for medical use; diagnostic substances for medical use; contrasting substances for medical imaging; scanning diagnostic reagents for use in vivo; diagnostic imaging agents for magnetic resonance imaging (MRI); radiopharmaceuticals for clinical and medical use; radiopharmaceutical norms and sources for nuclear medicine; radioactive pharmaceutical preparations and non-radioactive reagents for producing radiopharmaceuticals for in-vivo diagnosis or for therapeutic use; gases and mixtures for medical imaging; pre-filled vials containing reagents for medical diagnosis; pre-filled cartridges containing chemical solutions for medical use; pre-filled cylinders containing gases and gas mixtures for medical use; implantable radiotherapy devices consisting of encapsuled radio-isotope brachytherapy sources; radiotherapy administration system consisting of radioactive pellets and of a bioabsorbable carrier set; disposable paper or cellulose diaper-pants, diapers and napkins.Class 7Machine tools, power-operated tools; motors and engines, except for land vehicles; machine coupling and transmission components, except for land vehicles; ***agricultural*** implements, other than hand-operated hand tools; incubators for eggs; automatic distribution machines; apparatus, equipment and instruments for electricity production, namely electrical and wind energy generators generating electricity; turbines; turbines for energy production; wind turbines for energy production; wind turbines linked to wind farms, turbine-powered production installations, namely installations for electricity production; power-generating engines; and parts and components of all the aforesaid goods; solar powered energy electricity generators; machines and machines systems, including parts and accessories for electricity production, transformation and conversion; dynamos, electric motors of all kinds, steam and gas turbines and their parts, electrical generators and their parts, aircraft engines, compressors; laundry washing machines, dishwashers, waste grinders and compacters; pumps, namely centrifugal pumps, diaphragm pumps, bellows pumps, pumps and transfer pumps; liquid control devices, namely valves, regulators, actuators, ejectors, liquid separation cartridges and their parts, including semi-permeable membranes; filtering cartridges for industrial machines for filtering of coating solutions for the manufacturing of magnetic tapes; filtering cartridges for industrial machines for filtering of petrochemicals; filtering cartridges for industrial machines for filtering of drinking water; filtering cartridges for industrial machines for filtering of beer; filtering cartridges for industrial machines for filtering of chemical products; machines for supplying and applying chemicals for industrial use; axial-flow and centrifugal compressors; reciprocating compressors; screw and sliding-vane compressors; rotary, vacuum, electric, submerged and centrifugal pumps; turbo-expanders, namely, air and electric compressors; compressed natural gas (CNG) refueling machines for land vehicles and industrial equipment and accessories and parts of all the aforesaid goods, namely pumps, valves, fuel filters, filter housings, distributor rotors, blades, bearings and mechanical joints; steam condensers; boat engines; turbo-compressors for engines; fuel injectors; welding machines; industrial robots; machines for insertion of electronic components; dry etching machines; electric micro-discharge machines; optical discs productions systems; precision connection equipment; treatment machines for printed wiring panels; welding rods; machines for assembling parts; brazing machines; machines for fixing screws; electrical tools; electric motors, electric generators; elevators (lifts); washing and drying machines, electric washing machines, electric dishwashers; compressors (non-surgical); pumps, electric pumps; mixing, cutting and chopping machines; blender machines; electric centrifuges; electric food processors; electric meat grinders; electric can openers; electric knife sharpeners; electric coffee grinders; electric ice crushers; electric waste-processing machines; garden tools, electric lawnmowers, garden vaporizers for disinfectants and insecticides; electric apparatus for cleaning, electric vacuum cleaners, electric floor polishers; electric window cleaners; hand-held electric tools and implements; welding machines, metal cutting machines by arc, gas or plasma; blenders, centrifuges, hand-held mixers, food processors; electric door-opening devices; carbon electrodes for welding; electric arc-welding apparatus; welding electrodes; electric wrenches (tools); fuel pumps for service stations for aircraft engine refuelling; calibrated fuel pumps; belts for conveyors; transmission belts not for land vehicles; belt conveyors ; brakes for machines; hydraulic hoses, not of metal, for use in machines; non-metallic hoses for transferring hydraulic power in machines; non-metallic hoses for use in hydraulic systems of machines; hydraulic quick release couplings for high pressure hoses used in machines; plastics pipes (fitted parts of machines); hydraulic connectors (pipes) being parts of machines ; tire repairing machinery; pressure chambers as parts of tire repairing machinery; tire buffers as parts of tire repairing machinery; tire tread rollers and stitchers, as parts of tire repairing machinery; tire tread cutters and bonding agent applicators used in recapping tires as parts of tire repairing machinery; pneumatic shock absorbers (air springs, for machine elements not for land vehicles); rubber springs for non-vehicular suspension systems; rubber treads for tracked excavators; rubber treads for tracked cranes; rubber treads for tracked snow removers; rubber treads for tracked pavers; rubber treads for tracked mining machinery.Class 9Scientific, research, navigation, surveying, photographic, cinematographic, audiovisual, optical, weighing, measuring, signalling, detecting, testing, inspecting, life-saving and teaching apparatus and instruments; apparatus and instruments for conducting, switching, transforming, accumulating, regulating or controlling the distribution or use of electricity; apparatus and instruments for recording, transmitting, reproducing or processing sound, images or ***data***; recorded and downloadable media, computer software, blank digital or analogue recording and storage media; mechanisms for coin-operated apparatus; cash registers, calculating devices; computers and computer peripheral devices; diving suits, divers' masks, ear plugs for divers, nose clips for divers and swimmers, gloves for divers, breathing apparatus for underwater swimming; fire-extinguishing apparatus; protective helmets for sports; glasses, sunglasses, sports goggles; computer game software; fuel distribution equipment, namely electric fuel-level gauges, control valves for regulating gas flow and fuel lines; operating software for calibrated fuel pumps for refueling of land vehicles, marine vehicles and aircraft; operating software for flow control panels for refueling of land vehicles, marine vehicles and aircraft; operating software for fuel lines and pump nozzles for refueling of land vehicles, marine vehicles and aircraft; gas meters; on-board and roadside signaling and communication systems, train inspection systems, crossing notification systems, apparatus for electric control of switching; GPS tracking and monitoring systems for the transit and railway industries; capacitors; circuit breakers; circuit-breaker patch boards; circuit closers; contact breakers; commutators; current rectifiers; current limiters; electric contacts; electric collectors; electric conductors; electric connectors; electric controllers; electric inductors; electric power supply systems; distribution boards [electricity]; branch boxes [electricity]; electrical distribution consoles; electrical switchboards and switchboxes; software for troubleshooting and maintenance of programmable controllers; software for cardiac vessel analysis, including heart vessel analysis, also with calculation functions with regard to blood vessels; software for medical patient-monitoring equipment; software for receiving, processing, transmitting and displaying ***data***; software for developing customized programs for asset allocation; software for use on line enabling vendors of office equipment to place orders, to manage portfolios and communicate with the company; software for accessing mortgage and insurance information; software for ***collecting*** ***data*** concerning vital signs; software for analyzing electrical systems and electronic instruction manuals sold as a unit therewith; software for employees of financial institutions used for assessing customers’ financial investments and processing the sale of the identified investments; software for obtaining information on the risk of flooding with regard to real property; software for developing graphic user interfaces and displaying ***data***; software for calculating mortgage payments; software for controlling and managing vehicle fleet maintenance services; software for using and accessing commercial computer services; software used by clients to obtain information regarding lease portfolios; software for a radiology information system for radiologists and radiology departments; software for managing databases containing information on employees and patients for archiving purposes and patient monitoring; software installed on and used with PCs and medical monitoring equipment for graphic user interfaces; software for sending encrypted and compressed ***data*** to radio-paging (transport) systems; software for providing access to web sites so that buyers and sellers can carry out business transactions by electronic means; software for subterranean navigation, namely navigation of the assembly of a depth probe for oil drilling and drilling assemblies so as to route subterranean installations; electronic, nuclear, industrial and laboratory, testing, measuring, calculating and monitoring instruments and apparatus; electrical products, electricity production and distribution products and voltage surge protection products, namely lightning conductors, armored rods; switches for lighting; input/output controls and devices; fuses; controls for lighting; switch boxes; LEDs, namely light-emitting diodes; voltage regulators for electric power; voltage surge protectors; voltage surge limiters; voltmeters; electrical circuit boards; relays and timers; solenoids and limit switches; manual full-voltage starters; reduced-voltage starters; electric switches and disconnecting switches; splitters for circuit boards and pumping panels; circuit breakers and disconnecting switches; transformers; electric circuit and electric lighting boards; electric wires; cables; cords and conductors; electric wiring; lightning conductors; electricity meters; wattmeters; grounding resistances; humidity and temperature sensors; industrial calibration sensors, push buttons, engine and motor control centers and their electric controls and voltage regulators included in this class; computer programs and software for medical use, industrial use and for research; electrophoresis apparatus; chromatography columns and pumps; apparatus for particle or laser rays microfabrication; apparatus for bio-informatics systems; scintillation apparatus; imaging apparatus for radioactive and luminescent emissions; integrated synthesis and purification systems; oligonucleotide-producing apparatus; optical laser systems for digital imaging; glassware for laboratories; vials and micro-vials; microtiter plates; software for managing hospital operating rooms; software for intensive care information management; software for industrial operation control; software and manuals therefor sold as unit for factory management; graphic interface computer programs for controlling machines in industrial automation applications; software for creating graphic presentations and editing dynamic ***data*** interfaces for real-time graphic applications for industrial and commercial use; communication software for connecting computer network users; software for plastic injection molding; software for controlling, monitoring, simulating, communicating, recording and ***collecting*** ***data*** and for factory automation; software for integration of manufacturing machine operations, process control, supply of ***data*** for displaying, problem monitoring and production report generation; software packages for operating and programming grinders in the manufacturing industry; computer hardware for monitoring industrial processes, namely computer monitors; portable computers, Ethernet cards and cables; computer networking hardware, memory cards; microchips; microprocessors; computer network hubs, switches and routers, computer accessories, displaying devices and terminals; computer whiteboards; processors and system cards; call controllers, operator interfaces, reference interfaces and ***data*** collectors; applications for manufacture and control, namely for statistical process control, ***data*** ***collection***, direct digital control; document management systems; digital signal processing products and systems, namely, industrial automation controls and programmable logic controllers; adaptive control product in the form of an external controller for optimizing rough and semi-rough cutting performance of machine tools; wired and remote input/output electric equipment; input/output modules; interface modules; electricity supplies; assembly equipment; anti-theft and burglar alarm systems; logic programming computers for security systems; control panels for security systems; electronic burglar detectors; electronic glass-breakage detectors; electronic vibration detectors; magnetic contacts for security systems; electronic switch plates for security systems; electronic motion detectors for alarm systems; electronic motion-sensitive switches; fixed connection sirens for security systems; audio loudspeakers for security systems; electronic navigation systems for security systems; access control and alarm monitoring systems; fire, heat and smoke alarms and detectors; computer cards access control systems; card readers, card encoders and encoded cards for card-operated access control systems; video cameras; video devices for object recognition; video devices for object tracking; video devices for reading license plates; video devices for checking alarms; video devices for facial recognition; video devices for vehicle recognition; video devices for traffic detection; video devices for access door control; video devices for burglar detection; processing hardware or software used for analyzing digital video images for automatically extracting, recording and reporting information automatically, and remote video monitoring systems for security and surveillance applications; central video monitors; video recorders; apparatus for shooting and filming; closed-circuit video systems; closed-circuit video systems consisting of one or several cameras and camera housings; wireless, short-range and radiofrequency transceivers; transceivers for electrical lines; communication monitoring equipment for operating closed-circuit cameras; communication monitoring equipment, namely numeric-pad controls, matrix switching devices, multiplexers, digital video recorders, integrated swinging panoramic zoom dome cameras, remote video controllers, receivers, electronic alarms, video transmission devices; personal digital assistants (PDAs) configured for use by real estate professionals; communication interfacing devices for personal digital assistants (PDAs); fiber-optic transmission systems, namely fiber-optic transmitters, receivers and transceivers for transmission of video signals, audio signals and ***data*** via optical fibers; electric switches; electromechanical locking devices; magnetic cards for locks, access control, presence control, alarms and security systems; portable electronic hardware for reception, control, storage, handling, display and transmission of ***data*** and for actuating electronic locks; electronic access cards and readers and encoders thereof; magnetic access cards and readers and encoders thereof; memory access cards and readers and encoders thereof; proximity cards; proximity cards readers; proximity cards encoders; electronic keys and readers and encoders thereof; barcode access cards and readers, encoders and laminators thereof; access keypads; radio-frequency tracking tags; tracking and control systems consisting of one or several radio-frequency beacons, detectors and transceivers for determining and checking the location and movements of tangible assets, stocks and individuals; infrared sensors; control boards; access card readers; video imaging equipment and systems; video surveillance equipment and systems; digital hard disk recording equipment and systems; network transmission equipment and systems; remote access equipment and systems; networked digital video storage servers; applications for surveillance and access control; applications for alarm and security monitoring; computer software and hardware for monitoring and operating access and security systems comprising locking systems, doors, access and identification devices and security cases in the form of boxes for securing keys; surveillance systems sold separately or as components or in the form of sets comprising one or several surveillance cameras, hidden cameras, closed-circuit television cameras, camera housings, camera stands, lenses, video monitors, video recorders, digital recorders, video recording media, video switches; surveillance systems sold separately or as components or in the form of sets comprising control panels, numerical pad controls, joysticks; surveillance systems sold separately or as components or in the form of sets comprising interface apparatus for alarms and access control equipment, transceivers, receivers, transmitters, signal processors, multiplexers, matrix switches, controls, control panel casings, switch housings, transformers, switches, splitters, coaxial cables, connectors, motion detectors, microphones and loudspeakers; user interface software and control software for management of access, security and fire-extinguishing systems; electric locks; portable electronic communication and computer equipment for ***data*** reception, control, storage, handling, display and transmission for operating electronic locking devices; electronic key holders, readers and encoders; ***data*** processing computer software and hardware; electric power supplies, namely batteries, rectifiers/regulators of current/voltage and transformers; control panels, namely electronic apparatus designed for electronically monitoring a predefined activity and for activating an anti-theft alarm; loudspeakers for sirens and electronic siren controls, namely ringer tone generators and amplifiers for sirens; software for controlling communication equipment for operating and controlling closed-circuit cameras; switching devices integrating magnetically triggered blade switches for anti-theft alarm systems and fire alarm systems, integrated into industrial tracking apparatus, revolution counters, security lock systems for equipment cabinets, industrial position-monitoring apparatus, electric cables and pump and valve monitoring apparatus and home security alarm systems; electric and electronic checking apparatus for detecting the presence of certain substances on individuals, in luggage and freight; electric and electronic checking apparatus for detecting the presence of explosives and/or narcotics on individuals, in luggage and freight; apparatus for detecting the presence of explosives and other contraband; timers or sensitive apparatus for detecting changes in conditions for launching and monitoring regeneration or washing cycles for water treatment equipment; control valves for water treatment and filtering equipment; bioreactors for cell culture; portable analysis instruments, namely a probe with a recorder for ***data*** conversion equipped with microprocessors for measuring organic and inorganic products in water; filters and filter housings for laboratories; membrane filters for laboratories; silt density measuring devices; deionization devices for laboratories, filters and filter housings for laboratories; liquid separating apparatus for laboratories; membranes for laboratories; liquid flow control devices, namely pumps, valves, flowmeters and regulators for laboratories; ozone monitoring instruments; laboratory equipment, namely porous titration microplates for cellular biology and other applications in life sciences; electronic controls for treatment of industrial and commercial water supply systems; electronic controls for treatment of boiler water systems; electronic controls for treatment of water cooling systems; electronic controls for treatment of cooling water systems; electronic controls for treatment of closed water-supply systems; electronic controls for treatment of systems for paper and pulp treatment; electronic controls for fuel treatment systems; electronic controls for metal treatment systems for analyzing the chemistry of the system, determining the proper treatment program, applying the desired treatment and monitoring the effectiveness of the treatment; ***data*** management software in the field of paper, pulp and water treatment; electronic controls for ***data*** processing in the field of paper, pulp and water treatment; apparatus for industrial water-supply systems for measuring and checking pH and conductivity; apparatus for supplying an industrial, commercial or municipal water supply system with measured quantities of chemicals; electronic testing apparatus for water treatment; laboratory testing equipment, namely apparatus for testing deposit levels and corrosion speed; equipment and instruments for mobile laboratory equipped for measuring and monitoring pH, conductivity and concentration of chromate in domestic and industrial waters; equipment and instruments for mobile laboratory equipped for carrying out inorganic and microbiological water testing; electronic and electrochemical products, namely fuel cells; apparatus for converting photo-electric radiation to electrical energy, namely, photovoltaic solar modules, hybrid photovoltaic solar modules, electronic sensors for measuring solar radiation, photo-cells; apparatus for converting electronic radiation to electric energy, namely photovoltaic solar modules, systems and components and all related system components; printers, laser printers, ink-jet printers, multi-function and multi-purpose printers, parts of all the aforesaid goods; portable electronic devices for wireless reception and/or transmission of audio and video ***data*** with integrated memory; software for synchronization of ***data*** between a remote unit or station and a fixed unit or station, and software providing a one-way and/or two-way wireless connection to ***data***; portable digital electronic apparatus and software related thereto; portable electronic devices for wireless ***data*** reception and/or transmission; software for re-orientation of messages, electronic mail and/or other ***data*** from a personal computer or a server towards one or several portable electronic devices; computer software and programs for wireless device operation and management; telecommunication devices; software for accessing, searching, indexing and retrieving information and ***data*** from global computer networks and global communication networks, and for navigation on the aforesaid networks websites; software for sending and receiving short messages and electronic mail and for filtering non-text information from ***data***; portable electronic devices for voice, video, ***data*** and image communications; computer game software for mobile telephone receivers; electronic game software for mobile telephone receivers; software packages; batteries, dry cells and batteries, rechargeable batteries, battery chargers, storage batteries, solar cells and batteries, fuel cells; carbon electrodes for dry batteries; wiring apparatus; electric cables; electric ducts; floor ducts specially designed for housing electric cables; ballast (for discharge lamps); under carpet wiring systems; code lighting-switches; magnetic contactors and starter switches; circuit protectors; switching devices; electric connecting boxes; device switches; output jacks; plugs (electric); electric timers; other wiring devices; signaling apparatus and instruments, video intercoms, intercom systems, electric door chimes, intercoms, fire alarms, gas-leak alarms, anti-theft alarms, portable emergency intercoms; acoustic machines and apparatus; radios; tape recorders/players; radio cassette recorders; portable tape players; compact disc recorders/players; minidisc recorders/players; minidisc decks consoles; DVD (digital versatile disc) audio recorders/players; secured digital recorders/players; secured digital cards; loudspeakers; tuners; amplifiers; stereo component systems; disc readers; graphic equalizers; radio alarm clocks; integrated circuit recorders; digital audio processing devices; earphones; headphones; microphones; cassette recorders/players; software for compact discs (prerecorded); electric megaphones; language laboratories; audio systems for cars; public address systems; audio mixers; audio equipment cleaning equipment, namely magnetic head cleaning equipment; audio cables, video cables, other audio machines; audiovisual machines and apparatus; television sets; cathode ray tube display devices; cathode ray tubes; image pick-up tubes; plasma television sets; plasma displays; LCD (liquid crystal display) television sets; liquid crystal display monitors; television sets combined with video tape recorders; television sets combined with disc players; antennas; tuners for satellite broadcasting; television tuners; Internet terminals; video projectors; video cassette recorders; camcorders; video printers; laser disc players; video CD (compact disc) players; software for video CD (compact disc); video recorders/players for DVDs; color video systems for large-scale display; cable television systems; hard disk units; video imaging devices; electric optical display boards; multi-purpose electric display systems; closed-circuit video equipment systems; software for DVDs; television cameras; video switches; non-linear editing systems; editing controllers; DVD creation systems; light emitting diodes (LED) displays; optical disc machines and apparatus; optical disc units, optical disc recorders, optical disc players, optical disc changers, optical disc cartridges, optical disc recording systems; communication apparatus and machines; facsimile transceivers; transceivers; telephones; cellular mobile telephones; cases for cellular mobile telephones; telephone answering machines; private auto-switch systems; global positioning system receivers; radiotelephones; marine radars; radio-paging receivers; mobile communication systems; multi-channel access radio systems; electric panels for traffic information; videoconferencing systems; private portable telephone systems; local network systems; AV codecs (coder-decoders); navigation systems for cars (road guidance systems); electronic systems for road toll ***collection***; GPS (global positioning system) antennas; checking (supervision) apparatus and instruments; communication and surveillance systems for apartment buildings; intruder detection systems; automated systems for surveillance and control of functions within buildings; electric multi-layer security apparatus; checking (supervision) apparatus and instruments, communication and surveillance systems for apartment buildings, intruder detection systems, automated systems for surveillance and control of functions within buildings, electric multi-layer security apparatus; automatic control machines and instruments; electric distribution boards; road signal control apparatus; bus location systems; ultrasound vehicle detectors; information and telecommunication networks for road traffic management; light dimmers; light switches; inverters; programmable control systems; electrical enclosures; domestic electricity production systems; power capacitors; ***data*** processing equipment; computers and computer peripherals; word processors; software (recorded); image scanners for personal computers; PC (personal computer) cards; computer keyboards; mouse (***data*** processing equipment); CD-ROM (compact disc-read only memory) units; diskette units; card reading/writing systems; barcode readers; time recorders; portable ***data*** terminals; point-of-sale systems; ***data*** ***collection*** terminals; personal digital assistants (PDAs); DVD-RAM/ROM (digital versatile disc-random access memory / read only memory) units; CAD/CAM (computer-aided design/computer-aided manufacturing) systems; electronic calculators; uninterrupted power supplies for computers / communication / broadcasting; external storage devices; video cassettes; cleaning heads; D-VHS (video ***data*** home systems); other computer peripherals; video tapes; audio cassettes; diskettes; optical discs; mini-discs; DVDs (digital versatile discs); integrated circuit memory cards; weighing and measuring apparatus and instruments; thermoluminescent dosimetry systems; portable x-ray dosimeters; electronic meters; ammeters; electricity consumption meters; grip measuring devices; electric apparatus for measuring leakance; electric insulation meters; thermometers; measuring system processors; electric multi-circuit sector voltage monitors; micro-precision measuring devices; pacers; audio/video analyzers; oscilloscopes; modulators; distortion meters; sensors, light-sensitive sensors, thermometric sensors, position sensors, angular velocity sensors, rotation sensors, angle sensors, dew point sensors, other sensors; electric components; light emitting diodes; liquid crystals; liquid crystal display modules; magnetrons; transistors; semi-conductor storage devices; one chip micro-computers; cartridges for electric condenser microphones; thermostats; integrated circuits; gray-scale image processors; thermal printing heads; magnetic heads; permanent magnets; relays; display components; semi-conductor lasers; charge coupling devices (CCD device); image detectors; film capacitors; over-oxygenation membrane units; electric tuner units; high-frequency units; coin validation units; note validation units; magnetic card reading/writing devices; voltage-controlled oscillators; phase-locking circuit synthesizing modules; wireless communication module units; optical transmission components; printed wiring boards; loudspeaker components; electricity supplies; AC (alternating current) adaptors; focusing magnets; inductors (coils); capacitors for electric apparatus; electric signal filters; deflection coils; thermistors; varistors; piezoelectric ceramic components; acoustic-optical components; potentiometers; printing units; hybrid integrated circuits; switching components; heat-welding wiring boards; transparent touch panels; electroluminescent components; remote control units; magnetic resistance elements; thermal disconnects; ***data*** processing equipment, in particular for financial applications; operating system programs; computer hardware and software, in particular for local and wide-range computer networks development, maintenance and use; systems for reading memory cards and systems for reading stored ***data*** including integrated circuit memories and bank card memories; automatic ticket dispensers; accounting machines; encoded cards, including magnetic cards and integrated circuit cards, in particular for financial applications; card readers, printing apparatus, including printing apparatus for ***data*** processing systems and financial transaction systems; machines for banking institutions; encoders and decoders; modems; encoded magnetic cards; electronic ***data*** carrier cards; encoded magnetic cards readers; electronic ***data*** cards reader; electronic encryption systems; computer hardware; computer terminals; software used in financial services, in the banking and telecommunication industries; electric and electronic products, namely calculating machines, pocket planners, alarms; bank cards, including printed bank cards and bank cards with magnetic memory and with integrated circuit memory; bank cards, credit cards, debit cards, including such cards equipped with integrated circuits and microprocessors; memory cards (smart cards); automated teller machines (ATMs); ***data*** processing equipment and computers including cards equipped with microprocessors and integrated circuits; computer hardware in the form of integrated circuit cards and card readers containing transponders and other proximity payment devices; mouse pads; machines and machine systems, including parts and accessories for transmission, distribution and control of electricity; electrical displacement devices; electricity control and regulation devices; electricity measuring instruments; electrical protection devices; switchboards; switchboard apparatus; wiring devices; liquid control devices, namely, flowmeters, manostats, sequential timers, electric switches and controls; audio amplifiers for keyboards; external memories for musical instruments; systems for managing ***data*** and preserving archives in the field of anesthesia; gradient coils, namely magnetic gradient coils for magnetic resonance imaging; alarm devices for tire pressure; pressure gauges for vehicle tires; rubber testing machines; smart watches; induction devices, namely, induction transmitters; electrostatic precipitators.Class 11Apparatus and installations for lighting, heating, cooling, steam generating, cooking, drying, ventilating, water supply and sanitary purposes; solar panels, panels for capturing solar energy; solar lighting accessories, namely lighting units and solar light fixtures for indoor and outdoor use; solar-thermal installations, namely solar-thermal modules; solar water-heaters; gas and electric cooking apparatus for household use, namely cooking rings, electric and gas cookers; gas and electric ovens and cooktops; heat exchangers; heavy-wall chemical reactors and nuclear reactors and accessories and components thereof, namely, heat pumps, valves for steam systems and valves for regulating gas and liquid flow; electric lamps of all kinds and their parts; electric lighting accessories and their parts; freezers, air-conditioning apparatus, electric ovens, electric refrigerators; microwave ovens for cooking; wall-mounted cooking ovens for household use; food warming drawers; convection ovens, electric and gas cooktops; electric and gas cooking ovens; ventilation hoods for stoves and exhaust fans; water filters; water softeners; laundry driers; electric fans, ceiling fans, flashlights; lamps and lights for vehicles; electric lights for Christmas trees; liquid separation devices; liquid concentration devices; liquid recycling devices; filters for filtering of solids from gas and liquids or for filtering of liquids from gas and for filtering of an immiscible liquid from another; spiral elements or cartridges - contained in a tubular plastic sleeve for concentrating goods and removing impurities in liquid treatment systems; water conditioning devices for residential use; reverse osmosis modules and their membranes; devices and systems for water purification consisting of clarification units; electric deionization systems; condensate polishing filters; vacuum degassing devices; ultraviolet sterilization devices; ion exchangers for the purification of water; systems for regeneration of acids and caustic products; reverse osmosis systems; forced-air carbonate removal devices; filters; systems for supplying chemicals and devices for storage of bulk goods, sold with automatic controls and instruments for monitoring device and system operation parameters; electrochemical purification devices for liquids for industrial, commercial and municipal use; water filtering devices for household, industrial and commercial use; wastewater purification units; drinking water purification devices for household, industrial and commercial use; liquid separating devices, namely industrial liquid filters; recycling devices, namely liquid purification devices; water treatment equipment, namely cartridges; water treatment equipment for household use, namely water softeners and water conditioners; support filters and depth filters for removing deposits, iron, sulfur, tastes and smells from water; reverse-osmosis water purification devices; depth filter units and cartridges for filtering liquids and air for household, industrial and commercial use; disposable cartridge filters for filtering industrial water; apparatus and installations for lighting; incandescent lamps; gas discharge starters; grooved fluorescent lamps; fluorescent lamps; tungsten halogen lamps; pocket searchlights; fluorescent lanterns; fluorescent lighting apparatus; dynamo lighting kits for bicycles; germicidal lamps; other lighting apparatus; cooking apparatus and installations; automatic bread-making machines for household use; electric kettles; electric rice cookers; gas rice cookers; slow cookers; electric grills; toasters; coffee machines; electric thermal-insulating coffee makers; induction cooktops; electric barbecue grills; microwave ovens; gas cookers with ovens; electric saucepans; sink basin; other kitchen ranges; refrigerating and freezing apparatus and installations, refrigerators, freezers, cold/hot water dispensers, freezing and refrigerating display cases, electric water coolers, ice-making apparatus; ventilation apparatus and instruments; electric air purifiers; extractor hoods for cookers; electric dehumidifiers; electric humidifiers; blowers; blinds propelling cold air; air exhaust units; ceiling fans; heating apparatus and installations, apparatus for steam generating, drying, cooling and air conditioning; air conditioners; blade fans for air conditioning; apparatus for cooling air by evaporation; stoves; electric radiators; electric blankets; electrically heated floor carpets; kerosene-powered fan heaters; electric foot warmers (kotatsu); wireless gas radiators; water distribution apparatus; electric bidets; toilets; self-cleaning toilet seats; portable toilets; systems for wastewater treatment by aeration; water purifiers; incinerators (waste incinerators); household waste processors; saunas; bathtubs; electric showers; water heaters, gas-powered instantaneous water heaters, other water heaters; driers, dish driers, electric hair driers, laundry driers, other driers; electric lamps, electric driers, electric-resistance heating cables; metallic sinks.Class 12Vehicles; apparatus for locomotion by land, air or water; electric motors and diesel engines for land vehicles; bicycles, tires and tubes for bicycles, automatic vehicles, electric bicycles; tires; tires for passenger cars; tires for trucks; tires for buses; tires for racing cars; tires for automobiles; retreaded tires for passenger cars; retreaded tires for trucks; retreaded tires for buses; retreaded tires for racing cars; retreaded tires; retreaded tires for automobiles; inner tubes for passenger cars tires; inner tubes for trucks tires; inner tubes for buses tires; inner tubes for racing cars tires; inner tubes for automobiles tires; wheels and rims for passenger cars; wheels and rims for trucks; wheels and rims for buses; wheels and rims for racing cars; wheels and rims for automobiles; tread rubber for retreading tires for the above-mentioned vehicles; tires for two-wheeled motor vehicles; inner tubes for two-wheeled motor vehicles; wheels and rims for two-wheeled motor vehicles; bicycles and their parts and fittings; tires for bicycles; inner tubes for bicycles; wheels and rims for bicycles; adhesive rubber patches for repairing tubes or tires; tread rubber for retreading tires for two-wheeled motor vehicles or bicycles; tread rubber for retreading tires for aircraft; tread used to retread tires; preformed tire tread; rubber patches for repairing vehicle tread; shock absorbers (for land vehicles); air springs for land vehicles; air springs for railway cars; suspension shock absorbers for vehicles; tricycles for infants; tires for off-the-road vehicles; tires for scrapers on wheels; tires for motor graders on wheels; tires for shovel loaders on wheels; tires for tire rollers on wheels; tires for wheeled cranes on wheels; tires for cranes on wheels; tires for snow plows on wheels; tires for pavers on wheels; tires for mining machinery on wheels; continuous tracks for vehicles, namely continuous tracks for ***agricultural*** machinery; continuous tracks for vehicles, namely continuous tracks for mining machinery; continuous tracks for vehicles, namely continuous tracks for construction and cargo handling machinery; rubber pads to be attached to shoe plates of metal crawlers; continuous tracks for vehicles, namely continuous tracks for snow removers.Class 14Coins, ingots and medals in precious metals or in their alloys, commemorative or not; jewelry, precious and semi-precious stones; pins; horological and chronometric instruments; key rings.Class 16Paper, cardboard; printed matter, in particular stamps; newspapers, periodicals, books, photographs and posters; bookbinding material; stationery and office requisites, except furniture; adhesives for stationery or household purposes; artists' and drawing materials; paint brushes; instructional or teaching materials; plastic sheets, films and bags for wrapping and packaging; printers' type, printing blocks; computer printouts; chequebooks, punched cards; newspapers and periodicals in the field of information technology; paper shredders; electric staplers; battery-powered letter openers; electric pencil sharpeners; electric perforators; electronic typewriters; ribbon cartridges for electronic typewriters; apparatus for printing cheques; thermal paper.Class 18Leather and imitations of leather; leather vanity cases (not fitted); leather bags for mountain-climbing; leather rucksacks (backpacks); leather wallets (purses); briefcases (leather goods); leather attaché-cases; leather suitcases; leather school bags; leather handbags; key cases (leatherware); leather straps; animal skins and hides; luggage and carrying bags; umbrellas and parasols and walking sticks; whips, harness and saddler; collars, leashes and clothing for animals.Class 19 Materials, not of metal, for building and construction; rigid pipes, not of metal, for building; asphalt, pitch, tar and bitumen; transportable buildings, not of metal; monuments not of metal; thermoplastic building and construction materials, namely thermoplastic molded and extruded materials used as substitutes for wood, metal or glass, for supporting or covering; doors (not of metal); rain gutters; ceiling panels; folding doors; wooden floors; roofing tiles; prefabricated houses; laminates; connecting tracks; building materials with soundproofing properties; non-metallic roofs, with solar cells; plastic panels for building and construction; building materials with thermal insulation properties; thermoplastic materials used as building materials for insulation, covering (roofing) and glazing; water pipes made of PVC (polyvinyl chloride); antiseismic construction materials, not of metal; antiseismic rubber building materials; roofing membranes; bituminous roofing waterproof membranes; non-metal bridge construction materials, covered with rubber.Class 21Household or kitchen utensils and containers; cookware and tableware, except forks, knives and spoons; combs and sponges; brushes, except paintbrushes; brush-making materials; articles for cleaning purposes; unworked or semi-worked glass, except building glass; glassware, porcelain and earthenware; implements for cleaning clothing, toothbrushes; electric toothbrushes; ultrasound cleaning apparatus for dentures; dental floss, holders for dental floss, toothpicks, holders for toothpicks; non-electric implements and materials included in this class, all for cleaning; parts and components of all the aforesaid goods included in this class; holders and dispensers for all the aforesaid goods, all included in this class; electric trouser presses; corkscrews, electric and non-electric; bottle openers, electric and non-electric; electrical devices for attracting and destroying insects; electric combs.Class 25Clothing, footwear, headwear.Class 28Games, toys and playthings; video game apparatus; gymnastic and sporting articles; decorations for Christmas trees; playing cards; electric floats for fishing; apparatus for tying fishing lines to hooks; electronic apparatus for practicing golf; wax applicators for skis; stationary exercise bicycles and rollers; rubber balls ; golf equipment, namely, trolleys for golf bags, golf clubs, golf bags, with or without wheels, golf gloves; sports bags shaped to contain specific sports apparatus; tennis rackets; tennis balls.Class 29Meat, fish, poultry and game; meat extracts; preserved, frozen, dried and cooked fruits and vegetables; jellies, jams, compotes; eggs; milk, cheese, butter, yoghurt and other milk products; edible oils and fats.Class 30Coffee, tea, cocoa and artificial coffee; rice, pasta and noodles; tapioca and sago; flour and preparations made from cereals; bread, pastries and confectionery; chocolate; ice cream, sorbets and other edible ices; sugar, honey, treacle; yeast, baking-powder; salt, seasonings, spices, preserved herbs; vinegar, sauces and other condiments; ice (frozen water).Class 32Beers; non-alcoholic beverages; mineral and aerated waters; fruit beverages and fruit juices; syrups and other non-alcoholic preparations for making beverages.Class 35Advertising; dissemination of advertising matter via all media, in particular in the form of thematic messages centered on human values; advertising by sponsoring; online advertising and marketing services; business management; business administration; office functions; promoting the goods and services of others, by means of contractual agreements, in particular sponsoring and licensing agreements, enabling them to gain additional notoriety and/or enhanced image and/or a surge of sympathy derived from the notoriety and/or enhanced image resulting from cultural and sporting events, in particular international events, and/or a surge of sympathy generated by the above; promoting the goods and services of others by means of what is referred to as the initial interest factor leading the public to consider, among a multitude of competitors, goods or services presented to the public bearing signs, emblems or messages able to capture its attention; promoting the goods and services of others by means of the so-called image transfer; rental of advertising space of all type and on all media, whether digital or not; business administration of the participation of national teams to an international athletic competition, and promoting the support to said teams with the public and the concerned circles; inventory management services; consultation relating to stock monitoring services; advertising by means of direct marketing for others consisting in marketing of databases; consultation for advertising by means of direct marketing for others consisting in marketing of databases; consultation services in connection with business reorganization; truck and automobile fleet management services, namely billing and consulting in connection with the administrative management of truck and automobile fleets; business administration consultancy; administrative management of power plants of others; business consultation in connection with the management of power plants; commercial administration of contracts for repair and servicing; supply chain commercial management services; business consulting services relating to the purchase and supply of chemical services and products; commercial supply management of products; establishing product inventory; consulting, marketing, analysis of prices and costs concerning devices for electrochemical purification of liquids for industrial use; administrative, commercial and technical management of computer files; ***data*** input and processing services; department store retail services connected with the sale of beauty products, toiletries, machines for household use, hand tools, optical goods, domestic electrical and electronic equipment; information services concerning the sale of raw materials; commercial information services; commercial information agencies services; photocopiers rental services; promoting the sale of goods and services of others by means of advertisements, promotional competitions, awarding of prizes and bonuses in the form of promotional lotteries, discounts, reduction tokens and value-added offers in connection with the use of payment cards; promoting sporting competitions and events for use by others; promoting concerts and cultural events for others, organization of exhibitions for commercial or advertising purposes; provision of documentation, namely direct mail advertising, distribution of advertising material, distribution of samples, reproduction of documents; advertising concerning the promotion of commercial sales of goods and services for retail sale purposes; provision of information in connection with e-commerce and electronic retail sale; provision of information concerning the purchase of goods and services on line via the Internet and other computer networks; advertising concerning transport, travel, hotels, accommodation, food and meals, sports, entertainment and sightseeing tours provided through tourist agencies; maintenance of computerized databases; digital file management comprising a portfolio of images and video sequences intended for use under license in traditional advertising and in the promotion of behaviour (moral advertising); providing online market for the buyer and seller of goods and services; retail services or wholesale services for tires; retail services or wholesale services of clothing, footwear, headgear; retail services or wholesale services for sports goods; retail services or wholesale services for bicycles and parts and fittings for bicycles; retail or wholesale services for pharmaceutical, veterinary and sanitary preparations and medical supplies; presentation of goods on communication media, for retail purposes; procurement services for others [purchasing goods and services for other businesses]; retail services or wholesale services of jewellery, horological instruments, fashion accessories, bags, memorabilia.Class 36Insurance; financial affairs; banking; monetary affairs; real estate affairs; credit card services; financing of sporting and cultural activities; rental of buildings and outbuildings designed for hosting corporate entertainment events; equity and private mark financing services; financial analyses and consultation; financial services in connection with credit cards; credit card services, namely granting credit to others; financial asset management for others; insurance and reinsurance services, namely underwriting of all types of insurance; equity capital investment services; insurance underwriting services in the field of bonds; financial security underwriting services; personal loan financing; lending against collateral; acquisition financing services; commercial financing services; commercial real-estate agency services; mutual funds; loan and private capital investments; services for providing information in the field of the aforesaid services services of assistance and consultancy in the field of the aforesaid services; lease-purchasing of mobile and modular structures; insurance brokerage services; credit agency services in the field of commercial and consumer credit; financing of real estate loans and financial and banking services; monetary operations in particular by means of bank cards or customer loyalty cards; financial clearing services; issuance of checks and letters of credit; financial services; insurance services; financial operations; bill payment services; debit card services; payment card services; pre-paid card services; electronic transactions by credit and debit card; electronic transfer of funds; smart card and electronic money services; provision of liquidities; credit card and payment services replacing cash payments; electronic transfer of capital; check verification; check cashing services; automated teller and safe deposit system services; payment processing services; transaction authentication and verification services; provision of financial information via a global computer network; financial sponsoring of festivals and concerts; financial services for purchasing goods and services sold in retail at points-of-sale for promotion purposes; provision of information services in the field of tourism, namely providing financial information; financial services for tourist assistance purposes; lease-purchasing of telephones, facsimile machines and other telecommunication equipment; lease-purchasing of transport containers; financial sponsorship of sporting activities.Class 37Building construction; replacement, overhaul and maintenance of power plants, motors and engines, turbines, wind turbines and apparatus, equipment and instruments for energy and electricity production and their parts, components and accessories; installation, maintenance and repair services for turbo-expanders compressors and pumps; installation, maintenance and repair services for fuel pumps; installation, maintenance and repair services for fuel distribution equipment compressors and pumps; installation, maintenance and repair services for compressed natural gas (CNG) refueling equipment compressors and pumps; installation, maintenance and repair services for gas turbines compressors and pumps; installation, maintenance and repair services for steam turbines compressors and pumps; installation, maintenance and repair services for air-cooled heat exchangers compressors and pumps; installation, maintenance and repair services for steam condenser compressors and pumps; installation, maintenance and repair services for heavy-wall reactors compressors and pumps; installation, maintenance and repair services for tubular reactors compressors and pumps; maintenance and repair services for oil and gas pipelines; drilling and pumping of oil and gas; drilling for crude oil; installation of tubes and pipelines for drilling of oil wells; rental of tools for drilling oil and gas wells; diagnosis services of airplane engines, turbines, electrical equipment, medical equipment and locomotives; repair services of airplane engines, turbines, electrical equipment, medical equipment and locomotives; maintenance services of airplane engines, turbines, electrical equipment, medical equipment and locomotives; rental of construction equipment; chemical cleaning services for glass-coated reactor vats used in the chemical and pharmaceutical treatment industries; maintenance services for heat transfer systems and of condensers; maintenance and repair services for equipment with computerized cooling systems; repair and maintenance services for machines, instruments, apparatus and electrical equipment; maintenance and repair services in the oil and gas field; services relating to installation of point-of-sales terminals in stores; computer maintenance services; installation and repair of electric apparatus repair of radio receivers and television receivers; repair and maintenance of electric apparatus and instruments for communication; repair and maintenance of electric household appliances; repair and maintenance of electric lighting apparatus; repair and maintenance of electric apparatus for distribution and control; repair and maintenance of electric motors; repair and maintenance of machines and instruments for measuring and/or testing; repair and maintenance of medical apparatus and instruments; repair and maintenance of metalworking machines and tools; repair and maintenance of cooking apparatus; repair and maintenance of automatic vending machines; repair and maintenance of water purification apparatus; repair and maintenance of musical instruments; repair and maintenance of watches and clocks; repair and maintenance of gas-fired water heaters for household use; repair and maintenance of bathtubs; repair of toilets with water points; installation or repair and maintenance of computer hardware; repair and maintenance of air-conditioning apparatus; installation, maintenance and repair of office equipment and machines; installation, repair and maintenance of machinery equipment; repair of vehicles; repair and maintenance of computers; repair and maintenance of electronic printers; repair of telephones; electricity works and installation of telecommunication equipment; installation, maintenance and repair of compressors, pumps, namely, machines, turbo-expanders, fuel pumps and fuel distribution equipment, CNG refueling equipment, gas turbines, steam turbines, air-cooled heat exchangers, steam condensers, heavy-wall reactors and tubular reactors; repair and maintenance of oil and gas wells; repair and maintenance of tires for automobiles; retreading of tires; repair and maintenance of tires for two-wheeled motor vehicles; repair and maintenance of bicycles and their parts; repair and maintenance of tires for bicycles; tire repair and recapping services.Class 38Telecommunications; television program broadcasting, broadcasting of televised programs (live or recorded); cellular telephone communication; communications by electronic computer terminals, by databases and by telecommunication networks connected to the Internet; communications by telegraphs; communications by telephone; communications by facsimile machines; radio paging services; teleconferencing communications; television broadcasting; cable television broadcasting; radio broadcasting; news agencies; other message transmission services; providing access to a commercial site on the internet; radio and television broadcasting provided via the Internet; electronic mail; providing access to computer information newsletters and to discussion forums on line; transmission of messages and images via computers; providing access to home and office shopping services via computer and/or interactive communication technologies; telecommunication of information (including web pages), of computer programs and of all other ***data***; electronic mail services; providing user access to the Internet; services of telecommunication connections to the Internet or to databases; providing access to digital music web sites on the Internet; rental of access time to a central database (telecommunications); provision of access to search engines; providing discussion forums on the Internet; rental of access time to a central server database; rental of access time to a computer database (telecommunication services); simultaneous broadcasting, in particular by means of electronic interconnections, of films and of video and sound recordings; wireless ***data*** messaging services, in particular services enabling a user to send and/or receive messages via a wireless ***data*** network; one-way and two-way messaging services; electronic transmission of ***data***, images, documents, mails, messages and audio and video ***data***, via local or global computer and communication networks; electronic transmission of ***data***, images, documents, mails, messages and audio and video ***data*** via the Internet, intranets, extranets, television; electronic transmission of ***data***, images, documents, mails, messages and audio and video ***data*** via mobile communication networks, cellular networks and satellite networks; electronic transmission of software via local or global communication networks, including the Internet, intranets, extranets, television, mobile communication networks, cellular networks and satellite networks; providing access to databases and to local or global communication networks, including the Internet, intranets, extranets, television, mobile communication, cellular and satellite networks; transmission and relay of messages, namely electronic transmission of messages; telecommunication services for the dissemination of information by mobile telephone, namely, transmission of ***data*** to mobile telephones; communication by mobile telephone; voice communication transmission and reception; transmission and reception on a value-added network; telecommunication services by telematic means and by multimedia networks; rental of access time to a database server center; operating networks for transmission of value-added ***data*** (multimedia systems, interactive videography, global computer telecommunication networks).Class 39Transport; packaging and storage of goods; travel arrangement; storage of media containing still and moving images; distribution of oil or gas by pipelines; rental of automobiles, airplanes, self-propelled and marine vehicles; delivery and storage of chemicals in the field of water treatment and of pulp and paper making systems; boat transport; vehicle reservation services; services of provision of information concerning travel; travel reservation services; pre-trip transportation planning assistance services; printing materials distribution; transport ticket reservation; services of provision of information in the field of tourism, namely providing transport information; services of provision of information in the field of tourism, namely providing information on the reservation of tickets for transport, travel and sightseeing tours; services of provision of information in the field of tourism, namely providing information on planned activities for sightseeing tours and transport; services in connection with transport for tourist assistance; tourist reservation services, namely ticket reservation services and transport reservation services; services of provision of information relating to prices, timetables and means of transport; assistance provided to tourists in connection with the reservation of tickets for transport, travel and sightseeing tours; assistance provided to tourists in connection with planned activities for sightseeing tours; tourist reservation services, namely reservation of tickets for transport, travel and sightseeing tours; preparation of travel reports via a global computer network.Class 41Education; providing of training; entertainment; sporting and cultural activities, televised sporting and cultural entertainment; organization of exhibitions for cultural and educational purposes; organization of lotteries and competitions; betting and gambling services in connection with or relating to sports; entertainment services provided during sporting events or concerning sporting events; organization of sporting and cultural events and activities; organization of real or virtual sporting competitions; providing sports facilities; entertainment in the nature of television news shows; entertainment services in the nature of creation, development and production of television programming; entertainment services in the nature of an ongoing reality based television program; entertainment in the nature of ongoing television programs in the field of sport; rental of audio and video equipment; production of films, other than advertising films; production of sound and video recordings; presentation and distribution of films and of sound and video recordings; rental of films and of sound and video recordings; rental and/or provision via a computer network of interactive education and entertainment products, namely interactive compact discs, CD-ROMs, computer games; entertainment, namely presentation of interactive education and entertainment products, namely interactive compact discs, CD-ROMs, computer games; radio and television coverage of sporting events; production of television and radio programs and of videotapes; production of cartoons; production of animated programs for television; reservation of tickets for sporting events and shows; timing of sports events; organization of beauty contests; interactive entertainment; on-line betting services; provision of games on the Internet; provision of raffle services; services of provision of information concerning entertainment or education, provided on line from a ***data*** bank or the Internet; electronic game services provided by means of the Internet; providing on line electronic publications; publication of books, magazines, texts (other than publicity texts) and periodicals; on line publication of electronic books, magazines, texts (other than publicity texts) and periodicals; provision of digital music from the Internet; provision of sporting results; services of provision of information concerning sports and sporting events; rental of recorded sounds and images; audio production services; services of provision of information concerning sporting events provided on line from a computer database or the Internet; editing and publishing services; provision of digital music (non-downloadable); offering digital music by means of telecommunications; publication of ***statistics*** regarding sporting results and audience ratings for sporting competitions; training in the use and operation of systems for signaling and notification of crossings for the railway and transit industries; conducting of seminars, conferences, symposiums or workshops in the field of medical imaging and diagnosis intended for medical practitioners and employees of pharmaceutical companies; education services, namely conducting of seminars, conferences, symposiums or workshops in the field of life sciences and biotechnology for scientists and researchers; conducting of seminars on problems in connection with industrial water treatment; training services in all the aforesaid fields; training services in the field of management and medicine by means of the use of instructions and demonstrations provided on line, via the Internet, intranets and extranets; education services, namely conducting of practical training workshops, courses and seminars including demonstrations in the field of medicine and management; design, conducting and hosting of courses, seminars and all training activities in the field of information technology; organization and performance of concerts; booking of seats for shows; movie presentations; services of provision of information in terms of entertainment; film production; show production; theater production services; operation of golf facilities; health club services (fitness training); sports camp services; presentation of live performances; film projection; organization of shows (impresario services); holiday camp services [entertainment]; movie studios; news reporter services; provision of on-line electronic publications, not downloadable; music hall services; education services, namely conducting of courses, seminars, presentations, video presentations; provision of educational material, namely dissemination of material in the field of financial knowledge; education services in the field of tourism; services of provision of information in the field of tourism, namely services of provision of information regarding reservation of tickets for recreational events; services of provision of information in the field of tourism, namely services of provision of information regarding entertainment; services of provision of information in the field of tourism, namely services of provision of information regarding planned sporting, cultural and recreational activities; services in connection with entertainment for tourist assistance; tourist reservation services, namely activity and entertainment reservation services; assistance services for tourists concerning reservation of tickets for recreational events; assistance services for tourists concerning planned sporting, cultural and recreational activities; presenting of prizes rewarding the authors of exceptional acts or performances; arranging and conducting ceremonies relating to the presentation of prizes and awards.Class 42Scientific and technological services and research and design relating thereto; industrial analysis and research services; carrying out laboratory analyses; design and development of computer hardware and software; services relating to wind and wind energy, namely professional consultancy and engineering services; design for others in connection with wind energy; industrial design services; design of equipment and installations for generating energy, wind energy and electricity; engineering services, technical consultancy and research for the gas and oil industries; exploration services relating to oil and gas; geophysical probing for the oil and gas industries; oil and gas field analysis; oil and gas prospecting, namely locating and testing of wells; gas and oil well testing; oil and gas pipeline inspection; remote diagnosis and monitoring services in connection with compressors; remote diagnosis and monitoring services in connection with pumps; remote diagnosis and monitoring services in connection with turbo-expanders; remote diagnosis and monitoring services in connection with fuel pumps and fuel distribution equipment; remote diagnosis and monitoring services in connection with compressed natural gas (CNG) refueling equipment; remote diagnosis and monitoring services in connection with gas turbines; remote diagnosis and monitoring services in connection with steam turbines; remote diagnosis and monitoring services in connection with air-cooled heat exchangers; remote diagnosis and monitoring services in connection with steam condensers; remote diagnosis and monitoring services in connection with heavy-wall reactors; remote diagnosis and monitoring services in connection with tubular reactors; information technology solution services in the field of railway and transit industries on a global scale; research, consultancy and assistance services in connection with engineering, design and development problems encountered by governments, individuals and industrial, commercial and utility companies; computer programming services for others; software design and analysis services for others; information technology consultancy services; maintenance and updating of computer software for others; software installation; design and analysis of computer systems for others; consultancy services relating to chemical research; consultancy services in connection with the discovery and evaluation of medicines and components with diagnostic, prophylactic and/or therapeutical properties; consultancy services concerning diagnostic methods by means of optical laser systems; tests for high ***data*** rate analysis for producing medicines; customer synthesis and analysis services; biotechnology services; technical assistance in connection with factory automation software, namely maintenance of software and periodical updating of software; customized design of security access systems; design and consultancy services relating to configuration of systems used in fiber-optic technology applications; technical assistance services, namely resolution of problems in connection with computer hardware, video and electronic communication and computer software; technical consultancy services relating to information technology and software in the field of access and security systems; technical consultancy services relating to surveillance cameras; customized design of security systems, access systems and systems for checking inventories and tangible assets for others; laboratory and testing services for liquid separation and membrane testing; engineering and technological consultancy services regarding water treatment; engineering and technological consultancy services regarding water supply systems; engineering and technological consultancy services regarding cooling water circuits; engineering and technological consultancy services regarding industrial boiler water systems; engineering and technological consultancy services regarding systems for water supply and industrial processes; engineering and technological consultancy services regarding industrial fuel treatment systems; engineering and technological consultancy services regarding pulp and paper making systems; engineering and technological consultancy services regarding systems for treating plastics and metals; engineering and technical assistance services concerning the design and configuration of systems comprising computer hardware and software for use in treatment of water supply systems; engineering and technical assistance services concerning the design and configuration of systems comprising computer hardware and software for use in treatment of pulp and paper making systems; engineering and technical assistance services concerning the design and configuration of systems comprising computer hardware and software for use in treatment of oil and petrochemical product treatment systems; engineering and technical assistance services concerning the design and configuration of systems comprising computer hardware and software for use in treatment of metal and plastic finishing operations; consultancy services in all the aforesaid fields; chemical testing concerning supply of chemical treatment products via industrial water systems; programming for information processing machines, in particular programming services in the field of electronic money; development of computer programs for securing ***data*** transfers; industrial research and development services in the field of information technology; all technical consultancy in the field of information technology; development of computerized databases and computer programs; development of software concerning machines, apparatus and instruments; rental of ***data*** processing apparatus; computer engineering services; consultancy regarding computer programming and ***data*** processing, particularly in connection with financial transactions; hosting of computer sites (Web sites); maintenance of software; provision of Internet search engines; quality control; computer ***data*** recovery; research and development of new products (for others); technical project studies; surveying; updating of software; maintenance of software, engineering, testing and research concerning electric machines, apparatus and instruments, computer rental; recovery of ***data***, images, documents, mails, messages and audio and video ***data*** via local or global communication networks; recovery of ***data***, images, documents, mails, messages and audio and video ***data*** via the Internet, intranets, extranets, television; recovery of ***data***, images, documents, mails, messages and audio and video ***data*** via mobile communication networks, cellular networks and satellite networks; identification and testing of microbiological organisms; management of value-added ***data*** computer servers comprising multimedia systems, interactive videography, global computer networks for telecommunications; consultancy regarding information technology management; industrial research, development and testing in the field of sport; scientific research in the field of sports; hosting weblogs [blogs]; hosting and providing electronic platforms for sharing and transmitting ***data***; providing, via an Internet platform, interactive computer applications enabling users to note (personal evaluation) the performance of an athlete, to vote for an athlete, as well as record their comments, and also enabling them to consult ratings, votes and comments from other users; hosting and providing an Internet platform enabling users to identify and vote for athletes participating in an international athletic competition, as well as to monitor the performance of these athletes.Class 43Services for providing food and drink; temporary accommodation; cafeteria and restaurant services; welcoming and hospitality services, namely providing food and drink; food and drink catering; reservation of hotels and temporary accommodation; bar services; cafés; rental of meeting rooms; tourist homes; services of provision of information in the field of tourism, namely providing accommodation information; services of provision of information in the field of tourism, namely providing information on provision of food and meal; accommodation services for tourist assistance; services in connection with providing food and meal for tourist assistance; reservation services for tourism, namely reservation of hotel rooms and of food and meal; services of provision of information in the field of tourism, namely services of provision of information concerning the reservation of hotel rooms, accommodation, food and meal; assistance provided to tourists concerning the reservation of hotel rooms, accommodation, food and meal; tourist reservation services, namely reservation of hotel rooms, accommodation, food and meal; rental of mobile and modular structures.

Filing Date: 4 August 2020

Date of registration: 20 November 2020

Representative name: Bird & Bird LLP

**Load-Date:** December 1, 2020

**End of Document**



[***Crop cover is more important than rotational diversity for soil multifunctionality and cereal yields in European cropping systems***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H841-F129-P4HB-00000-00&context=1516831)

Nature Food

January 2021

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**Section:** Pg. 28-37; Vol. 2; No. 1; ISSN: 2662-1355

**Length:** 6893 words

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**Body**

Main

The environmental costs of intensive agronomic practices such as tillage, fertilization and use of pesticides, in addition to the expansion of cropping areas, necessitate more sustainable practices that increase crop production on existing arable land while maintaining its capacity to provide a range of functions and services–. Such sustainable cropping systems can optimize both crop yields and soil multifunctionality (SMF), that is, the capacity of soils to simultaneously provide multiple ecosystem functions and services. A promising approach to accomplish these goals simultaneously is to promote above- and below-ground biodiversity,.

A large part of the Earth’s biodiversity is below ground, a significant portion of which consists of soil microbial communities. Soil microbial diversity plays an integral role in soil processes such as ***nutrient*** cycling, carbon storage and the development of soil structure. Recent evidence from natural ecosystems suggests that soil microbial diversity promotes ecosystem functioning and SMF,. In ***agricultural*** systems, microbial diversity can promote crop yields and quality,. It is, however, still unclear whether increasing microbial diversity can promote yields through positive effects on soil functioning.

A potential approach to promote microbial diversity centres on modifying the associated plant community. For example, it has been shown that increasing taxonomic and functional plant diversity can increase soil microbial diversity in both natural ecosystems, and cropping systems–. This is due primarily to differences in biochemical composition of plant tissues, and therefore input into the rhizosphere via root and leaf litter, all of which vary in their ability to support specific microbial communities. Moreover, beside positive effects on microbial communities, studies have shown that increasing taxonomic and functional diversity in ***agricultural*** systems can promote plant yield, although most of them compare cover crops versus bare soils,, or diverse cash-crop rotations versus monocropping, (Fig. ), and usually at a single location or multiple sites within a given climatic region. This constrained approach does not capture the diversity of practices utilized by farmers in European cropping systems, which typically include a variety of cash crops, cover crops and occasionally forage leys (that is, pastures) within a given rotation (Fig. ).

Crop covers and diversity types commonly used in temperate cropping systems.

Definitions are from the USDA National ***Agricultural*** Library.

In addition, ***agricultural*** management practices such as tillage and fertilization can have significant effects on soil microbial community structure, diversity and overall ecosystem functioning. However, most studies examining the effects of soil biodiversity on cropping systems have done so without explicitly considering the interwoven relationships between crop diversity, management practices and environmental factors such as climatic conditions and soil properties. This lack of system-level analysis limits our understanding of the linkages between biodiversity, climate and ***agricultural*** management, and thus impedes our ability to improve both yield and soil functioning through targeted management practices.

Here we investigated the effects of crop and soil microbial diversity on SMF and yield across conventionally managed European ***agricultural*** fields encompassing a broad gradient in soil and climate conditions. We ***collected*** soils as well as detailed crop, management and climatic information from 155 sites along a 3,000 km north–south European gradient (from Spain to Sweden, Supplementary Fig. ). We also assessed the total crop cover, or the proportion of time the field was planted with either a cash crop, cover crop or forage ley during this same period, as crop cover has been shown to increase the delivery of certain ecosystem services, and thus should not be overlooked as a potential contributing factor to SMF and yield.

Results and discussion

Crop cover time and type affect crop diversity

In many European cropping systems, a typical crop rotation includes various cash crops often interspersed with cover crops, forage leys and periods of bare soil (Fig. ). The average species richness of each crop cover type (Fig. ), as well as the total crop cover (Fig. ), greatly differed between and within countries, as can be seen from the high scatter of individual ***data*** points for each country. This led to a range in overall crop diversity and crop cover across our sampling network, with the highest values in Switzerland and the lowest in Spain and Sweden (Fig. ).

Crop species richness by country and crop type.

a–c, The average crop species richness of cash crops (brown boxes) (a), cover crops (green boxes) (b) and forage leys (purple boxes) (c) for each country during the past ten-year crop rotation period. Crop species richness of each field site is shown as individual ***data*** points, while the boxplots represent the median and range of crop species richness of each specific crop type per field in each country.

Distribution of crop cover in each country over a ten-year crop rotation.

The average proportion of time either bare (that is, unplanted), or covered with either cash crops, cover crops or forage leys over the past ten-year crop rotation for each country.

Relationship between crop diversity and crop cover across our sampling network.

a–c, The average crop species diversity (using the Shannon diversity index) (a), proportion of time with crop cover for each country within the sampling network (b) and Pearson correlation between these two variables (\*\*\*P < 0.0001) (c). Spain, n=22; France, n=29; Switzerland, n=38; Germany, n=35; and Sweden, n=31. The boxplots in a and b represent the median and range in values of crop diversity and proportion of time with crop cover of all sampled fields in each country, respectively.

A factor clearly contributing to the larger crop diversity in Switzerland was the reduced proportion of time spent with bare soil compared to the other countries (Fig. ). Furthermore, while all countries had a relatively similar proportion of time with cash crops (ranging between an average of two and four different cash-crop species), Switzerland had the largest proportion of time with additional crop cover, including both cover crops and forage leys (Fig. ). This additional crop cover had a strong capacity to increase overall diversity (Fig. ), especially when multispecies forage leys were planted (Fig. ). However, here we assessed the taxonomic diversity of crop species, as opposed to functional diversity, but recommend future studies to additionally integrate functional differences (that is, leaf and root traits) between the species used in rotation as a way to improve understanding of the links between crop diversity and soil microbial diversity.

The large difference in crop diversity between countries is influenced by a complex interplay of environmental, economic and social factors, and thus an in-depth assessment of such drivers was beyond the scope of this study. However, by comparing overall crop diversity and cover (Fig. ) with the long-term mean annual temperature and precipitation (Supplementary Fig. ) across these countries, it is clear that differences in climatic conditions play an important role in the ability of farmers to extend the cropping season with cover crops or forage leys. For example, reduced precipitation in Spain is undoubtedly a major limiting factor of crop diversity, while in Sweden, reduced temperatures restrict the duration of the growing season as well. Additionally, in contrast to the EU countries, ***agriculture*** in Switzerland is highly regulated through policies that offer substantial financial incentives for farmers, and this comes with the need to include particular management practices such as including cover crops and leys in the crop rotation, which was likely a factor contributing to higher crop diversity in Switzerland.

Drivers of soil microbial diversity depend on environmental factors

Crop diversity had a significant and positive effect on bacterial diversity (Fig. ), but did not affect fungal, archaeal or cercozoan diversity (Supplementary Fig. ). This indicates that the benefits obtainable by diversity appear to saturate at between five and ten crop species in rotation (Supplementary Fig. ). Certain plant species may also be more beneficial towards bacterial diversity than others, and thus adding additional species may no longer be advantageous.

The impact of ***agricultural*** management practices on bacterial diversity, crop yield and SMF.

Bacterial diversity and crop diversity were calculated using the Shannon diversity index. Crop cover was calculated as the proportion of time during the past ten-year crop rotation planted with either a cash, cover or forage crop. The management intensity index was calculated using the PCA approach, and included variables related to fertilization, tillage and pest-control measures. Country origin of individual samples are depicted by colour. A red asterisk indicates a significant spatial (latitude and longitude) and country effect according to our linear mixed-effects model (\*P < 0.05, \*\*P < 0.01, \*\*\*P < 0.0001; see Supplementary Table ).

However, after considering environmental variables and management practices, the effect of crop diversity on microbial diversity became negligible (Fig. and Supplementary Table ). Variation due to individual countries and spatial attributes appeared, therefore, to be a strong driver of soil microbial diversity across the sites surveyed, as found in other studies,. Thus, the effectiveness of managing crop diversification for promoting soil biodiversity is clearly dependent on environmental factors. Many studies showing a positive impact of diverse crop rotations on soil biodiversity are based in a single climatic zone,, and thus environmental drivers are not considered in such assessments. While clearly of great value to farmers and land-managers in a given area, this single-location approach limits our understanding of the extent of how much crop diversity generally affects soil microbial diversity in comparison to climatic, edaphic and soil management practices.

Structural equation model showing the effects of environmental and anthropogenic management factors on soil microbial diversity, SMF and crop yield.

The numbers adjacent to the lines are the standardized path coefficients. Blue and red arrows indicate positive and negative relationships between variables, respectively. The arrow width is proportional to the strength of the relationship. The proportion of variance explained is given by each response variable (R2) and measures of overall model fit are shown in the upper right-hand corner. \*P < 0.05, \*\*P < 0.01, \*\*\*P < 0.0001. Non-significant paths are not shown. Full model results are given in Supplementary Table . Chai ML, model fit test ***statistic*** using chi-squared maximal likelihood; CFI, comparative fit index; SRMR, standardized root mean square residual; RMSEA CI, root mean square error of approximation confidence interval.

The overall weak effect of crop diversity on microbial diversity may be attributed to the fact that we compared legacy effects of crop rotational diversity over the previous ten years, while at the actual time of sampling there was only a single crop species in the field. Considering this, it may not be surprising that the strength of this crop diversity–soil biodiversity relationship is not as evident as that found in studies of grasslands, where multiple plant species are present at the same time. This indicates that diversifying cropping systems in space, for example, by intercropping (Fig. ), may be more beneficial for promoting soil biodiversity and function than crop diversification through sequential rotations as done in this study,. Moreover, earlier studies testing the effects of crop rotations on soil microbial communities in long-term ***agricultural*** trials often compared soils from fields with diverse crop rotations to monocultures. In our study, only 5.8% of our field sites were monocultures, perhaps explaining why the effects observed were not so pronounced. Alternatively, here we focus on wheat and small grain cropping systems, and thus our results must not be extrapolated to other crop rotations. It is possible that other cash crops besides wheat are better able to reveal the potential benefits of residual crop diversity on microbial diversity.

In contrast to the limited effect of diversified crop rotations, the proportion of time with crop cover had a pronounced, yet taxa-specific influence, on soil microbial diversity (Fig. and Supplementary Fig. ). For example, both bacterial and cercozoan diversity were positively correlated with a longer duration of crop cover, while archaeal diversity was negatively correlated. Fungal diversity was not affected by crop cover time. However, the effect of crop cover time on the diversity of bacterial, archaeal and cercozoan communities was as strong as that of environmental factors (Fig. and Supplementary Table ). We hypothesize that the impact of crop cover time on microbial diversity is stronger than that of crop cover diversity, because having a constant source of carbon and ***nutrients*** (that is, through rhizodeposition and root and leaf residues) is generally more important, and can support a more diverse community, than having extended periods of reduced or no inputs. Our findings thus suggest that there is potential to increase microbial diversity through increasing the duration of crop cover, for example, by incorporating cover crops and/or temporary grass–clover forage leys into crop rotations, which has shown a positive effect on below-ground diversity, soil functioning and ecosystem service provision,.

In areas experiencing climatic extremes (that is, low precipitation in southern Spain and low temperatures in northern Sweden), the ability to increase the proportion of crop cover via cover crops and leys is clearly more limited. However, given our results, it is likely that even small increases in crop duration may be worthwhile. For example, hardier cereal varieties in Sweden could potentially extend the crop cover time by up to several months, and give more time for carbon-rich roots to develop that could in turn contribute to improvements in soil fertility and feed more soil microbes. Additionally, intersowing a cover crop in between cash-crop rows before the end of the growing season in Spain may permit a short-lived cover crop following the main cash crop without the need to incorporate irrigation practices, and thus benefit future crop yields with increased organic matter and—in the case of leguminous cover crops—an organic nitrogen source,. However, in areas where water is particularly scarce, it is important to consider any potential negative impacts of increased crop cover on water dynamics, such as a reduction in water availability for the following crop due to reduced water recharge, before beginning such a practice.

Proportion of time with crop cover positively impacts SMF

In addition to understanding the links between above- and below-ground biodiversity in ***agricultural*** systems, a primary goal of this study was to determine if these factors, and the associations between them, play a role in driving SMF. To create an overall measure of SMF, we categorized the 25 measured soil functions and indicators into four categories representative of soil structure, fertility, activity and soil nitrogen cycling potential, as these are key components of soil quality and are intimately linked with functioning (Supplementary Fig. ).

Similar to studies in natural ecosystems, we found that mean annual precipitation and soil clay content had a significant and positive effect on SMF (Fig. ). We also found an equally strong and positive impact of crop cover time on SMF, even at the individual country level, with three out of five countries showing a positive impact of crop cover on SMF (Supplementary Table ). Contrary to results from natural ecosystems, as well as to our initial hypothesis, we did not see a strong impact of crop diversity on SMF. We tested through multiple structural equation models not only overall species richness, but also the proportion of different crop cover types (that is, cash crops, cover crops and forage leys), and whether or not they included leguminous species (Supplementary Fig. ). In all cases the proportion of time with crop cover and environmental variables were the best predictors of SMF, while diversity did not play a significant role.

In contrast to our initial hypothesis, we found that SMF was negatively correlated with bacterial diversity (Fig. and Supplementary Table ). However, we also found a negative correlation between clay content and bacterial diversity, lending support to previous studies showing that soil mineral heterogeneity, such as that found in sandier soils, contributes to greater bacterial diversity in microbial community assemblages, and thus explaining why bacterial diversity had an overall negative effect on SMF in this study. In contrast, we found a strong, positive relationship between total microbial biomass and SMF (Supplementary Fig. ). It is generally assumed that as soil carbon increases (that is, through particular management practices or organic matter application), soil microbial biomass will increase as well, which can maximize the ability of the soil to perform essential ecosystem functions and services and create a positive feedback loop that further enhances microbial biomass. Furthermore, and due to functional redundancy, many microbial species can perform the same function, so that a decrease in any particular species or taxa will not necessarily affect overall functioning since other groups can take over these processes,. Our findings thus indicate that the positive effects of crop cover and diversification on soil functioning are mediated through increasing microbial biomass rather than the actual diversity itself,.

Management intensity, crop cover and bacterial diversity drive crop yield

Crop yields were primarily driven by management intensity, crop cover and bacterial diversity (Fig. ). The positive impact of management intensity is not surprising given the clear benefits of fertilization, tillage and pesticides on crop production. We found that the duration of crop cover, not crop diversity itself, had a beneficial impact on yield. We attribute this in part to the hump-shaped relationship between crop diversity and yield, which indicates that although crop diversity at lower levels of diversity increases yields, at higher diversity levels, crop yields are negatively affected (Fig. ). When assessing this impact in terms of the number of different crop species in a crop rotation, we see that similarly to bacterial diversity, crop yield increases until between five to ten species are reached, at which point increasing diversity has no impact on yields (Supplementary Fig. ). Similarly to bacterial diversity, it is likely that certain crops within the rotation are more beneficial towards subsequent crop yields than others. For example, including leguminous cover crop species into the rotation can increase yields, while on the other hand, cropping systems with a high proportion of cash crops, despite adequate fertilizer inputs, may not show the same effect if the ***nutrient***-rich biomass is removed from the fields.

Bacterial diversity was found to be positively correlated with crop yields (Fig. ). Further studies are needed to test whether the positive relationship between bacterial diversity and crop yield is indirect (that is, the environmental conditions typical for high yields may promote many bacterial taxa and thus contribute to high bacterial diversity). Alternatively, the presence of a diverse bacterial community may directly promote crop yields, as many different types of plant growth promoting rhizobacteria found in ***agricultural*** soils are known to promote crop growth. Our results show that soil nitrogen cycling rates increase as bacterial diversity increases, potentially leading to more efficient processing of added fertilizers and thus more nitrogen uptake and subsequently higher yields (Supplementary Fig. ).

We found no effect of cercozoan and archaeal diversity, and a negative relationship between fungal diversity and crop yield, although this effect was weak compared with the other factors such as management intensity and mean annual temperature (MAT) (Fig. ). As the main predator of bacteria, cercozoa are important regulators of bacterial communities. However, our results suggest that the possible effect of trophic interactions between cercozoa and bacteria were at most marginal, and that other factors were more important for explaining crop yield. Additionally, although recent studies have shown that archaea associated with cereal fields are dominated by ammonia oxidizers,, far less is known about the roles of archaea and cercozoa in ***agricultural*** settings from a multitrophic perspective, thus again calling for more research efforts to understand their functional interactions.

While many recent studies have shown a positive effect of crop rotational diversity on yields at the larger scale,, they did not directly compare the duration of crop cover to crop diversity as we did. Nonetheless, we do not propose that crop diversity is not beneficial or a worthwhile practice. Indeed, crop diversity has been shown to contribute to a variety of ecosystem services not assessed here,. We recommend considering practices that, in addition to striving for increased diversity, extend the growing season as well (that is, the use of cover crops or forage leys, for example).

No clear link between SMF and yields

Although previous studies have shown a link between increased crop rotational diversity and improved temporal stability of crop yields, whether this yield stability is linked to improved soil functioning has not been evaluated. As our SMF index was developed using indicators of soil functions known to increase crop yields, we hypothesized that yields and SMF would be strongly and positively linked. However, our overall structural equation modelling (SEM) indicated that SMF and yield were negatively, but weakly, associated (Fig. ). Further inspection through regression analysis did not confirm this, as no connection between these two factors was observed (Supplementary Fig. ). Thus, we report that no clear link was found between these two variables. Instead, it appeared that SMF was mainly driven by environmental factors and crop cover, whereas crop yield was primarily impacted by anthropogenic factors (management intensity and crop cover) and soil bacterial diversity (Fig. ). Environmental effects influenced yield more through indirect mechanisms, particularly through their influence on bacterial diversity, fungal diversity and SMF (Supplementary Fig. ).

It has been shown that crop yields can be improved by increasing soil organic matter,, which in turn is known to contribute to many additional ecosystem functions and services. Given the importance of soil carbon, this soil parameter is included in many ecosystem and SMF assessments. However, Wood et al. found that not all carbon pools have the same effect on crop yields. For example, they found that soil organic carbon associated with the fine soil fraction was significantly and negatively correlated with crop yields, showing that carbon accumulation in cropping systems does not necessarily have a positive impact on yields. Furthermore, recent studies have shown the beneficial relationship between soil organic matter and crop yields is only valid up to ~2% soil organic carbon, after which point the relationship is less clear. Although soil carbon should have both a direct and indirect effect on many of our SMF indicators, our temperate European sites had an average soil organic carbon concentration of 2.4%. This could explain why SMF was not as tightly linked with yields as expected.

Crop yields were positively correlated with management intensity (Fig. ). This implies that yield increases in sites with increasing tillage events, fertilizer inputs and pesticide applications. Since both soil structure and activity are key components of our SMF index, the increased use of both tillage and fertilization practices may have contributed to the decoupling between SMF and yield found in our study.

Just as most studies showing a positive link between SMF and plant productivity are based on observations of natural systems,, our results in cropping systems suggest that improving SMF as a means to increase crop yield may be more applicable, or in fact only applicable, in ***agricultural*** systems reliant on ecosystem services, including low-input and organic systems, where access to chemical fertilizers is limited, and thus the majority of the crop nutritional needs must be met through increases in soil biological processes such as nitrogen fixation, ***nutrient*** turnover and accumulation of organic matter,. Our observations also demonstrate that farmers and farm managers in most conventional cropping systems in Europe must actively work towards a balance between yields and SMF, as they are not necessarily complementary.

Summary

We found that the proportion of time with crop cover, regardless of its diversity, had a significantly positive impact on bacterial diversity, SMF and crop yields. Yet given the environmental, economic and social constraints on farmers regarding the main cash crops that can be grown in a given country or location, increasing cash-crop diversity may not be possible or recommended in all cases. Instead, we found that increasing the proportion of time with crop cover may be a better approach than trying to increase crop diversity within the rotation in our investigated land-use gradient in Europe. This approach can also increase overall crop diversity without necessarily increasing management intensity, since cover crops are not fertilized or sprayed with pesticides, and the residues are left on the field, thus leading to increased soil organic matter.

We found that SMF did not positively contribute to crop yields, which shows a disconnect between these two objectives across our study sites. Given this lack of synergy between these two important goals of sustainable intensification, care must be taken to balance the provision of food with environmentally beneficial functions and services, since they do not always go hand in hand.

Methods

Field sites

During the spring of 2017, we sampled 155 sites encompassing ***agricultural*** sites and experimental farms across a north–south gradient of Europe including sites in Sweden (n = 31), Germany (n = 35), Switzerland (n = 38), France (n = 29) and Spain (n = 22) (Fig. ). To reduce variation between sites as much as possible, we targeted fields planted with wheat (Triticum aestivum) (n = 121, 78% of sites). When wheat fields were not available, another cereal species was chosen instead (that is, barley, Hordeum vulgare (n = 26); oat, Avena sativa (n = 6); rye, Secale cereale (n = 1); or triticale, Triticosecale sp. (n = 1)). Additionally, we sampled soils primarily from conventionally managed plots that engage in tillage and inorganic fertilization practices. Our study sites included a high range of crop diversities, such as monocultures, simple cereal–legume rotations and more diverse rotations including intercropping. Although 18 field sites in Switzerland and 8 sites in Germany were technically organically managed (16.7%), they did not statistically differ from the conventional sites in terms of yield, SMF or microbial diversity, and thus were included in the dataset. Information regarding grain yield, crop rotation history, crop management practices and general site characteristics were obtained by surveying the farmers and farm managers of each site through a questionnaire. Long-term mean annual precipitation (MAP) and MAT for each site were downloaded from the WorldClim database ([*https://www.worldclim.org/*](https://www.worldclim.org/)).

Soil ***collection*** and processing

Soils were sampled during anthesis (that is, the crop-flowering period), which ranged between May in the southern sites and up through July in the northern sites. At each site, eight soil samples were taken in a circular pattern within a 10 m radius using a 5-cm-diameter auger and to a depth of 20 cm. Three of these cores were kept intact and used to measure bulk density and soil aggregation. The remaining soil cores were homogenized and sieved to 2 mm. Portions of this soil were air dried for further processing of soil physical and chemical properties as well as enzyme activities, kept refrigerated at 4 °C for microbial biomass and basal respiration determination and frozen at −18 °C for DNA extraction and potential nitrogen cycling rates. Subsamples of all samples were then shipped to each laboratory for specific measurements to reduce analytical errors.

Soil functional measurements

Soil structure was assessed by measuring the soil aggregation and bulk density of each sample. Briefly, the bulk density was measured as the mass of dry soil contained in the sample cylinder volume, and soil aggregation was measured using the wet-sieving method. In addition to structure, a variety of soil ***nutrients*** indicative of soil fertility were measured, as well as cation-exchange capacity (CEC) and water-holding capacity (WHC) using the Swiss standard protocols.

Soil activity was estimated by measuring basal respiration, as well as by the potential activity of seven extracellular enzymes related to the carbon, nitrogen and phosporus cycles: α-1,4-glucosidase (starch degradation), β-1,4-glucosidase (starch degradation), β-xylosidase (hemicellulose degradation) and β--cellobiohydrolase (cellulose degradation) for the carbon cycle; β-1,4-N-acetylglucosaminidase (chitin degradation) and -leucine aminopeptidase (protein degradation) for the nitrogen cycle; and acid phosphatase (phosphorus mineralization) for the phosphorus cycle. Soil enzyme activities were assessed fluorometrically following the methods described in Bell et al. (see ). Basal respiration was measured as CO2 produced in preincubated soils over 72 h at 50% WHC.

Soil nitrogen cycling was determined by measuring five rates related to different aspects of the soil nitrogen cycle (ammonification, nitrification, depolymerization, mineralization and nitrogen transformation) following a 14 day incubation. Potential denitrification activity was determined with the acetylene inhibition technique following Pell et al.. Details are described in the . In addition to the soil functions mentioned above, soil pH and texture were included as drivers of soil microbial diversity in the SEM, and were measured on each sample using the Swiss standard protocols.

Soil multifunctionality

To create an overall measure of SMF we developed an index consisting of the average of four variables representative of soil structure, fertility, activity and soil nitrogen cycling potential (Supplementary Fig. ). Soil structure was composed of soil aggregation and bulk density. Soil fertility was composed of organic carbon, total soil nitrogen, total soil phosphorus, available calcium, magnesium, potassium, phosphorus, cation exchange capacity and WHC. Soil activity was composed of basal respiration as well as potential xylanase, α-glucosidase, β-glucosidase, N-acetylglucosaminadase, cellobiase, leucine aminopeptidase and phosphatase enzyme activities. Soil nitrogen-cycling potential was assessed using the rates of potential nitrogen transformation, depolymerization, ammonification, denitrification, mineralization and nitrification.

A principal coordinate analysis (PCA) score for each of the four latent variables making up the composite variable was then calculated (see Meyer et al. for a detailed description). In this approach, each variable was standardized (mean, 0; s.d., 1) before running a PCA. This generates values for each principal coordinate axis for each field (number of axes equal to the number of empirical variables used for input). The eigenvectors of each of the empirical measures were considered such that larger positive values reflected greater SMF of each of the empirical measures. However, since our variable for soil structure was defined as the mean weight diameter of the different aggregate size fractions and bulk density, the loadings of each of these on each axis should therefore be predominantly positive. However, since a lower bulk density is associated with better soil structure, the axis was inverted around 0 by multiplying the axis scores by −1. The scores of each axis were then averaged after weighting by the proportion of variation each explained by each eigenvalue. Each latent variable is thus defined as:

For ease of interpretation, we rescaled the latent variables (soil structure, soil fertility, soil activity and soil nitrogen cycling) between 0 and 1, where 1 would indicate the maximum of each category, and 0 would indicate the minimum. We also ensured that the raw values of each latent variable correlated positively with the final variable. In contrast to Meyer et al., the overall SMF index was then computed by averaging the four rescaled latent variables. This was done to ensure that all four soil functional categories were equally accounted for in the SMF index.

Soil microbial diversity

Soil DNA was extracted from 250 mg of each soil sample using the DNeasy PowerSoil-htp 96 well DNA isolation kit (Qiagen). Amplicons of bacterial 16S rRNA genes were generated in two steps according to Berry et al.. The fungal internal transcribed spacer (ITS) region was amplified using the PacBio SMRT Sequencing platform (Pacific Biosciences) with the primers ITS1f (CTTGGTCATTTAGAGGAAGTAA) and ITS4 (TCCTCCGCTTATTGATATGC) targeting the entire ITS region (~630 bp),. For measuring archaeal diversity, archaeal 16S rRNA gene fragments, encompassing the V3–V4 hypervariable regions, were amplified by a two-step polymerase chain reaction procedure (see ). Cercozoa diversity was measured by carrying out a two-step polymerase chain reaction to amplify a fragment (~350 bp) of the V4 region of the 18S rRNA gene using the primers sets designed by Fiore-Donno et al.. For a detailed description of our DNA sequencing methods, see .

Alpha diversity of soil bacterial, fungal, archaeal and cercozoa populations were assessed individually using the Shannon–Weaver index of diversity. All alpha diversity indexes were calculated from operational taxonomic unit abundances rarefied at the lowest number of sequences found in each taxa. Community analyses were performed with R software and the package VEGAN.

Crop yield, cover and diversity

Since not all sites had the same cereal species, yields could not be compared directly. Therefore, we calculated a standardized yield for each site using the grain yield recorded by the farmer or farm manager of each site divided by the average yield of that crop species across all five countries for the 2017 growing season based on FAO STAT.

To assess crop diversity at each site, we calculated the Shannon diversity index of all plant species planted during the past ten-year crop rotation. The proportion of crop cover was calculated as the number of months with plant cover (either cash crop, cover crop or forage ley) divided by the total number of months in the crop rotation period. We chose this approach, rather than looking at isolated effects of each crop cover type individually (that is, only cover crops) to standardize for location specific practices, since not all crop types were present in all fields. Moreover, crop cover is an especially important indicator used for assessing below-ground carbon inputs and soil processes, and thus was also an ideal indicator for our study.

Management intensity

Considering the diversity of different management practices performed in each site across the network, we created a single variable to describe management intensity which could then be compared across sites. This included ***data*** related to fertilizer application, pesticide use and tillage from the 2017 growing season. The specific management variables included in our index consisted of the total amount of mineral nitrogen applied (nitrate and ammonium), the number of tillage events and the maximum tillage depth, and the number of insecticide, herbicide and fungicide applications (Supplementary Fig. ). These values were then used to construct our index using the PCA approach described above. However, for this index we did not create a composite variable, as was done for SMF, but included all of the above parameters into a single management index scaled between 1 and 0, with a score of 1 indicating the maximum intensity of management practice observed, while 0 would indicate the minimum.

***Data*** processing and statistical analyses

To analyse direct effects of environmental (MAP, MAT, soil clay content and soil pH) and anthropogenic effects (management intensity, crop diversity and proportion of time with crop cover) on soil microbial diversity, SMF and yield, both linear and non-linear regressions were made using all sites collectively. To determine the best model for each relationship, first- and second-order linear models were made using single dependent and independent variables, and the model with the highest adjusted R2 value was ultimately chosen. In addition, separate linear mixed-effects models were used to test country effects of management practices on soil microbial diversity, SMF and crop yields using individual management variables as the fixed factors and latitude and longitude nested within country as the random factor (Supplementary Table ). We then used SEM to understand the direct and indirect controls of environmental parameters, management practices and diversity of microbial taxa (bacteria, fungi, archaea and cercozoa) on standardized crop yield and SMF (Fig. , Supplementary Table ). All relationships in the SEM were compared with the bivariate relationships to confirm that the overall conclusions drawn were valid across multiple approaches.

Because of the strong non-linear relationships between the environmental factors and several response variables of interest, we used the first PCA axis of the environmental variables and their square (MAT, MAP, pH and clay content) as variables in the SEM model to incorporate non-linearity into the model following Delgado-Baquerizo et al.. All other variables are included assuming a linear relationship, and thus this additional step was not conducted. Our initial structural equation models included latitudinal and longitudinal ***data*** to account for geospatial autocorrelation, either by including these variables in the model directly, or by building a piecewise structural equation model and correcting for latitude and longitude as random factors. However, the strong collinearity between latitude and our environmental variables could not be overcome in these earlier modelling attempts, regardless of the statistical package used to build the structural equation model. Thus, we accounted for spatial variation between sites by including both MAP and MAT into the model, which are strongly and significantly correlated with latitude (Supplementary Fig. ) and removed the collinearity issue described above. Therefore, the final SEM was made using the lavaan package, and the final model was determined by selecting the best fit using the chi-squared parameter (Supplementary Table ).

Using the results from the SEM, we then calculated the direct and net indirect effects of environmental and anthropogenic factors on the standardized yield through effects on soil microbial diversity and SMF (Supplementary Fig. ). The direct effect is the standardized path coefficient and the net indirect effect is the sum of each individual indirect effect (calculated as the product of all effects in a single path). Indirect effects were calculated in two ways. The first was by quantifying indirect effects on yield through impacts on soil microbial diversity and SMF (Supplementary Fig. ), and the second was to measure the anthropogenic and environmental factors on yield through changes in SMF driven by soil microbial diversity (Supplementary Fig. ). All statistical analyses were done with R software.

Reporting Summary

Further information on research design is available in the linked to this article.

**Acknowledgements**

We thank all the farmers and farm managers for allowing us to sample their fields and for completing our detailed questionnaires. We also thank A. Held, A. Bonvicini, S. Müller, S. Zhao, V. Somerville, A. Brugger, O. Scholz, D. Bugmann, R. Heiz, B. Seitz and M. Roser for help with both field work and laboratory analyses. The Digging Deeper project was funded through the 2015–2016 BiodivERsA COg call for research proposals, with the national funders Swiss National Science Foundation (grant 31BD30-172466), Deutsche Forschungsgemeinschaft (317895346), Swedish Research Council Formas contract 2016-0194), Ministerio de Economía y Competitividad (Digging\_Deeper, reference PCIN-2016-028) and Agence Nationale de la Recherche (ANR, France, grant ANR-16-EBI3-0004-01).

**Notes**

Supplementary informationis available for this paper at [*https://doi.org/10.1038/s43016-020-00210-8.Peer*](https://doi.org/10.1038/s43016-020-00210-8.Peer) review informationNature Food thanks H. Kahiluoto, T. Bowles and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

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[***Being different matters! A closer look into product differentiation in specialty coffee family farms in Central America***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6084-J4H1-JBN9-R0KV-00000-00&context=1516831)

Cross Cultural

February 28, 2020

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**Section:** Pg. 165-188; Vol. 27; No. 2; ISSN: 2059-5794

**Length:** 12373 words

**Byline:** Allan Discua Cruz, Leonardo Centeno Caffarena, Marcos Vega Solano.

**Body**

**ABSTRACT**

Purpose

There is a growing interest in understanding the strategic behaviour of family firms producing international commodities such as coffee, particularly in contexts where decisions about what products to sell, where to commercialise them and how to promote them appear to be highly based on both business and family aspects. The purpose of this paper is to explore product differentiation strategies in family firms in the specialty coffee industry across Latin American countries. Whilst the socioeconomic relevance of coffee production in Central America is unequivocal, the approach and rationale of families that engage in specialty coffee production remain underexplored.

Design/methodology/approach

This study examines product differentiation in specialty coffee family farms across countries in Central America: Guatemala, Honduras and Nicaragua. The study relies on in-depth interviews, case studies and an interpretative approach to unpick the dynamics of product differentiation by families in business dedicated to producing specialty coffee.

Findings

The findings show that product differentiation in specialty coffee family farms is influenced by both business and family aspects and driven by entrepreneurial stewards. Coffee-farming families can engage in product differentiation through a shared vision, a combination of traditional and specialised knowledge, and through the continuous development of an exchange network. The findings reveal a connection between families in business balancing family and business interests, and the strategic intention to build up their assets entrepreneurially over time.

Originality/value

This study contributes to the literature on stewardship and strategic behaviour in family firms when families in business engage in differentiating their products in a highly competitive industry. More specifically, this study focuses on companies across countries where coffee is of crucial socioeconomic importance, and where the said companies are owned and managed by families. The study expands understanding of product differentiation in family-enterprise-first businesses and suggests that the family elements in differentiation can be explained through an entrepreneurial stewardship perspective.

**Introduction**

In 2018, the world consumed 165 million sacks of coffee, an increase of 2.1 percent from the previous year, and there are expectations that this will rise further in the future (ICO, 2019). Rough ***statistics*** from the International Coffee Organisation (ICO) indicate that approximately three billion cups of coffee are consumed every day around the world, with North America, Europe and Japan accounting for almost 53 percent of coffee consumption. In the USA alone, the retail value of the coffee market reached US$87→88 billion in 2018, with coffee houses continuing to be significant places of consumption outside the home (SCAA, 2019). Coffee is a long-standing, internationally traded, ***agricultural*** commodity worthy of attention because of increasing levels of competition, varying customer demands and product saturation (Bacon, 2008; Ponte, 2002; Rueda and Lambin, 2013). Still, whilst the increasing sophistication of the coffee industry has pushed producers worldwide to find ways to transform their product into a differentiated, added value offering (Ponte, 2002; Reinecke *et al.*, 2012), there is little understanding about how and why coffee-producing firms differentiate their products. As the history of the coffee industry around the world has been long associated with—and dominated by—family businesses (Pendergrast, 2010), their approach to product differentiation merits further attention.

This study is motivated by the need to understand the approach and rationale behind product differentiation strategies in family businesses that engage in specialty coffee production. Such a pursuit is important, as recent studies suggest that family businesses may engage in diverse strategies in order to compete (Basco, 2014). Discerning how and why a differentiation strategy emerges in family business is valuable, as such an undertaking is positioned as the *sine qua non* to achieve long-term competitiveness in increasingly challenging environments. Family business strategies, such as product differentiation, may be only understandable within the specific context and place in which they occur, as they reflect unique dynamics where family members interact with diverse actors across time (Roscoe *et al.*, 2013). To advance understanding, this study focuses on the approach and rationale behind a product differentiation strategy in family firms producing specialty coffee.

In the coffee industry, product differentiation can be achieved by highlighting special features linked to a place of origin (Teuber, 2010; Mizumoto, 2009). Yet, the increasing association of family dynamics with strategies in the farming sector cannot be underestimated (Fitz-Koch *et al.*, 2019). The influence of family in product differentiation may be more relevant than previously believed. Recent studies suggest that families may engage in product differentiation within existing firms through common understandings, resources and relationships (Discua Cruz *et al.*, 2013). Yet there is no empirical evidence as to how and why it occurs in family businesses across countries that produce and commercialise coffee. Thus, this study aims to answer the following questions: *How and why do family businesses in the coffee industry engage in product differentiation? To what extent does family influence product differentiation in the coffee industry?*

To answer our questions, this study focuses on cases from Guatemala, Honduras and Nicaragua, where coffee plays a vital socioeconomic role (Paz Cafferata and Pomareda, 2009) and family businesses dominate (Fernández Pérez and Lluch, 2016; Müller *et al.*, 2019). Such a context is relevant as some farming families, when facing diverse contextual pressures, may opt to exit the coffee industry, while others may differentiate their products (Vega Solano and Discua Cruz, 2017). To contribute to the understanding of this subject, this study draws on the underlying premises of product differentiation strategies, strategic behaviour (Basco, 2014) and entrepreneurial stewardship in family firms (Discua Cruz *et al.*, 2013). Based on the narratives of families in business (Hamilton *et al.*, 2017) that produce specialty coffee, we extend understanding of the motivation and rationale behind a differentiation strategy in family businesses.

The findings reveal that coffee-farming families can construct a differentiated product by creating a shared family vision and ***collective*** commitment to remain in business together, leveraging and combining existing and newly acquired resources, and shaping the creation and development of a business network. Taken together, the findings extend understanding of family-enterprise-first firms and suggest that in coffee family businesses, product differentiation may be shaped over time by entrepreneurial stewards who build and leverage family assets and relational resources.

The paper continues as follows: It first describes the theoretical background, and then it explains the contextual dimensions in the coffee industry and the research method. It follows up by focusing on case findings and discussion. Finally, it suggests limitations and opportunities for further research.

**Theoretical framework**

**A focus on family businesses**

Using an appropriate definition provides a starting point from which to theorise about family businesses and differentiation strategies. Family business researchers agree that the intertwinement between family and business is what defines a family firm (Melin *et al.*, 2014). Such intertwinement differentiates family businesses from non-family counterparts in the long term, makes every family business unique and has consequences in creating an idiosyncratic bundle of resources resulting from the interaction of family and business, known as ‘familiness’ (Habbershon *et al.*, 2003). Resources influenced by familiness relate to human and social capital, patient financial capital, survivability capital and governance structures and costs, which create a unique competitive advantage for a family firm (Sirmon and Hitt, 2003, p. 345). Recent studies argue that the examination of the influence of family in such resources needs to also consider the creation, integration and exchange of knowledge within a family business, and between the business and its context (Cabrera-Suárez *et al.*, 2018). As various definitions abound and serve different research purposes (Diaz-Moriana *et al.*, 2019; Howorth *et al.*, 2010; Astrachan *et al.*, 2002; Chua *et al.*, 1999; Westhead and Cowling, 1998), this study focuses on a definition that highlights strategy and resources. In this study, a family business will be considered as a firm where family members participate in the business and own enough equity to be able to exert control over strategy (Howorth *et al.*, 2010). Such a definition is important, as strategy deals with the direction and scope of an organisation over the long term, achieving advantages in a changing environment through the configuration of resources and competences, with the aim of fulfilling the values and expectations of powerful actors in an organisation (Johnson *et al.*, 2008, p. 3).

The importance of a definition for cross-cultural studies of strategic behaviour in family firms relates to examining family-oriented vs. business-oriented decision-making (Basco, 2014). Family-oriented decision-making relates to the advantages (e.g. monitoring and control, long-term perspectives, decision-making, culture, among others) and disadvantages (e.g. lack of succession planning, nepotism, professionalisation, among others) of family involvement in how a firm is governed and managed, which can provide every family business with unique strategic choices (Basco, 2014). Business-oriented decision-making relates to how organisations compete successfully in the marketplace when the family participates in the firm, focusing on efficient operations to achieve lower costs than competitors as regards raw material suppliers, internal processes such as inventories, human resources and technologies, distribution channels, as well as sales and marketing techniques (Basco, 2014, p. 974).

Differences in the way family-oriented and business-oriented decision-making influence family firms can be expected in studies across countries (Au *et al.*, 2018). Au *et al.* (2018), drawing on a quantitative study of 959 family firms from 26 countries, argue that there are cultural-dependent countervailing effects on the strategic behaviour within family firms. Their study posed that multigenerational family involvement is positively related to strategic renewal—that is, the process by which family firms adapt to changing conditions in their environment to ensure survival (Sievinen *et al.*, 2019). Basco (2014), on a study of 732 firms across several sectors and geographical regions within a country, evidenced that when a family's involvement alters the firm's decision-making in different areas (such as human resources, strategic processes and succession), then a family-enterprise-first firm—that is, a firm that combines business and family-oriented decision-making—can emerge and create the conditions for a product differentiation strategy. Thus, further studies of product differentiation as a strategy in family businesses across countries are needed.

**Product differentiation**

Product differentiation is a strategic choice that demands extensive knowledge of a product, shared commitment of those involved and a substantial resource investment without any certainty of success (Harrigan, 1980). Differentiation advantages typically arise from a customer's perception that a particular product is more valuable. The ‘fit’ of the product characteristics to market needs, as well as the firm's ability to market such characteristics, creates a differentiation advantage (Galdeano-Gómez *et al.*, 2008). Thus, a differentiation strategy may focus on the benefits or qualities of a product or service by creating something unique. The key difference from non-family counterparts is that family firms can ‘fit’ together business-oriented and family-oriented decision-making and strategic behaviour to achieve better performance (Basco, 2014).

For farming families, product differentiation may be a relevant strategic choice for several reasons. First, because international markets differentiate products based on tangible (e.g. physical attributes) and/or intangible features (e.g. production processes and/or trade practices, environmental sustainability) (Carvalho *et al.*, 2016), farming families may then engage in a unique differentiation approach, based on family and contextually influenced resources (Roscoe *et al.*, 2013). Second, as a differentiation strategy focuses on the benefit or quality of a product or service by creating something unique (e.g. design, quality or innovation), then family businesses may compete based on both family and business features not offered by competitors (Basco, 2014). In the context of family-oriented and business-oriented objectives, Basco (2014) argues that commitment to value or trust may allow a stewardship culture to emerge.

**A stewardship perspective**

For farming families, differentiation may challenge a traditional approach to managing existing resources. Land tenure is associated with farming families because farms are most often the exclusive source of income and residence for a family (Alsos *et al.*, 2011). Thus, there is an implicit and powerful motivation to engage in strategies that can safeguard a family's livelihood and lifestyle (Jervell, 2011). Protecting a family farm may be underpinned by a stewardship perspective, which helps to understand the behaviour of family (and non-family members) members acting like stewards, looking after the common good of the family business (Davis *et al.*, 2010).

Stewardship theory assumes a relationship-based system with a focus on non-financial objectives, explaining situations in which individuals serve the organisational good (Davis *et al.*, 1997), based on an intrinsic desire to pursue ***collective*** goals, and relying on trust as a control mechanism (Madison *et al.*, 2016). Such a perspective explains how and why family firms are differentiated from their non-family counterparts (Miller *et al.*, 2008). A stewardship lens is relevant for this study, as it is based on the recognition that family business owners and managers are not always self-serving, and that goals and motivations can be aligned as understanding about who they serve, which includes the whole organisation in the long run (Davis *et al.*, 2010). Based on such features, recent studies advocate that stewardship practices and behaviours are more likely to be evident in family firms than in non-family firms (Carradus *et al.*, 2019; Neubaum *et al.*, 2017). Dodd and Dyck (2015, p. 314) argue that longer-term commitment to their firm, reputation enhancement through engaging in stewardship activities and shared identification of members with core cultural values may explain why family firms place greater emphasis on stewardship.

Le Breton-Miller and Miller (2018, p. 233) advocate that in family firms, stewardship benefits from devoted and disciplined stewards. Such individuals may engage in entrepreneurial stewardship—that is, when family business members engage in growing the family assets entrepreneurially, not just safeguarding them for the next generation (Discua Cruz *et al.*, 2013, p. 39). Entrepreneurial stewards can relate to individuals that integrate shared interests, act upon a concern for the long-term welfare of the family business and its immediate environment rather than self-interest and are involved in the creation and leverage of key resources within the firm (Le Bretton Miller and Miller, 2018; Dodd and Dyck, 2015). Product differentiation could emerge as a behaviour of entrepreneurial stewards when the intention is a ***collective*** approach to improve a family firm (Vega Solano and Discua Cruz, 2017). This may occur when a ***collective*** approach that relies on shared vision and commitment, the leverage of existing resources, as well as the creation of exchange networks based on diverse relationships is encouraged. This perspective connects appropriately with a differentiation strategy in family firms put forward by Basco (2014), which draws on an organisational culture that emerges from the intertwinement between family and business, and the nurturing of internal and external stewardship relationships. Yet, there is limited understanding as to the extent to which these perspectives could explain the behaviour of family businesses in industries where product differentiation is imperative (e.g. coffee (Donnet *et al.*, 2007)).

This study acknowledges the uncertain nature of business-oriented and family-oriented decision-making (Basco, 2014) when products are differentiated in a coffee-farming context. Such uncertainty suggests that courses of action and decisions are explored by members of an entrepreneurial farming family through dialogue and interaction with others (family friends, potential customers, trading counterparties and financing agents and government officials) and a place, in a process of ‘articulation, ‘ of slowly exploring how things or ideas (e.g. differentiation) unfold (Roscoe *et al.*, 2013). Recent studies show that farming families can pursue opportunities that are based on strategies which are aligned to family members' perspectives, as well as influenced by the context in which they operate (Fitz-Koch *et al.*, 2019). This occurs because exploring diverse options may be as dependent on the aspects of a place, such as local climate or natural features (water, soil, climate, sun) and fauna, as they are on the farming family, the community, the available resources or market demand. Thus, product differentiation may be contingent on family members engaging in entrepreneurial stewardship and operating in specific temporal and geographical instances.

**Contextual aspects in the coffee industry**

Coffee is one of the most consumed products around the world (Tucker, 2017). In 2017, the top ten coffee-producing countries were Brazil, Vietnam, Colombia, Indonesia, Ethiopia, Honduras, India, Uganda, Mexico and Guatemala (de Toledo *et al.*, 2017). Producers worldwide are challenged to find ways to transform and add value to their coffee (Ponte, 2002; Reinecke *et al.*, 2012). Coffee-farming families may face diverse contextual pressures that may prompt diverse strategic responses, including product differentiation (Kilian *et al.*, 2006). Key influences for coffee-farming families can be understood through Wright *et al.*'s (2014) levels of contextual importance (organisational, institutional and temporal).

Table I shows that in terms of a temporal dimension, the coffee sector can be influenced by market shocks, trends and demands. Declines in coffee prices can have a profound impact across coffee-producing regions, as they influence land use decisions and consumer demand over time. The last two decades have seen the emergence of geographic indications, appellations of origin and specialised certification as mechanisms to guarantee the quality and attributes that global markets demand from coffee (Paz Cafferata and Pomareda, 2009). Consumer demand for differentiation in coffee has been growing significantly, relying on intrinsic characteristics or perceived product attributes that relate to place, process and circumstances by which the coffee is cultivated, produced, processed and marketed (Mizumoto, 2009; Lara Estrada *et al.*, 2017).

In terms of an institutional dimension, farming families are strongly influenced by local legal frameworks, government systems and worldwide policies. For example, Reinecke *et al.* (2012) suggested that ‘meta standardisation’ of sustainable practices, which relates to the process by which different standards from various contexts become interconnected to form a new and universal standard, may drive the device of institutional policies to regulate coffee production or commercialisation. Moreover, Rueda and Lambin (2013) argue that the trends impulsed by gourmet, eco-concerned consumers are modifying the coffee value chain, changing the landscape in coffee-producing countries worldwide, with more producers changing their business models to standardisation in order to benefit from price stability and exclusivity contracts. For some countries, the coffee sector represents not only one of the largest contributors to gross domestic product (GDP) and foreign direct investment, but is also a component of national identity.

Regarding the organisational dimension, Table I shows that whilst farming families may benefit from idiosyncratic resources (Sirmon and Hitt, 2003), they also often deal with restricted financial resources, the limited skills and knowledge of their family, unpredictable working conditions and complex family→work dynamics. Taken together, the items described in Table I suggest that farming families who engage in product differentiation may follow a risky path in trying to safeguard their families' livelihoods.

**Specialty coffee**

Speciality coffee is a sector characterised by distinct approaches to sourcing, processing, brewing and serving coffee, aiming to create a unique product. In addition to claims of superior taste, specialty coffee companies celebrate the craftsmanship of coffee roasting and preparation around specialised roasting processes, product freshness and a deliberate differentiation from bulk commercial grade coffees (Bacon, 2008). In particular, estate-grown coffee, as designated by the Specialty Coffee Association of America (SCAA), comes from a specific coffee farm and is grown with a standardised technique to achieve a unique taste. For instance, to capture the value offered in the specialty market segment, high-quality coffees are often associated with and named after their places of origin (e.g. Jamaican Blue Mountain) (Donnet *et al.*, 2007). Yet, producing estate-grown coffee usually involves higher costs and specific and stringent quality standards compared to commercial bulk versions (Niederhauser *et al.*, 2008), suggesting the importance of diverse and specialised skills as well as building up an exchange network (Howorth *et al.*, 2014). Further understanding of how and why some families engage in coffee differentiation and the extent to which they can influence such strategic choice is warranted.

**Method**

To further understand how and why coffee-farming families engage in product differentiation and the extent of their influence, this study is concerned with the experiences and views of those involved in family firm management. Depth rather than breadth was deemed important, and thus detailed and in-depth insights were needed (Stake, 2008). Qualitative methods are ideal to capture detailed perspectives and provide a more valid explanation of what is going on in family firms. An interpretivist perspective based on the narratives of families in business (Hamilton *et al.*, 2017) and multiple case study design (Reay and Zhang, 2014) was considered as the best way to reveal the motivations and rationale behind decisions and practices. Case studies represent an established approach within the methodological canon of family business research (Melin *et al.*, 2014). Reay and Zhang (2014) pose that a comparative case study approach allows moving beyond a single case study within a place to a comparison of cases, which allows a richer perspective.

Cases were selected based on where ‘*the processes being studied are most likely to occur*’ (Denzin and Lincoln, 2000, p. 370), which for this study were coffee-farming families engaged in specialty coffee production. We deliberately sought out family firms in Central America that were representative of what we wanted to study, which in this case were family firms that engaged in producing estate-grown coffee. This study focuses on three countries: Guatemala, Honduras and Nicaragua, which share a common history yet have developed differently (Black, 2018); family firms and coffee production are deeply influential in these nations.

As the case selection was purposive, we needed privileged access. To address the difficulty of obtaining information from family businesses in Latin America (Jones, 2004), the personal relationships of the authors with the selected businesses facilitated the setting up of in-depth interviews. Case studies of purposefully selected firms provided a systematic way of looking at processes and events, observing contemporary phenomena within real-life contexts, gathering and analysing ***data*** and reporting results (Leppäaho *et al.*, 2016). Furthermore, case studies from multiple countries were selected in order to provide more insight into coffee differentiation and to help add external validity (Riege, 2003). Evidence was gathered through interviews with the family members directly responsible for strategic decision-making. On average, the interviews lasted between two and three hours and were conducted on the premises of the family farms. Names have been changed due to anonymity requests by the interviewees.

**Guatemala: the Santa Ana farm**

Guatemala has a population of around 16.7 million and a GDP of about US$75.6 billion (World Bank, 2017). Coffee production in 2017 was about 3.1 million 60-kg sacks, representing around US$500 million for the Guatemalan economy (ANACAFE, 2017; USDA, 2017). The United States, Japan and Canada are the top export markets. The Santa Ana farm is located in the Antigua region of Guatemala. Antigua is internationally renowned for its high-quality coffees and is located between three volcanoes in a valley with an ideal climate for cultivating coffee. The farm was acquired by Augusto Soto in 1943, and has belonged to the Soto family for three generations. To date, Santa Ana has an annual production of 290 quintals (1 quintal = 100 kilograms/kg) of coffee beans. In 1988, most coffee producers in Guatemala had no incentive to improve quality or to differentiate their product. As the ICO agreement expired in 1988, the Soto family evaluated the idea of exiting from coffee farming through the sale of arable land for real estate development. Roberto, a third-generation member, argued that focusing on existing production could ‘save the farm and honor the family legacy’. Roberto and his wife Clara were entrusted to differentiate their estate-grown coffee in order to save the family firm.

**Honduras: the San Antonio farm**

Honduras has a population of around 9.2 million and a GDP of about US$22.9 billion (World Bank, 2017). Honduras is currently the largest coffee producer in Central America, the third largest in Latin America and the sixth largest globally, in coffee exports by volume, with a production in 2017 of about 6.5 million 60-kg sacks (USDA, 2017). Coffee represents around 10 percent of its GDP. The San Antonio farm, located in the region of Guaimaca, has been owned by the Rojas family since 1930. Guaimaca has been increasingly heralded for the quality of its coffee, due to its topography, soil variety and microclimates (IHCAFE, 2017). The farm was started by Antonio Rojas, and there are currently two generations working on the farm. Yet, over the years, disease, combined with a drop in international coffee prices, created issues for the firm. The Rojas family decided to support Lester, a member of the third generation, to lead a differentiation project for the family coffee business. San Antonio had traditionally sold their coffee to Honduran coffee exporters through bulk packaging but decided to engage in exporting their own estate-grown product, ‘San Antonio Guaimaca Estate’, in 2015. To date, San Antonio has an annual production of 500 quintals of high-quality coffee beans, with equal amounts exported to the United States and Italy.

**Nicaragua: The Santa Gertha farm**

Nicaragua has a population of about 6.2 million and a GDP of about US$13.8 billion (World Bank, 2017). Coffee is the most important crop in Nicaragua, due to its economic, social and environmental impact (Kühl, 2004). In 2017, Nicaragua exported around three million quintals, generating US $446 million for the economy (CETREX, 2018). The Santa Gertha farm was founded in 1977 by the Schmidt family, descendants of German immigrants, in the Matagalpa region. This region is known as an ethnic enclave, where the first coffee plantations of Nicaragua were started by German immigrants. Over the years, the Schmidt family developed different businesses in the agroindustrial and tourism sectors, including estate-grown coffee. The founders, Hans and Heidi, have four daughters, but only the oldest, Melissa, is involved in the business. The remaining three daughters are indirectly involved in the companies (exporting coffee to the USA, and by online sales). During the 1980s, the Schmidt family had to leave the country due to the Sandinista Revolution (Cervantes-Rodriguez, 2006). The family fled to the United States, where the daughters completed their university education and got married. The family returned to Nicaragua after democratic governments were re-established in the 1990s and reclaimed their farm. Their coffee began to be exported as an estate-grown product in 1992, with the name ‘Café Gertha Matagalpa’. In 2017, they exported around 5,000 quintals, with 80 percent going to the United States and the remainder to Spain.

The initial ***data*** analysis was in Spanish; translation into English was done later. Interpretive methods were used to analyse how and why coffee differentiation was pursued by family members. The early stages of the analysis included categorising responses to differentiation aspects alongside a pattern search. ***Data*** analysis was inductive, as the study sought to understand individual perceptions and experiences (Grbich, 2007). The search for meaning led us to gain an in-depth understanding of meanings and diverse perspectives about the motivation and rationale behind coffee differentiation. Based on Neergard and Leitch (2015), the authors started by independently examining the ***data*** in interviews, observation notes and documents. Then, a coding process was carried out by reading and rereading transcripts, notes and documents, and then using codes for sentences or paragraphs in order to organise ***data***. Once coding was completed, ***data*** were organised to identify emerging themes, which were discussed by the authors in order to refine interpretations. Analysis of the ***data*** was reiterative in moving between ***data*** and emerging findings (Alvesson and Skoldberg, 2000). The interpretation of emergent findings was discussed with case study participants in follow-up interviews to gain their perspectives and to inform ongoing analysis. In analysing the ***data***, experience of the Guatemalan, Honduran and Nicaraguan cultures was important—as was experienced in being part of family businesses in such countries—in order to increase understanding and confidence, which minimised disagreements in the analytical process (Discua Cruz *et al.*, 2013, 2020). Finally, findings were ‘re-contextualised’ by comparing them to arguments in existing literature (Neergard and Leitch, 2015).

Table II summarises the ***data*** coding, themes and concepts that emerged in the process. In the findings section, compelling excerpts from the ***data*** are used to effectively illustrate the arguments made. Manual analysis methods and ***data*** in tables support the key themes emerging from the analysis (Pratt, 2009). The aim was to increase transparency and address the validity of the article (Gibbert and Ruigrok, 2010).

**Analysis**

Analysis of the ***data*** revealed that business-oriented and family-oriented decision-making influenced the approach and rationale of families engaging in coffee differentiation. Family-oriented sources, such as succession processes, family, human and social capital, as well as business-oriented sources such as changing customer demands, institutional practices and diverse governmental systems, influenced the rationale of farming families in their forays into product differentiation.

**Differentiation through shared vision and commitment**

Evidence suggests that differentiation was driven by shared visions, represented by a ***collective*** understanding of the future that a family in business wanted to create, which for these families revolved around a commitment to be involved in the development of a differentiated product by looking after not only the family assets but also the environment and communities where their coffee is produced. Table II shows that in all cases, family members—as entrepreneurial stewards—displayed shared understandings shaped by prior successes, failures and challenges. A shared vision to be in business together and offer a unique product allowed all families to move from commercialising an undifferentiated commodity to offering a certified estate-grown coffee, a sought-after brand in the specialty coffee market.

A shared understanding to bring out the best features of their products was influenced by the families' frustration about neglecting their unique product in the past. This was the case with Santa Ana and San Antonio, where the local prestige of their coffee had been diluted, as in prior decades international markets did not demand—or were unwilling to pay a premium price for—their high-quality coffee. Moreover, the lack of such demand hindered their investments into dedicated coffee-processing facilities, which, in addition to initial low production volumes of high-quality coffee, meant that their coffee beans had to be mixed with beans purchased from other nearby producers who were not committed to quality. As a result, their coffee ended up as a diluted and undifferentiated product.

In addition, a shared vision was grounded on the long history of family involvement in coffee production and their permanence in their location. Evidence revealed that coffee from each case had always been known for its quality since their first harvests (Table II). A shared vision instilled by founding generations—to be known as producers of high-quality coffee—influenced entrepreneurial stewards' commitment to safeguard a family heritage in coffee production whilst balancing decisions based on latest market demands. Lester (San Antonio) expressed:We have been doing this [high-quality coffee production] for three generations, our history is linked to this place [Guaimaca], we all wanted that customers realised that our dedication to produce the best coffee comes from looking after these lands for a long time…. [yet] this is a business and we cannot live out of family sentiment alone, we have to compete with the best product possible and that depends on us bringing out the best about this place….

A ***collective*** vision to produce high-quality coffee as a family, over time, was shared by entrepreneurial stewards, who noted family responses when diverse contextual crises appeared. This was recorded when family members were forced to leave their business to later return and reinitiate operations (Santa Gertha), when extended family encouraged the divestment of the coffee farm following the expiration of the ICO agreement (Santa Ana), or when coffee production was perceived as less profitable *in lieu* of other ***agricultural*** products in the long term (San Antonio).

Table II shows that a shared vision also involved looking after their immediate environment. For example, entrepreneurial stewards committed themselves to looking after their geographical location by using only organic methods and relying only, very occasionally, on chemical aggregates for soils. In San Antonio and Santa Gertha, some workers live within the farm properties and are thus motivated to look after the place where they live and work. Novel recycling methods allowed the use of no more than three cubic metres of water per quintal of processed coffee; this approach reduces water pollution substantially compared to previous methods. Wastewater was treated at the end of the process. Coffee was naturally sundried or dried in ovens that are fuelled by coffee husks, thus encouraging minimal waste. Environmental sensitivity (e.g. a gradual switch to hydro and solar energy in San Antonio and Santa Gertha) and respect for nature (e.g. it is strictly forbidden to hunt or capture living species in Santa Gertha) were shared by family members in all cases. A shared vision of improving the community and the environment, and its importance from a business standpoint, was encapsulated by Hans from Santa Gertha:…30 years ago, the idea of gourmet coffee was born in the United States, so marketers are looking for farms that meet several requirements. The more requirements they have, such as height, history, location, managed by the family, that coffee is grown under shade, that the area has not been deforested, that the animals in the mountains are not hunted, that the social conditions of the employees are good, that the place is always clean… then the price improves…

Table II shows that in all cases, the surrounding community was central in the shared vision of entrepreneurial stewards to differentiate their products. For example, in Santa Gertha, around 200 permanent workers work and live on the property, and have homes that have basic services, including food, energy and education subsidised by the family business. Santa Ana and San Antonio support activities that improve technical education and raise the living standards of non-family employees. In the case of Santa Gertha and San Antonio, many of the current members of their managerial teams were born on the farm premises and are the offspring of senior employees who live nearby. Such non-family members perceive themselves as stewards of a legacy of how these families combine looking after their communities and the production of high-quality coffee over time.

**Differentiation through leveraging and combining traditional and specialised knowledge**

Differentiation based on stewarding resources entrepreneurially involves family members leveraging resources over time and building on them through a combination with new resources. This approach was evidenced in the combination of traditional and specialised knowledge by entrepreneurial stewards in coffee production, which influenced both business-oriented and family-oriented decision-making. ‘Traditional’ in this case relates to the indigenous skills, knowledge and techniques accumulated by family members, which is derived from the interaction with the environment and has been in existence for at least 100 years (Barrios and Trejo, 2003; Grossman, 2003). Traditional, *a priori,* knowledge (cultivation, weeding, soil management) was generated by the personal experiences of prior generations, whilst specialised, *a posteriori*, knowledge relates to the use of scientific applications for coffee productivity (e.g. ethnopedology) (Ericksen and Ardón, 2003; Winklerprins, 1999).

Table II shows that entrepreneurial stewards identified that coffee trends were favouring high-quality ‘traditional’ coffee and that differentiation, based on traditional knowledge to bring out such features in coffee, was relevant, but also that new techniques were needed. This was noted by Roberto, from Santa Ana:Coffee traders in developed countries became concerned about their profits declining in mixed quality varieties of coffee. Some traders encouraged “nostalgia” in their customers, who gradually demanded “old-fashioned” traditional coffee. Niche markets were then created for consumers willing to pay a premium price for top-quality coffee … We became interested in this trend as it was evident that there was a market ready to consume a differentiated product. It was our only window of opportunity to achieve an advantage.

In all cases, knowledge about high-quality coffee production in a particular place was transferred from one generation to the next, as family members lived on the farm and were socialised from childhood into estate-grown coffee production (e.g. cultivation, harvesting and processing). Transgenerational knowledge exchange may have undergone successive refinement, leading to a system of understanding of natural resources and relevant ecological processes (Pawluk *et al.*, 1992) in coffee production. Access to such knowledge made family members perceive themselves as stewards of traditional skills and techniques within a geographical location. Such knowledge helped entrepreneurial stewards identify and build on outstanding characteristics of their coffee plantations to cater for the demand of ‘traditional coffee’ local to their places (Antigua, Guaimaca and Matagalpa).

Yet, traditional knowledge was influenced by the fact that coffee production was a primary concern, while specialised knowledge entailed a more holistic view of plant productivity (Ericksen and Ardón, 2003) and coffee management practices. Specialised ***agricultural*** engineering degrees or education in subjects related to the management of ***agricultural*** ventures and marketing was pursued, locally and overseas, by entrepreneurial stewards. Such practices were geared to influence decision-making based on family and business objectives (Basco, 2014). In addition, families sought support from experts from local governmental agencies (Santa Ana, San Antonio) and foreign technicians (Santa Gertha). For instance, Santa Gertha relied on non-family German experts for specialised knowledge in coffee production, while family members focused on coffee commercialisation. In Santa Gertha, the forced migration of the family to the USA allowed family members to learn about a growing demand for estate-grown coffee from farms that could attest to their heritage and also provide evidence of traceability for new markets. New techniques in monitoring and commercialising coffee (Niederhauser *et al.*, 2008) have been introduced by entrepreneurial stewards. San Antonio and Santa Gertha have catalogued every hectare of their coffee fields by GPS, so that now they can monitor field production and maintenance as well as sell their estate-grown coffee with a designation of very precise origin.

Evidence across cases also highlighted that knowledge passed down from generations was combined with technical knowhow brought forward by incoming generations. For instance, Santa Ana and San Antonio junior generations, due to pursuing specialised degrees in ***agricultural*** engineering, could identify the temperature range that gave coffee plants an ideal environment and the type of soil where coffee was best cultivated to support its maturation process and reach high-quality estate status. Knowing such factors in detail, combined with traditional methods, favoured the quality of coffee produced (Lara Estrada *et al.*, 2017) and addressed diverse climatological problems (such as frost and drought). In all cases, coffees cultivated by these families were harvested on mountains, with altitudes ranging between 1,200 and 1,500 m above sea level. Such features were known over generations to be critical not only for coffee quality but also for the minimal occurrence of coffee diseases and for experimentation in terms of new coffee varieties that could be introduced by using new techniques. Combining traditional and specialised knowledge allowed that at least three varieties of coffee could be grown in all the farms, so sowing density was optimal per square metre of land. Coffee parasites were handled in an environmentally friendly manner, using traps (traditional techniques used by Santa Ana and San Antonio). Annual rainfall for all farms was optimal for all cases, between 850 and 952 mm. Alternative irrigation was drawn from man-made wells when needed, which helped reach consistency in the quality of coffee produced (Santa Ana, Santa Gertha). All cases added value to a quality bean, produced exclusively on farm premises and avoiding any mix with other beans.

The cases reveal that as ***agriculture*** is highly dependent on the local environment, traditional knowledge was of particular importance, as it contained a cherished understanding of the particular set of local cultural and natural resources possessed by family members. Such knowledge, when combined with scientific know-how, technical practices and skills both in coffee production and commercialisation, can influence the approach to a differentiated product, over time, by entrepreneurial stewards. The qualities that differentiated the estate-grown coffee in every case were its origin, coffee bean variety, cultivation and preparation process, supported by the combination of traditional and scientific knowledge. When such properties were technically understood, they provided distinctive features that highlighted both the heritage of coffee produced by a family in a place and novel techniques.

**The creation and development of a support and exchange network**

The evidence suggested that entrepreneurial stewards engaged in nurturing and leveraging new and old family and non-family ties, external recognition and commercial alliances. Developing an exchange network that encompasses support, customer and supplier networks (Casson and Giusta, 2007; Shaw *et al.*, 2017) was paramount for a differentiation strategy.

Lester, from San Antonio, encapsulated such importance when expressing:… Good family relationships help out because they will try to help you get what you need, whether it is funds, insight about coffee, or customers for your products. Yet because coffee is widely available here, then connecting with international consumers is crucial… foreign buyers know what they are looking for, they have different methods, but we realise that they want to know more about something we take for granted → this place! That is why we added the Guaimaca aspect. Good relationships with them [customers] will go a long way in business… I am sure if we start winning more competitions we can then go back to the negotiating table and ask for better prices, we can then improve the farms and bring up the reputation of coffee produced in this place…we can then assure clients for the long run and our relationship will be stronger….

Family exchange networks were relevant when the focus on a differentiated product demanded additional investments in modern processing plants. Table II shows that for Santa Ana and San Antonio, family networks were critical when attempting to procure access to external funding for product differentiation. In these two cases, families activated ties in banking to facilitate access to bank funds. In Santa Gertha, entrepreneurial stewards were supported with cash and interest-free loans. In every case, such funding allowed new coffee plants to: increase cultivation density, make organic fertilisation programmes become widespread, make pruning and shading for coffee bushes a priority and put previously idle farm land to use. Funding procured through family networks allowed farms to achieve a consistent quality and thus helped to produce high-quality, estate-grown coffee.

Non-family exchange networks were also gradually shaped through the creation and nurturing of relationships with diverse actors related to coffee commercialisation. Santa Ana and San Antonio entrepreneurial stewards have developed good relationships with governmental offices dealing with coffee commercialisation. This approach allows coffee-farming families to keep updated on opportunities to promote their products. Since the year 2000, the Guatemalan (ANACAFE) and Honduran National Coffee Association (IHCAFE) have shown a shift in government policy towards collaboration with the private sector. In addition to technical support, these organisations have organised regional and national competitions, such as the ‘Cup of Excellence’ auction, a competition where an expert group of national and international judges selects the best coffee produced in a particular year and rewards high-quality coffee producers (Teuber and Herrmann, 2012). The contest winners have samples of their coffee sent to specialty coffee buyers throughout the world. The Santa Ana sample, labelled ‘Genuine Santa Ana Antigua’, has won a third-place prize in the past, while San Antonio's ‘San Antonio Guaimaca Estate’ coffee achieved an invitation last year, yet has not won a prize to date. Such interaction favoured the relevance of traditional family knowledge in coffee production as well as providing new information for business-oriented decision-making.

By participating in competitions, entrepreneurial stewards gradually developed relationships with interested consumers and encouraged the emergence of alliances. As Santa Ana coffee began gaining recognition, a large retail company became interested in their product. This retail company establishes alliances for supplying coffee to the USA with one sole strategic focus—quality. As a result of being recognised, retailers pay a higher price per sack compared to the average paid at the New York Sugar, Coffee, and Cocoa Exchange (NYSCCE). The potential for other major players to secure the production of Santa Ana coffee has prompted other international buyers to offer exclusive rights by guaranteeing a fixed price for the product. Moreover, Santa Ana's commitment to address environmental concerns within their immediate community has impacted the preferences of new consumers. A large US customer paid preferential rates when social and environmental issues were addressed (Table II). The price increase allowed Santa Ana to improve the differentiating features of their specialty coffee and at the same time benefit their community in the long term.

In San Antonio, entrepreneurial stewards are now committed to continue participating in coffee competitions guided by IHCAFE staff. Alliances in high-quality coffee production began in 2015, when Anibal, who studied a master's degree in ***agriculture*** in Italy, managed to contact a large Italian retail company. The Italian company asked for samples and was fascinated by the blends they could create. In San Antonio and Santa Ana, representatives from large retailers visited the farms and secured exclusive coffee procurement. Moreover, such external relationships advised that the features of the place where coffee was planted and harvested needed to be included in future promotions. In doing so, entrepreneurial stewards were interested in creating new ties in various networks to leverage relationships in the long term.

Santa Gertha has opted not to participate in such competitions, due to scepticism about governmental support or intervention. Yet, ‘Café Gertha Matagalpa’ is strongly positioned in Nicaragua because of the promotions made by foreigners living in the country and the inhabitants of Matagalpa, many of whom are of German origin and promote products made by fellow migrants. For Santa Gertha, alliances emerged as their coffee began to be exported as a ‘coffee of origin’ in 1992 with the name of ‘Café Santa Gertha’ to the United States; the importer recommended that the name be changed to ‘Café Gertha Matagalpa’, because it sounded more romantic and highlighted the features of its place of origin, a name that has lasted to date. Contrary to Santa Ana and San Antonio, Santa Gertha has managed to position itself adequately in the international market due to in-house marketing. They have patented their name in the USA and associated it with international certifications. Their coffee is consumed by elitist associations in the USA, who require coffee with high quality and the same consistency as the previous year. Meeting such specifications demands control of the coffee variety and a commitment to promote the unique features of the Matagalpa region. Addressing such demands allows ‘Café Gertha Matagalpa’ to achieve a higher price.

In all cases, and motivated by increasing demands from customer networks about traceability and QR codes (Dabbene *et al.*, 2014), information about every batch includes specifications such as height, precipitation, soil composition, sun exposure and bean variety.

The gradual development of an exchange network, comprising the combination of existing ties (e.g. family support for business growth) and new ties (e.g. proactive engagement in competition to promote alliances), has allowed the shaping of the uniqueness of a product, as well as catering for changing customer demands internationally. Leveraging existing and new relationships have influenced the decision-making approach of farming families to engage in product differentiation based on family and business aspects.

**Conclusion**

This study embarked on understanding how and why family businesses in the coffee industry engage in product differentiation and to what extent family influences product differentiation in the coffee industry. A shared vision and commitment, knowledge and leverage of traditional and novel ways of producing high-quality coffee, and the gradual shape of an exchange network by entrepreneurial stewards, underpin how and why product differentiation is engaged. Moreover, product differentiation in specialty coffee-farming farms appears to be associated as much with a strategic choice as with an entrepreneurial outcome influenced by families. Intrinsic characteristics or perceived attributes within a place, as well as the ways by which entrepreneurial stewards approach how coffee is produced, processed and marketed over time, are relevant in product differentiation in family businesses.

**Theoretical contribution**

This study contributes to the literature by comparing coffee family farms across Central America. In doing so, this study contributes to stewardship literature in family firms in two ways. First, findings suggest that a product differentiation strategy may be engaged through devoted and disciplined individuals (Le Breton-Miller and Miller, 2018) who behave entrepreneurially (Discua Cruz *et al.*, 2013). Such entrepreneurial stewards encourage a commitment among family members to bring out the unique features of their product, without neglecting a caretaking approach for their environment. In addition, entrepreneurial stewards can combine traditional and newly acquired expertise to create a complex set of knowledge. Finally, they can develop an exchange network grounded on family support, as well as proactive engagement in business competitions and alliance development.

Second, by engaging in a cross-cultural comparison, the findings extend our understanding of entrepreneurial stewardship by revealing that a differentiated ***agricultural*** product, offered by a family firm over generations, demands a ***collective*** vision and approach (Fitz-Koch *et al.*, 2019; Roscoe *et al.*, 2013). The rationale relates to family members' long-term vision to be in business together and a shared commitment to look after the family's assets over time (Discua Cruz *et al.*, 2013). This is further supported by the intention of entrepreneurial stewards to look after a tradition of producing a high-quality product over generations through leveraging existing and new resources whilst looking after the community and environment that influence such outcomes.

In terms of strategic behaviour, this cross-cultural study expands our understanding of family-enterprise-first family firms, as the findings suggest that the gradual development of a dual knowledge system and an exchange network allows families to fulfil a shared vision. A knowledge perspective on coffee production has its roots in the resource-based perspective of a family firm, which assumes that diverse and distinctive resources (valuable and rare, difficult to imitate and substitute) may allow family firms to process information and capabilities in order to achieve competitive advantages (Barney *et al.*, 2001). The early involvement of younger members has the potential to produce deeper levels of firm-specific tacit knowledge (Sirmon and Hitt, 2003, p. 342). Still, it is in the ability to transfer knowledge (Lobley, 2010) and combine it with new knowledge that such resources (e.g. human capital) can be associated with higher levels of performance. Such a combination makes knowledge used in differentiation appropriable, scarce, highly specialised and difficult to imitate, whilst remaining associated with the family realm (Chirico and Salvato, 2016). Leveraging traditional and specialised knowledge can endow entrepreneurial stewards with a forward-looking balance of skills and competencies relevant for business decision-making (Basco, 2014; Cabrera-Suárez *et al.*, 2018). Moreover, the findings extend our understanding of organisational cultures that can emerge from the nurturing of internal and external stewardship relationships (Basco, 2014) by revealing that strong relationships with internal and external stakeholders are nurtured for the long run, supporting both family-oriented and business-oriented decision-making that can influence strategic renewal.

Finally, this cross-cultural study contributes to understanding how context can affect strategic decisions in family-enterprise-first family firms. Disturbances or critical events, in contextual dimensions, such as a change in international policies or adverse governmental systems (Wright *et al.*, 2014), may either minimise or reinforce the shared family vision to engage in product differentiation. A shared vision, a combination of resources and a gradual development of an exchange network can be put in jeopardy when interruptions or contextual disturbances occur (Table I), which may unbalance the family-oriented/business-oriented decision-making of a firm over time, influencing the motivation and rationale to pursue any strategy (Howorth *et al.*, 2014). In essence, the findings and contribution of this study gravitate around the cross-cultural focus in understanding the strategies of families in business that produce specialty coffee.

**Limitations**

This study has a few caveats, and so its findings must be interpreted with caution. First, the sample of comparative cases is small, and the sampling logic would have been stronger if a broader sample of cases from countries with significant levels of coffee production had been included, such as Brazil, Mexico, Peru and Colombia. Nonetheless, the sample consists of family firms that produce specialty coffee from well-established places, allowing theoretical relevance (Eisenhardt, 1989). Second, all the cases focus on individual firms and are in a single industry; thus, research on family firms from other industries or across industries in different countries, where defining characteristics of differentiation can be examined in relation to a place, should be conducted (Spielmann *et al.*, 2019); ***collective*** approaches through cooperatives should also be studied (Hadjielias and Poutziouris, 2015).

**Practical implications**

The findings also have practical implications for family business managers who have to design and execute strategies where family-oriented and business-oriented decision-making may be intrinsically linked to stewardship. A shared vision can be an anchor when disturbances emerge, as it embodies what the family firm is about and what it must focus on and do to survive. To move beyond involvement to commitment, a shared vision could be instilled through early socialisation in order to gradually reflect the philosophy, language and values of the family in decision-making (Seaman *et al.*, 2019; Discua Cruz *et al.*, 2020). The importance of traditional knowledge cannot be overstated, as it serves as a means for family and non-family members to perceive themselves as custodians or stewards, influencing the agreement of common objectives in the long term. Families who fail to acknowledge the relevance of transferring and combining knowledge for improved performance and decision-making (Cabrera-Suárez *et al.*, 2018; Chirico and Salvato, 2016) may be limited in their ability to reach an optimal differentiation strategy based on both family and business aspects in the long term. Finally, the findings reveal how family businesses can build on their competitive advantage through product differentiation, which can serve not only as a relevant business strategy but also as a path to establish a relevant governance mechanism when balancing family and business goals over time (Basco, 2017).

**Further research**

This study opens the door for further cross-cultural research in settings that are affected by changing contextual aspects (e.g. see Estrada-Robles *et al.*, 2018; Basco *et al.*, 2019), such as family firms producing artisanal products or engaged in tourism, manufacturing and creative industries (music, art, film and literature) in alternative contexts. Moreover, future cross-cultural studies focusing on diverse strategies in family businesses that produce international commodities (e.g. wine, see Spielmann *et al.*, 2019) should consider different levels and units of analysis (Basco and Pérez Rodríguez, 2009; Discua Cruz and Basco, 2018). Finally, recent studies suggest that we should expect variation in the entrepreneurial and strategic behaviour of family firms across generations (Au, 2018), and thus quantitative cross-country studies that test the relationship between entrepreneurial stewardship (Discua Cruz *et al.*, 2013) and specific strategies in family firms (Basco, 2014) are warranted. Further studies that focus on product differentiation in family businesses across countries can support, challenge and extend the results of this study. This study challenges researchers to expand understanding about the strategic behaviour of family firms across countries that engage in product differentiation of items consumed worldwide.

**Table I** Contextual framework in the coffee-farming context across countries

| **Contextual dimensions** | | |
| --- | --- | --- |
| **Organisational** | **Institutional** | **Temporal** |
| Goals for asset preservation | Governmental support, policy, and regulatory agencies | Changing practices in farming |
| Tacit knowledge | Technology processes | Regulations in land and inheritance law |
| Strong intra- and inter-generational bonds | Strong community social capital | Family life cycles |
| Specialised human capital | Tradition of farming sector | Expectations of family succession |
| Family labour and financial support | Inheritance laws | Changes in society/environmental concerns |
| Family emotional support | Cultural expectations | Industry trends and market demands |
| Resilience during hard times | Business networks | International policy changes |

**Source(s)**: Wright *et al.* (2014), Vega Solano and Discua Cruz (2017), Rueda and Lambin (2013), Ponte (2002)

**Table II *Data*** coding

| **Excerpts from *data*** | **First-order concepts** | **Second-order themes** |
| --- | --- | --- |
| ‘By the end of 1988 the farm was transferred to Roberto with a mandate to keep the farm in the hands of the family…. He was a young man with great ambition and a desire to improve what previous generations had started. … his main goal was to emulate his grandparents, who established the Santa Ana farm in the Antigua region in Guatemala…’ (Clara, Santa Ana) | Family vision for business build-up | Shared vision and commitment |
| ‘The changes that have taken place did not happen overnight, but over 40 years, but over time they made a huge impact on local communities and the environment…Our farm has around 750 manzanas [land measure → 1 manzana = 1.75 acres], and 200 of them have been kept as virgin jungle to maintain the micro-climate of the region, to produce the water people drink, and maintain greenery on walking trails…there are little tigers, monkeys, squirrels, pumas, agoutis, cuyusos, dantos or tapir, sloth bears, deer, mountain pigs and birds, including the quetzal…’ (Heidi, Santa Gertha) | Shared understanding about looking after the environment |  |
| ‘We have just acquired more land, and our goal is to create a real coffee experience, where people can come to the local hotel we are starting now in the mountains, go for coffee trails and enjoy the mountains… we have tried hard to stop deforestation because the best coffee grows under shade of large trees, and those trees take decades to reach such height…this then changes the micro climate and we can experiment then with new strains of coffee plants; they are naturally fertilized and we can ensure that organic ***nutrients*** reach these sites… we have to do it for future generations of this community and our family…’ (Lester, San Antonio) | Looking after the community and the environment |  |
| ‘However, all the daughters, together with their relatives, have shown interest in the future to settle in the property of Santa Gertha. The son of the oldest daughter (grandson of the founders) is studying two careers (***agriculture*** and journalism) … everyone, in one way or another, will be involved in the various activities that comprise the company because there is space for everyone.’ (Heidi, Santa Gertha) | Complementing family objectives with future business growth |  |
| ‘Roberto wanted all employees to feel like they are part of the family. Through the payment of higher prices for our products we started to improve workers' conditions on site.’ (Clara, Santa Ana) | Looking after the community and workforce through a shared and aligned vision |  |
| ‘…that initiative supported what we wanted to do in the farm…a score of 80% means a price increase of $8.00/quintal and a score of 90% means a price increase of $9.00/quintal. In its first evaluation, we received a score of 84%, thereby getting an $8.00/quintal price increase. By engaging in this initiative supported by the large retailer in the US, all employees now enjoy benefits that are uncommon on other coffee farms in Antigua, such as a health clinic on site, dining facilities, resting quarters.’ (Roberto, Santa Ana) | Family intention to look after the community through business decision-making |  |
| ‘…we train the local community on coffee plants and how to look after its environment, I mean you have to teach that coffee is better in well-looked-after land, with plenty of trees … that requires training and education, in that way people start to look after the plants and treat the environment for their families too… we all [family] know our family survival in producing coffee is connected to their welfare too.’ (Anibal, San Antonio) | Common understanding of the importance of looking after the environment and community |  |
| ‘I attained a specialized ***agricultural*** engineering degree from the Pan-American ***Agricultural*** School Zamorano (in Honduras), and later pursued a specialized degree in the University of Florida (USA)….our coffee had always enjoyed great prestige due to its quality, and it was at least always possible to commercialize it. Why not do everything possible to improve the quality of the farm's product to get a better price? Why not go even further to include other factors in addition to price that could differentiate the product and make it widely known and attractive to consumers at a premium price?’ (Roberto, Santa Ana) | Specialised knowledge in ***agriculture*** | Combination of traditional and specialised knowledge |
| ‘I mean, you have to get involved in the development of what your parents started, it is a family goal that we expand on our farm and allow other family members to be involved. I studied ***agricultural*** engineering at Zamorano (Honduras) and coffee was my passion. I learned all the knowledge my grandfather gave to my dad about how to plant coffee and they made sure I knew the secrets they had learned over the years… yet now due to the changes of weather you have to combine that knowledge with new ways of cultivating coffee… After university, I could apply modern techniques to the knowledge my family had over generations, since my grandfather, to develop good yield in our plantations and produce better coffee…I have attended every training course for coffee there is, it is really a commitment we make as a family.’ (Lester, San Antonio) | Family influence in the use of specialised knowledge |  |
| ‘One of the problems is that in Matagalpa (where Santa Gertha is located) there was not a university for years, so it was often the case that the next generation that came to the country as a settler, did not study, yet brought with them a tradition in farming or working ethics that was useful in blending family and business goals…The descendants of Europeans usually study in good schools in Nicaragua, and then do their undergraduate and postgraduate studies abroad.’ (Hans, Santa Gertha) | Traditional knowledge to complement lack of specialised knowledge |  |
| ‘Heidi speaks Spanish, English, and German, and gives international talks about community improvement topics around coffee. She has already delivered talks in Barcelona, Austria and Seattle, which is the capital of gourmet coffee, about ‘women building community’, and also in New York…’ (Hans, Santa Gertha) | Family members disseminating information about the place where family coffee is produced |  |
| ‘You need to specialize to be in coffee farming, my son is good in coffee production yet he also relies on the commitment of the family to support the family vision… we have exported in bulk for years, but now specialty coffee requires us to go back to the roots of coffee, to know the process inside out and demonstrate that coffee is looked after, that all organic methods are used and that it can compete in taste. As the new cafe was set up we needed to show the relevance of our knowledge of this place, its soils, that we can bring out the best coffee out of it but also that family members were committed for generations to this, it is the only way you can really show you are just not growing any type of coffee.. it is our name after all that is displayed in our coffee bags, our family history is there but also we can be proud that we build on that generational knowledge with new techniques …’ (Lucia, San Antonio) | Specialised knowledge in ***agriculture*** related to traditional family knowledge |  |
| ‘Our farms are located between 1,240 and 1,500 m…when coffee is at higher altitude, production occurs as in a kind of a refrigerator, so the ripening process slows down, producing a stronger and more aromatic grain; that's why they call it ‘gourmet’ coffee. It needs to be produced at more than 1,000 m, without chopping the peel during its process, with limited sun exposure, and then picked at the right time.’ (Hans, Santa Gertha) | Importance of understanding the key natural features of a place and product |  |
| ‘…you need to rely on who you know to produce good coffee; the banks are crucial for this yet we would not go to a bank to put our property as collateral unless we are certain that our harvest will be good. That is the confidence we have when we have applied all we know… the bank officials know my dad and have seen him improve his sales every year, so it was easier for me to go to the bank and ask for more funds just to expand a bit on introducing new plants and improve irrigation when needed…’ (Lester, San Antonio) | Family networks for support | Development of an exchange network |
| ‘The products offered by the company have improved by technical assistance; for example, we bring non-family members, who are technicians from Germany, to help develop our products… this is done in combination with local knowledge…Many of the new products that they have were emerging because of the exclusivity of the market that visits Santa Gertha, since the majority of visitors are foreigners who have settled in the country or who are visiting from overseas; then we can talk to them in our nearby restaurant to talk and get a lot of feedback on the quality of the services, new (coffee) products, etc.’ (Heidi, Santa Gertha) | Non-family networks' support for differentiation |  |
| ‘…the alliance with our main customer relied on sincerity, loyalty and mutual interest. Seattle's had something that we wanted, which was price stability, because at that time the ICO agreement had expired and prices were extremely volatile. On the other hand, we also had something that our customer wanted: an extremely high-quality coffee ideal for their expansion plan.’ (Roberto, Santa Ana) | Alliance influence on building commercial relationships |  |
| ‘Alliances with large players are needed if you want your coffee to be widely known, I mean we could send samples anywhere yet we needed a stable relationship. Italians love coffee so we needed to contact a known brand. Anibal studied in Italy and he knew people there because he always took coffee samples when he returned… he was then able to contact them and ask them if they wanted to try our new blends based on estate-grown coffee… the Italians were looking to differentiate as well so it worked really well, they love what they could do with our coffee and we like that we could have a new customer, not only the US market.’ (Lester, San Antonio) | Alliances' influence on acknowledging customer demands |  |
| ‘…You need to compete because you can have the best coffee according to your taste, yet it is the final consumer who chooses which coffee he wants. We have to promote our coffee but unless it is out there competing and winning competitions we will be just one more coffee. That is why we enter competitions now, we know our coffee is good and we just achieved the invitation for the cup of excellence, we may not win anything but just getting our name out there in this competition is good, I also get to see what others are doing and what features international experts are looking for…’ (Lester, San Antonio) | Alliances' influence on changing market trends |  |
| ‘Such an achievement was the result of improving our product, attending fairs in the past and of gaining recognition through competition to show that we are committed to our farm and our product.’ (Roberto, Santa Ana) | Increased interest in international alliances and symbiotic relationships |  |
| ‘My wife, contrary to the Latin American culture, made a deal with our daughters: ‘do not ask for parties, on the contrary you can travel’; and in fact, they began to travel, which has given them a cultural, linguistic, professional, discipline, contact with others, etc. that otherwise they would not have had access to.’ (Hans, Santa Gertha) | Family objectives in building alliances |  |

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[***TOPIC PAGE: Construction - impact on chemicals***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:614K-7YW1-F046-717T-00000-00&context=1516831)

Global News + ICIS Chemical Business (ICB)

October 23, 2020 Friday

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**Length:** 11600 words

**Body**

More than 30 petrochemicals and specialty chemicals are key ingredients in products used for modern construction adhesives, ad-mixtures, sealants, coatings, paints, flooring, insulation, water proofing, and many more.

Those materials enjoy good demand when infrastructure development takes place, but the construction industry has been adversely impacted by the coronavirus pandemic, although to a lesser extent than automotive, another key end market for petrochemicals.

Public infrastructure investments can be a major contributor to reviving economies and employment during a crisis.

Petrochemicals used in construction and infrastructure are likely to post higher demand in some regions as governments try to revive their wilted economies post-pandemic.

Construction activity in Asia, where most countries are developing economies, is set to growth healthily as the region ramps up infrastructure spending.

Within Asia, China is planning a major infrastructure development campaign to bolster its slowing economy by spending billions of dollars in projects.

On this topic page we analyse the impact of the coronavirus crisis and efforts by different governments to revive economies by developing infrastructure on the chemicals markets, bringing together the latest news reported by ICIS.

Scroll down to see the latest interactive content and useful resources.

[1]Click here to register for regular updates to help you navigate these challenging times. Image credit: Shutterstock

ICIS Analytics viewpoint Construction: All countries registered a year on year contraction in construction activity in Q3 (except China and South Korea), with social distancing restrictions affecting building activity. The worst affected in Q3 included Argentina, Malaysia, India, Brazil, Russia and several nations in the EU, which all registered double-digit negative growth year on year. Moreover, fears about a second wave of infections are growing and countries are starting to impose restrictions on activity again, which could further delay any recovery.

The eurozone construction sector reported a marginal decrease in PMI of 47.5 in September, compared with 47.8 in August.

In the UK, the construction PMI rose to 56.8 in September from 54.6 in August, signifying further expansion. Activity should only come back slowly because uncertainty is still strong. Infrastructure build should be first back, with commercial construction (shops and offices) likely to be some way off.

US housing starts registered a 5% month on month downtick (according to Oxford Economics).

The country is still experiencing social unrest, which adds to other factors weighing down the economy in general. Lower government budgets, limited credit and low savings levels could hinder investment in H2 as well. According to the Associated General Contractors of America (AGC), 16,000 housing jobs were added in August, although infrastructure and non-residential construction lost 11,000 jobs. There is a renewed level of activity on the residential side, with weak non-residential activity. There is an also an increasing level of pessimism among contractors because of project delays, cancelations or budget cuts, as noted by the AGC.

As in the other regions, Asian construction is also under stress (with the exception of China). Some countries have been worse hit than others. The speed and degree of recovery will largely depend on government stimulus packages, credit lines and the timely availability of skilled construction workers. India has been one of the worst affected, with workers leaving cities and moving back to rural areas.

China continues to perform better than other major economies.

In August, investment in real estate registered a 12% year on year growth rate, according to Oxford Economic forecasts. China construction output registered growth of 11.9% year on year in Q3 and is forecast to finish the full year with a growth rate of 3%, driven by strong momentum in the residential sector. However, there are some doubts as to whether growth will be as strong in 2021 as in H2 2020. In contrast, Indian construction output registered a decline of 15.2% year on year in Q3 2020 and is expected to continue on a downward trajectory. There is long way to go before any recovery, as it is forecast that sales will not reach pre-pandemic levels until the end of 2021.

ICIS Analytics viewpoint- August Construction: Except for China and South Korea, all other regions are expected to register a contraction of construction activity in Q3. Social distancing restrictions are affecting building activity. The worst affected countries in Q3 include Argentina, Malaysia, India, Brazil, Russia and the UK - all registering double-digit negative growth.

The eurozone construction sector reported a PMI of 47.8 in August, compared with 48.9 in July. The contraction is mainly driven by a low level of activity in civil and commercial building output. Home construction projects have been only marginally affected. The UK PMI fell to 54.6 in August from 58.1 in July, signifying substantial downgrade risk. Activity is not expected to return to pre-pandemic levels until Q3 2021. In the western world the lingering effects of the pandemic will be felt even when restrictions are lifted. This includes transport and logistic bottlenecks, staffing issues and weaker demand.

The overall level of performance is mixed in the US, depending on state rules, with some states slower to lift the lockdown. US housing figures registered growth of 22.6% month on month in July, which has bought it closer to pre-pandemic levels of output. Low mortgage rates could stimulate demand, but high infection rates in many states have made businesses cautious. There are also substantial risks to this outlook with a second wave of virus infections, or extreme risk aversion by customers, likely to change the picture.

With the latest output figures, China s construction industry is exhibiting a classic V-shaped recovery. According to Oxford Economics, Chinese real estate investment continues to bounce back with year-on-year growth of 11.7% in July, with construction output growth expected to be at 12% year on year in Q3 2020. India s construction output registered a record low of -16% year on year in Q2 and is expected to continue its downward trajectory. There is long way to recovery, with the pre-pandemic level of sales not forecast to be reached until the end of 2021.

ICIS Analytics viewpoint- July Construction: Typically, there is a strong relationship between construction activity and overall economic growth. As a result, GDP forecasts serve as an important indicator in determining the future of the sector. Although restrictions are beginning to ease around the world, in its June 2020 outlook, the International Monetary Fund (IMF) further downgraded its global GDP forecast by 1.9% to -4.9% for 2020, with a very slow recovery seen in 2021.

The eurozone construction PMI is showing recovery, owing to measures taken by governments to boost the sector. The index increased to 48.3 in June, from an all-time low of 15.1 in April. However, the market is far from strong with a weak order book and many projects still postponed. Similarly, the UK s PMI recovered from an all-time low of 8.2 in April to 50.1 in June.

US housing registered an uptick of 4.3% month on month in May from its largest monthly decline in April. However, the country is still experiencing social unrest which is weighing down the economy in general. Lower government budgets, limited credit and low savings levels could hinder investment in H2 as well.

Like all other major economic regions, Asian construction is also under stress, with some countries worse hit than others. The speed and degree of recovery will largely depend on government stimulus packages, credit lines and the timely availability of skilled construction workers. India has been one of the worst affected with severe restrictions to mobility. However, China is on its way back to recovery, as investment in real estate grew by 8.1% year on year in May and slowly returning after the pandemic.

Given the state of key macro indicators, including GDP, unemployment, debt levels etc, a worst-case scenario where a recovery takes much longer than expected cannot be ruled out. In addition, a second phase of lockdowns is under way in some countries, which may prolong a recovery.

By Jincy Varghese, ICIS demand analyst, [2][*jincy.varghese@icis.com*](mailto:jincy.varghese@icis.com) and Rhian O Connor, ICIS senior analyst, [3][*rhian.oconnor@icis.com*](mailto:rhian.oconnor@icis.com)

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[4]Tight supply pushes up Mideast rigid polyol prices despite low demand By Prateek Pillai 23-Oct-20 14:28 SINGAPORE (ICIS)--Spot prices of rigid polyol cargoes in the Middle East were assessed to be firmer amid continued supply shortages. Despite a slowdown in demand due to weakness in the downstream construction sector, the limited supply meant that those buyers who were in need of replenishing their inventories found themselves in a poor negotiating position.

[5]US existing home sales rise 9.4% in September, fourth increase in a row By Stefan Baumgarten 23-Oct-20 01:42 HOUSTON (ICIS)--US existing-home sales rose 9.4% month on month to an annual rate of 6.54m in September, marking a fourth consecutive month of growth, the National Association of Realtors (NAR) said on Thursday. Compared with September 2019, sales rose 20.9% year on year.

[6]US shift to suburbs boosts chems used in durables - Dow CFO By Al Greenwood 22-Oct-20 23:21 HOUSTON (ICIS)--More US consumers are moving out of the city and into the suburbs, which is creating profound changes in buying habits that are increasing demand for appliances, automobiles and other durable goods, the chief financial officer of Dow said on Thursday. Dow noted strength across furniture, bedding, appliances, construction and automobiles. Some of the increase is due to companies restocking, said Howard Ungerleider, chief financial officer. He made his comments in an interview with ICIS.

[7]Asian epoxy resins at 6-month high on strong China demand By Ai Teng Lim 21-Oct-20 18:03 SINGAPORE (ICIS)--Asian epoxy resins prices have hit a six-month high with support from good demand in China, and the uptrend looks poised to hold amid a rosy near-term economic prognosis for China. Recent economic ***data*** have reflected a sterling improvement in the performances of the automobile and construction sectors in China.

For instance, China s September vehicle sales grew nearly 13% year-on-year, and property development investment in the country also grew a healthy 5.6% year-on-year for the period of January-September 2020. The latter invariably heralds increased activity and tempo in the construction sector.

[8]US housing starts rebound in September By Stefan Baumgarten 20-Oct-20 23:28 HOUSTON (ICIS)--US housing starts rose 1.9% month on month in September, following a 5.1% decline in August, the US Census Bureau said in a report on Tuesday. Single-family housing starts in September were at a rate of 1,108,000, up 8.5% from August, and single-family permits were 1,119,000, up 7.8%.

[9]China property development investment grows 5.6% in Jan-Sept By Fanny Zhang 19-Oct-20 12:32 SINGAPORE (ICIS)--China s property development investment posted a growth of 5.6% on year in the first three quarters, with that on housing up by 6.1%, the National Bureau of ***Statistics*** (NBS) said on Monday.

[10]EPCA 20: Firm China TiO2 export sentiment out of kilter with Europe's status quo By Heidi Finch 08-Oct-20 23:21 LONDON (ICIS)--Firm China titanium dioxide (TiO2) export sentiment, amid a snug and rebounding market, is somewhat out of kilter with the well-covered and recovering, albeit challenged European status quo. Some European traders, who source from Asia, are facing higher prices for Q4 shipments due to snug supply in China, rebounding downstream demand and higher costs, but traction in Europe is proving challenging. This is because Europe is well-supplied and is recovering, but also facing some unsettling market factors.

[11]EPCA 20: European ethanolamines buyers seek pandemic-proof contracts for 2021 By Jane Gibson 08-Oct-20 19:55 LONDON (ICIS)--The time has come for buyers and sellers on the European ethanolamines market to think about contract terms for 2021. The EPCA usually offers an opportunity for the market to look ahead to the next year, digesting potential changes in end-user markets and expected growth in the economy as a whole. The biggest demand growth opportunity in 2021 would come from the construction sector, where demand for triethanolamine (TEA) 85% was likely to continue to grow, producers said.

[12]EPCA '20: Europe MA players may recover losses from lockdowns by year end By Anne-Sophie Briant-Vaghela 07-Oct-20 20:48 LONDON (ICIS)--Europe's maleic anhydride (MA) market has taken several months to awaken from the deep slumber it was thrown into by the pandemic in May, but September and October order books have been filled at lightning speed with players watching in disbelief. Unsaturated polyester resins, which account for roughly 45% of the continent's MA consumption, have been responsible for a sharp pick up in MA orders in the past few weeks after a long spell of quiet improvement.

[13]Swiss Sika expands mortar production in China By Pearl Bantillo 06-Oct-20 14:41 SINGAPORE (ICIS)--Sika has expanded its mortar production in China via commissioning a new facility in Chengdu, the Swiss producer said on Tuesday. Details on investment and plant capacity were not disclosed. Sika will benefit from strong demand in Chengdu, the capital of Sichuan province in southwestern China, as well as from the launch of new products and expansion of distributor network.

Citing estimates, the company said construction in the world s second-biggest economy is expected to grow 6.1% in 2021, with the average annual growth pegged at around 5% until 2029.

[14]BASF closes sale of construction chem ops to private equity By Stefan Baumgarten 01-Oct-20 01:22 LONDON (ICIS)--BASF has completed the divesture of its construction chemicals business to an affiliate of global private equity firm Lone Star, effective midnight, 30 September. Under a deal agreed in December 2019, Lone Star's purchase price was 3.17bn, on a cash and debt-free basis.

[15]US construction spending rose 1.4% in August By Stefan Baumgarten 01-Oct-20 23:06 HOUSTON (ICIS)--US August construction spending rose 1.4% month on month from July, led by a 3.7% increase in residential construction, the US Census Bureau said in a ***data*** release on Thursday. Compared with August 2019, total construction spending was up 2.5% year on year.

[16]Europe PS and EPS mixed demand expectations for Q4 depending on downstream sector By Stephanie Wix 01-Oct-20 03:57 LONDON (ICIS)--Expectations in both the European polystyrene (PS) and expandable polystyrene (EPS) markets are mixed regarding October demand levels and Q4, since some downstream sectors have had stronger buying trends than others. Overall the EPS market has been stronger this month compared with PS, due to softening activity in some downstream PS applications. Meanwhile, construction buying activity is also stable to softer in both PS and EPS markets, due to the financial impact of the coronavirus on construction companies. Some players have seen more stable demand than others, depending on region.

[17]Asia s caustic soda market supply to remain healthy; demand recovery sluggish By Jonathan Chou 30-Sep-20 17:19 SINGAPORE (ICIS)--Spot supply for liquid caustic soda in Asia is expected to outweigh demand in the near term, as producers in the region continue to grapple with high inventory levels amid sluggish uptake. Asia s PVC market has been supported by resurgent demand amid production outages that constrained inflows of deep-sea supply.

Caustic soda is used in the manufacture of pulp and paper products, alumina, soap, water treatment, and textiles, while PVC sees different end-uses in applications such as pipes and profiles, in the construction industry, and for medical devices.

[18]Europe POM and PBT demand increase ahead of Q4 discussions By Zubair Adam 29-Sep-20 19:56 LONDON (ICIS)--There has been an increase in demand in Europe for polyacetal (POM) and polybutylene terephthalate (PBT) ahead of Q4 negotiations. The rise has continued from August into September.

[19]With China's economy on a roll, domestic petchem demand brightens up By Felicia Loo 28-Sep-20 14:10 SINGAPORE (ICIS)--While major world economies are still struggling with the coronavirus pandemic that has bruised their economies, China is on the fast lane to recovery, supported by Beijing s stimulus measures. China wasted no time in whipping its economy back to shape following the outbreak of the deadly virus which was detected late last year in the city of Wuhan, with infrastructure and construction amongst its priorities.

[20]Commercial-construction recovery lags behind residential - HB Fuller By Al Greenwood 25-Sep-20 01:30 HOUSTON (ICIS)--The recovery in the commercial construction market should continue in the fourth quarter, but at a slower rate than that for residential, US-based adhesives producer HB Fuller said on Thursday.

Although commercial construction is lagging behind residential, it is still improving, said Jim Owens, CEO. He made his comments during an earnings conference call.

[21]Construction, automotive outlook murky for US PA in H2 By Antoinette Smith 23-Sep-20 05:38 HOUSTON (ICIS)--The H2 outlook for demand for US phthalic anhydride (PA) is hazy, with strong construction activity expected to taper with cooler weather, and automotive sales unlikely to surge in the remaining months of the year.

US builder confidence in the market for newly built single-family homes rose to an all-time high in September, as housing leads the economic recovery from the coronavirus downturn. Demand for new homes remains high, supported by low interest rates, the National Association of Home Builders (NAHB) said.

[22]US existing home sales keep rising, lumber shortage hits inventory By Stefan Baumgarten 22-Sep-20 23:09 HOUSTON (ICIS)--US existing home sales continued to rise in August, but high prices and a shortage of lumber tightened already scarce housing inventories, the National Association of Realtors (NAR) said on Tuesday.

Existing-home sales marked a third consecutive month of gains in August up 2.4% from July to a seasonally-adjusted annual rate of 6.0m in August. Sales rose 10.5% year on year from August 2019. Total housing inventory at the end of August totalled 1.49m units, down 0.7% from July and down 18.6% from one year ago.

[23]Tight supply continues to drive Middle East isocyanate prices By Prateek Pillai 18-Sep-20 22:38 SINGAPORE (ICIS)--Spot prices for isocyanate cargoes in the Middle East continued to rise as tight supply conditions meant that demand outstripped supply in the week ended 17 September. Demand from the construction industry in the form of insulation foams has also rebounded, as the end of the summer months coincided with a rise in construction activity.

[24]US October oxo-alcohols price-increase initiatives emerge By Larry Terry 18-Sep-20 04:07 HOUSTON (ICIS)--Separate US October oxo-alcohols price-increase initiatives emerged from two producers as September price talks continued amid generally improving volumes. Month-on-month oxo-alcohols volume gains have become more common since coronavirus strictures broadly began to ease in May, despite resurgent cases across the US in recent months. Among downstream markets, architectural coatings continue to drive most volume, with automotive manufacturing gaining ground but not expected to reach year-ago levels.

[25]INSIGHT: US polyurethane demand recovering faster than expected from Q2 low points By Zachary Moore 18-Sep-20 00:50 HOUSTON (ICIS)--Demand for polyurethane systems in the US has staged a faster than expected recovery from the low points in consumption seen in the second quarter. North American demand for polyurethanes plunged in April and May during the period of strictest coronavirus-related movement restrictions. Industry participants at the time expected demand recovery to be slow and gradual, with a resumption of pre-crisis demand expected to be delayed until 2022.

[26]US August housing starts fall 5.1% from July By Stefan Baumgarten 17-Sep-20 23:00 HOUSTON (ICIS)--US housing starts and building permits fell month on month in August, the US Census Bureau said in a ***data*** release on Thursday. US builder confidence in the market for newly built single-family homes rose to an all-time high in September, an industry trade group reported earlier. The American Chemistry Council (ACC) estimates each new home built represents some $15,000 worth of chemicals and derivatives used in the structure or in the production of component materials.

[27]Europe construction output stable in July but nearly 4% lower year on year By Morgan Condon 17-Sep-20 21:44 LONDON (ICIS)--The European petrochemicals-intensive construction sector was relatively stable in July but nearly 4% lower year on year, the EU s statistical agency ***Eurostat*** said on Thursday. Production in July edged up by 0.2% in the eurozone, month on month; in the wider 27-country EU, it fell by 0.1%.

[28]SE Asian MA offers spike with domestic China rally By Ai Teng Lim 11-Sep-20 13:09 SINGAPORE (ICIS)--Southeast Asian import offers for maleic anhydride (MA) surged, following significant gains seen in the domestic yuan-denominated market. Market participants largely expect the Chinese domestic market to hold steady at least until the extended China National Day holidays start in early October, which could likely continue to support sentiment for US dollar-denominated MA cargoes. Domestic trades have been boosted by improved demand, as construction sector activities are resuming at a steady pace within China in recent weeks, market sources said.

[29]Europe Sep isocyanates contracts jump; TDI posts record leap By Fergus Jensen 10-Sep-20 23:34 LONDON (ICIS)--Europe isocyanates contracts for September were assessed this week, jumping triple digits as strong demand for rigid and flexible polyurethane (PU) foams outstripped limited feedstock supply. European market tightness is being mirrored by supply constraints in the US and Asia, which are expected to feature in October contract talks."Construction is doing very well," said one Europe-based MDI producer. "Panels production, sandwich panels, floor panels and composite wooden panels are all at very healthy levels," the producer added.

[30]INSIGHT: End market numbers show chemicals face further turmoil By Rhian O'connor 10-Sep-20 20:00 LONDON (ICIS)--Prospects for a speedy recovery for the chemicals sector remain bearish in the face of fresh end market ***data*** hinting at further volatility. New numbers released by Oxford Economics last week show further downgrades to production forecasts for 2020 across most end markets and most regions. China continues to be the bright spark of global growth, at least on reported numbers. Recent news of higher than expected manufacturing exports from China highlights its continued role as manufacturer to the world.

[31]Melamine producers to face turnarounds in late Q3, Q4 as buyers prepare for quarterly negotiations By Deniz Koray 10-Sep-20 06:27 HOUSTON (ICIS)--Multiple melamine producers are either currently undergoing scheduled turnarounds or will begin them this fall and winter. Since there is only one US producer of melamine, production levels in Europe and Asia are also important to monitor.

[32]INSIGHT: Huntsman Q3 upward guidance signals improving automotive, construction trends By Joseph Chang 10-Sep-20 03:58 NEW YORK (ICIS)--Huntsman s upside guidance on polyurethanes (PU) for Q3 2020 highlights improving trends in construction and automotive, two key markets for the entire chemicals sector. Huntsman said the improved outlook is being driven by continued strength in construction-related markets, better than expected improvement in automotive demand and higher overall margins.

[33]US July construction spending inches up, led by residential construction By Stefan Baumgarten 02-Sep-20 00:49 HOUSTON (ICIS)--US July construction spending rose slightly month on month from June, with a 2.1% increase in residential construction offsetting declines in non-residential and public construction, the US Census Bureau said in a ***data*** release on Tuesday.

July US construction spending: Annual rate, billion US$ Change from June Total 1,364.6 +0.1% Private 1,013.5 +0.6% -Residential 546.6 +2.1% -Non-residential 466.9 -1.0% Public 351.1 -1.3%

Compared with July 2019, total construction spending was down 0.1% year on year.

[34]North American PS sales rise month on month in July; sales remain lower year on year By Zachary Moore 28-Aug-20 07:19 HOUSTON (ICIS)--North American sales of polystyrene (PS) rose month on month in July while sales remained lower compared with the same month of the prior year, according to ***data*** recently released by the American Chemistry Council (ACC) and Vault Consulting. PS sales have been rising incrementally over the past two months after posting significant declines in the months of April and May during the period of the most stringent coronavirus-related lockdowns.

[35]US housing in V-shaped recovery, pending home sales rise 5.9% in July - NAR By Stefan Baumgarten 27-Aug-20 23:16 HOUSTON (ICIS)--US pending sales of existing homes rose 5.9% month on month in July, with sales in each of the four major regions rising, the National Association of Realtors (NAR) said. July s increase marked the third consecutive month of growth in pending home sales. Year on year, contract signings rose 15.5% from July 2019. Home buyers are returning to the housing market after large parts of the economy were shut down in March and April to contain the coronavirus.

[36]European nylon 6 August contract prices settle between rollover and slight increase By Stephanie Wix 26-Aug-20 04:13 LONDON (ICIS)--European nylon 6 contract prices for August have settled between rollover and an increase of 0.01/kg, driven by stable market dynamics and the 6/tonne increase for key feedstock benzene. Demand in non-automotive sectors, such as construction, textiles, household, nylon yarns and carpet fibres, remains broadly stable.

[37]SE Asian MA import offers supported by a buoyant China but demand stays structurally soft By Ai Teng Lim 22-Aug-20 00:03 SINGAPORE (ICIS)--Southeast Asian maleic anhydride (MA) import offers picked up slightly this week, as sellers were motivated by the strong showing in the domestic yuan-denominated markets to hold their ground in September negotiations.

MA is used heavily in the region for the manufacturing of unsaturated polyester resins (UPR). UPR is in turn dependent on consumption from sectors like automotive and construction, which are still reeling from the coronavirus-induced global economic slowdown.

[38]Mexico s PVC demand from construction sector remains questionable By Luly Stephens 20-Aug-20 03:12 HOUSTON (ICIS)--Demand for polyvinyl chloride (PVC) from the construction sector in Mexico has not improved, despite the optimism that emerged in June when the local government considered construction an essential industry. Effective 1 June, and following the guidelines published by the Health and Labor Ministries, construction activity could be resumed in Mexico. But with the construction sector already sluggish prior to the virus crisis, and both public and private construction projects halted due to the rapid spread of the virus, the construction industry recorded a Q2 contraction estimated at -30%.

[39]US housing starts rise in July By Tracy Dang 20-Aug-20 06:26 HOUSTON (ICIS)--US privately owned housing starts in July rose for the third straight month, measured on a seasonally adjusted annual rate, the US Census Bureau said in a report. Year on year, new home construction was up. Building permits rose month on month, and housing completions rose.

[40]Asia PVC to see snug supply amid turnaround, limited deep-sea volumes By Jonathan Chou 20-Aug-20 13:29 SINGAPORE (ICIS)--Asia's spot polyvinyl chloride (PVC) supply is expected to remain snug amid an ongoing northeast Asian producer s turnaround, as well as limited deep-sea availability from the US. Supply of deep-sea material from the US has been limited since July amid improved domestic demand in the construction sector.

[41]Europe construction output climbs in 4.0% in June, down on year By Morgan Condon 20-Aug-20 18:34 LONDON (ICIS)--Construction output in Europe rebounded in June month on month, according to the latest ***data*** from ***Eurostat***. Production in the sector rose by 4.0% in the eurozone and by 2.9% in the wider EU in June as lockdown restrictions continued to ease. France marked the highest increase at 12.0%. As a key end-market for the chemicals industry, a pickup in construction is likely to support demand and prices for some products in the sector.

[42]Feedstock spreads for Middle East isocyanates reach new highs By Prateek Pillai 19-Aug-20 19:22 SINGAPORE (ICIS)--Feedstock spreads for toluene diisocyanate (TDI) and polymeric methylene diphenyl diisocyanate (PMDI) in the Middle East have risen to their highest levels in a year. In the week ended 14 August, the feedstock spread for TDI reached $1,469/tonne while the PMDI spread touched $1,123.50/tonne. This trend has been driven by an increasing disparity between demand and supply for both isocyanates as production levels have failed to keep up with growing downstream foam demand. TDI is used for the creation of foam products like mattresses, rugs and cushions while PMDI is used primarily for producing insulation foams used in the construction sector.

[43]US-Canada PVC sales outpace production, constricting exports By Bill Bowen 13-Aug-20 05:51 HOUSTON (ICIS)--Demand and production of polyvinyl chloride (PVC) remains out of balance in the US and Canada, and is muddying market participants' view of the remainder of 2020. Monthly domestic sales of US and Canada PVC resins climbed enough to put July's figures among the highest of the past five years, trimming exports and reducing inventories, according to preliminary figures released Wednesday by an industry group. July s sales outpaced production, reducing inventories to about seven days' worth of sales, the producer said.

[44]INSIGHT: Seasonally softer summer for styrene but September sentiment stronger By Helena Strathearn 11-Aug-20 23:50 LONDON (ICIS)--Summer holidays have taken some players out of the European styrene market and there is a downturn in manufacturing output as is traditional, but the slowdown is not expected to be as notable nor as long as usual and the outlook for September is stronger. August demand for styrenics will see a seasonal slump, most notably in southern Europe, but it will probably not be as impactful as in previous years. September demand is expected to pick up on restocking and also as many end-use markets such as construction can continue until the end of October, and some into November or early December. Construction, appliances, electronics, white goods packaging, fish boxes packaging and sanitary applications demand has been holding fairly well but not yet returned to 2019 levels.

[45]China ECH prices rise as domestic supplies tighten; outlook clouded By Ai Teng Lim 11-Aug-20 15:02 SINGAPORE (ICIS)--China s domestic prices for epichlorohydrin (ECH) recovered some lost grounds this week as domestic supplies bucked earlier anticipations to turn tighter, instead of lengthening further. But with demand conditions still broadly dampened by nagging global economic worries, this may serve to curtail upside potential of ECH spot pricing, even if supply constraints seen this week do persist for some time more.

[46]China's petrochemical prices consolidate in July, demand largely stable By Yvonne Shi 04-Aug-20 16:48 SINGAPORE (ICIS)--China's petrochemical market fluctuated within a narrow range in July. The prices of most chemical products saw limited changes. Overall demand appeared to be generally stable, whereas supply pressure differed from product to product. On the whole, the sustainability of demand into construction markets is better, followed by the automotive industry, while textiles are weaker.

[47]US June construction spending falls from May By Tracy Dang 04-Aug-20 03:11 HOUSTON (ICIS)--US construction spending in June fell month on month but rose year on year on a seasonally adjusted basis, the US Census Bureau said in a Monday report. Residential construction was down month on month and year on year. Nonresidential construction was down month on month but up year on year.

[48]European PVC July prices rise more sharply than ethylene, market tightens By Chris Barker 03-Aug-20 18:39 LONDON (ICIS)--Average European polyvinyl chloride (PVC) contract prices rose for July by more than the cost increase from ethylene as a result of tighter availability in the market. A number of sellers achieved increases of 45/tonne or more because of higher demand and tighter availability. However, larger buyers were in some cases able to avoid increases above the ethylene cost. Price trends were consistent across NWE and the Mediterranean, with UK increases assessed at similar levels. In central and Eastern Europe there was a higher settlement with one producer source noting increases of 50-55/tonne on average.

[49]INTERVIEW: Chemours sees TiO2 volume recovery in Q3 driven by architectural coatings - CEO By Joseph Chang 31-Jul-20 23:33 NEW YORK (ICIS)--The world s largest producer of titanium dioxide (TiO2), Chemours, expects a sequential rebound in volumes in the low- to mid-teens percentage-wise, driven by architectural coatings, its CEO said on Friday. As we pivot to the third quarter, we re seeing a pick-up on the coatings side but maybe a shift in North America to not just DIY (do-it-yourself) but also into contract painting. People are starting to get more comfortable painting outside as well as inside, said Mark Vergnano, CEO of Chemours, in an interview with ICIS. In the second quarter, which saw TiO2 volumes fall by around 20% sequentially versus Q1 and 9% year on year, demand was driven mostly by DIY coatings demand - from customers with their own stores or those with access to big box retailers, he noted.

[50]India PVC market to face sustained tight import supply By Zhi Xuan Ho 24-Jul-20 14:21 SINGAPORE (ICIS)--Trade in the polyvinyl chloride (PVC) market in India slowed this week, with business for August shipments largely concluded in the previous week. Sentiment in the market remains bullish, with many market players expecting supply to remain tight moving forward.

[51]US August oxo-alcohols price efforts driven partly by expected upstream pressure By Larry Terry 24-Jul-20 06:25 HOUSTON (ICIS)--US August oxo-alcohols price-increase initiatives have emerged on an anticipated increase in the upstream July propylene contract and persistent margin pressure. July propylene negotiations, however, are still underway, with talks protracted by rising spot bids and offers.

[52]Europe extrusion PC July prices fall for third month on weak demand, ample availability By Miguel Rodriguez Fernandez 23-Jul-20 18:32 LONDON (ICIS)--Contract prices for extrusion grade polycarbonate (PC) have fallen slightly for the third consecutive month in July amid weak demand and ample supply. Most monthly extrusion grade business was concluded with rollovers and double-digit reductions.

[53]Asia petrochemical demand mixed amid tightening supply By Felicia Loo 23-Jul-20 12:27 SINGAPORE (ICIS)--Demand for key petrochemicals in Asia is mixed, with some markets in the pits despite shrinking supply, while other products appear to fare better, as the onslaught of the coronavirus carries on. But the overall market outlook for the second half of the year will be dim amid weakness in the world's second-biggest economy.

[54]China 2020 H1 real estate development investment rises 1.9% By Fanny Zhang 16-Jul-20 14:37 SINGAPORE (ICIS)--China invested yuan (CNY) 6.28tr ($897bn) on real estate development in the first half of 2020, an increase of 1.9% from the same period in last year, reversing the continuous decrease in previous months, ***data*** from the National Bureau of ***Statistics*** (NBS) showed on Thursday.

[55]US polyester polyol prices decline on weaker feedstock costs By Zachary Moore 16-Jul-20 06:37 HOUSTON (ICIS)--US polyester polyol prices were assessed 2 cents/lb ($44/tonne) lower as key feedstock costs continue to trend lower. Sentiment in major polyester polyol feedstock markets suggests that these markets may be nearing a trough as energy costs move higher and general economic activity is improving from the low points seen in prior months.

Demand from the construction sector has bounced back quicker than many other major consuming sectors of polyols and downstream polyurethane systems, although overall demand levels remain below pre-crisis levels.

[56]US plastic, chemical demand remains soft, margins stay depressed By Al Greenwood 16-Jul-20 03:30 HOUSTON (ICIS)--Demand for plastics and basic chemicals in the US was soft, while margins remained depressed, the Federal Reserve said on Wednesday.

The anecdote was among several that the US central bank ***collected*** in its recent Beige Book, a summary of US economic activity during the past six weeks among the Fed's 12 districts. The latest Beige Book contains information ***collected*** through 6 July. The comments about demand came from the 11th Federal Reserve District, which includes northern Louisiana and all of Texas, and has many of the nation's refineries and petrochemical plants.

[57]China s amines market under pressure on high stocks and weak demand By Yuanlin Koh 15-Jul-20 17:03 SINGAPORE (ICIS)--China s ethanolamines market is looking bearish in the near term on excess supply, as demand continued to struggle. China, hit by the rains, saw a drop in demand, especially in DEA s (diethanolamines) downstream DEIPA (diethanol isopropanolamine) used mainly as cement aids in the construction industry. Demand in this sector was initially picking up after the coronavirus pandemic in the country, as the economy reopened, and with government support, demand for DEA flourished.

[58]Asian epoxy resins export discussions sink deeper on poor demand By Ai Teng Lim 14-Jul-20 15:21 SINGAPORE (ICIS)--Asian epoxy resins export discussions lost more ground this week as sellers lowered offers to boost demand. Epoxy resins is heavily used in automobile and construction sectors, both of which are still struggling to find a firmer footing in the pandemic-ravaged global economy.

[59]INSIGHT: Construction could pave the way for Q3 chemicals recovery in Europe By Morgan Condon 10-Jul-20 23:25 LONDON (ICIS) As with all forms of industry, the coronavirus came in like a wrecking ball, bludgeoning any chances of growth in the construction sector for the first half of 2020. The foundations have been laid for a return to industrial activity, however, as lockdown restrictions across Europe have been eased, which could provide support for chemicals used in the construction industry.

[60]US construction is returning to pre-Covid levels - trade group By Al Greenwood 19-Jun-20 01:37 HOUSTON (ICIS)--In many parts of the US, construction activity is returning to levels that predate the coronavirus (Covid-19), a trade group said on Thursday. The Associated General Contractors of America (AGC) based its finding on its new survey and on ***data*** from Procore, a construction-technology company. Procore analysed workers' hours. Based on that analysis, construction activity has returned to pre-coronavirus levels in 34 US states. Among eight large cities, Dallas, Texas, and Miami, Florida, are back to pre-pandemic levels. Some construction companies are adding new workers, the AGC said. According to its survey, 21% are adding employees. That compares with 25% that were letting workers go between March and May. In June, only 8% of construction companies were forced to furlough or lay off workers, the AGC said.

[61]US housing starts rebound in May By Tracy Dang 18-Jun-20 06:33 HOUSTON (ICIS)--US privately owned housing starts in May rose after three consecutive months of declines, measured on a seasonally adjusted annual rate, the US Census Bureau said in a report. Year on year, new home construction was down. Building permits fell month on month, and housing completions fell. The housing market is a key consumer of chemicals, driving demand for a wide variety of chemicals, resins and derivative products such as plastic pipe, insulation, paints and coatings, adhesives, and synthetic fibres, among many others. The American Chemistry Council (ACC) estimates each new home built represents some $15,000 worth of chemicals and derivatives used in the structure or in the production of component materials.

[62]June EPS demand improving in the US, but remains below pre-crisis levels By Zachary Moore 17-Jun-20 06:27 HOUSTON (ICIS)--US demand for expandable polystyrene (EPS) is improving as economic activity picks up and lockdown measures ease. However, overall activity and EPS consumption both remain below pre-crisis levels. Activity in the construction sector has improved as lockdown measures are eased, although there is some concern that most current activity revolves around the completion of existing projects, rather than the start-up of new projects. Projections from ICIS Analytics suggest that construction activity will rise above 2019 levels in 2021, although creditworthiness concerns may limit the number of new projects.

[63]Eurozone, EU construction continues dropping in April as lockdown limits production By Morgan Condon 17-Jun-20 19:06 LONDON (ICIS)--Construction throughout the EU plummeted in April as countries implemented quarantine restrictions to combat rising coronavirus infection rates, according to first estimates from EU ***statistics*** agency ***Eurostat*** on Wednesday. This has served to weigh on demand for chemicals used in the sector. Production in the construction sector decreased by 14.6% in the eurozone and by 11.7% in the wider EU area in April compared with the previous month and accounting for seasonal adjustment.

[64]China Jan-May real estate investment contracts 0.3% year on year By Fanny Zhang 15-Jun-20 14:22 SINGAPORE (ICIS)--China s real estate development investment in the first five months of 2020 slipped 0.3% year on year to Chinese yuan (CNY) 4.59tr ($647m), official ***data*** showed on Monday. The decline has eased from 3.3% recorded in January to April. Investment in house construction in January-May stood at CNY3.38tn, unchanged from the previous corresponding period. It was an improvement from the 2.8% fall in January-April 2020. Real estate developers house construction acreage in the five-month period increased 2.3% on year to 7.6bn square metres (sqm), slower than the 2.5% growth in January-April.

[65]Europe Melamine Q3 contract talks yet to begin, demand outlook remains uncertain By Melissa Hurley 11-Jun-20 23:54 LONDON (ICIS)--European melamine contract discussions for the third quarter could begin later than usual, as consumers find it challenging to plan volume requirements given the fragile state of the economy as lockdowns ease.

In the spot market, there is increased pressure, and prices have been assessed stable to softer this week. Demand outside contractual requirements is weak, given the demand issues experienced in the market.

The [66]construction industry has been adversely impacted by the coronavirus pandemic, although to a lesser extent than automotive, another key end market for petrochemicals.

[67]Europe PU feedstocks prices hit new lows as demand pickup lags By Fergus Jensen 11-Jun-20 20:28 LONDON (ICIS)--Incremental improvements in demand for polyurethane (PU) products have slowed downward pressure on the Europe isocyanates and polyols markets where supply is abundant, and producers are now hoping for a reversal in the coming months. June contracts for polyols, toluene diisocyanate (TDI), and crude and pure methylene diphenyl diisocyanate (MDI) were all settled below May contract levels, and in some cases at hit new record lows. According to one Europe-based reseller, the construction market in NWE was now at 90% of activity, compared with this time in 2019. Demand for adhesives and wood binding has also improved, as well as that for insulation panels and spray foam, among others.

[68]US MDI, TDI demand remains sluggish even as overall economic activity picks up By Zachary Moore 11-Jun-20 06:27 HOUSTON (ICIS)--Demand for US methylene diphenyl diisocyanate (MDI) and toluene diisocyanate (TDI) remain sluggish even as the broader macro-economy is observing some pick-up in activity. Localities throughout the US are gradually easing lockdown measures, leading to some improvement in broader economic indicators. The construction sector has been performing better than most of the other major sectors of polyurethane demand, although participants feel that the success of the sector may be temporary.

Much of the activity in the sector is being driven by work to complete projects that had been underway prior to the recent crisis. There are concerns that activity might slow down once these projects are completed. US housing starts fell 29.7% year on year in April 2020, according to ***data*** from the US Census Bureau.

[69]US epoxy players monitoring demand amid economic reopening By Tarun Raizada 10-Jun-20 05:21 HOUSTON (ICIS)--US epoxy is facing some uncertainty in June amid the economic reopening. Q2 demand has softened during the pandemic, with typical seasonal trends not materialising so far. There is stronger demand from architectural do-it-yourself (DIY) and packaging coatings, which is being more than offset by softer demand from architectural do-it-for-me (DIFM), automotive and industrial coatings. The US building and construction sector could prove to be far more resilient than the automotive sector. But the pandemic is creating a volatile backdrop for chemical companies as they navigate the road to recovery. Epoxy resins are used as adhesives on metals and construction materials, as well as in coatings and automobiles.

[70]Asian MA afloat on some buying, but demand uncertainties loom By Ai Teng Lim 05-Jun-20 09:52 SINGAPORE (ICIS)--As post-coronavirus production recovery commences gingerly across Asia this week, buying tempo also picked up in Asia s maleic anhydride (MA) market to keep spot prices afloat. But with longer-term global economic outlook still clouded by many uncertainties, from geopolitical tensions to macro-level demand-supply imbalances, it remains to be seen if the buying could sustain for long.

[71]North American PS sales drop 21.8% year on year in April By Zachary Moore 05-Jun-20 05:49 HOUSTON (ICIS)--North American total sales and captive use of polystyrene (PS) fell by 21.8% in April 2020 compared with the same month of the prior year, according to ***data*** recently released by the American Chemistry Council (ACC) and Vault Consulting. The coronavirus outbreak and subsequent containment measures caused a sharp drop in overall economic activity in April, impacting production and sales of PS across most consumption segments.

[72]US manufacturing contracts again in May but overall economy expands - ISM By Tracy Dang 02-Jun-20 06:53 HOUSTON (ICIS)--US manufacturing activity contracted for the third consecutive month in May, but at a slower pace from April, the Institute of Supply Management (ISM) said on Monday. The overall economy returned to expansion after a month of contraction, the report said.

Three months into the manufacturing disruption caused by the coronavirus pandemic, comments from the panel were cautious (two cautious comments for every one optimistic comment) regarding the near-term outlook, said Tim Fiore, chair of the ISM.

[73]European plasticizers see slightly better demand in June, but still very mixed By Jane Massingham 04-Jun-20 23:24 LONDON (ICIS)--The first days of June are continuing to portray a rather mixed picture in terms of demand for plasticizers. Various countries are seeing lockdown restrictions that are allowing some businesses to return to work. One seller noted it is still challenging and said: Demand is not so great and continues to be like that, but it is building up slowly and should be better as June progresses and July should be more. The automotive sector continues to be the hardest hit but there are sectors of the construction industry starting to come back.

[74]Europe chemicals to gain from EU green deal spending plans - bank By Tom Brown 04-Jun-20 21:10 LONDON (ICIS)--European chemicals players are expecting to see increased business momentum on the back of the EU s green deal expected to unlock hundreds of billions of euros of investment in sustainability projects, according to Credit Suisse. A virtual conference organised by the bank hosted management teams from 20 chemicals, ***agriculture***, packaging and cement firms address investors, with all chemicals firms present noting expectations for an increase in sales on the back of the mooted EU green investment plan.

However, little visibility on uplift from the measures is expected over the next 12-18 months.

[75]Thailand greenlights $9bn airport project to BBS consortium By Fanny Zhang 04-Jun-20 14:48 SINGAPORE (ICIS)--Thailand s cabinet approved a bid by BBS consortium to develop a $9bn U-Tapao Airport and Eastern Aviation City project at the country s southeastern coast, according to local media reports.The winning bid was approved on 2 June and the government is expected to sign the contract with BBS consortium on 19 June, these reports added. The announcement follows the passage of $58bln economic support package on 31 May by Thailand s parliament to ease the impact of the coronavirus on the economy and people.

[76]Australia launches A$680m stimulus for residential construction By Pearl Bantillo 04-Jun-20 12:33 SINGAPORE (ICIS)--Australia has launched a stimulus package worth Australian dollar (A$) 680m ($470m) to boost activity in the construction sector, which was hit by the coronavirus pandemic. Dubbed the HomeBuilder program , the funds will help support 140,000 direct jobs in the residential construction sector, Australian Prime Minister Scott Morrison said on Thursday.

Under the programme, all eligible owner-occupiers will receive a grant of A$25,000 either to build a new home or renovate an existing home. Construction must start within three months of the contract date. Based on eligibility criteria for applicants and price caps on new home builds (A$750,000) and renovation (A$150,000-750,000), the government expects to hand out 27,000 of such grants under the programme.

[77]INTERVIEW: US construction outlook far more positive than automotive - Huntsman CEO By Joseph Chang 03-Jun-20 06:56 NEW YORK (ICIS)--The US building and construction market is recovering and proving far more resilient than the automotive sector, the CEO of Huntsman Corp said on Tuesday. In homebuilding, DIY [do it yourself] and OSB [oriented strand board] are doing quite well. It s down from a year ago but nowhere near what we expected a month or two ago, said Peter Huntsman, CEO of Huntsman Corp, in an interview with ICIS amid the American Chemistry Council (ACC) virtual annual meeting.

Building products, furniture, insulation, and OSB are showing some resilience, he added. Huntsman is a major producer of methylene diphenyl diisocyanate (MDI), heavily used in the construction market in insulation, binding and coatings, and in the automotive sector in bumpers, conveyor belts and other parts, as well as coatings. Polymeric MDI is used as a binder in OSB, an engineered wood used in construction. Pure MDI is used in coatings, adhesives, sealants and elastomers (CASE).

[78]Covestro volumes down sharply in April-May, improvement expected for June By Tom Brown 29-May-20 00:46 LONDON (ICIS)--Covestro's core volumes dropped 30% in April and May, but order book levels point to an improvement in June, according to the company and analysts at Baader Bank. April automotive sector customer demand fell 60% in the EU and North America, with furniture market demand falling 45% year on year a 30% increase in medical polycarbonates (PC) demand unable to offset the scale of the falls elsewhere.

Overall polyurethanes (PU) volumes fell 40% in April while moves to channel PC material to less affected markets mitigated the volume decline in that division to 20%. Coatings, adhesives and sealants (CAS) sales dropping at a similar level, Baader said, citing an investor call chaired by Covestro CEO and CFO, Markus Steilemann and Thomas Toepfer, respectively.

[79]INSIGHT: Asia phenol market unlikely to recover until 2021 By Angeline Soh 25-May-20 19:02 SINGAPORE (ICIS)--Asia s phenol market is unlikely to make a full recovery in the second half of this year as the coronavirus pandemic has caused end-market demand to plummet. The International Monetary Fund (IMF) has predicted the global economy will shrink by 3% this year, describing the current crisis as the worst the world has faced since the Great Depression in the 1930s.

There has been a boom in end-use products heavily used during the pandemic such as packaging, disinfectants like hand sanitisers, and face masks. However, other segments like automobile and construction have been underperforming.

[80]China downplays pollution issue; still hopes to meet emission targets By Fanny Zhang 25-May-20 16:40 SINGAPORE (ICIS)--China has not emphasized pollution issues at its parliamentary sessions this year, toning down its commitment to emissions targets, as it places top priority to getting businesses back to normal amid the coronavirus pandemic.

Employment, poverty alleviation, control on financial risk, consumption growth and business recoveries are key topics of discussions at the country s biggest political gathering in Beijing, which kicked off on 22 May. The National People s Congress (NPC) and the Chinese People s Political Consultative Conference (CPPCC) are holding their annual meeting until 28 May.

[81]US May oxo-alcohols prices continue to trend weaker By Larry Terry 22-May-20 06:23 HOUSTON (ICIS)--Weaker pricing for US May oxo-alcohols free market contract ranges continues to be more evident, but the magnitude of declines is not yet clear. Major downstream construction- and automobile-coatings demand has yet to gain any seasonal momentum, with easing coronavirus strictures still in the early stages.

[82]US PVC contracts for June nominated higher as demand creeps back amid lower operating rates By Bill Bowen 22-May-20 06:09 HOUSTON (ICIS)--US producers of polyvinyl chloride (PVC) have separately nominated June contracts higher by 3 cent/lb ($66/tonne) as lower operating rates limit supply and demand begins to creep back. The announcements come as a bit of a surprise and some market participants say that the outcome will certainly depend on how demand recovers as coronavirus lockdowns ease.

US spot export prices have fallen sharply in recent weeks as coronavirus precautions destroyed demand in key exporting markets, including China, Turkey, India, Malaysia, Peru and Argentina, among others.

[83]US existing home sales fall to lowest level in 10 years By Stefan Baumgarten 21-May-20 22:55 HOUSTON (ICIS)--US existing-home sales fell to their lowest level in April since July 2010 amid the lockdowns and restrictions authorities imposed from mid-March through April to contain the coronavirus (Covid-19) pandemic.

Existing home sales fell 17.8% from March to a seasonally-adjusted annual rate of 4.33m in April, and they were down 17.2% year on year from April 2019, the National Association of Realtors (NAR) reported on Thursday.

[84]Weak soda ash demand in Asia may continue to offset output cuts in China By Helen Lee 20-May-20 16:31 SINGAPORE (ICIS)--Asia s soda ash market remains under pressure amid rising inventory pressure in China, on the back of weak downstream demand due to extended social isolation measures. Supply remained more than sufficient despite ongoing and impending shutdowns at several soda ash plants in China.

China s domestic demand was just as downbeat on account of liquidity issues and high inventories faced by downstream glass producers on the back of poor performance in the construction/real estate sector.

[85]BASF to work with a China university on infrastructure solutions By Fanny Zhang 20-May-20 13:50 SINGAPORE (ICIS)--BASF and China s Harbin Institute of Technology (HIT) have signed a cooperation agreement to jointly conduct research on material solutions for sustainable infrastructure applications, according to a statement from BASF.

According to the agreement, research teams from BASF and the HIT will work together on the testing of new applications for BASF s advanced materials to cut emissions and energy costs to the construction industry.

[86]Long-term outlook for Asia airport construction still strong - Fitch By Fanny Zhang 15-May-20 16:25 SINGAPORE (ICIS)--Long-term prospects for Asia s airport construction funded by public investment are expected to remain largely intact despite the ongoing coronavirus pandemic that crippled the aviation market, credit ratings firm Fitch said in a report.

We remain optimistic about the eventual recovery of the aviation sector in the medium to long term, and hence, continue to be bullish on the growth of Asia s airports sector, it said.

[87]China real estate development investment down 3.3% in Jan-Apr By Fanny Zhang 15-May-20 14:50 SINGAPORE (ICIS)--China s real estate development investment totalled yuan (CNY) 3.3 trillion in January-April, a decrease of 3.3% from the same period in last year, the National Bureau of ***Statistics*** (NBS) said on Friday. Investment in housing projects stood at CNY2.4tn in January-April, down by 2.8% year on year.

In January-April, real estate developers house construction acreage increased 2.5% on year to 7.4bn square metres (sqm), down from a 2.6% expansion in January-March period.

[88]US plasticizers ranges holding steady amid weak fundamentals By Larry Terry 15-May-20 07:18 HOUSTON (ICIS)--US diisononyl phthalate (DINP), dioctyl terephthalate (DOTP) and dioctyl phthalate (DOP) prices were unchanged amid continued pressure from softer April propylene and flat-to-weaker downstream demand so far in May. Some near-term upward price pressure may stem from higher 2-ethylhexanol (2-EH) spot prices in east Asia this week. The effect was expected to be mostly nominal, but enough to exert some counter pressure.

[89]Europe May ethanolamines talks ongoing amid mixed downstream demand, balanced supply By Jane Gibson 14-May-20 00:57 LONDON (ICIS)--May ethanolamines contract talks continued in Europe this week - with sellers looking for rollovers and buyers seeking lower prices.

[90]China PO prices rise in traditional off-season By Jady Ma 14-May-20 23:05 SINGAPORE (ICIS)--Propylene oxide (PO) prices in China have gained ground on higher feedstock prices and firm fundamentals, although the industry has entered its traditional off-season. On 14 May, PO prices in east China were assessed at yuan (CNY) 9,400/tonne, up by 20.1% compared with the prices on 17 April, according to ICIS ***data***

[91]US MMDI prices slide on falling downstream demand By Zachary Moore 14-May-20 06:46 HOUSTON (ICIS)--US prices for monomeric methylene diphenyl diisocyanate (MMDI) were assessed 4 cents/lb ($88/tonne) lower, as demand remains poor during the economic slowdown created by the coronavirus outbreak and subsequent containment measures.

Construction demand has been weak, as many projects have slowed or suspended operations owing to economic uncertainty, along with public health concerns.

RESOURCES

China's government is expected to focus on large-scale infrastructure and other development projects as ways to bolster economic growth and generate employment, especially more so now because of the fall out of the coronavirus pandemic.

ICIS has compiled a list of key existing projects that different provincial authorities have announced.

More than half of these are construction and infrastructure projects, while some are manufacturing plants and research and development (R&D) initiatives.

The source for the interactive is local NDRC. The list is incomplete and will be updated regularly by ICIS. Changes will happen as the government authorities and companies revise their development plans.

Construction in China - Asia s biggest and the world s second-largest economy - slumped at an annualized double-digit rate in the first quarter of 2020 as overall economic output shrank for the first time in two decades amid the coronavirus pandemic.

In 2019, the sector accounted for 7.2% of the country s GDP.

Eurozone Construction PMI August 2020

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[***Council of the European Union: JOINT STAFF WORKING DOCUMENT The EU Special Incentive Arrangement for Sustainable Development and Good Governance ('GSP+') assessment of Armenia covering the period 2018 - 2019 Accompanying the document Joint Report to the European Parliament and the Council Report on the Generalised Scheme of Preferences covering the period 2018-2019 PDF document ST 5949 2020 ADD 211-02-2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5Y6F-P9W1-F0YC-N24P-00000-00&context=1516831)

Impact News Service

February 12, 2020 Wednesday

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**Length:** 12192 words

**Body**

Brussels: Council of the European Union has issued the following document:

5949/20 ADD 2 FG/syRELEX.1.A ENCouncil of theEuropean UnionBrussels, 11 February 2020(OR. en)5949/20ADD 2SPG 1WTO 11COVER NOTEFrom: Secretary-General of the European Commission,signed by Mr Jordi AYET PUIGARNAU, Directordate of receipt: 10 February 2020To: Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council ofthe European UnionNo. Cion doc.: SWD(2020) 17 finalSubject: JOINT STAFF WORKING DOCUMENTThe EU Special Incentive Arrangement for Sustainable Development andGood Governance ('GSP+') assessment of Armenia covering the period2018 - 2019Accompanying the documentJoint Report to the European Parliament and the CouncilReport on the Generalised Scheme of Preferences covering the period2018-2019Delegations will find attached document SWD(2020) 17 final.Encl.: SWD(2020) 17 finalEN ENEUROPEANCOMMISSIONHIGH REPRESENTATIVEOF THE UNION FORFOREIGN AFFAIRS ANDSECURITY POLICYBrussels, 10.2.2020SWD(2020) 17 finalJOINT STAFF WORKING DOCUMENTThe EU Special Incentive Arrangement for Sustainable Development and GoodGovernance ('GSP+') assessment of Armenia covering the period 2018 - 2019Accompanying the documentJoint Report to the European Parliament and the CouncilReport on the Generalised Scheme of Preferences covering the period 2018-2019{JOIN(2020) 3 final} - {SWD(2020) 16 final} - {SWD(2020) 18 final} -{SWD(2020) 19 final} - {SWD(2020) 20 final} - {SWD(2020) 21 final} -{SWD(2020) 22 final} - {SWD(2020) 23 final} - {SWD(2020) 24 final} -{SWD(2020) 25 final}1Armenia 1. Summary AssessmentFollowing the Velvet Revolution and democratic changes of 2018, the Government of Armenia has made commitments regarding the respect of human rights and good governance and started taking legislative and other steps to implement those commitments. The results are yet to be seen. While fully transforming the system will take time, Armenia is now a country in transition, demonstrating strong political will for democratisation. The new authorities' agenda prioritises areas where the EU has been traditionally advocating change. Armenia is making progress over time on the 27 GSP+ conventions, though concerns remain on the implementation of the reforms.PrioritiesDuring the reporting period 2018-2019, monitoring focused on several priority areas: the adoption of new Judicial and Criminal codes, as well as a standalone law against domestic violence; anti-corruption measures and prosecutions; and the draft Law on Ensuring Equality. Furthermore, there was focus on progress on aligning domestic legislation on illegal trade of endangered species and biosafety with international standards. A GSP+ monitoring mission took place in September 2018, in connection with the first EU-Armenia Partnership Committee in Trade Configuration.Human RightsImprovements in freedom of assembly took place following the Velvet Revolution of 2018. Progress was noted in legislation on Domestic Violence and its implementation, including improving support services for survivors and awareness-raising activities. Also, the legislative framework on gender equality was improved. The ratification of the Council of Europe Convention on preventing and combatting violence against women and domestic violence (known as the Istanbul Convention) is high on the agenda of the Armenian government, although finalisation is not expected in 2019. Furthermore, the Armenian Human Rights Defender notes a decline in the use of pre-trial detention. Increased oversight of practices of ill-treatment and torture in the police is expected with the introduction of video surveillance systems in interrogation rooms in 2019 and 2020.However, there are some delays in adopting a new Criminal Code and a stand-alone law on anti-discrimination. A draft Law on Ensuring Equality was published in March 2018; the new government has launched a new discussion on the topic and plans to finalise a draft at the beginning of 2020. A series of cases of hate speech and harassment against LGBTQI people continue to challenge the generally positive environment surrounding democratic change. On 23 May 2019, the EU issued a local statement calling for better protection of the human rights of sexual minorities in the country1.The government has declared independence and accountability of the judiciary as a top political priority, while some concerns remain. Efforts so far include the adoption of a new Judicial Code in April 2018; a 2019-2023 Strategy and Action Plan for judicial and legal reforms, which is currently awaiting the Government’s approval; the introduction of several e-1 [*https://eeas.europa.eu/delegations/armenia/60790/statement-behalf-delegation-european-union-and-eu-member-states-embassies-resident-armenia\_en2governance*](https://eeas.europa.eu/delegations/armenia/60790/statement-behalf-delegation-european-union-and-eu-member-states-embassies-resident-armenia_en2governance) tools; and the planned adoption of the Criminal Code, and Criminal Procedure Code (for 2020).Labour RightsLimited progress was observed during the monitoring period but the new government showed commitment and resumed work to address key issues, such as the re-establishment of a fully-fledged labour inspection system and the revision of the Labour Code. The signing of a new Decent Work Country Programme between Armenia and the ILO in May 2019 is a promising step to advance on issues such as the labour inspection system.In 2019, ILO lifted its concerns about the use of correctional labour as punishment for political or ideological views, which is a positive development.The preparation of a new Labour Code was dropped in favour of amending the existing one. Amendments were prepared in 2018 and work continues under the new government, which plans to finalise amendments by 2021. The amendment adopted in June 2019 to prohibit discrimination is a significant achievement, especially as adoption of a stand-alone comprehensive anti-discrimination law is still pending; however, several other deadlines were missed.On labour inspections, timid steps were made so far and the existing labour inspectorate remains without sufficient competences and capacity outside occupational health and safety to effectively enforce the eight fundamental conventions. The new government has, however, engaged in a roadmap with the ILO to be completed by October 2020. Parliament has pased amendments to the Labour Code to extend the mandate of the Labour Inspectorate. Re-establishing a fully-fledged labour inspection system in line with the corresponding ILO conventions ratified by Armenia remains a priority.More effort is needed on child labour. A majority of working children are in unpaid or informal employment and cannot benefit from the protection of the legislation on child labour. The Health and Labour Inspectorate remains without sufficient capacity to enforce child labour legislation and there is no other competent agency. The definition of forced labour in national legislation still needs to be brought in line with the ILO conventions and more efforts are needed to curb the risks of forced labour and labour exploitation for economic migrants to and from Armenia.EnvironmentThe ratification of the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer signals Armenia’s commitment to international environmental standards. Furthermore, the authorities reported progress in aligning national legislation with the Convention on International Trade in Endangered species of Wild Fauna and Flora (CITES) requirements, while full alignment is still pending. Concerns remain around low penalties for violations of CITES and the Cartagena Protocol on Biosafety. These are not expected to have a serious deterrent effect. Lack of capacity and financing needs to be addressed.Good GovernanceArmenia maintains good international cooperation in the area of drug control. Anti-corruption has been flagged as a main priority for the new Government, with efforts currently focused on addressing corruption in the judiciary.3Status of ratification and reportingArmenia maintained ratification of all 27 Conventions required by GSP+ and has mostly reported according to requirements (see annex). Armenia did not comply with reporting obligations on two human rights conventions (the United Nations Convention on the Rights of the Child – CRC and the International Covenant on Economic, Social, and Cultiral Rights -ICCPR) and one environmental convention (CITES). 2. Recent developments Profound political changes took place in Armenia. In April-May 2018, there were mass peaceful protests (the so-called ‘Velvet revolution’), which ousted former authorities from power and brought democratic changes to the country. Early parliamentary elections were held on 9 December 2018, in full respect of the fundamental freedoms and with broad public trust2. This was in contrast with previous parliamentary polls, marred by malpractice and lack of a genuinely democratic environment3.EU-Armenia relations also entered a new stage. The Comprehensive and Enhanced Partnership Agreement (CEPA) was signed in the margins of the Eastern Partnership Summit in Brussels on 24 November 2017. The Armenian parliament ratified CEPA unanimously on 11 April 2018 and the European Parliament gave its consent on 4 July 2018. The provisional application of CEPA began on 1 June 2018 and a detailed CEPA Implementation Roadmap was adopted by decision of the Armenian Prime Minister on 1 June 2019. The Roadmap was welcomed by the EU-Armenia Partnership Council held in Brussels on 13 June 2019.The new Government is committed to human rights and pursues democratic reforms, including a comprehensive justice reform. Armenia has embarked on the process of structural reforms ensuring the rule of law and modernisation of the country, with a special focus on building an open economy. The Government announced a series of reforms in early February2 Statement of Preliminary Findings and Conclusions of the International Election Observation Mission (9 December 2018 elections):   [*https://www.osce.org/odihr/elections/armenia/4058903*](https://www.osce.org/odihr/elections/armenia/4058903) OSCE/ODIHR Election Observation Mission Final Report (2 April 2017 elections):   [*https://www.osce.org/odihr/328226EU-*](https://www.osce.org/odihr/328226EU-) Armenia Development CooperationThe EU is the largest donor to Armenia. The Single Support Framework for Armenia for 2017-2020 is based on the EU-Armenia Partnership Priorities and contributes to the implementation of the 20 Deliverables for 2020 agreed in the context of the Eastern Partnership.EU assistance to Armenia was indicatively programmed between €144 million and €176 million for 2017-2020. In addition, Armenia benefited from funds in the Annual Action Programme 2018 (€10 million). In recognition of Armenia's progress since the political transformation with regard to citizen's rights, justice, equality, dignity, and individual freedoms and in recognition of Armenia's determination to pursue a reform agenda and to implement the Comprehensive and Enhanced Partnership Agreement (CEPA) effectively, Umbrella funds of €25 million were added to our initial support for 2019, bringing the total 2019 envelope to €65 million.The EU has a substantial portfolio focused on supporting the reform agenda, the focal regions (Shirak, Lori and Tavush), private sector development, and infrastructure investments (blending). In particular, more than €800 million in the form of blended loans and grants has been invested in energy, ***agriculture***, and transport sectors. EU assistance is focused on the swift implementation of CEPA, including through a CEPA Reform Agenda Facility which can provide expertise of High Level Advisors in selected sectors (€23 million) and CEPA banking facility providing support to private sector in adjusting to the requirements of the Agreement (€10 million).42019 with a new five-year Programme. Good governance and the fight against corruption are among the Government's top priorities. While fully transforming the system will take time, Armenia is now a transition country demonstrating strong political will for democratisation, with the new authorities' agenda prioritising areas where the EU has been traditionally advocating change.4The Azerbaijani-Armenian and Turkish-Armenian borders are closed in view of the unresolved Nagorno-Karabakh conflict. Only two borders, with Georgia in the north and Iran in the south, remain open. This seriously affects Armenia's economic performance, hampering both imports and exports.3. EU-Armenia trade and GSPIn 2018, Armenia's economy grew by 5.2%, following a growth of 7.5% in 2017. According to the National Statistical Committee of Armenia, the GDP growth for the first half of 2019 stood at 6.8%, whereby almost all sectors showed growth except ***agriculture***, which recorded a decline. In 2018, the World Bank classified Armenia as an upper-middle income economy for the second year in a row.Trade relations between the EU and Armenia are regulated by the new Comprehensive and Enhanced Partnership Agreement. The EU accounts for around 25% of Armenia's total trade in 2018. The EU is thus Armenia's second trading partner after Russia (26%) and before China (11%). In 2018, total EU imports of goods from Armenia amounted to € 373 million. This is a 4.7% decrease compared to 2017, but still reflects a clear upward trend compared to previous years (€ 205 million in 2015 and € 351 million in 2016). The 2018 EU imports mainly consisted of non-ferrous metals, ores and other minerals, and clothing. The EU exported goods worth € 863 million to Armenia in 2018 (a 20.3% growth compared to 2017) – mainly machinery and transport equipment, and chemicals.Figures 1-3 below describe Armenia's utilisation of GSP+ in the context of the EU's overall imports from Armenia5.Armenia maintained a GSP+ utlisation rate of over 90%, with a slight drop in 2018. Usage of GSP+ continues to be highly concentrated on base metals (aluminium, iron, and steel). Reported figures for GSP+ imports to the EU for 2018 decreased significantly compared to prevous years. This is largely the result of a significant share of EU imports from Armenia having been registered as confidential by EU Member States 6.4European Commission. Partnership Implementation Report on Armenia, 20 May 2019,   [*https://eeas.europa.eu/sites/eeas/files/partnership\_implementation\_report\_armenia.pdf5*](https://eeas.europa.eu/sites/eeas/files/partnership_implementation_report_armenia.pdf5) GSP-***statistics*** only cover goods imported in the EU market, i.e goods released for free circulation in the EU. The GSP ***statistics*** do not cover other EU-imports, like goods imported for the customs inward processing procedure or re-imports after the customs outward processing procedure6 Trade flows registered as “confidential” do not show up in the GSP+ usage figures and regime 1 normal trade; but do show up in total trade figures (regime 4).   [*https://ec.europa.eu/****eurostat****/cache/metadata/en/ext\_go\_agg\_esms.htm#conf15371950686595Figure*](https://ec.europa.eu/eurostat/cache/metadata/en/ext_go_agg_esms.htm#conf15371950686595Figure) 1: Armenia imports to the EU 2016-2018 rateFigure 2: Armenia imports to the EU 2016-2018Armenia - imports to the EU 2016-2018 (M€)2016 2017 2018 trend 2016-2018Total imports 310.0 351.1 207.9 -32.9%GSP+ eligible 116.4 135.5 74.9 -35.7%GSP+ preferential 107.8 130.3 68.2 -36.8%Utilisation rate 92.6% 96.2% 91.0% -1.6%6Figure 3: Product Diversification of GSP+ Preferential Imports, 20184. Compliance with GSP+ Obligations4.1 UN Human Rights ConventionsArmenia's human rights situation has improved since the political changes of 2018, withadvances on freedom of assembly. However, several challenges remain with regard to theuncontrolled online hate speech and in a number of other areas, including the penitentiary,and ensuring freedom of expression for minority groups such as religious and sexualminorities. The new authorities' plans for a comprehensive police reform are encouraging inthis regard. A series of cases of death threats and harassment against LGBTQI peoplecontinue to challenge the generally positive environment surrounding democratic change. On23 May 2019, the EU issued a local statement calling for better protection of the human rightsof sexual minorities in the country.7In 2018-2019, Armenia continued to addressshortcomings identified under the GSP+ relatedconventions. The Armenian authorities alsosustained efforts to improve the involvement ofcivil society in the implementation andmonitoring of the 2017-2019 National HumanRights Action Plan (NHRAP). However, theNHRAP lacks effective monitoring andevaluation tools to measure its progress. Thereare some issues with the quality of the ActionPlan and its implementation. These are mainly7   [*https://eeas.europa.eu/delegations/armenia/60790/statement-behalf-delegation-european-union-and-eumember-states-embassies-resident-armenia\_enPromoting*](https://eeas.europa.eu/delegations/armenia/60790/statement-behalf-delegation-european-union-and-eumember-states-embassies-resident-armenia_enPromoting) Human and LabourRights in Armenia through GSP+Starting from February 2018, theEurasia Partnership Foundation (EPF)is implementing this EU-fundedproject in Armenia with the support ofDemocracy Reporting International(DRI). The project aims to strengthenthe capacities of Armenian regionalCSOs in producing high-quality,evidence-based alternative reports tothe UN Committee on Economic,Social and Cultural Rights and UNCommittee on the Rights of the Child.7due to the lack of inter-sectorial cooperation compromises.In February 2019, the government launched the process of developing the new NHRAP 2020-2022. Civil Society Organisations (CSOs) consider this process a priority for the proper implementation of human rights and should be included in the coordination council for this Action Plan. It is important that the new Human Rights Strategy and Action Plan sets clear priorities, contains measurable indicators, and ensures a proper monitoring mechanism. The government plans to circulare the draft NHRAP by the end of 2019.In September 2019 Armenia signed the Second Optional Protocol to the International Covenant on Civil and Political Rights, aiming at the abolition of the death penalty and also the Optional Protocol to the Convention on the Rights of the Child on a communications procedure, a positive development. Armenia was elected as a member of the UN Human Rights Council on 17 October 20198.International Convention on the Elimination of All Forms of Racial Discrimination (CERD)The four largest ethnic minorities – Yezidi, Assyrians, Russians, and Kurds - are represented in the Armenian National Assembly, in accordance with Armenia's electoral legislation. However, challenges remain in the way of further increasing tolerance of diversity in Armenian society and tackling discrimination of ethnic minorities.A draft Law On Ensuring Equality was developed by the Ministry of Justice and was put for public discussions into e-draft platform in 2018. This draft Law envisaged guarantee of equal opportunities for each person to exercise their rights and freedoms. The draft Law also ensured the creation of a specialised equality body under the Human Rights Defender’s Office, creating mechanisms for assistance to victims of discrimination and for examination in alleged cases of discrimination. The Ministry of Justice published a new version of the draft Law in July 2019. The adoption of the law is a benchmark of the EU-Armenia Human Rights Budget Support programme. The government has launched new discussions on the draft Law and plans to finalise a draft legal act in the beginning of 2020.Civil society organisations have expressed concern that the equality body as set up by the draft Law, and implementation in general, would be ineffective; and that the list of protected grounds as currently stated is incomplete, as it does not include the state of health, maternity, pregnancy, sexual orientation, gender identity, place of residence and economic status.9 Discrimination on the basis of sexual orientation, which is not covered by the draft Law on Ensuring Equality, remains a highly sensitive issue.International Covenant on Civil and Political Rights (ICCPR)Following the Velvet revolution, a number of persons allegedly detained on political grounds were released from detention. Visible efforts were made to discontinue the practice of excessive use of pre-trial detentions. Furthermore, a large-scale amnesty was announced in November 2018.The new government declared achieving independence of the judiciary a top political priority. According to civil society partners, demonstrated political will in this regard played a8   [*https://www.rferl.org/a/armenia-elected-un-human-rights-council/30222721.html9*](https://www.rferl.org/a/armenia-elected-un-human-rights-council/30222721.html9) Eurasia Partnership Foundation - DRI report.8critical role in significantly limiting practices of direct intervention of the executive into judicial proceedings. The handling of several high-profile anti-corruption cases against former government officials will be an important signal of the new government’s commitment to judicial independence. Furthermore, to address systemic issues in the justice sector, the Government launched a public discourse in May 2019 on the introduction of ‘transitional justice’ elements in Armenia.The new Judicial Code was adopted by the National Assembly on 7 February 2018 and entered into force on 9 April 2018. The adoption of new Criminal Code and Criminal Procedure Code is planned during 2020. Overall, these new codes are in line with international standards and in respect of the relevant international conventions. Work is ongoing on the establishment of procedures for the verification of the professional integrity of the judges, as well as on other aspects aimed at ensuring the accountability, efficiency and independence of the judiciary from political and party influence and at increasing public trust in the courts.The ambitious new Justice Reform Strategy 2019-2023 and its Action Plan were finalised in record time by the new Government and adopted in October 2019. Furthermore, between 2010 and 2019, e-governance tools have been introduced in the justice sector of Armenia, including the e-Civil Status Registry, the e-Police component, the e-Citizen portal, the on-line Interactive Portal for draft laws, e-Notary, e-Penitentiary, and e-Apostille, leading to a reduction of corruption risk and an increase in efficiency in the justice system.International Covenant on Economic, Social and Cultural Rights (CESCR)Since the breakout of the Syrian crisis in 2011, Armenia received some 22,000 Syrian refugees of Armenian origin. EU support to Syrian refugees in Armenia continued in 2018 with a new project focusing on improving the social and economic resilience of Syrian Armenians and the host population, and on strengthening relevant institutional capacities for economic growth in Armenia.Discrimination of vulnerable groups, such as persons with disabilities, LGBTQI people, and national minorities, in particular children from ethnic and religious minorities, requires further policy changes, including a stand-alone anti-discrimination law. A new and comprehensive law on National Minorities is pending adoption.EU- Armenia Policy Dialogue on Justice ReformsThe EU-Armenia justice policy dialogue was lanched in September 2018 with the aim to support a comprehensive justice reform.The EU has provided support aimed at strengthening government’s capacity to develop a comprehensive strategy and implement the reform in the framework of the Consolidation of the Justice System in Armenia programme (€4 million). Short-term assistance has been mobilised through the TAIEX instrument to support the costing and and share lessons learnt from reform efforts in other partner countries.The EU is ready to mobilise further resources to support the implementation of reform through a sector reform performance contract (budget support) and assist with further assessment through the EU-funded Justice Survey project and a comprehensive functional review of the justice system.9For persons with disabilities, employment and education as well as polling stations remain hardly accessible. The government discussed addressing some of these issues in the draft law on the Rights of Persons with Disabilities. The National Disability Commission was dissolved by the new government. The process of forming the new Commission is not transparent, according to some CSO partners. Reform of public transportation that would address concerns of people with disabilities is pending. Labour rights of persons with disabilities are not addressed. The ongoing exercise of developing amendments to improve the Labour Code is meant to raise awareness of discrimination in employment and address the existing shortcomings. Inclusive education policy is not well implemented, as the resources and capacities are not sufficient to ensure that children with disabilities can be adequately integrated in public schools. A 2017-2021 Strategy on Social Inclusion of Persons with Disabilities and 2018 Annual work plan on Social Inclusion of Persons with Disabilities and its Action Plan are in place.Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW)A Law on Prevention of Domestic Violence and Protection of the Victims of Domestic Violence was passed by the National Assembly in December 201710. Overall, the Law ensures preventive and protective mechanisms, as well as state assistance for domestic violence survivors. The Law is partially in compliance with the CEDAW General recommendation No. 19 on gender-based violence and with the Council of Europe Convention on Preventing and Combating Violence against Women and Domestic Violence (Istanbul Convention).In February 2018, the Armenian Government approved the Action Plan for the implementation of the Law on Domestic Violence, and in July 2018 set up the Council on Prevention of Violence in the Family, the coordination body for policies on prevention of domestic violence. The Government also drafted relevant decrees regulating requirements for shelter staff members and establishing a centralised record of domestic violence cases. In 2019, the Government aims to increase the number of shelter spaces and establish state-run shelters; and to conduct campaigns to educate the public about the new law, on how to file complaints, and about the availability of services. In discussions with the Council, the Police stressed several persisting problems with regard to the adoption of by-laws necessary for implementation of the Law. One of the main impediments is the lack of referrals of juveniles who exercise violence in the family to rehabilitation centres on one hand, and the lack of such centres on the other.During the second half of 2018, 990 cases of violence within the family were registered in Armenia; in 431 cases a warning was issued, and in 131 cases imminent measures of interference were applied.In January 2018, the Republic of Armenia signed the Istanbul Convention. The ratification of the Convention is high on the agenda of the new Government and National Assembly. In May 2019, the Ministry of Justice initiated the internal ratification procedures. However, the process has been highjacked by homophobic and pseudo-10 For details, please refer to the biennial report for 2016-2017, SWD(2018) 32 final of 19.1.2018In April 2019, the Council of Europe Office in Armenia launched a new 2,5-year project Preventing and combating violence against women and domestic violence in Armenia: continuing the path towards ratification of the Istanbul Convention (€600,000), funded by the governments of Liechtenstein and Norway. The project aims to prepare Armenia for the Istanbul Convention; and to ensure the Armenian legal and policy framework on preventing and combating domestic violence will be in line with Council of Europe standards.10homophobic groups questioning the definition of gender given in the Convention.The Ministry of Labour and Social Affairs announced the start of a five-year Gender Strategy (2019-2024). To ensure the continuity of gender policy and take into account the existing issues and new challenges to achieving gender equality, the new Government is developing a draft Strategy and Programme of Activities for Implementation of Policy on Ensuring Equal Rights and Equal Opportunities for Women and Men in the Republic of Armenia for 2019-2023. The Strategy defines the priority directions of the state policy on equal rights and equal opportunities for women and men and aims to create favourable conditions for women and men in all areas of public life. The draft has been finalized and made public on 21 May 201911, but has not been approved yet.A draft decree on the establishment of a new Council of Issues on Equality between Men and Women is currently under consideration by the Government since May 2019. The decree proposes the revision of the Council’s functions and powers, strengthening its capacity to effectively monitor and implement policies on gender equality and taking into account CEDAW’s recommendations from Armenia’s Fifth and Sixth Periodic Reports.Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (CAT)Ill-treatment, torture, inhumane and degrading treatment are explicitly prohibited by law. Development of specific legislative safeguards (e.g through amendments to the Criminal Procedure Code, new Law On Pardon) is underway. Concerns remain with regard to the continuing practice of ill-treatment and torture, particularly in police custody12, as well as with regard to mechanisms for accountability and opportunities for civic oversight of closed facilities.The political developments in the country resulted in a change of the police leadership. The new leadership embarked on police reforms, including in the area of prevention of torture. In 2018, the Special Investigative Service launched a number of criminal cases relating to ill-treatment committed by police officers. However, official ***data*** and information on the outcomes of the cases is not publicly available. In addition, the Armenian police is working on establishing a new patrol police, in order to address ill-treatment.Civil society organisations continued to report allegations and occurrences of torture and ill-treatment in the country. By mid-2018, 71 cases were reported, out of which only one was sent to the court. Human Rights Watch, in its 2019 country report13, referred to the events of April-May 2018, specifying alleged use of stun grenades by the police on April 16, leaving 46 people injured, including six policemen.11   [*http://www.mlsa.am/wp-content/uploads/2019/05/naxagic-genderayin-razmavarutyun.docx12*](http://www.mlsa.am/wp-content/uploads/2019/05/naxagic-genderayin-razmavarutyun.docx12)   [*https://rm.coe.int/16806bf46f.13*](https://rm.coe.int/16806bf46f.13)   [*https://www.hrw.org/world-report/2019/country-chapters/armeniaUnder*](https://www.hrw.org/world-report/2019/country-chapters/armeniaUnder) the EU’s Support to Human Rights Protection in Armenia programme, 10 pilot police stations should benefit from video surveillance systems in interrogation rooms in 2019 and 2020. The action is aimed at decreasing the practice of ill treatment and torture. The legal framework was discussed and the terms of reference for purchase of the required equipment was submitted.11The Armenian National Preventive Mechanism’s (under the Human Rights Defender) workload increased significantly during the 2018-2019 reporting period, as it conducted visits to penitentiary institutions, social care homes, childcare institutions, and psychiatric centers. Three prisons were far below the international standards and need to be upgraded. Regarding the lack of quality medical care for prisoners, Armenia plans to establishing special wards in public hospitals.According to the information presented by the Prosecutor General's Office during the Human Rights Dialogue (Brussels, 8 April 2019), there are recent positive trends in terms of decrease of use of pre-trial detention (PTD), as well as decrease of unjustified motions for PTD. Instructions to prioritize alternative sentences have already been translated into practice; however, legal amendments and strengthening of the Probation Service, including funding for GPS monitoring in case of house arrest are needed.Convention on the Rights of the Child (CRC)The current legislative framework includes the National Strategy and Action Plan on Child Rights Protection (2017-2021). Furthermore, the Human Rights Protection Strategy 2017-2021 and its Action Plan include a special chapter on child rights. De-institutionalization of the child care system is a priority in the Government Programme for 2017-2022. The Child Rights Unit under the Human Rights Defender (HRD) Office is appointed as the CRC monitoring mechanism. UNICEF has been assisting the Child Rights Unit to strengthen monitoring. At the same time, the National Commission for the Protection of Children's Rights continues to be inactive and fails to perform its mandate. In October 2018, The Human Rights Defender’s Office issued a comprehensive ad hoc Report on the State of Fulfilment of Armenia's Commitments under the the Convention and its protocols, with recommendations in each of the areas covered.14 Challenges remain with the ongoing de-institutionalisation reforms meant to address the problem of overrepresentation of children with disabilities in residential institutions15, where it is believed their needs are not addressed adequately. Amendments to the Family Code were enacted in 2018 to allow for the development and strengthening of alternative care system in the country, including foster care reform. The government has also adopted a Concept on the Development of Alternative Services (service centres, foster care and adoption mechanisms)16 and considers the possibility of delegating provision of these services to relevant civil society partners. However, before the community-based centres for children with disabilities envisaged under the EU Human Rights Budget Support Programme would be established, the existing arrangements within residential institutions have been abandoned, creating a gap in provision of services. Serious issues also persist with the implementation of inclusive education reform, as most children with disabilities are effectively left out of schools.14   [*https://www.unicef.org/armenia/media/2116/file/Commitments%20under%20the%20Convention%20of%20the%20rights%20of%20the%20child-the%20state%20of%20fulfillment%20by%20Armenia.%20Ad%20Hoc%20public%20report.pdf15*](https://www.unicef.org/armenia/media/2116/file/Commitments%20under%20the%20Convention%20of%20the%20rights%20of%20the%20child-the%20state%20of%20fulfillment%20by%20Armenia.%20Ad%20Hoc%20public%20report.pdf15)   [*http://transmonee.org/country/armenia/16*](http://transmonee.org/country/armenia/16)   [*http://www.ohchr.org/\_layouts/15/WopiFrame.aspx?sourcedoc=/Documents/Issues/Disability/ProvisionSupport/NGOs/Save%20the%20Children%20Armenia.doc&action=default&DefaultItemOpen=1.12Armenia*](http://www.ohchr.org/_layouts/15/WopiFrame.aspx?sourcedoc=/Documents/Issues/Disability/ProvisionSupport/NGOs/Save%20the%20Children%20Armenia.doc&action=default&DefaultItemOpen=1.12Armenia) joined the Global Partnership to End Violence against Children as a path-finding country in 2018. However, the law on Domestic Violence does not envisage mechanisms to support child victims of violence. Conclusions and priorities Improvements in freedom of assembly followed the Velvet Revolution of 2018. Progress was noted in legislation on Domestic Violence and its implementation, including support services for survivors and awareness-raising activities; as well as work on improving the legislative framework on gender equality. The ratification of the Istanbul convention would be a significant further step in this direction and should remain a priority for the new government. Furthermore, the Human Rights Defender notes a decline in the use of pre-trial detention. Increased over-sight of practices of ill-treatment and torture in the police is expected with the delayed introduction of video surveillance systems in interrogation rooms in 2019 and 2020. However, we note the delays in adopting a new Criminal Code and stand-alone law on anti-discrimination. A series of cases of hate speech and harassment against LGBTQI people continue to spoil the generally positive environment surrounding democratic change. The government has declared independence of the judiciary as a top political priority, while some concerns remain. The drafting of a new 2020-2022 Human Rights Action Plan is a priority for the government and civil society partners. The new Judicial Code entered into force on 9 April 2018. However, after the political changes in Armenia during April-May 2018, the Government has planned to amend the Judicial Code in 2020 in order to address the recommendations of Venice Commission and OSCE/ODIHR. The adoption of new Criminal Code and Criminal Procedure Code is planned for 2020.4.2 ILO Labour Rights ConventionsThe majority of the monitoring process was conducted with the former government. The new government confirmed engagement and started acting on key issues, such as the Labour Code and the Labour inspectorate.The preparation of a new Labour Code was dropped in favour of amending the existing one. A package of amendments submitted to the Government in summer 2018 addressed several gaps identified by the ILO in relation to the fundamental conventions. The new Government has confirmed its intention to amend the Labour Code in order to respond to ILO requirements, but restarted the drafting process. Public discussion on the envisaged amendments was launched in May and June 2019. The office of the Human Rights Defender issued a public report with a comparative analysis of the Armenian Labour Law and international standards in 201917. A working group involving key stakeholders is aiming to17   [*https://www.ombuds.am/images/files/d42f63d5739ccce32e17bc5a53424c7c.pdf13develop*](https://www.ombuds.am/images/files/d42f63d5739ccce32e17bc5a53424c7c.pdf13develop) draft amendments by 2021. A positive step in this respect was the amendment to the Labour Code to define and prohibit discrimination in employment, adopted on 4 June 2019.A new Health and Labour Inspectorate was established in April 2018 (Law on State Administration Bodies), reporting directly to the Government and with limited powers and a mandate limited to occupational health and safety (OSH) and guarantees for workers under the age of 18, pregnant or breastfeeding women, and child care workers. There is still no enforcement body for labour legislation on matters linked to general working conditions or employment relations (wages, employment contracts, welfare provisions).Following the initial steps in 2018 on the labour inspection system, the government is developing a roadmap towards a fully-fledged inspection system with support from the ILO under the EU-funded project, to be finalised by October 2020. Under the Government Plan, draft legislation based on the roadmap would be submitted to the Prime Minister in October 2021. Parliament passed a package of amendments to the Labour Code envisaging an extended mandate of the Health and Labour Inspectorate in December 2019. Poor capacities of the administration and institutions, coupled with a lack of financial and human resources, remain important impediments to effective implementation and progress.Freedom of Association and ***Collective*** Bargaining (Conventions 87 and 98)Gaps in the legislation remain to be addressed. A package of amendments to the Labour Code were presented to the former Government in January 2018, addressing some of the issues related to the right to strike (e.g threshold to call a strike; definition of minimum service with the social partners). Work continued under the new government and a new package of amendments is being prepared.Concerns relate to the exclusion of some categories of civil servants, self-employed, liberal professions, and informal workers from forming and joining trade unions. Furthermore, issues remain around the excessively high minimum membership requirements for the formation of both trade unions and employers' organisations; and ambiguous provisions on workers' representation in the absence of trade unions.De facto, the present legislation (Labour Law and the Law on Trade Unions) continues to discourage the formation of unions independent of the majority and branch trade unions. A draft bill to amend the Law on Trade Unions would facilitate the establishment of independent trade unions, but maintains restrictions for certain professions (police, judges, etc.). It was passed on to the Parliament but is not on the agenda yet. Shortcomings remain in the Law, which allows for unilateral termination of ***collective*** agreements in case of privatisation and/or restructuring of a company and for circumventing the representative trade unions for ***collective*** bargaining at enterprise level.Although this is a requirement of the Labour Code, there is still no official registration of ***collective*** agreements. In practice, freedom of association and ***collective*** bargaining are also constrained by the fact that unions or workers’ representatives are commonly perceived as fully dependent on the goodwill of employers (e.g employer’s informal consent required to establish a trade union in the company), by employers’ and workers’ organisations both lacking expertise and negotiating skills, and by a weak negotiation culture within businesses.The new 2018-2020 Decent Work Country Programme (DWCP), signed by Armenia and the ILO in May 2019, includes activities relating to freedom of association and ***collective*** bargaining.14Abolition of Forced Labour (Conventions 29 and 105)Existing legislation (Criminal Code, Labour Code) prohibits forced or compulsory labour of any form, but still lacks a clear and comprehensive definition of forced labour in line with the ILO Conventions. Amendments to the Labour Code are envisaged with a deadline in 2020 under the 2019-2022 National Action Plan against Trafficking in Persons, which is still to be approved.In its latest comments in 2019, the ILO lifted its concerns about correctional labour as a punishment for expressing political or ideological views and for conduct of public officials harmful to the state or other interests.Exposure to forced labour and labour exploitation remains closely related to trafficking in persons. Armenian labour migrants abroad face forced labour, often following recruitment fraud and exorbitant recruitment fees, notably in Russia, the United Arab Emirates (UAE), and Turkey. Armenian women and children are subjected to sex trafficking abroad and to sex and labour trafficking and forced begging within Armenia. Children working in ***agriculture***, construction, and service provision are vulnerable to labour trafficking. An increasing number of Indian migrants who willingly seek employment in the informal sector in Armenia are reported to face forced labour18. Armenia was downgraded in the 2018 US Department's Trafficking in Persons Report as not fully meeting the minimum standards for the elimination of trafficking due to less serious and sustained efforts and maintained as Tier 2 in the 2019 Report.The impossibility of conducting workplace inspections, remains a key barrier to identifying, investigating and preventing forced labour. In addition, the fewer prosecutions and convictions of traffickers suggest a key shortcoming. Of the nine cases investigated in 2018, five were forced labour and one both sex trafficking and forced labour. Only one case was prosecuted and no trafficker was convicted. Anti-trafficking institutions remain in place, as well as a referral mechanism for victims. Action Plans are implemented, but regular reporting on activities and results is lacking. More efforts are needed to identify victims of forced labour, including training of officials of relevant State agencies, and better cooperation between law enforcement bodies.Minimum Age for Work and Worst Forms of Child Labour (Conventions 138 and 182)Poverty, an underlying cause of child labour, significantly decreased in the last years but remains high. Child poverty reduction was a priority of the former Government, which had launched a reform of the family benefit system as a main poverty reduction measure.Armenia does not feature on the latest US Department of Labour’s List of Goods Produced by Child (or Forced) Labour. Children working in ***agriculture***, construction, and service provision are reported to be vulnerable to labour trafficking, but comprehensive ***data*** on child labour are lacking. The last national survey was conducted with the support of the ILO in 2015. The National Strategy on Child Rights Protection 2017-2021 and the corresponding Action Plan reflect the recommendations of the 2015 Child Labour survey.18 US, 2019 Trafficking Report15There was no change in child labour legislation during the reporting period. A major shortcoming to be urgently addressed according to the ILO is that the bulk of working children remains without legal protection since provisions in the Labour Code relating to child labour, including the minimum age for employment, do not apply to work performed outside a formal labour relationship, such as unpaid work, work in the informal sector or self-employment.There is still no effective mechanism to enforce child labour legislation. The Health and Labour Inspectorate remains without sufficient capacity in that respect and there is no other competent agency. Apart from a dedicated unit within the police, there are no integrated systems in place to monitor child labour.Measures on the education side, if effectively implemented, could help curbing child labour. Longer compulsory education, until the age of 19, has been in force since September 2017. However, there is no information about the necessary enhancing of school and teaching capacities. Projects with international partners19 helped making the education system more inclusive and reducing drop-outs, which can be an incentive to child labour. Armenia's limited capacity and resources to sustain the developed tools through its own means beyond funded projects is, however, an issue.Equal Remuneration and Elimination of Discrimination (Conventions 100 and 111)The gender gap in labour market participation and employment remain high at around 20 and 17 pp respectively20, also reflecting the poor job opportunities in the country overall. Armenia improved its ranking in the 2018 Global Gender Gap index to 98th out of 149 countries, but still features among the lowest-ranked in Eastern Europe and Central Asia. The gender pay gap remains at an average 33.5% and even higher in sectors like finance and insurance or IT. Efforts to address this issue, such as a gender-neutral job classification and remuneration system, remain concentrated in the public administration.The existing legislation (Labour Code and Law on Equal Rights and Equal Opportunities for women and men) still needs to be amended to rightly incorporate the principle of equal pay for work of equal value, as requested by the ILO. Equal access to employment and recruitment is not well covered by legislation. Legislation still does not cover sexual harassment in employment and occupation.Prohibition of discrimination had been enhanced by the amended Constitution, which entered in force in 2018. It was further strengthened by the introduction of a new article in the Labour Code in June 2019, defining and prohibiting discrimination in employment. Protected grounds are aligned with those in the Constitution and the new article specifically prohibits both direct and indirect discrimination at all stages of legal labour relations.19   [*https://www.unicef.org/armenia/en/what-we-do/education20*](https://www.unicef.org/armenia/en/what-we-do/education20) 2018, World Bank Development Indicators, dataThe EU-funded OxYGen programme focuses on women’s capacity building for a gender equality agenda and addresses labour rights, gender-based discrimination in the labour market, and gender wage disparities. The goal of this programme, part of the INSPIRED+ GSP project, is to enable local CSOs to create a road map for ensuring equal labour rights for women and men in Armenia.16The latest version of draft Law on Ensuring Equality was published in July 2019. The draft law contains a comprehensive definition of discrimination and prohibited grounds for discrimination, as well as the responsibilities of employers in terms of preventing and prohibiting discrimination in the workplace. The role of the Equality Council tasked with assisting the Human Rights Defender with implementation, however, would be only an advisory one and would not cover the private sector. Discrimination on the basis of sexual orientation is not covered by the draft Law on Equality and remains a highly sensitive issue.A Draft Strategy and Programme of Activities for Implementation of Policy on Ensuring Equal Rights and Equal Opportunities for Women and Men for 2019-2023 is being finalised. Before its submission to the Government, it is being checked to ensure that it is fully in line with international standards, notably, CEDAW Concluding Observations and UPR Observations.In practice, most discrimination issues identified by national and international stakeholders relate to gender. Women reportedly face discrimination at every stage of the employment relationship. Sexual harassment is widespread and often unreported. Discrimination in employment and occupation is also reported on other grounds (age, sexual orientation, disabilities, and ethnicity)21. Mandatory employment quotas for people with disabilities were suspended for bigger public and private firms in May 2017. Discrimination on the ground of sexual orientation remains a highly sensitive issue. In a recent ranking on LGBTQI equality laws and practices in Europe, Armenia was ranked 47th of 49 countries (ILGA-Europe 2019). ILO CEACR underlined the need for proactive measures to address discrimination between different ethnic groups in the labour market. Conclusions and priorities Progress has been limited, but the new government is engaging on key issues such as labour inspections and amending the Labour Code in response to ILO requests. The new 2019-23 Decent Work Country Programme with the ILO and the prolonged EU project to GSP+ implementation offer opportunities to advance on both issues. Re-establishing a fully-fledged labour inspection system, duly mandated and empowered in line with ILO conventions on labour inspections, which Armenia has ratified, remains an urgent matter. The impossibility to conduct inspections outside occupational health and safety is a major impediment to effective control of forced and child labour. More needs to be done to eliminate child labour and to guarantee that all working children, including those out of a formal employment relationship can benefit from the protections of the child labour legislation. A roadmap has been developed with the ILO and work is starting on a legal basis for an extended mandate covering all labour rights, expected to be in place by end 2020. Amendments to the Labour Code on the prohibition of discrimination were a significant step, By providing a broader legal basis to the prevention and protection against discrimination, the adoption of the draft Law On Ensuring Equality would have an additional positive impact on the application of the ILO fundamental conventions N° 100 and 111.21 USDOS, 2018 Human Rights Report17Further envisaged changes to the Labour Code remain essential to close the gaps identified by the ILO on the effective application of fundamental conventions in law. Adopting the draft law amending the Law on Trade Unions is needed to better guarantee freedom of association. The definition of forced labour in national legislation still needs to be brought in line with the ILO conventions and more efforts are needed to curb the risks of forced labour and labour exploitation for economic migrants to and from Armenia.4.3 UN Conventions on Environmental Protection and Climate ChangeConvention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)Armenia's national legislation related to the implementation of CITES remains ranked as Category 3, which means that it does not meet the requirements for the Convention's implementation. Some CITES legislation is in place, and some provisions have been translated and submitted to the Secretariat as of September 2018. Once provisions are fully submitted, the Government and the Secretariat are to agree on the legislative analysis, and the possibility for reaching Category 1 status.The Armenian authorities have taken some steps to address the four minimum requirements set by the CITES secretariat. A Management and Scientific Authority, respectively the Ministry of Nature Protection and the Interagency Council, have been appointed since 2008. The government envisages the full establishment of the Interagency Council by the end of 2019. Trade in specimens in violation of CITES is prohibited by the Law On Fauna and amendments to the Code of Administrative Offences. Penalties for such trade are covered in the legislation on administrative and environmental offences, as well as the Customs Code. The current level of fines is low and is unlikely to have dissuasive impact for potential offenders. The final requirement of CITES is on the seizure of illegally traded or possessed specimens. A draft Article to this effect in the Criminal Code has not yet been adopted.During 2018, Armenian authorities actively worked with the CITES Secretariat on the introduction of the electronic CITES permit system, which will improve the transparency of the process, reduce corruption risks, illicit trade of wildlife, and facilitate the exchange of information between management, scientific authorities and business entities. Regarding the issuing of CITES permits in electronic format, it should be mentioned that the RA Customs Service no longer works with the Automated System for Customs ***Data*** (ASYCUDA).Basel ConventionOver the reporting period, no salient shortcomings regarding the implementation of the Basel Convention were identified22.Convention on Biological Diversity (CBD)Due to delays in the submission of Armenia’s Sixth National Report under CBD, no significant updates on implementation are available. Currently, the two main policy documents in the area of biodiversity are the revised National Strategy and Action Plan on the22 For details, please refer to the biennial report for 2016-2017, SWD(2018) 32 final of 19.1.201818Conservation, Protection, Reproduction and Use of Biological Diversity, and its associated Action Plan for 2016-2020, as well as the Strategy of the Republic of Armenia for Special Protected Nature Areas and the State Programme for Protection and Usage, adopted in September 2014.The Caucusus is considered among the world’s most endangered biodiversity hotspots. The main pressures to biodiverity in Armenia are related to the development of industry, ***agriculture***, urbanization, and exploitation of forests and grasslands. Armenia has set up specially protected areas covering 70% of the country’s flora and fauna, as well as special strategies for particular species, such as the Armenian moufflon, bezoar goat, and panther.Stockholm Convention on Persistent Organic Pollutants (POPs)Armenia submitted an update to its National Implementation Plan (NIP), addressing the Fifth Conference of the Parties (COP 5) amendments, on 23 April 2018. According to the government, the updated NIPs with new POPs listed in Stockholm Convention COP 6 (due in 2016) and COP 7 (due in 2018) were under finalisation, but have not been submitted to Secretariat yet.The government prepared and approved a Concept of Republic of Armenia Law on Chemicals in November 2018. The draft Law on Chemicals will be submitted to the Government of RA in 2020.Constraints on effective implementation include the lack of education in the refrigeration and air-conditioning industry, which may be a barrier to the introduction of new ozone and climate friendly technologies. Additionally, customs entry points are not equipped with Ozone-Depleting Substances (ODS) identifiers to allow field-testing to distinguish between ODS and non-ODS refrigerants.Cartagena Protocol on BiosafetyA draft Law On Genetically modified organisms (GMO) along with the package of other related laws23 was finalised and made public on 4 September 201824. The Law’s main purpose is to provide regulations for the usage of GMOs and to ensure biosafety25. Among other regulations, the Draft Law: (i) provides for definition of GMOs and related concepts; (ii) sets for the main principles of GMO regulation and utilization; (iii) use of GMOs for ***agricultural*** purposes; (iv) prohibition and prevention of illegal utilization of GMOs. Under the new government, the relevant ministries reported drafting a National Law regarding Biosafety of Genetically Modified Organisms to be submitted to the National Assembly.23   [*https://www.e-draft.am/projects/1178/about24*](https://www.e-draft.am/projects/1178/about24)   [*https://www.e-draft.am/projects/117825*](https://www.e-draft.am/projects/117825)   [*https://www.e-draft.am/projects/1178/aboutA*](https://www.e-draft.am/projects/1178/aboutA) pilot project (2016-2018) on the Reduction of Unintentional Organic Pollutants Releases (U-POPs) from Open Burning Sources aimed to reduce the releases of dioxins and furans while renovating a selected landfill.Another project, Elimination of Obsolete Pesticide Stockpiles and Addressing POPs Contaminated Sites within a Sound Chemicals Management Framework in Armenia (ending in 2019) aims to eliminate obsolete pesticides and liquidation from the Nubarashen burial site.19Article 285 of the Draft amendments to the Code on Administrative Offences prohibits and provides for administrative liability for the violation of the rules biosafety in utilization of GMOs, in the form of fines. These lenient penalties are not expected to have a substantial preventative effect, in particular taking into account the benefits of the illegal use of GMOs.Conventions on Climate ChangeThe main constraints pertaining to the implementation of the United Nations Framework Convention on Climate Change (UNFCCC), as raised by Armenia in their Second Biennial Update Report from May 2018, are dependence on external financing, shortage and frequent rotation of qualified specialists with knowledge of the Convention, as well as low awareness of the Convention at local/regional level. The authorities planned to complile Armenia’s draft 4th National Communication by the end of 2019, though still outstanding. A EU4Climate regional project plans to develop a Nationally Determined Contributions (NDC) implementation roadmap by October 2020.In February 2017, Armenia ratified the Paris Agreement of the UNFCCC, and the Doha amendment to the Kyoto Protocol.As for the Montreal Protocol, Armenia continues phasing out hydrochlorofluorocarbons (HCFCs). Stage II of the HCFC Phase-out Management Plan covers the period of 2016-2020. This should enable Armenia to meet its obligations under the Montreal Protocol on the accelerated phase-out of HCFCs and will effectively target reaching 35% phase-out of HCFCs by 2020. The phase-out plan covers legislative changes, improving facilities at refrigaration and air-conditioning training institutions and customs, and technical assistance and refrigeration technicians.Armenia ratified the Kigali Amendment to the Montreal Protocol in May 2019, adding powerful greenhouse gases HCFCs to the list of substances controlled under the Protocol. Conclusions and priorities The ratification of the Kigali Amendment to the Montreal Protocol in 2019, in addition to the Paris Agreement and Doha amendment in 2017, signals Armenia’s continued commitment to international environmental standards. Furthermore, the authorities reported some progress in aligning national legislation with CITES requirements, but more needs to be done. Concerns remain around low penalty amounts for violations of CITES and the Cartagena Protocol, which are not expected to have a serious deterrent effect. Challenges persist in terms of capacity and financing.4.4 UN Conventions on Good GovernanceInternational Drug Control ConventionsThe International Narcotics Control Board (INCB) undertook a mission to Armenia in June 2018. The INCB reports increased cannabis seizures and a decline in cannabis resin seizures for 2013-2017 in the Southern Caucusus region, which Armenia is a part of. Armenia continued to seize increasing amounts of methamphetamine in 2017, trafficked into the20country mainy from Iran. A high prevalence of opiate use was noted26. The 2018 INCB report does not comment on Armenia’s implementation status, after considerable improvement efforts noted in 2015, including the 2016 Law on Drugs and other drug control reforms.Armenia has, in recent years, reported a rise in seizures of narcotic drugs including cocaine, opium and cannabis resin, which may indicate that the country is increasingly being targeted for transit. While illicit drug use in the country is thought to be moderate, its exact extent is difficult to gauge in the light of the limited epidemiological ***data*** available.In terms of regional cooperation, Armenia is a part of the ***Collective*** Security Treaty Organisation (along with Belarus, Kazakhstan, Kyrgyzstan, the Russian Federation, and Tajikistan), which carried out two large-scale joint operations in 2017 to counter drug-trafficking. Armenia also participated in a regional workshop on joint investigation teams and controlled deliveries in February – March 2018.UN Convention against Corruption (UNCAC)While the fight against corruption has become a priority for the Armenian Government in the past years and important legislative and policy developments are taking place, shortcomings remain and the public perception of corruption in the country remains negative. The last UNCAC review from 2015 noted a need for closer alignment of Armenian legislation with some principles and definitions of the Convention. On the other hand, UNCAC reviewing experts highlighted some legal provisions as good practice, including the aim to expedite international cooperation and mutual legal assistance.Armenia’s ranking in the 2018 Transparency International Corruption Perception Index improved to 105 out of 176 countries (from 113th place). There was a slight improvement of perceived level of public sector corruption score at 35 out of 100 (where zero means 'highly corrupt') in 2017-8, compared to 33 in 2016.There were several legislative changes in the previous reporting period, such as the criminalisation of illicit enrichment and an anti-corruption package including a Law on the Corruption Prevention Commission, the Law on Making Amendments in the Law on Public Service and the Law on Whistleblowing System. The package was to enter into effect in early 2018. The preliminary assessment of the package was positive, but concerns remain, for example regarding the selection process of the board members of the Corruption Prevention Commission; and the extension of the coverage of the declaration of income obligations for civil servants.Corruption prevention is among the top priorities of the new government27. The authorities adopted a new Anti-Corruption Strategy (2019-2021) with the intention to set up the Corruption Prevention Commission as an independent anti-corruption body. On 21 May 2019, the official page for the Integrated Whistle-blower platform (   [*www.azdararir.am*](http://www.azdararir.am)) was launched with participation of the high-level governmental officials from the Prime Minister's Office, Prosecutor General's Office, and Ministry of Justice.26   [*https://www.incb.org/documents/Publications/AnnualReports/AR2018/Annual\_Report\_Chapters/05\_Chapter\_III\_Annual\_Report\_2018\_E\_.pdf27*](https://www.incb.org/documents/Publications/AnnualReports/AR2018/Annual_Report_Chapters/05_Chapter_III_Annual_Report_2018_E_.pdf27)   [*http://www.primeminister.am/en/press-release/item/2018/05/18/Prime-Minister-Nikol-Pashinyan-introduced-SRC-chairman/.21In*](http://www.primeminister.am/en/press-release/item/2018/05/18/Prime-Minister-Nikol-Pashinyan-introduced-SRC-chairman/.21In) 2018, 409 criminal cases of corruption and official nature were investigated by the Special Investigation Service. According to the Prosecutor General Office of RA, during 2018, 960 persons were prosecuted on corruption cases investigated by the bodies of inquiry from which 470 were officials. There are several high-profile criminal cases on corruption involving members of the previous government. Those include the former President of Armenia, Mr Rober Kocharian and co-defendants, charged with overthrowing constitutional order in 201828 and in 2019 for taking a bribe in the amount of 3 million USD29. The former Chief of the Army Headquarters General Yuri Khachaturov and former Minister of Defense General Seyran Ohanian were charged for overthrowing the constitutional order; the former Chief of Staff of the Kocharian’s Presidential Office, Armen Gevorgian was charged for assisting the bribery. The Prosecutor’s Office approved the indictment and sent it to court in April 2019. Other cases include former Minister of Environment Aram Harutyunyan, wanted under charges of taking a bribe of 14 million USD from a business woman Silva Hambardzumya for not hindering her investment operations in the mining business30.The prevention of money-laundering is closely related to the fight against corruption as corruption represents one of the main predicate offences in connection with the illicit laundering of proceeds in the context of Armenia. Armenia has made good and steady progress in strengthening its legal framework in relation to anti-money laundering as well as counter-terrorist financing and its effective implementation in the recent years. Some deficiencies remain and should be further mitigated. For instance, domestic politically exposed persons and their family members and associates are not subject to specific enhanced customer due diligence requirements. Law enforcement authorities should continue to increase their efforts to pursue money laundering and seize criminal proceeds in line the risks faced by the country. Conclusions and priorities Armenia is on track with fulfilling its obligations under international drug control conventions. The fight against corruption has been highlighted by the new government as one of its main policy priorities. A new Anti-corruption Strategy for 2019-2021 and its Action Plan were adopted. The establishment of an independent corruption prevention body with operative-investigative functions, the Commission for Prevention of Corruption, is underway. Furthermore, Armenia has made good and steady progress in strengthening its legal framework in relation to anti-money laundering as well as counter-terrorist financing and its effective implementation in the recent years.28   [*https://www.rferl.org/a/former-armenian-president-kocharian-charged-with-bribe-taking/29767678.html29*](https://www.rferl.org/a/former-armenian-president-kocharian-charged-with-bribe-taking/29767678.html29)   [*https://www.azatutyun.am/a/29909924.html30*](https://www.azatutyun.am/a/29909924.html30) Hambartsumian told RFE/RL in October that she had to pay a USD14 million bribe in 2008 to then-Environment Minister Aram Harutyunian.22ANNEX Armenia – Treaty Ratification and ReportingConventionStatus of ratification / reservations31Compliance with reporting obligations to monitoring bodies1. Convention on the Prevention and Punishment of the Crime of GenocideAccession: 23.06.1993No reservationsNo reporting obligations2. International Convention on the Elimination of All Forms of Racial DiscriminationAccession: 23.06.1993No reservationsCompliant with reporting obligationsLast report submitted on 29.12.2015 Last concluding observations from 31.05.2017 Last follow-up state party report submitted on 31.08.2018 Next report due by 23.07.2020 3. International Covenant on Civil and Political RightsAccession: 23.06.1993No reservationsCompliant with reporting obligationsLast report submitted on 08.07.2019 Last concluding observations from 31.08.2012 Last follow-up state party report submitted on 11.04.2016 4. International Covenant on Economic, Social and Cultural RightsAccession: 13.09.1993No reservationsLack of compliance with reporting obligationsLast report submitted on 16.07.2011 Last concluding observations from 15.07.2014 Latest report was due by 30.05.2019 5. Convention on the Elimination of All Forms of Discrimination against WomenAccession: 13.09.1993No reservationsCompliant with reporting obligationsLast report submitted on 11.03.2015 Last concluding observations from 18.11.2016 Last follow-up state party report submitted on 10.06.2019 Next report due by 30.11.2020 6. Convention against Torture and other Cruel, Inhuman or Degrading Treatment or PunishmentAccession: 13.09.1993No reservationsCompliant with reporting obligationsLast report submitted on 24.06.2015 Last concluding observations from 07.12.2016 Last follow-up state party report submitted on 20.08.2018 Next report due by 07.12.2020 7. Convention on the Rights of the ChildAccession: 23.06.1993No reservationsLack of compliance with reporting obligationsLast report submitted on 04.02.2010 Last concluding observations from 08.07.2013 Latest report was due by 22.01.2019 8. Convention concerning Forced or Compulsory Labour,Ratification: 2004Compliant with reporting obligationsLatest CEACR32 comments: Direct Request 2018.31 Reservations do not apply in the ILO system, so there is no relevance to providing information on reservations under each of these conventions.23No. 29Next report due in 2020.9. Convention concerning Freedom of Association and Protection of the Right to Organise, No. 87Ratification: 2006Compliant with reporting obligationsLatest CEACR comments: Direct Request 2016.Last report received in 2019.Next report due in 2022.10. Convention concerning the Application of the Principles of the Right to Organise and to Bargain Collectively, No. 98Ratification: 2003Compliant with reporting obligationsLatest CEACR comments: Direct Request 2016.Last report received in 2019.Next report due in 2022.11. Convention concerning Equal Remuneration of Men and Women Workers for Work of Equal Value, No. 100Ratification: 1994Compliant with reporting obligationsLatest CEACR comments: Observation 2016; Direct Request 2016.Last report following comments received 26.09.2018 Next report due in 2021.12. Convention concerning the Abolition of Forced Labour, No. 105Ratification: 2004Compliant with reporting obligationsLatest CEACR comments: 2019 replies received do not raise further comments.Next report due in 2020.13. Convention concerning Discrimination in Respect of Employment and Occupation, No. 111Ratification: 1994Compliant with reporting obligationsLatest CEACR comments: Direct Request 2016.Last report following comments received 26.09.2018 Next report due in 2021.14. Convention concerning Minimum Age for Admission to Employment, No. 138Ratification: 2006Compliant with reporting obligationsLatest CEACR comments: Direct Request 2018.Next report due in 2020.15. Convention concerning Minimum Age for Admission to Employment, No. 182Ratification: 2006Compliant with reporting obligationsLatest CEACR comments: Direct Request 2018.Next report due in 2020.16. CITESAccession: 10.04.2008No reservationsLack of compliance with reporting obligationsLast Annual Report (2016) submitted on 01.11.2017 Annual Reports for 2017, 2018 due.Last Biennial Report33 (2009-2010) submitted on 19.07.2012 Biennial Reports for 2011-12, 2013-14, and implementation34 report for 2015-2017 due.Annual Illegal Trade report for 2017 due.17. Montreal ProtocolAccession: 01.10.1999Compliant with reporting obligations32 ILO Committee of Experts on the Application of Contentions and Recommendations33 Mandatory but not subject to compliance procedures.34 Implementation reports (formally biennial reports) are mandatory, but not subject to compliance procedures.24No reservationsMost recent annual ***data*** for 2016 was submitted.No more recent reporting ***data*** is available.18. 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Global News + ICIS Chemical Business (ICB)

November 20, 2020 Friday

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**Length:** 13609 words

**Body**

More than 30 petrochemicals and specialty chemicals are key ingredients in products used for modern construction adhesives, ad-mixtures, sealants, coatings, paints, flooring, insulation, water proofing, and many more.

Those materials enjoy good demand when infrastructure development takes place, but the construction industry has been adversely impacted by the coronavirus pandemic, although to a lesser extent than automotive, another key end market for petrochemicals.

Public infrastructure investments can be a major contributor to reviving economies and employment during a crisis.

Petrochemicals used in construction and infrastructure are likely to post higher demand in some regions as governments try to revive their wilted economies post-pandemic.

Construction activity in Asia, where most countries are developing economies, is set to growth healthily as the region ramps up infrastructure spending.

Within Asia, China is planning a major infrastructure development campaign to bolster its slowing economy by spending billions of dollars in projects.

On this topic page we analyse the impact of the coronavirus crisis and efforts by different governments to revive economies by developing infrastructure on the chemicals markets, bringing together the latest news reported by ICIS.

Scroll down to see the latest interactive content and useful resources.

[1]Click here to register for regular updates to help you navigate these challenging times. Image credit: Shutterstock

ICIS Analytics viewpoint October October showed some signs of improvement for the construction market, with strong growth recorded on the residential side of the business. It is expected that by early 2021, much of the pandemic induced output loss will be reclaimed globally. However, there are mixed signals for the future, as the pandemic has drastically reduced demand for office buildings, hotels and other commercial spaces.

China continues to be the bright spark in the global economy, and the country leads the recovery in APAC. China construction output is expected to register growth of 10.2% in Q4 year on year and is forecast to finish with full-year growth of 3.2%.This is driven by strong momentum in the residential sector. In contrast, Indian construction is still under pressure, with forecast output decline of -10.8% in Q4 year on year (Oxford Economics). Nonetheless, recovery is expected starting Q1 2021, with output level expected to reach pre-pandemic levels by Q3 2021. If the current growth momentum is maintained, recovery can be expected quicker than originally anticipated.

ICIS Analytics viewpoint September All countries registered a year on year contraction in construction activity in Q3 (except China and South Korea), with social distancing restrictions affecting building activity. The worst affected in Q3 included Argentina, Malaysia, India, Brazil, Russia and several nations in the EU, which all registered double-digit negative growth year on year. Moreover, fears about a second wave of infections are growing and countries are starting to impose restrictions on activity again, which could further delay any recovery.

The eurozone construction sector reported a marginal decrease in PMI of 47.5 in September, compared with 47.8 in August.

In the UK, the construction PMI rose to 56.8 in September from 54.6 in August, signifying further expansion. Activity should only come back slowly because uncertainty is still strong. Infrastructure build should be first back, with commercial construction (shops and offices) likely to be some way off.

US housing starts registered a 5% month on month downtick (according to Oxford Economics).

The country is still experiencing social unrest, which adds to other factors weighing down the economy in general. Lower government budgets, limited credit and low savings levels could hinder investment in H2 as well. According to the Associated General Contractors of America (AGC), 16,000 housing jobs were added in August, although infrastructure and non-residential construction lost 11,000 jobs. There is a renewed level of activity on the residential side, with weak non-residential activity. There is an also an increasing level of pessimism among contractors because of project delays, cancelations or budget cuts, as noted by the AGC.

As in the other regions, Asian construction is also under stress (with the exception of China). Some countries have been worse hit than others. The speed and degree of recovery will largely depend on government stimulus packages, credit lines and the timely availability of skilled construction workers. India has been one of the worst affected, with workers leaving cities and moving back to rural areas.

China continues to perform better than other major economies.

In August, investment in real estate registered a 12% year on year growth rate, according to Oxford Economic forecasts. China construction output registered growth of 11.9% year on year in Q3 and is forecast to finish the full year with a growth rate of 3%, driven by strong momentum in the residential sector. However, there are some doubts as to whether growth will be as strong in 2021 as in H2 2020. In contrast, Indian construction output registered a decline of 15.2% year on year in Q3 2020 and is expected to continue on a downward trajectory. There is long way to go before any recovery, as it is forecast that sales will not reach pre-pandemic levels until the end of 2021.

ICIS Analytics viewpoint- August Except for China and South Korea, all other regions are expected to register a contraction of construction activity in Q3. Social distancing restrictions are affecting building activity. The worst affected countries in Q3 include Argentina, Malaysia, India, Brazil, Russia and the UK - all registering double-digit negative growth.

The eurozone construction sector reported a PMI of 47.8 in August, compared with 48.9 in July. The contraction is mainly driven by a low level of activity in civil and commercial building output. Home construction projects have been only marginally affected. The UK PMI fell to 54.6 in August from 58.1 in July, signifying substantial downgrade risk. Activity is not expected to return to pre-pandemic levels until Q3 2021. In the western world the lingering effects of the pandemic will be felt even when restrictions are lifted. This includes transport and logistic bottlenecks, staffing issues and weaker demand.

The overall level of performance is mixed in the US, depending on state rules, with some states slower to lift the lockdown. US housing figures registered growth of 22.6% month on month in July, which has bought it closer to pre-pandemic levels of output. Low mortgage rates could stimulate demand, but high infection rates in many states have made businesses cautious. There are also substantial risks to this outlook with a second wave of virus infections, or extreme risk aversion by customers, likely to change the picture.

With the latest output figures, China s construction industry is exhibiting a classic V-shaped recovery. According to Oxford Economics, Chinese real estate investment continues to bounce back with year-on-year growth of 11.7% in July, with construction output growth expected to be at 12% year on year in Q3 2020. India s construction output registered a record low of -16% year on year in Q2 and is expected to continue its downward trajectory. There is long way to recovery, with the pre-pandemic level of sales not forecast to be reached until the end of 2021.

ICIS Analytics viewpoint- July Typically, there is a strong relationship between construction activity and overall economic growth. As a result, GDP forecasts serve as an important indicator in determining the future of the sector. Although restrictions are beginning to ease around the world, in its June 2020 outlook, the International Monetary Fund (IMF) further downgraded its global GDP forecast by 1.9% to -4.9% for 2020, with a very slow recovery seen in 2021.

The eurozone construction PMI is showing recovery, owing to measures taken by governments to boost the sector. The index increased to 48.3 in June, from an all-time low of 15.1 in April. However, the market is far from strong with a weak order book and many projects still postponed. Similarly, the UK s PMI recovered from an all-time low of 8.2 in April to 50.1 in June.

US housing registered an uptick of 4.3% month on month in May from its largest monthly decline in April. However, the country is still experiencing social unrest which is weighing down the economy in general. Lower government budgets, limited credit and low savings levels could hinder investment in H2 as well.

Like all other major economic regions, Asian construction is also under stress, with some countries worse hit than others. The speed and degree of recovery will largely depend on government stimulus packages, credit lines and the timely availability of skilled construction workers. India has been one of the worst affected with severe restrictions to mobility. However, China is on its way back to recovery, as investment in real estate grew by 8.1% year on year in May and slowly returning after the pandemic.

Given the state of key macro indicators, including GDP, unemployment, debt levels etc, a worst-case scenario where a recovery takes much longer than expected cannot be ruled out. In addition, a second phase of lockdowns is under way in some countries, which may prolong a recovery.

By Jincy Varghese, ICIS demand analyst, [2][*jincy.varghese@icis.com*](mailto:jincy.varghese@icis.com) and Rhian O Connor, ICIS senior analyst, [3][*rhian.oconnor@icis.com*](mailto:rhian.oconnor@icis.com)

REGIONAL DEMAND OUTLOOKS

LATEST HEADLINES

[4]Thailand Q3 economic contraction eases to 6.4% year on year By Pearl Bantillo 16-Nov-20 17:26 SINGAPORE (ICIS)--Thailand s economy posted a slower contraction of 6.4% year on year in the third quarter, aided by improved exports, private investments and consumption. Construction posted a stronger growth of 10.5% from a 7.4% pace in the second quarter.

[5]Asian MA discussions at year-high on better demand, mounting costs By Ai Teng Lim 20-Nov-20 10:07 SINGAPORE (ICIS)--Asian spot talks for maleic anhydride (MA) have hit a new year-high, as offers rose on the back of steep logistical costs at a time when demand is picking up with robust post-coronavirus economic recoveries in the region.

[6]Mideast petrochemical demand mixed amid rising coronavirus cases By Felicia Loo 19-Nov-20 12:51 SINGAPORE (ICIS)--The petrochemical markets in the Middle East were mixed, with polyethylene (PE) and polypropylene, as well as PE pipe grade affected by a curtailment in demand amid the pandemic, though the polystyrene (PS) market proved otherwise.

[7]Eurozone construction sector's traditional post-summer pick-up fails to materialize By Jonathan Lopez 19-Nov-20 21:23 LONDON (ICIS)--Output in the eurozone s petrochemicals-intensive construction sector fell in September, according to statistical office ***Eurostat***, even though the month traditionally sees a rebound because southern Europe returns to work after the summer break.

[8]US October housing starts rise 4.9%, permits remain flat By Stefan Baumgarten 18-Nov-20 22:44 HOUSTON (ICIS)--US October housing starts rose 4.9% month on month while building permits remained flat, according to the [9]latest ***data*** by the US Census Bureau on Wednesday.

[10]China s Guangju plans coal-based chemical project in Inner Mongolia By Fanny Zhang 20-Nov-20 12:57 SINGAPORE (ICIS)--China s Guangju New Material is planning to invest CNY13.3bn ($2bn) to construct a coal-based chemical project at Wuhai in Inner Mongolia, a company source said on Friday.

[11]China Jan-Oct property development investment expands 6.3% By Fanny Zhang 16-Nov-20 17:27 SINGAPORE (ICIS)--China s investment in property development increased by 6.3% in January-October, with that on housing up by 7.0%, according to ***data*** from the National Bureau of ***Statistics*** (NBS).

[12]US construction, chem industry optimistic about Biden infrastructure plan By Janet Miranda 13-Nov-20 03:10 HOUSTON (ICIS)--US President-elect Joe Biden s extensive infrastructure plan, known as the Build Back Better programme, could help the non-residential construction sector stave off job losses and stimulate growth in the chemical industry. The plan aims to create millions of jobs and rebuild infrastructure including roads, bridges, green spaces, and water systems to withstand the impact of climate change.

[13]US ABS market continues to tighten on lower supply, healthy demand By John Donnelly 12-Nov-20 08:05 HOUSTON (ICIS)--The US acrylonitrile-butadiene-styrene (ABS) market has firmed sharply in the past month and a tight supply-and-demand balance is likely to continue in the near term. Domestic demand continues to be robust, with the housing, auto production and appliance sectors having rebounded from the economic lockdown earlier this year. Demand has also increased for electronics, seasonal toys and furniture.

[14]Chinese ethanolamines sentiment grows steadily worse amid sharp falls in local market By Yuanlin Koh 11-Nov-20 18:13 SINGAPORE (ICIS)--China s ethanolamines registered another sharp drop in the yuan-denominated market on long supply, especially in the diethanolamines (DEA) sector. Coupled with the startup of a new domestic plant - Sinopec Zhongke - during the weekend, sentiment plunged even further. According to market players, there were almost 20,000 tonnes of DEA at Chinese inventories.

[15]Europe November epoxy resins sentiment bullish, on supply shock waves, buoyant demand By Heidi Finch 11-Nov-20 03:43 LONDON (ICIS)--The Europe epoxy resins market is facing supply shock waves and an increasingly bullish sentiment in November, due to both domestic and import constraints, along with buoyant demand. Contrary to typical low seasonal expectations at this time of year, demand is buoyant, with little-to-no sign of any seasonal slowdown in the construction sector, buoyed by mild temperatures so far.

[16] US polycarbonate prices increase on tight supply, strong demand By John Donnelly 05-Nov-20 08:00 HOUSTON (ICIS)--November prices for US polycarbonate (PC) rose on supply/demand tightness and lack of import alternatives. The PC supply/demand balance has been tight, with imports limited and end-use demand strong. End-use demand has been strong, particularly in the housing sector and for appliances. Housing starts and permits grew in September. The warm winter moved up construction activity and completed and remodeled homes are now seeing increasing appliance needs.

[17]France industry still growing despite lockdown, China acrylics suffer on wider Asia - Arkema CEO By Jonathan Lopez 05-Nov-20 21:27 LONDON (ICIS)--The four-week lockdown n imposed by the French government last week will not bring the economy to a standstill like the one in the second quarter, with key downstream sectors operating normally, the CEO at French chemicals major Arkema said on Thursday. Sectors linked to building and construction gradually recovered over the summer and they are still doing quite ok. Because of that, for us this lockdown is quite different to the previous one, especially for Bostik which was greatly affected earlier in the year; it is doing quite ok now, said Le Henaff, speaking to reporters from Paris.

[18]Chinese ethanolamines market turns bearish on surplus By Yuanlin Koh 04-Nov-20 17:40 SINGAPORE (ICIS)--An influx of ethanolamines cargoes at Chinese ports have hit sentiment in the country, particularly in the diethanolamines (DEA) sector. According to market players, there were almost 20,000 tonnes of DEA at Chinese inventories.

[19]US construction spending rose 0.3% in September By Adam Yanelli 03-Nov-20 00:55 HOUSTON (ICIS)--US September construction spending rose by 0.3% month on month from August, led by a 2.8% increase in residential construction, the US Census Bureau said in a ***data*** release on Monday. Compared with September 2019, total construction spending was up by 1.5% year on year.

The construction market is a key consumer of chemicals, driving demand for a wide variety of chemicals, resins and derivative products such as plastic pipe, insulation, paints and coatings, adhesives and synthetic fibres, among many others.

[20]Europe HCl market remains tight; annual price discussions to begin November-December By Chris Barker 30-Oct-20 03:25 LONDON (ICIS)--The European hydrochloric acid (HCl) market has remained tight ahead of annual contract price negotiations on the back of upstream production issues, although output in the isocyanates industry has begun to rise in late October.

Isocyanates production at BASF and Covestro has increased with the latter s plant restarting, but HCl supply remains restricted because of the effects of the shutdowns earlier in the fourth quarter. The majority of HCl in Europe is produced as a byproduct of the isocyanates industry.

[21]SE Asian MA offers bullish on tight supplies and cost pressures By Ai Teng Lim 30-Oct-20 13:21 SINGAPORE (ICIS)--Southeast Asian import offers for maleic anhyride (MA) spiked this week, as spot supplies dried up and cost pressure rose. Judging from a recent string of positive regional economic indicators, the latest being a year-on-year increase in Singapore s September chemical production and industrial output, downstream off-take for raw materials like MA has been robust, especially from the unsaturated polyester resins (UPR) sector which has heavy applications in the construction and automobile industries.

[22]US oxo-alcohols markets may see more momentum after October gains By Larry Terry 30-Oct-20 07:07 HOUSTON (ICIS)--Higher US October oxo-alcohols free-market contract prices may not be the end of price momentum in this year of new seasonal-demand precedents. Downstream, US existing-home sales rose 9.4% month on month to an annual rate of 6.54m in September, marking a fourth consecutive month of growth, the National Association of Realtors (NAR) said. Compared with September 2019, sales rose 20.9% year on year. Demand from construction, although remaining largely on par with September strength so far, is expected to taper off as the US holiday season begins to gear up in November.

[23]Europe epoxy resins market finely balanced, amid various pulls on supply By Heidi Finch 28-Oct-20 01:45 LONDON (ICIS)--The Europe epoxy resins market is finely balanced in late October and this could continue for November, because of various pulls on supply.

Construction activity has recovered well from the coronavirus Q2 lockdowns, with little to no sign of any seasonal slowdown yet. While construction demand is expected to seasonally slow during Q4, when winter conditions set in, the slowdown could be mitigated to some extent this year by tighter inventory controls, due to coronavirus uncertainty and Brexit-related stock-building.

[24]Asia melamine sees firmer indications on stronger Chinese demand By Joson Ng 27-Oct-20 16:16 SINGAPORE (ICIS)--Melamine spot price indications were firmer in Asia as of 27 October for Chinese exports. Demand in China was gaining strength, driven by the construction sector. Some producers said they were not able to fulfil certain orders.

[25]Tight supply pushes up Mideast rigid polyol prices despite low demand By Prateek Pillai 23-Oct-20 14:28 SINGAPORE (ICIS)--Spot prices of rigid polyol cargoes in the Middle East were assessed to be firmer amid continued supply shortages. Despite a slowdown in demand due to weakness in the downstream construction sector, the limited supply meant that those buyers who were in need of replenishing their inventories found themselves in a poor negotiating position.

[26]US existing home sales rise 9.4% in September, fourth increase in a row By Stefan Baumgarten 23-Oct-20 01:42 HOUSTON (ICIS)--US existing-home sales rose 9.4% month on month to an annual rate of 6.54m in September, marking a fourth consecutive month of growth, the National Association of Realtors (NAR) said on Thursday. Compared with September 2019, sales rose 20.9% year on year.

[27]US shift to suburbs boosts chems used in durables - Dow CFO By Al Greenwood 22-Oct-20 23:21 HOUSTON (ICIS)--More US consumers are moving out of the city and into the suburbs, which is creating profound changes in buying habits that are increasing demand for appliances, automobiles and other durable goods, the chief financial officer of Dow said on Thursday. Dow noted strength across furniture, bedding, appliances, construction and automobiles. Some of the increase is due to companies restocking, said Howard Ungerleider, chief financial officer. He made his comments in an interview with ICIS.

[28]Asian epoxy resins at 6-month high on strong China demand By Ai Teng Lim 21-Oct-20 18:03 SINGAPORE (ICIS)--Asian epoxy resins prices have hit a six-month high with support from good demand in China, and the uptrend looks poised to hold amid a rosy near-term economic prognosis for China. Recent economic ***data*** have reflected a sterling improvement in the performances of the automobile and construction sectors in China.

For instance, China s September vehicle sales grew nearly 13% year-on-year, and property development investment in the country also grew a healthy 5.6% year-on-year for the period of January-September 2020. The latter invariably heralds increased activity and tempo in the construction sector.

[29]US housing starts rebound in September By Stefan Baumgarten 20-Oct-20 23:28 HOUSTON (ICIS)--US housing starts rose 1.9% month on month in September, following a 5.1% decline in August, the US Census Bureau said in a report on Tuesday. Single-family housing starts in September were at a rate of 1,108,000, up 8.5% from August, and single-family permits were 1,119,000, up 7.8%.

[30]China property development investment grows 5.6% in Jan-Sept By Fanny Zhang 19-Oct-20 12:32 SINGAPORE (ICIS)--China s property development investment posted a growth of 5.6% on year in the first three quarters, with that on housing up by 6.1%, the National Bureau of ***Statistics*** (NBS) said on Monday.

[31]EPCA 20: Firm China TiO2 export sentiment out of kilter with Europe's status quo By Heidi Finch 08-Oct-20 23:21 LONDON (ICIS)--Firm China titanium dioxide (TiO2) export sentiment, amid a snug and rebounding market, is somewhat out of kilter with the well-covered and recovering, albeit challenged European status quo. Some European traders, who source from Asia, are facing higher prices for Q4 shipments due to snug supply in China, rebounding downstream demand and higher costs, but traction in Europe is proving challenging. This is because Europe is well-supplied and is recovering, but also facing some unsettling market factors.

[32]EPCA 20: European ethanolamines buyers seek pandemic-proof contracts for 2021 By Jane Gibson 08-Oct-20 19:55 LONDON (ICIS)--The time has come for buyers and sellers on the European ethanolamines market to think about contract terms for 2021. The EPCA usually offers an opportunity for the market to look ahead to the next year, digesting potential changes in end-user markets and expected growth in the economy as a whole. The biggest demand growth opportunity in 2021 would come from the construction sector, where demand for triethanolamine (TEA) 85% was likely to continue to grow, producers said.

[33]EPCA '20: Europe MA players may recover losses from lockdowns by year end By Anne-Sophie Briant-Vaghela 07-Oct-20 20:48 LONDON (ICIS)--Europe's maleic anhydride (MA) market has taken several months to awaken from the deep slumber it was thrown into by the pandemic in May, but September and October order books have been filled at lightning speed with players watching in disbelief. Unsaturated polyester resins, which account for roughly 45% of the continent's MA consumption, have been responsible for a sharp pick up in MA orders in the past few weeks after a long spell of quiet improvement.

[34]Swiss Sika expands mortar production in China By Pearl Bantillo 06-Oct-20 14:41 SINGAPORE (ICIS)--Sika has expanded its mortar production in China via commissioning a new facility in Chengdu, the Swiss producer said on Tuesday. Details on investment and plant capacity were not disclosed. Sika will benefit from strong demand in Chengdu, the capital of Sichuan province in southwestern China, as well as from the launch of new products and expansion of distributor network.

Citing estimates, the company said construction in the world s second-biggest economy is expected to grow 6.1% in 2021, with the average annual growth pegged at around 5% until 2029.

[35]BASF closes sale of construction chem ops to private equity By Stefan Baumgarten 01-Oct-20 01:22 LONDON (ICIS)--BASF has completed the divesture of its construction chemicals business to an affiliate of global private equity firm Lone Star, effective midnight, 30 September. Under a deal agreed in December 2019, Lone Star's purchase price was 3.17bn, on a cash and debt-free basis.

[36]US construction spending rose 1.4% in August By Stefan Baumgarten 01-Oct-20 23:06 HOUSTON (ICIS)--US August construction spending rose 1.4% month on month from July, led by a 3.7% increase in residential construction, the US Census Bureau said in a ***data*** release on Thursday. Compared with August 2019, total construction spending was up 2.5% year on year.

[37]Europe PS and EPS mixed demand expectations for Q4 depending on downstream sector By Stephanie Wix 01-Oct-20 03:57 LONDON (ICIS)--Expectations in both the European polystyrene (PS) and expandable polystyrene (EPS) markets are mixed regarding October demand levels and Q4, since some downstream sectors have had stronger buying trends than others. Overall the EPS market has been stronger this month compared with PS, due to softening activity in some downstream PS applications. Meanwhile, construction buying activity is also stable to softer in both PS and EPS markets, due to the financial impact of the coronavirus on construction companies. Some players have seen more stable demand than others, depending on region.

[38]Asia s caustic soda market supply to remain healthy; demand recovery sluggish By Jonathan Chou 30-Sep-20 17:19 SINGAPORE (ICIS)--Spot supply for liquid caustic soda in Asia is expected to outweigh demand in the near term, as producers in the region continue to grapple with high inventory levels amid sluggish uptake. Asia s PVC market has been supported by resurgent demand amid production outages that constrained inflows of deep-sea supply.

Caustic soda is used in the manufacture of pulp and paper products, alumina, soap, water treatment, and textiles, while PVC sees different end-uses in applications such as pipes and profiles, in the construction industry, and for medical devices.

[39]Europe POM and PBT demand increase ahead of Q4 discussions By Zubair Adam 29-Sep-20 19:56 LONDON (ICIS)--There has been an increase in demand in Europe for polyacetal (POM) and polybutylene terephthalate (PBT) ahead of Q4 negotiations. The rise has continued from August into September.

[40]With China's economy on a roll, domestic petchem demand brightens up By Felicia Loo 28-Sep-20 14:10 SINGAPORE (ICIS)--While major world economies are still struggling with the coronavirus pandemic that has bruised their economies, China is on the fast lane to recovery, supported by Beijing s stimulus measures. China wasted no time in whipping its economy back to shape following the outbreak of the deadly virus which was detected late last year in the city of Wuhan, with infrastructure and construction amongst its priorities.

[41]Commercial-construction recovery lags behind residential - HB Fuller By Al Greenwood 25-Sep-20 01:30 HOUSTON (ICIS)--The recovery in the commercial construction market should continue in the fourth quarter, but at a slower rate than that for residential, US-based adhesives producer HB Fuller said on Thursday.

Although commercial construction is lagging behind residential, it is still improving, said Jim Owens, CEO. He made his comments during an earnings conference call.

[42]Construction, automotive outlook murky for US PA in H2 By Antoinette Smith 23-Sep-20 05:38 HOUSTON (ICIS)--The H2 outlook for demand for US phthalic anhydride (PA) is hazy, with strong construction activity expected to taper with cooler weather, and automotive sales unlikely to surge in the remaining months of the year.

US builder confidence in the market for newly built single-family homes rose to an all-time high in September, as housing leads the economic recovery from the coronavirus downturn. Demand for new homes remains high, supported by low interest rates, the National Association of Home Builders (NAHB) said.

[43]US existing home sales keep rising, lumber shortage hits inventory By Stefan Baumgarten 22-Sep-20 23:09 HOUSTON (ICIS)--US existing home sales continued to rise in August, but high prices and a shortage of lumber tightened already scarce housing inventories, the National Association of Realtors (NAR) said on Tuesday.

Existing-home sales marked a third consecutive month of gains in August up 2.4% from July to a seasonally-adjusted annual rate of 6.0m in August. Sales rose 10.5% year on year from August 2019. Total housing inventory at the end of August totalled 1.49m units, down 0.7% from July and down 18.6% from one year ago.

[44]Tight supply continues to drive Middle East isocyanate prices By Prateek Pillai 18-Sep-20 22:38 SINGAPORE (ICIS)--Spot prices for isocyanate cargoes in the Middle East continued to rise as tight supply conditions meant that demand outstripped supply in the week ended 17 September. Demand from the construction industry in the form of insulation foams has also rebounded, as the end of the summer months coincided with a rise in construction activity.

[45]US October oxo-alcohols price-increase initiatives emerge By Larry Terry 18-Sep-20 04:07 HOUSTON (ICIS)--Separate US October oxo-alcohols price-increase initiatives emerged from two producers as September price talks continued amid generally improving volumes. Month-on-month oxo-alcohols volume gains have become more common since coronavirus strictures broadly began to ease in May, despite resurgent cases across the US in recent months. Among downstream markets, architectural coatings continue to drive most volume, with automotive manufacturing gaining ground but not expected to reach year-ago levels.

[46]INSIGHT: US polyurethane demand recovering faster than expected from Q2 low points By Zachary Moore 18-Sep-20 00:50 HOUSTON (ICIS)--Demand for polyurethane systems in the US has staged a faster than expected recovery from the low points in consumption seen in the second quarter. North American demand for polyurethanes plunged in April and May during the period of strictest coronavirus-related movement restrictions. Industry participants at the time expected demand recovery to be slow and gradual, with a resumption of pre-crisis demand expected to be delayed until 2022.

[47]US August housing starts fall 5.1% from July By Stefan Baumgarten 17-Sep-20 23:00 HOUSTON (ICIS)--US housing starts and building permits fell month on month in August, the US Census Bureau said in a ***data*** release on Thursday. US builder confidence in the market for newly built single-family homes rose to an all-time high in September, an industry trade group reported earlier. The American Chemistry Council (ACC) estimates each new home built represents some $15,000 worth of chemicals and derivatives used in the structure or in the production of component materials.

[48]Europe construction output stable in July but nearly 4% lower year on year By Morgan Condon 17-Sep-20 21:44 LONDON (ICIS)--The European petrochemicals-intensive construction sector was relatively stable in July but nearly 4% lower year on year, the EU s statistical agency ***Eurostat*** said on Thursday. Production in July edged up by 0.2% in the eurozone, month on month; in the wider 27-country EU, it fell by 0.1%.

[49]SE Asian MA offers spike with domestic China rally By Ai Teng Lim 11-Sep-20 13:09 SINGAPORE (ICIS)--Southeast Asian import offers for maleic anhydride (MA) surged, following significant gains seen in the domestic yuan-denominated market. Market participants largely expect the Chinese domestic market to hold steady at least until the extended China National Day holidays start in early October, which could likely continue to support sentiment for US dollar-denominated MA cargoes. Domestic trades have been boosted by improved demand, as construction sector activities are resuming at a steady pace within China in recent weeks, market sources said.

[50]Europe Sep isocyanates contracts jump; TDI posts record leap By Fergus Jensen 10-Sep-20 23:34 LONDON (ICIS)--Europe isocyanates contracts for September were assessed this week, jumping triple digits as strong demand for rigid and flexible polyurethane (PU) foams outstripped limited feedstock supply. European market tightness is being mirrored by supply constraints in the US and Asia, which are expected to feature in October contract talks."Construction is doing very well," said one Europe-based MDI producer. "Panels production, sandwich panels, floor panels and composite wooden panels are all at very healthy levels," the producer added.

[51]INSIGHT: End market numbers show chemicals face further turmoil By Rhian O'connor 10-Sep-20 20:00 LONDON (ICIS)--Prospects for a speedy recovery for the chemicals sector remain bearish in the face of fresh end market ***data*** hinting at further volatility. New numbers released by Oxford Economics last week show further downgrades to production forecasts for 2020 across most end markets and most regions. China continues to be the bright spark of global growth, at least on reported numbers. Recent news of higher than expected manufacturing exports from China highlights its continued role as manufacturer to the world.

[52]Melamine producers to face turnarounds in late Q3, Q4 as buyers prepare for quarterly negotiations By Deniz Koray 10-Sep-20 06:27 HOUSTON (ICIS)--Multiple melamine producers are either currently undergoing scheduled turnarounds or will begin them this fall and winter. Since there is only one US producer of melamine, production levels in Europe and Asia are also important to monitor.

[53]INSIGHT: Huntsman Q3 upward guidance signals improving automotive, construction trends By Joseph Chang 10-Sep-20 03:58 NEW YORK (ICIS)--Huntsman s upside guidance on polyurethanes (PU) for Q3 2020 highlights improving trends in construction and automotive, two key markets for the entire chemicals sector. Huntsman said the improved outlook is being driven by continued strength in construction-related markets, better than expected improvement in automotive demand and higher overall margins.

[54]US July construction spending inches up, led by residential construction By Stefan Baumgarten 02-Sep-20 00:49 HOUSTON (ICIS)--US July construction spending rose slightly month on month from June, with a 2.1% increase in residential construction offsetting declines in non-residential and public construction, the US Census Bureau said in a ***data*** release on Tuesday.

July US construction spending: Annual rate, billion US$ Change from June Total 1,364.6 +0.1% Private 1,013.5 +0.6% -Residential 546.6 +2.1% -Non-residential 466.9 -1.0% Public 351.1 -1.3%

Compared with July 2019, total construction spending was down 0.1% year on year.

[55]North American PS sales rise month on month in July; sales remain lower year on year By Zachary Moore 28-Aug-20 07:19 HOUSTON (ICIS)--North American sales of polystyrene (PS) rose month on month in July while sales remained lower compared with the same month of the prior year, according to ***data*** recently released by the American Chemistry Council (ACC) and Vault Consulting. PS sales have been rising incrementally over the past two months after posting significant declines in the months of April and May during the period of the most stringent coronavirus-related lockdowns.

[56]US housing in V-shaped recovery, pending home sales rise 5.9% in July - NAR By Stefan Baumgarten 27-Aug-20 23:16 HOUSTON (ICIS)--US pending sales of existing homes rose 5.9% month on month in July, with sales in each of the four major regions rising, the National Association of Realtors (NAR) said. July s increase marked the third consecutive month of growth in pending home sales. Year on year, contract signings rose 15.5% from July 2019. Home buyers are returning to the housing market after large parts of the economy were shut down in March and April to contain the coronavirus.

[57]European nylon 6 August contract prices settle between rollover and slight increase By Stephanie Wix 26-Aug-20 04:13 LONDON (ICIS)--European nylon 6 contract prices for August have settled between rollover and an increase of 0.01/kg, driven by stable market dynamics and the 6/tonne increase for key feedstock benzene. Demand in non-automotive sectors, such as construction, textiles, household, nylon yarns and carpet fibres, remains broadly stable.

[58]SE Asian MA import offers supported by a buoyant China but demand stays structurally soft By Ai Teng Lim 22-Aug-20 00:03 SINGAPORE (ICIS)--Southeast Asian maleic anhydride (MA) import offers picked up slightly this week, as sellers were motivated by the strong showing in the domestic yuan-denominated markets to hold their ground in September negotiations.

MA is used heavily in the region for the manufacturing of unsaturated polyester resins (UPR). UPR is in turn dependent on consumption from sectors like automotive and construction, which are still reeling from the coronavirus-induced global economic slowdown.

[59]Mexico s PVC demand from construction sector remains questionable By Luly Stephens 20-Aug-20 03:12 HOUSTON (ICIS)--Demand for polyvinyl chloride (PVC) from the construction sector in Mexico has not improved, despite the optimism that emerged in June when the local government considered construction an essential industry. Effective 1 June, and following the guidelines published by the Health and Labor Ministries, construction activity could be resumed in Mexico. But with the construction sector already sluggish prior to the virus crisis, and both public and private construction projects halted due to the rapid spread of the virus, the construction industry recorded a Q2 contraction estimated at -30%.

[60]US housing starts rise in July By Tracy Dang 20-Aug-20 06:26 HOUSTON (ICIS)--US privately owned housing starts in July rose for the third straight month, measured on a seasonally adjusted annual rate, the US Census Bureau said in a report. Year on year, new home construction was up. Building permits rose month on month, and housing completions rose.

[61]Asia PVC to see snug supply amid turnaround, limited deep-sea volumes By Jonathan Chou 20-Aug-20 13:29 SINGAPORE (ICIS)--Asia's spot polyvinyl chloride (PVC) supply is expected to remain snug amid an ongoing northeast Asian producer s turnaround, as well as limited deep-sea availability from the US. Supply of deep-sea material from the US has been limited since July amid improved domestic demand in the construction sector.

[62]Europe construction output climbs in 4.0% in June, down on year By Morgan Condon 20-Aug-20 18:34 LONDON (ICIS)--Construction output in Europe rebounded in June month on month, according to the latest ***data*** from ***Eurostat***. Production in the sector rose by 4.0% in the eurozone and by 2.9% in the wider EU in June as lockdown restrictions continued to ease. France marked the highest increase at 12.0%. As a key end-market for the chemicals industry, a pickup in construction is likely to support demand and prices for some products in the sector.

[63]Feedstock spreads for Middle East isocyanates reach new highs By Prateek Pillai 19-Aug-20 19:22 SINGAPORE (ICIS)--Feedstock spreads for toluene diisocyanate (TDI) and polymeric methylene diphenyl diisocyanate (PMDI) in the Middle East have risen to their highest levels in a year. In the week ended 14 August, the feedstock spread for TDI reached $1,469/tonne while the PMDI spread touched $1,123.50/tonne. This trend has been driven by an increasing disparity between demand and supply for both isocyanates as production levels have failed to keep up with growing downstream foam demand. TDI is used for the creation of foam products like mattresses, rugs and cushions while PMDI is used primarily for producing insulation foams used in the construction sector.

[64]US-Canada PVC sales outpace production, constricting exports By Bill Bowen 13-Aug-20 05:51 HOUSTON (ICIS)--Demand and production of polyvinyl chloride (PVC) remains out of balance in the US and Canada, and is muddying market participants' view of the remainder of 2020. Monthly domestic sales of US and Canada PVC resins climbed enough to put July's figures among the highest of the past five years, trimming exports and reducing inventories, according to preliminary figures released Wednesday by an industry group. July s sales outpaced production, reducing inventories to about seven days' worth of sales, the producer said.

[65]INSIGHT: Seasonally softer summer for styrene but September sentiment stronger By Helena Strathearn 11-Aug-20 23:50 LONDON (ICIS)--Summer holidays have taken some players out of the European styrene market and there is a downturn in manufacturing output as is traditional, but the slowdown is not expected to be as notable nor as long as usual and the outlook for September is stronger. August demand for styrenics will see a seasonal slump, most notably in southern Europe, but it will probably not be as impactful as in previous years. September demand is expected to pick up on restocking and also as many end-use markets such as construction can continue until the end of October, and some into November or early December. Construction, appliances, electronics, white goods packaging, fish boxes packaging and sanitary applications demand has been holding fairly well but not yet returned to 2019 levels.

[66]China ECH prices rise as domestic supplies tighten; outlook clouded By Ai Teng Lim 11-Aug-20 15:02 SINGAPORE (ICIS)--China s domestic prices for epichlorohydrin (ECH) recovered some lost grounds this week as domestic supplies bucked earlier anticipations to turn tighter, instead of lengthening further. But with demand conditions still broadly dampened by nagging global economic worries, this may serve to curtail upside potential of ECH spot pricing, even if supply constraints seen this week do persist for some time more.

[67]China's petrochemical prices consolidate in July, demand largely stable By Yvonne Shi 04-Aug-20 16:48 SINGAPORE (ICIS)--China's petrochemical market fluctuated within a narrow range in July. The prices of most chemical products saw limited changes. Overall demand appeared to be generally stable, whereas supply pressure differed from product to product. On the whole, the sustainability of demand into construction markets is better, followed by the automotive industry, while textiles are weaker.

[68]US June construction spending falls from May By Tracy Dang 04-Aug-20 03:11 HOUSTON (ICIS)--US construction spending in June fell month on month but rose year on year on a seasonally adjusted basis, the US Census Bureau said in a Monday report. Residential construction was down month on month and year on year. Nonresidential construction was down month on month but up year on year.

[69]European PVC July prices rise more sharply than ethylene, market tightens By Chris Barker 03-Aug-20 18:39 LONDON (ICIS)--Average European polyvinyl chloride (PVC) contract prices rose for July by more than the cost increase from ethylene as a result of tighter availability in the market. A number of sellers achieved increases of 45/tonne or more because of higher demand and tighter availability. However, larger buyers were in some cases able to avoid increases above the ethylene cost. Price trends were consistent across NWE and the Mediterranean, with UK increases assessed at similar levels. In central and Eastern Europe there was a higher settlement with one producer source noting increases of 50-55/tonne on average.

[70]INTERVIEW: Chemours sees TiO2 volume recovery in Q3 driven by architectural coatings - CEO By Joseph Chang 31-Jul-20 23:33 NEW YORK (ICIS)--The world s largest producer of titanium dioxide (TiO2), Chemours, expects a sequential rebound in volumes in the low- to mid-teens percentage-wise, driven by architectural coatings, its CEO said on Friday. As we pivot to the third quarter, we re seeing a pick-up on the coatings side but maybe a shift in North America to not just DIY (do-it-yourself) but also into contract painting. People are starting to get more comfortable painting outside as well as inside, said Mark Vergnano, CEO of Chemours, in an interview with ICIS. In the second quarter, which saw TiO2 volumes fall by around 20% sequentially versus Q1 and 9% year on year, demand was driven mostly by DIY coatings demand - from customers with their own stores or those with access to big box retailers, he noted.

[71]India PVC market to face sustained tight import supply By Zhi Xuan Ho 24-Jul-20 14:21 SINGAPORE (ICIS)--Trade in the polyvinyl chloride (PVC) market in India slowed this week, with business for August shipments largely concluded in the previous week. Sentiment in the market remains bullish, with many market players expecting supply to remain tight moving forward.

[72]US August oxo-alcohols price efforts driven partly by expected upstream pressure By Larry Terry 24-Jul-20 06:25 HOUSTON (ICIS)--US August oxo-alcohols price-increase initiatives have emerged on an anticipated increase in the upstream July propylene contract and persistent margin pressure. July propylene negotiations, however, are still underway, with talks protracted by rising spot bids and offers.

[73]Europe extrusion PC July prices fall for third month on weak demand, ample availability By Miguel Rodriguez Fernandez 23-Jul-20 18:32 LONDON (ICIS)--Contract prices for extrusion grade polycarbonate (PC) have fallen slightly for the third consecutive month in July amid weak demand and ample supply. Most monthly extrusion grade business was concluded with rollovers and double-digit reductions.

[74]Asia petrochemical demand mixed amid tightening supply By Felicia Loo 23-Jul-20 12:27 SINGAPORE (ICIS)--Demand for key petrochemicals in Asia is mixed, with some markets in the pits despite shrinking supply, while other products appear to fare better, as the onslaught of the coronavirus carries on. But the overall market outlook for the second half of the year will be dim amid weakness in the world's second-biggest economy.

[75]China 2020 H1 real estate development investment rises 1.9% By Fanny Zhang 16-Jul-20 14:37 SINGAPORE (ICIS)--China invested yuan (CNY) 6.28tr ($897bn) on real estate development in the first half of 2020, an increase of 1.9% from the same period in last year, reversing the continuous decrease in previous months, ***data*** from the National Bureau of ***Statistics*** (NBS) showed on Thursday.

[76]US polyester polyol prices decline on weaker feedstock costs By Zachary Moore 16-Jul-20 06:37 HOUSTON (ICIS)--US polyester polyol prices were assessed 2 cents/lb ($44/tonne) lower as key feedstock costs continue to trend lower. Sentiment in major polyester polyol feedstock markets suggests that these markets may be nearing a trough as energy costs move higher and general economic activity is improving from the low points seen in prior months.

Demand from the construction sector has bounced back quicker than many other major consuming sectors of polyols and downstream polyurethane systems, although overall demand levels remain below pre-crisis levels.

[77]US plastic, chemical demand remains soft, margins stay depressed By Al Greenwood 16-Jul-20 03:30 HOUSTON (ICIS)--Demand for plastics and basic chemicals in the US was soft, while margins remained depressed, the Federal Reserve said on Wednesday.

The anecdote was among several that the US central bank ***collected*** in its recent Beige Book, a summary of US economic activity during the past six weeks among the Fed's 12 districts. The latest Beige Book contains information ***collected*** through 6 July. The comments about demand came from the 11th Federal Reserve District, which includes northern Louisiana and all of Texas, and has many of the nation's refineries and petrochemical plants.

[78]China s amines market under pressure on high stocks and weak demand By Yuanlin Koh 15-Jul-20 17:03 SINGAPORE (ICIS)--China s ethanolamines market is looking bearish in the near term on excess supply, as demand continued to struggle. China, hit by the rains, saw a drop in demand, especially in DEA s (diethanolamines) downstream DEIPA (diethanol isopropanolamine) used mainly as cement aids in the construction industry. Demand in this sector was initially picking up after the coronavirus pandemic in the country, as the economy reopened, and with government support, demand for DEA flourished.

[79]Asian epoxy resins export discussions sink deeper on poor demand By Ai Teng Lim 14-Jul-20 15:21 SINGAPORE (ICIS)--Asian epoxy resins export discussions lost more ground this week as sellers lowered offers to boost demand. Epoxy resins is heavily used in automobile and construction sectors, both of which are still struggling to find a firmer footing in the pandemic-ravaged global economy.

[80]INSIGHT: Construction could pave the way for Q3 chemicals recovery in Europe By Morgan Condon 10-Jul-20 23:25 LONDON (ICIS) As with all forms of industry, the coronavirus came in like a wrecking ball, bludgeoning any chances of growth in the construction sector for the first half of 2020. The foundations have been laid for a return to industrial activity, however, as lockdown restrictions across Europe have been eased, which could provide support for chemicals used in the construction industry.

[81]US construction is returning to pre-Covid levels - trade group By Al Greenwood 19-Jun-20 01:37 HOUSTON (ICIS)--In many parts of the US, construction activity is returning to levels that predate the coronavirus (Covid-19), a trade group said on Thursday. The Associated General Contractors of America (AGC) based its finding on its new survey and on ***data*** from Procore, a construction-technology company. Procore analysed workers' hours. Based on that analysis, construction activity has returned to pre-coronavirus levels in 34 US states. Among eight large cities, Dallas, Texas, and Miami, Florida, are back to pre-pandemic levels. Some construction companies are adding new workers, the AGC said. According to its survey, 21% are adding employees. That compares with 25% that were letting workers go between March and May. In June, only 8% of construction companies were forced to furlough or lay off workers, the AGC said.

[82]US housing starts rebound in May By Tracy Dang 18-Jun-20 06:33 HOUSTON (ICIS)--US privately owned housing starts in May rose after three consecutive months of declines, measured on a seasonally adjusted annual rate, the US Census Bureau said in a report. Year on year, new home construction was down. Building permits fell month on month, and housing completions fell. The housing market is a key consumer of chemicals, driving demand for a wide variety of chemicals, resins and derivative products such as plastic pipe, insulation, paints and coatings, adhesives, and synthetic fibres, among many others. The American Chemistry Council (ACC) estimates each new home built represents some $15,000 worth of chemicals and derivatives used in the structure or in the production of component materials.

[83]June EPS demand improving in the US, but remains below pre-crisis levels By Zachary Moore 17-Jun-20 06:27 HOUSTON (ICIS)--US demand for expandable polystyrene (EPS) is improving as economic activity picks up and lockdown measures ease. However, overall activity and EPS consumption both remain below pre-crisis levels. Activity in the construction sector has improved as lockdown measures are eased, although there is some concern that most current activity revolves around the completion of existing projects, rather than the start-up of new projects. Projections from ICIS Analytics suggest that construction activity will rise above 2019 levels in 2021, although creditworthiness concerns may limit the number of new projects.

[84]Eurozone, EU construction continues dropping in April as lockdown limits production By Morgan Condon 17-Jun-20 19:06 LONDON (ICIS)--Construction throughout the EU plummeted in April as countries implemented quarantine restrictions to combat rising coronavirus infection rates, according to first estimates from EU ***statistics*** agency ***Eurostat*** on Wednesday. This has served to weigh on demand for chemicals used in the sector. Production in the construction sector decreased by 14.6% in the eurozone and by 11.7% in the wider EU area in April compared with the previous month and accounting for seasonal adjustment.

[85]China Jan-May real estate investment contracts 0.3% year on year By Fanny Zhang 15-Jun-20 14:22 SINGAPORE (ICIS)--China s real estate development investment in the first five months of 2020 slipped 0.3% year on year to Chinese yuan (CNY) 4.59tr ($647m), official ***data*** showed on Monday. The decline has eased from 3.3% recorded in January to April. Investment in house construction in January-May stood at CNY3.38tn, unchanged from the previous corresponding period. It was an improvement from the 2.8% fall in January-April 2020. Real estate developers house construction acreage in the five-month period increased 2.3% on year to 7.6bn square metres (sqm), slower than the 2.5% growth in January-April.

[86]Europe Melamine Q3 contract talks yet to begin, demand outlook remains uncertain By Melissa Hurley 11-Jun-20 23:54 LONDON (ICIS)--European melamine contract discussions for the third quarter could begin later than usual, as consumers find it challenging to plan volume requirements given the fragile state of the economy as lockdowns ease.

In the spot market, there is increased pressure, and prices have been assessed stable to softer this week. Demand outside contractual requirements is weak, given the demand issues experienced in the market.

The [87]construction industry has been adversely impacted by the coronavirus pandemic, although to a lesser extent than automotive, another key end market for petrochemicals.

[88]Europe PU feedstocks prices hit new lows as demand pickup lags By Fergus Jensen 11-Jun-20 20:28 LONDON (ICIS)--Incremental improvements in demand for polyurethane (PU) products have slowed downward pressure on the Europe isocyanates and polyols markets where supply is abundant, and producers are now hoping for a reversal in the coming months. June contracts for polyols, toluene diisocyanate (TDI), and crude and pure methylene diphenyl diisocyanate (MDI) were all settled below May contract levels, and in some cases at hit new record lows. According to one Europe-based reseller, the construction market in NWE was now at 90% of activity, compared with this time in 2019. Demand for adhesives and wood binding has also improved, as well as that for insulation panels and spray foam, among others.

[89]US MDI, TDI demand remains sluggish even as overall economic activity picks up By Zachary Moore 11-Jun-20 06:27 HOUSTON (ICIS)--Demand for US methylene diphenyl diisocyanate (MDI) and toluene diisocyanate (TDI) remain sluggish even as the broader macro-economy is observing some pick-up in activity. Localities throughout the US are gradually easing lockdown measures, leading to some improvement in broader economic indicators. The construction sector has been performing better than most of the other major sectors of polyurethane demand, although participants feel that the success of the sector may be temporary.

Much of the activity in the sector is being driven by work to complete projects that had been underway prior to the recent crisis. There are concerns that activity might slow down once these projects are completed. US housing starts fell 29.7% year on year in April 2020, according to ***data*** from the US Census Bureau.

[90]US epoxy players monitoring demand amid economic reopening By Tarun Raizada 10-Jun-20 05:21 HOUSTON (ICIS)--US epoxy is facing some uncertainty in June amid the economic reopening. Q2 demand has softened during the pandemic, with typical seasonal trends not materialising so far. There is stronger demand from architectural do-it-yourself (DIY) and packaging coatings, which is being more than offset by softer demand from architectural do-it-for-me (DIFM), automotive and industrial coatings. The US building and construction sector could prove to be far more resilient than the automotive sector. But the pandemic is creating a volatile backdrop for chemical companies as they navigate the road to recovery. Epoxy resins are used as adhesives on metals and construction materials, as well as in coatings and automobiles.

[91]Asian MA afloat on some buying, but demand uncertainties loom By Ai Teng Lim 05-Jun-20 09:52 SINGAPORE (ICIS)--As post-coronavirus production recovery commences gingerly across Asia this week, buying tempo also picked up in Asia s maleic anhydride (MA) market to keep spot prices afloat. But with longer-term global economic outlook still clouded by many uncertainties, from geopolitical tensions to macro-level demand-supply imbalances, it remains to be seen if the buying could sustain for long.

[92]North American PS sales drop 21.8% year on year in April By Zachary Moore 05-Jun-20 05:49 HOUSTON (ICIS)--North American total sales and captive use of polystyrene (PS) fell by 21.8% in April 2020 compared with the same month of the prior year, according to ***data*** recently released by the American Chemistry Council (ACC) and Vault Consulting. The coronavirus outbreak and subsequent containment measures caused a sharp drop in overall economic activity in April, impacting production and sales of PS across most consumption segments.

[93]US manufacturing contracts again in May but overall economy expands - ISM By Tracy Dang 02-Jun-20 06:53 HOUSTON (ICIS)--US manufacturing activity contracted for the third consecutive month in May, but at a slower pace from April, the Institute of Supply Management (ISM) said on Monday. The overall economy returned to expansion after a month of contraction, the report said.

Three months into the manufacturing disruption caused by the coronavirus pandemic, comments from the panel were cautious (two cautious comments for every one optimistic comment) regarding the near-term outlook, said Tim Fiore, chair of the ISM.

[94]European plasticizers see slightly better demand in June, but still very mixed By Jane Massingham 04-Jun-20 23:24 LONDON (ICIS)--The first days of June are continuing to portray a rather mixed picture in terms of demand for plasticizers. Various countries are seeing lockdown restrictions that are allowing some businesses to return to work. One seller noted it is still challenging and said: Demand is not so great and continues to be like that, but it is building up slowly and should be better as June progresses and July should be more. The automotive sector continues to be the hardest hit but there are sectors of the construction industry starting to come back.

[95]Europe chemicals to gain from EU green deal spending plans - bank By Tom Brown 04-Jun-20 21:10 LONDON (ICIS)--European chemicals players are expecting to see increased business momentum on the back of the EU s green deal expected to unlock hundreds of billions of euros of investment in sustainability projects, according to Credit Suisse. A virtual conference organised by the bank hosted management teams from 20 chemicals, ***agriculture***, packaging and cement firms address investors, with all chemicals firms present noting expectations for an increase in sales on the back of the mooted EU green investment plan.

However, little visibility on uplift from the measures is expected over the next 12-18 months.

[96]Thailand greenlights $9bn airport project to BBS consortium By Fanny Zhang 04-Jun-20 14:48 SINGAPORE (ICIS)--Thailand s cabinet approved a bid by BBS consortium to develop a $9bn U-Tapao Airport and Eastern Aviation City project at the country s southeastern coast, according to local media reports.The winning bid was approved on 2 June and the government is expected to sign the contract with BBS consortium on 19 June, these reports added. The announcement follows the passage of $58bln economic support package on 31 May by Thailand s parliament to ease the impact of the coronavirus on the economy and people.

[97]Australia launches A$680m stimulus for residential construction By Pearl Bantillo 04-Jun-20 12:33 SINGAPORE (ICIS)--Australia has launched a stimulus package worth Australian dollar (A$) 680m ($470m) to boost activity in the construction sector, which was hit by the coronavirus pandemic. Dubbed the HomeBuilder program , the funds will help support 140,000 direct jobs in the residential construction sector, Australian Prime Minister Scott Morrison said on Thursday.

Under the programme, all eligible owner-occupiers will receive a grant of A$25,000 either to build a new home or renovate an existing home. Construction must start within three months of the contract date. Based on eligibility criteria for applicants and price caps on new home builds (A$750,000) and renovation (A$150,000-750,000), the government expects to hand out 27,000 of such grants under the programme.

[98]INTERVIEW: US construction outlook far more positive than automotive - Huntsman CEO By Joseph Chang 03-Jun-20 06:56 NEW YORK (ICIS)--The US building and construction market is recovering and proving far more resilient than the automotive sector, the CEO of Huntsman Corp said on Tuesday. In homebuilding, DIY [do it yourself] and OSB [oriented strand board] are doing quite well. It s down from a year ago but nowhere near what we expected a month or two ago, said Peter Huntsman, CEO of Huntsman Corp, in an interview with ICIS amid the American Chemistry Council (ACC) virtual annual meeting.

Building products, furniture, insulation, and OSB are showing some resilience, he added. Huntsman is a major producer of methylene diphenyl diisocyanate (MDI), heavily used in the construction market in insulation, binding and coatings, and in the automotive sector in bumpers, conveyor belts and other parts, as well as coatings. Polymeric MDI is used as a binder in OSB, an engineered wood used in construction. Pure MDI is used in coatings, adhesives, sealants and elastomers (CASE).

[99]Covestro volumes down sharply in April-May, improvement expected for June By Tom Brown 29-May-20 00:46 LONDON (ICIS)--Covestro's core volumes dropped 30% in April and May, but order book levels point to an improvement in June, according to the company and analysts at Baader Bank. April automotive sector customer demand fell 60% in the EU and North America, with furniture market demand falling 45% year on year a 30% increase in medical polycarbonates (PC) demand unable to offset the scale of the falls elsewhere.

Overall polyurethanes (PU) volumes fell 40% in April while moves to channel PC material to less affected markets mitigated the volume decline in that division to 20%. Coatings, adhesives and sealants (CAS) sales dropping at a similar level, Baader said, citing an investor call chaired by Covestro CEO and CFO, Markus Steilemann and Thomas Toepfer, respectively.

[100]INSIGHT: Asia phenol market unlikely to recover until 2021 By Angeline Soh 25-May-20 19:02 SINGAPORE (ICIS)--Asia s phenol market is unlikely to make a full recovery in the second half of this year as the coronavirus pandemic has caused end-market demand to plummet. The International Monetary Fund (IMF) has predicted the global economy will shrink by 3% this year, describing the current crisis as the worst the world has faced since the Great Depression in the 1930s.

There has been a boom in end-use products heavily used during the pandemic such as packaging, disinfectants like hand sanitisers, and face masks. However, other segments like automobile and construction have been underperforming.

[101]China downplays pollution issue; still hopes to meet emission targets By Fanny Zhang 25-May-20 16:40 SINGAPORE (ICIS)--China has not emphasized pollution issues at its parliamentary sessions this year, toning down its commitment to emissions targets, as it places top priority to getting businesses back to normal amid the coronavirus pandemic.

Employment, poverty alleviation, control on financial risk, consumption growth and business recoveries are key topics of discussions at the country s biggest political gathering in Beijing, which kicked off on 22 May. The National People s Congress (NPC) and the Chinese People s Political Consultative Conference (CPPCC) are holding their annual meeting until 28 May.

[102]US May oxo-alcohols prices continue to trend weaker By Larry Terry 22-May-20 06:23 HOUSTON (ICIS)--Weaker pricing for US May oxo-alcohols free market contract ranges continues to be more evident, but the magnitude of declines is not yet clear. Major downstream construction- and automobile-coatings demand has yet to gain any seasonal momentum, with easing coronavirus strictures still in the early stages.

[103]US PVC contracts for June nominated higher as demand creeps back amid lower operating rates By Bill Bowen 22-May-20 06:09 HOUSTON (ICIS)--US producers of polyvinyl chloride (PVC) have separately nominated June contracts higher by 3 cent/lb ($66/tonne) as lower operating rates limit supply and demand begins to creep back. The announcements come as a bit of a surprise and some market participants say that the outcome will certainly depend on how demand recovers as coronavirus lockdowns ease.

US spot export prices have fallen sharply in recent weeks as coronavirus precautions destroyed demand in key exporting markets, including China, Turkey, India, Malaysia, Peru and Argentina, among others.

[104]US existing home sales fall to lowest level in 10 years By Stefan Baumgarten 21-May-20 22:55 HOUSTON (ICIS)--US existing-home sales fell to their lowest level in April since July 2010 amid the lockdowns and restrictions authorities imposed from mid-March through April to contain the coronavirus (Covid-19) pandemic.

Existing home sales fell 17.8% from March to a seasonally-adjusted annual rate of 4.33m in April, and they were down 17.2% year on year from April 2019, the National Association of Realtors (NAR) reported on Thursday.

[105]Weak soda ash demand in Asia may continue to offset output cuts in China By Helen Lee 20-May-20 16:31 SINGAPORE (ICIS)--Asia s soda ash market remains under pressure amid rising inventory pressure in China, on the back of weak downstream demand due to extended social isolation measures. Supply remained more than sufficient despite ongoing and impending shutdowns at several soda ash plants in China.

China s domestic demand was just as downbeat on account of liquidity issues and high inventories faced by downstream glass producers on the back of poor performance in the construction/real estate sector.

[106]BASF to work with a China university on infrastructure solutions By Fanny Zhang 20-May-20 13:50 SINGAPORE (ICIS)--BASF and China s Harbin Institute of Technology (HIT) have signed a cooperation agreement to jointly conduct research on material solutions for sustainable infrastructure applications, according to a statement from BASF.

According to the agreement, research teams from BASF and the HIT will work together on the testing of new applications for BASF s advanced materials to cut emissions and energy costs to the construction industry.

[107]Long-term outlook for Asia airport construction still strong - Fitch By Fanny Zhang 15-May-20 16:25 SINGAPORE (ICIS)--Long-term prospects for Asia s airport construction funded by public investment are expected to remain largely intact despite the ongoing coronavirus pandemic that crippled the aviation market, credit ratings firm Fitch said in a report.

We remain optimistic about the eventual recovery of the aviation sector in the medium to long term, and hence, continue to be bullish on the growth of Asia s airports sector, it said.

[108]China real estate development investment down 3.3% in Jan-Apr By Fanny Zhang 15-May-20 14:50 SINGAPORE (ICIS)--China s real estate development investment totalled yuan (CNY) 3.3 trillion in January-April, a decrease of 3.3% from the same period in last year, the National Bureau of ***Statistics*** (NBS) said on Friday. Investment in housing projects stood at CNY2.4tn in January-April, down by 2.8% year on year.

In January-April, real estate developers house construction acreage increased 2.5% on year to 7.4bn square metres (sqm), down from a 2.6% expansion in January-March period.

[109]US plasticizers ranges holding steady amid weak fundamentals By Larry Terry 15-May-20 07:18 HOUSTON (ICIS)--US diisononyl phthalate (DINP), dioctyl terephthalate (DOTP) and dioctyl phthalate (DOP) prices were unchanged amid continued pressure from softer April propylene and flat-to-weaker downstream demand so far in May. Some near-term upward price pressure may stem from higher 2-ethylhexanol (2-EH) spot prices in east Asia this week. The effect was expected to be mostly nominal, but enough to exert some counter pressure.

[110]Europe May ethanolamines talks ongoing amid mixed downstream demand, balanced supply By Jane Gibson 14-May-20 00:57 LONDON (ICIS)--May ethanolamines contract talks continued in Europe this week - with sellers looking for rollovers and buyers seeking lower prices.

[111]China PO prices rise in traditional off-season By Jady Ma 14-May-20 23:05 SINGAPORE (ICIS)--Propylene oxide (PO) prices in China have gained ground on higher feedstock prices and firm fundamentals, although the industry has entered its traditional off-season. On 14 May, PO prices in east China were assessed at yuan (CNY) 9,400/tonne, up by 20.1% compared with the prices on 17 April, according to ICIS ***data***

[112]US MMDI prices slide on falling downstream demand By Zachary Moore 14-May-20 06:46 HOUSTON (ICIS)--US prices for monomeric methylene diphenyl diisocyanate (MMDI) were assessed 4 cents/lb ($88/tonne) lower, as demand remains poor during the economic slowdown created by the coronavirus outbreak and subsequent containment measures.

Construction demand has been weak, as many projects have slowed or suspended operations owing to economic uncertainty, along with public health concerns.

RESOURCES

China's government is expected to focus on large-scale infrastructure and other development projects as ways to bolster economic growth and generate employment, especially more so now because of the fall out of the coronavirus pandemic.

ICIS has compiled a list of key existing projects that different provincial authorities have announced.

More than half of these are construction and infrastructure projects, while some are manufacturing plants and research and development (R&D) initiatives.

The source for the interactive is local NDRC. The list is incomplete and will be updated regularly by ICIS. Changes will happen as the government authorities and companies revise their development plans.

Construction in China - Asia s biggest and the world s second-largest economy - slumped at an annualized double-digit rate in the first quarter of 2020 as overall economic output shrank for the first time in two decades amid the coronavirus pandemic.

In 2019, the sector accounted for 7.2% of the country s GDP.

Eurozone Construction PMI August 2020

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Nature Sustainability

May 2020

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**Section:** Pg. 579-587; Vol. 3; No. 8; ISSN: 2398-9629

**Length:** 6864 words

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**Body**

Main

The United Nations 2030 Agenda for Sustainable Development establishes a unified set of global aspirations (that is, the Sustainable Development Goals (SDGs); see [*https://www.un.org/sustainabledevelopment/;*](https://www.un.org/sustainabledevelopment/;) Fig. ) that provides a roadmap for future prosperity by addressing key challenges including world poverty, hunger, disease and illiteracy. The 169 targets, across 17 SDGs, measured by 232 unique indicators, are ambitious and complex. Interdependencies among targets and the systems that contribute towards them mean that even the most effective efforts to address one global challenge may unintentionally exacerbate others if the approaches overlook potential wider impacts–. Identifying and ***collecting*** official global ***statistics*** to track progress toward each indicator is an additional challenge; ***data*** exist for some indicators, while there are considerable deficits for others (see [*https://ourworldindata.org/sdg-tracker-update*](https://ourworldindata.org/sdg-tracker-update)). Achieving the holistic vision of the SDGs requires coordination at multiple scales and among sectors, as well as inclusivity of services that are not explicitly mentioned in the language of the SDG targets. Consideration of these overlooked services in policy decisions will not only help achieve individual targets, but can also result in mutually beneficial synergies across the SDGs.

Relationships between inland fishery services and SDGs.

Strongly positive, positive and bidirectional relationships between all inland fishery services (see Table ) and each SDG, weighted by the total number of targets per goal. Longer segments signify greater relative importance.

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Inland fish within the SDGs

We assert that one suite of resources conspicuously absent from the current text of the SDGs is fish found in inland waters (that is, land-locked waters), inland fisheries and freshwater systems as well as the critical services that they supply. We use the general term ‘fish’ in colloquial reference but, in most instances, ‘fishes’ is more technically accurate as many inland fishery services involve multiple species. The lack of direct mention threatens the future of these services as some decision makers may presume that inland fish are indirectly but adequately accounted for under other goals and targets. At the extreme, omission from the SDG text may lead to decision makers being unaware of the need to protect inland fish at all.

Inland fish provide food for billions and livelihoods for millions of people worldwide and are integral to effective freshwater ecosystem function, yet the recognition of these services is worryingly absent in development discussions and policies. Inland fisheries are frequently undervalued or ignored compared with other key and ***data***-rich sectors, such as ***agriculture***, drinking water, power, sanitation, transportation and marine fisheries. As a result, the threats to inland fish, fisheries and key habitats may be seen only as issues to be mitigated once other needs have been satisfied, rather than as resources with immense benefits. Failure to consider the consequences of lost services from inland fish, fisheries and their habitats can pose unaccounted for risks, including the costs of subsidies to replace them,.

A key challenge for including inland fish within holistic sustainable development policies is accounting for the complexity of freshwater ecosystems, the scale and dynamics of commercial and subsistence fisheries, and competing multi-sectoral freshwater users. As a first step towards the inclusion of inland fish in these policies, we propose to highlight inland fishery services within the language of the SDG framework. This Perspective aims to make it easier for decision makers and stakeholders, naturally more familiar with development terminology, to understand the critical and diverse roles of inland fish across societies worldwide, and the opportunity for inland fisheries to better support achieving sustainable development. We do acknowledge that inland fishery services are highly context specific. Our intentions here are to initiate discussions at the global scale, rather than to directly dictate local policies.

To integrate inland fishery services within the SDG framework, (1) we used a qualitative approach to distil the ***collective*** perspective of authors with expertise in diverse inland fisheries to score a suite of nine sustainable ecosystem services associated with policies that support inland fish; and (2) we assessed whether the sustainable delivery of these services contributes positively, negatively or bidirectionally towards the attainment of individual SDG targets. To understand the resulting relationship matrix between these services and the SDGs, (3) we performed a correlation analysis among the nine services based on their relationships to the 169 SDG targets. Finally, to synthesize how SDGs relate to each service, (4) we performed a cluster analysis on the SDGs based on the correlation results.

Approaches on how best to address sustainability goals will differ in priority and shift in importance across countries, from developing to developed, tropical to temperate, low population density to highly populated. Recognizing this, our aim, similar to other efforts in the sphere of linking SDGs with nature-related elements (for example, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment Chapter Three), is to provide decision makers with an accessible reference for designing integrated policies and development schemes that enhance the contribution of inland fish to sustainable planning, as well as to offer an approach for addressing the SDGs holistically.

Inland fishery services

We identified nine ecosystem services preserved by the sustainable management of inland fish and freshwater ecosystems, hereafter referred to as ‘inland fishery services’ (Table ). This is not an analysis of services provided by inland fisheries only, but of the services emerging from approaching freshwater governance and interventions for sustainable inland fisheries. For the purposes of this study, all possible forms of inland fish on a global scale were considered, including aquaculture.

Sustainable inland fishery services examined in this exercise

|  | **Inland fishery service** | **Description** |
| --- | --- | --- |
| Livelihoods and subsistence income | The benefits of livelihoods can be beyond subsistence value (that is, subsistence income), including small-scale fishing operations and post-processing. |  |
| Commercial income | Financial gain associated with commercial and sale value of wild harvested, stocked and aquacultured inland fishes. |  |
| Food and nutrition | Contributions that inland fish make to food and nutrition, protein, calories and, particularly, essential micronutrients. |  |
| Recreational services | Includes recreational fishing industries (for example, charter boats and guides), ecotourism and hobbyists. |  |
| Cultural services | Includes a sense of community, traditional values, identity as fishers and inherent value of iconic species (for example, threatened and endangered species). |  |
| Educational and scientific opportunities within fisheries | Considers fisheries science and education broadly (for example, capacity building), such as student opportunities (that is, not only research), community engagement and public outreach. |  |
| Ecosystem function and biodiversity | From the premise that sustainably harvested fisheries require high functioning ecosystems and biodiversity contributes to ecosystem function. |  |
| Regulation of freshwater quality | From the premise that sustainably harvested inland fisheries require high freshwater quality. |  |
| Regulation of freshwater quantity, flow timing and variability | From the premise that sustainably harvested inland fisheries require natural-like freshwater quantity, flow and variability. |  |

The services and reasoning included in this study were: inland fish support livelihoods and income through the sale and trade of fish and fish products from individuals or industry, and through associated jobs in the fishery. They provide food and nutrition for billions of people globally, including protein and micronutrients. Recreational services and individual well-being are supported by inland fish, including recreational fishing (for example, charter tours and guided trips) and ecotourism. Inland fish can contribute cultural services by providing a sense of community through cultural icons (for example, salmon), giving identity to fishers as a source of cultural heritage and contributing symbolically to numerous faith traditions. Additionally, inland fish provide educational and scientific opportunities for capacity building, collaborative research and training of students. Finally, the maintenance of intact, functioning, freshwater ecosystems that support inland fish provides environmental services such as improvement of the quality of ecosystem function, enhancing biodiversity and protected areas, and regulating water quantity and quality. The inherent need for these services to maintain sustainable fisheries motivates natural resource managers to preserve environmental integrity.

We worked from the premise that the inland fishery services we scored operate under principles of sustainability and are maintained under an ideal management scenario inclusive of the freshwater environment, in which, therefore, no solely negative interactions would occur. Sustainable inland fishery services were characterized as those that do not disrupt the ecosystem on which they rely. For example, a sustainably managed fishery safeguards against overharvest, disruptions to food-web dynamics, introductions of non-native species, loss of biodiversity and undesirable effects of fishing (for example, ‘fishing down the food web’). Indeed, we assumed an idealized scenario in which fishery managers follow a philosophy similar to the one this study is suggesting: a holistic, ecosystem-level approach to their decisions, rather than focusing solely on fish production as a separate, unrelated entity.

The contribution of inland fishery services to the SDGs

Building from the methodology of Chapter Three of the IPBES Global Assessment, we scored the likely contribution of the nine inland fishery services towards the 169 targets of the SDGs using a matrix format that produced a total of 1,521 scores (Supplementary Table ). The extent to which each inland fishery service can contribute to the achievement of targets was assessed as follows: strongly positive; positive; weak or negligible; and, both positive and negative (see Table ). We scored each of the 1,521 relationships through a consensus process among the eight authors who collectively possess a wide range of experiences and diverse disciplinary knowledge. Scores were given only to services with direct links to SDG targets for a total of 386 relationships. To limit complexity, we chose not to consider tangential effects in this study (that is, those that involve inland fishery services but are principally driven by another factor, such as improvements in education due to the income gained from inland fisheries or waste reduction supported by recreational fisheries as a subset of ecotourism). Wherever published ***data*** were available to support a relationship, the reference was recorded to support our ***collective*** perspective. An initial round of scoring was conducted by individual authors according to professional expertise with particular services and the SDG targets. Initial assessments were then reviewed by the other authors and any comments were subsequently discussed to ensure that all scores were justified and defensible. To ensure consistency and check that there were no shifts due to accumulated experience during the process, we performed a secondary review of scores by each service, then by each goal. In the case of any discrepancies in either the interpretation of SDG text or in the assessment of the contribution by inland fishery services, we consulted experts from the InFish Research Network (with over 100 members from over 50 organizations in over 20 countries at the time of the exercise; [*http://infish.org/*](http://infish.org/)) and reviewed literature to make a final consensus decision.

An example subsection of the matrix used for scoring inland fishery services with SDG targets

| **SDG targets** | **Services** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **What impact do these services have on successfully achieving these targets?** | | | | | | | | | |
| **Target description** | **ID** | **Livelihoods and subsistence income** | **Commercial income** | **Food and nutrition** | **Recreational services** | **Cultural services** | **Educational and scientific opportunities within fisheries** | **Ecosystem function and biodiversity** | **Regulation of freshwater quality** | **Regulation of freshwater quantity, flow timing and variability** |
| **1. End poverty in all its forms everywhere** | 1 |  |  |  |  |  |  |  |  |  |
| By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than US$1.25 a day. | 1.1 | ++ | ++ | ? | ? | ? | ? | +/? | ? | ? |
| By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions. | 1.2 | ++ | ++ | ? | ? | ? | ? | +/? | ? | ? |
| Implement nationally appropriate social protection systems and measures for all. | 1.3 | ? | ? | ? | ? | ? | ? | ? | ? | ? |
| By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance. | 1.4 | +/? | +/? | +/? | ? | ? | ? | ? | ? | ? |
| By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters. | 1.5 | + | +/? | + | ? | ? | + | +/? | +/? | +/? |

For the description of the inland fishery services, see Table , and for the full scoring matrix, see Supplementary Table . Scoring was based on the following scale: +, a positive relationship (the service will increase successful target implementation); +/–, there is a direct relationship, but its direction is unclear, ambiguous or bidirectional (for example, a U-shaped relationship); •, there is no clear relationship (or the relationship is weak and indirect); double symbols (for example, ++) indicate particularly strong relationships.

SDGs most benefited by inland fishery services

To identify the SDGs most benefited by inland fishery services, we aggregated the individual target scores for each service and within each SDG. To address the different number of targets across the goals (for example, SDG 13 has five targets and SDG 17 has 19), we standardized the comparison by weighting each SDG by the total number of its targets, then, we created an aggregated score for all nine services for each SDG. We summarized the scores as strongly positive, positive and bidirectional relationships (Fig. ; note that no negative-only relationships were identified in this analysis, due to our approach of evaluating only sustainable inland fishery services, as described above).

Inland fishery services have the strongest positive relationship with achieving the goals of Zero Hunger (SDG 2), Clean Water and Sanitation (SDG 6), Responsible Consumption and Production (SDG 12) and Life on Land (SDG 15). Inland fisheries provide critical sources of food, particularly to low-income, food-insecure populations. Indeed, the effect of protecting freshwater ecosystem function for inland fish also leads to improving water quality for human use, yet the interaction between the health of freshwater ecosystems and their services is not sufficiently acknowledged,. Explicit reference to freshwater ecosystems and their services within the SDGs is made only in targets SDG 15.1 and 15.8, which are still predominantly terrestrial-focused.

Positive associations are also largely found between inland fishery services and Decent Work and Economic Growth (SDG 8), Responsible Consumption and Production (SDG 12), Climate Action (SDG 13) and Life Below Water (SDG 14). Inland fisheries make substantial contributions to local and, in some cases, national economies through employment and income,. The harvest of wild fisheries is often considered a ‘responsible’ food source as there are lower environmental costs than the production of other animal proteins. Inland capture fisheries, especially small-scale or artisanal, can have a lower carbon footprint because they are both harvested and consumed locally. And lastly, while SDG 14 aims to improve marine life, freshwater influences on marine resources are substantial, particularly at the estuarine interface.

Inland fishery services have the strongest bidirectional relationships with No Poverty (SDG 1), Gender Equality (SDG 5) and Affordable and Clean Energy (SDG 7). These bidirectional relationships demand most attention during policy and governance discussions as these sustainable inland fishery services can either contribute to or hinder achievement of these goals. In the case of SDG 1, promotion of inland fisheries and increased catch can contribute to poverty alleviation and income growth, and open up opportunities to invest in education or alternative livelihoods. For example, increasing ecotourism opportunities through recreational fishing could provide increased opportunities for livelihoods and income, but could reduce access to the resource by locals (depending on the specific fishery). Elsewhere, gender and power dynamics in certain inland fisheries (for example, Lake Victoria) have been observed to push women into compromising positions (for example, sex for fish transactions) while in other settings inland fisheries can provide economic stability or improved community status. Similarly, flow alterations are often categorized as ‘green’, providing affordable hydropower electricity, irrigation, drinking water, flood control and recreation services, yet the associated impacts of dams are considered a major threat to freshwater ecosystems and can result in the destruction of fish habitat and alteration of ecosystem function,. Recognizing these bidirectional relationships as key opportunities for engagement, dialogue and potential intervention could generate improved planning and more holistic development.

Correlations among inland fishery services

Assessing the correlations among the nine inland fisheries services based on the 169 assessed relationships to SDG targets (see ) revealed intuitive groupings. The two resulting groups were defined as ‘human well-being’ and ‘systems’ based on the SDGs to which the services contributed most substantially (Fig. ).

Correlogram of inland fishery services based on their relationships to the SDGs.

See Table for a description of inland fishery services. The size of a circle indicates the strength of the correlation and the colour indicates the direction of correlation (that is, blue = positive). Only significant correlations (P < 0.01) are shown. Two distinct groupings emerged: (1) well-being inland fishery services (commercial income; food and nutrition; livelihoods and subsistence income; and recreational services); and (2) systems inland fishery services (cultural services; ecosystem function and biodiversity; educational and scientific opportunities within fisheries; regulation of freshwater quality; and regulation of freshwater quantity, flow timing and variability).

Human well-being inland fishery services

We termed this group of services the ‘human well-being group’ because it comprised services related to the provision of food, livelihoods, income and recreation, all inherently associated with quality of life (perhaps most directly, through resource exploitation). These services naturally support SDGs that are strongly linked to livelihoods and economic potential, including No Poverty (SDG 1), Zero Hunger (SDG 2), Decent Work and Economic Growth (SDG 8) and Industry, Innovation and Infrastructure (SDG 9).

Systems inland fishery services

We termed this the ‘systems group’ because it is comprised of services generated by protecting freshwater systems as part of sustainable practice: water quality, water quantity, ecosystem function and biodiversity, as well as (to a lesser extent) cultural services, and fisheries science and education. The function of freshwater systems, including water quantity and quality, food-web dynamics and biodiversity, vitally support the more exploitative inland fishery services within the human well-being group. Cultural services and opportunities in science and education, though more human-orientated than the other services in this group, are less exploitative than the services found in the human well-being group. This group of services supports SDGs that are strongly linked to water and freshwater ecosystems, such as Clean Water and Sanitation (SDG 6), Climate Action (SDG 13), Life Below Water (SDG 14) and Life on Land (SDG 15).

Inland fishery services clusters

The challenge of integrating inland fisheries within development frameworks is translating the diversity of services to policy-relevant language and understandable metrics. To this end, we conducted a cluster analysis on the SDGs served by the two groups of inland fishery services (see ). Understanding how these services contribute to the SDGs can underpin policy recommendations. Of the six clusters formed, we identified the three SDG clusters served by the ‘human well-being’ group as ‘collateral’, ‘monetary’ and ‘consumer’, and one SDG cluster served by the ‘systems’ group as ‘environmental’ based on the SDGs most strongly represented within the clusters. The two remaining clusters lacked a substantial association with inland fishery services and were not considered further (Fig. ).

Dendrogram of the SDGs based on relationships to the two groups of inland fishery services.

a, Human well-being inland fishery services. b, Systems inland fishery services. The height (y axis) of the dendrogram represents the dissimilarity between clusters of targets. For the four clusters differentiated by at least half the maximum height, the sizes of the SDG icons represent the number of targets relevant to that cluster as a proportion of the total number of targets per goal; the remaining two clusters noted with a bar are larger groupings of SDG targets that lack a substantial association with inland fishery services and are not discussed in detail within the text.

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Collateral SDG cluster (bidirectional for many)

The collateral cluster of targets highlights a number of areas where inland fishery services have great potential to contribute positively to SDG targets, but may have collateral consequences that negatively impact the SDGs depending on the approach and application. This diverse cluster broadly encompasses targets from ten of the goals: No Poverty (SDG 1), Quality Education (SDG 4), Gender Equality (SDG 5), Decent Work and Economic Growth (SDG 8), Reduced Inequalities (SDG 10), Sustainable Cities and Communities (SDG 11), Responsible Consumption and Production (SDG 12), Life on Land (SDG 15), Peace, Justice and Strong Institutions (SDG 16) and Partnerships for the Goals (SDG 17). We consider identification of these interactions a particularly important result of our analysis. These interactions highlight opportunities to provide strong positive impacts towards achieving the goals through thoughtfully nuanced inland fishery management and policy. This would include the careful consideration of interactions between SDG goals, such as the linkages of services that fisheries provide in both reducing poverty and hunger.

Several targets within Gender Equality (SDG 5), Economic Growth (SDG 8) and Life on Land (SDG 15) stand out as having the potential for positive or negative relationships to fisheries. Interestingly, one of these goals, Life on Land (SDG 15), is the SDG that has the most relevance for inland fisheries (as the SDGs are currently interpreted) and highlights the importance of holistic planning and engagement with other sectors when implementing activities that enhance inland fishery services. In particular, the exploitation services that provide food, livelihoods and income from inland fisheries have the potential to negatively impact targets under Life on Land (SDG 15), unless consideration is given to the impact on other services provided by the shared ecosystem (for example, non-native introductions for food versus native biodiversity; conservation versus tourism development). These complex relationships emphasize the need to engage in cross-sectoral collaboration and focus on synergies rather than competing objectives. By implementing a more holistic approach during the planning stage of development projects or policy deliberations, potentially negative interactions can be turned into positive ones.

Monetary SDG cluster (positive for livelihoods, income and recreation)

The SDG targets in the monetary cluster are supported by a strongly positive association to inland fishery livelihoods, income and recreation. Jobs tied to inland fisheries, including tourism associated with recreational fisheries, directly provide income for the individuals working within the industry, and additionally provide taxable incomes that can strengthen economic growth, distinct from subsistence livelihoods, discussed above. Less tangible benefits (which we did not score in this exercise) are associated with other services, such as outdoor recreation and its influence on the well-being and improved mental health of a population– or the explicit aim of particular recreation and tourism services that support ecosystem resiliency to climate change.

Highlighting the value of inland fisheries for all levels (that is, subsistence, commercial and recreational), will help governments recognize the contribution of inland fisheries to economic growth broadly (SDG 8) and especially as small-scale enterprises (SDG 9.3), in low income countries (SDG 9.2). Working within national and regional planning efforts, and emphasizing that intact ecosystems can help mitigate the effects of climate change, can also help promote opportunities for fisheries communities to contribute to climate-change planning. For example, designing appropriate infrastructure for fisheries that addresses extreme events may further enhance the resiliency of some of the most vulnerable communities (SDG 13.1, 13.2).

Consumer SDG cluster (bidirectional for ecosystems)

The SDG targets in the consumer cluster are supported by a strongly positive association to food, livelihoods and income with bidirectional links to ecosystems. This cluster is distinguished by SDGs that relate to human well-being, namely poverty alleviation, food security and increasing economic prosperity. The direct consumption aspect of this cluster differentiates it from the monetary cluster above focused on economic growth. The links in the consumer cluster are highly interdependent; protein and micronutrients from fish also provide essential ***nutrients*** for health; improved health can increase involvement and productivity in the workforce; more work usually increases income, and thus reduces poverty and conflict (or violence). In this cluster, the bidirectionality for ecosystem services arises because these SDG targets have anthropocentric objectives, but ecosystem-focused management may restrict human benefits in the short-term. For example, conservation and fishery exclusion zones, which are positive for ecosystems and can restore exploited fisheries, may have negative short-term impacts on society by limiting access to the ecosystem services they provide. Invariably though, in the long-term, functioning ecosystems make many of these use-based services more sustainable and, ultimately, beneficial for human well-being.

The challenges, as well as opportunities, for the consumer SDG cluster are in finding ways to harness food, livelihoods and income that inland fisheries provide, while ensuring conservation actions to safeguard freshwater ecosystems are implemented. Careful planning and implementation of conservation actions, such as zoning programs or monitoring for illegal fishing, as well as conducting fisheries assessments and examining the distribution of fisheries resources could support income (SDG 2.3) and fisheries conservation efforts concurrently. Actions that could both support these SDG targets and enhance the role of small-scale fisheries include participation of fishers (particularly subsistence fishers) in policy creation and implementation, community-based conservation programs, training and capacity building for fishers, cooperative markets and microfinance loans. Programs that promote access to fair trade and sale of small-scale fisheries resources could increase local revenues that can be invested in social services (for example, education and sanitation), thus further reducing extreme poverty (SDG 1.1, 1.2). Furthermore, financial benefits from ‘sustainably sourced’ labelling of fish products could encourage companies to adopt more sustainable commercial inland harvest practices (SDG 12.1–12.4) that are integrated into reporting (SDG 12.6) as well as to improve sustainable food production systems (SDG 2.4).

Environmental SDG cluster (positive for ecosystems)

The SDG targets in the environmental cluster support freshwater ecosystems and services that explicitly require freshwater ecosystems to be in healthy condition. Achieving these targets requires functional ecosystems, including requisite water quantity and quality. A corollary to the maintenance of ecosystem function is the provision of inland fishery services derived from healthy freshwater ecosystems (for example, fisheries food production, ecotourism, climate adaptation and resilience). These associations show that freshwater ecosystems and the benefits supplied via inland fishery services are central to human well-being and sustainable development.

Actions that support progress towards the targets across the environmental cluster address the conservation of ecosystem function and environmental provisioning of water quality and flow. Several of the targets that are grouped in this cluster are associated directly with the state of freshwater ecosystems and our ‘natural heritage’ (for example, SDGs 6.6, 11.4, 15.1 and 15.8) or the targets are focused on benefits that explicitly require freshwater ecosystems to be in healthy condition (SDGs 2.4, 6.1, 6.4, 13.1 and 15.5). But, inland fishery services still require more than the tangential role that they are typically assigned within integrated water resources management. This demands a full appreciation of the biophysical factors that contribute to resilient freshwater ecosystems and their fisheries, and application of ecosystem-based management approaches that encompass ecological, human and governance aspects in sustainable freshwater resource management. All of the above requires cooperation between fisheries and water sectors for efficient resource management and represents a need for inland fishery managers to ‘join forces’ with water managers to ensure essential complementary services are maintained in the development process.

Boundaries and insights

In this exercise, we applied a strict set of rules to make our analysis tractable and our results directly applicable to policy and development discussions. First, we chose to focus our analyses on inland fishery services that have been provided sustainably (that is, current services that do not inhibit future services). There is a complex dynamic between the ecological, economic and social aspects of inland fishery service provision, and there are certainly unsustainable practices that could support achievement of some SDG targets in the short-term (for example, exploitation from unsustainable fisheries may reduce poverty reduction and support livelihoods in select cases, but these benefits will decline in the long-term). We made a conscious choice to focus on services through sustainable management to maintain the broader vision of the SDGs. We hope the evidence from this idealized scenario will motivate both fishers and governing bodies to update current methods and incorporate sustainable harvest and operations of inland fishery services in recognition of additional SDG benefits. Indeed, the success of any policy requires appreciation of system-specific characteristics and must build upon local expertise at both governing and resource user levels.

Second, in-depth discussions during the exercise included how additional targets could be supported by each individual inland fishery service through tangential or circuitous links. We classified these as no clear relationship because considering them otherwise could detract from a clear enumeration of the many stronger relationships. Consider, for example, how the services of livelihoods, commercial income and ecotourism are connected to clean water and sanitation (SDG 6); even if these services are sustainably managing their waste disposal, effluent, fuel storage and boat gas use, they were not viewed as making an important contribution to the success of this goal. Though a substantial task, we acknowledge greater accounting is needed to measure both positive and negative impacts, including tangential linkages, when assessing plans to achieve any specific SDG target.

Third, the exercise highlighted several pervasive inland fishery issues that often have value-laden implications, such as non-native species and aquaculture. For example, recreational fisheries and aquaculture that rely on non-native species, such as brown trout (Salmo trutta) or Atlantic salmon (Salmo salar), can still be considered as sustainably managed (for example, controlling waste), yet the impact on freshwater biodiversity can be severe–. Brown trout has been listed as one of the World’s Worst Invasive Alien Species, while also being valued for its benefits to meeting conservation and economic goals,. Both purposeful and unintentional introductions of non-native species can be detrimental to native freshwater species,, yet they are an integral part in some small-scale fish farms and, more commonly, in larger-scale aquaculture facilities. Similarly, the role of aquaculture as part of sustainable development– and in addressing food security or economic development continues to be debated and assessed. Many developing countries view aquaculture as a step toward achieving food and livelihood-related SDGs but potential environmental and ecological issues associated with the industry can lead to conflicts with other goals, such as SDG 15, and sustainability of wild capture fisheries that support food security in many parts of the world. In this Perspective, we do not attempt to make a value determination on the route policy should take but raise the point that identifying these potential conflicts is the first step towards holistic and informed policies that account for trade-offs between goals.

Lastly, our exercise underscored the need for careful consideration of each SDG target by implementing organizations. Many of the targets, as written, are difficult to interpret and the indicators provided are not always well-aligned. Even among the authors, we found vastly different interpretations of the targets and that the associated indicators were often narrowly focused, and sometimes subjective. Thus, countries attempting to use solely the ascribed indicators to address a given target are likely to be inconsistent in what they determine as necessary activities to address the goal. They may, at best, implement actions that do not make progress towards the target, or, at worst, implement actions that are detrimental to the goal. As targets and indicators are reconsidered, subject experts and local stakeholders need to be included to help address this issue.

Lessons learned and opportunities for application

This Perspective articulates that inland fishery services make a substantial contribution to food security, poverty alleviation, livelihoods, human well-being and ecosystem function within the context of the SDG framework (Fig. ). Given the influence SDGs have on designing policy, it is vital to understand and account for the value of inland fishery services towards achieving them. The world’s largest inland fisheries are in regions most in need of sustainable development; over 40% of global inland fish capture is reported from 50 low-income, food-deficit countries. Inland fisheries are also of global economic, social and ecological importance; up to 58 million people are estimated to be employed in the inland fisheries and women comprise more than half of that workforce; indirect costs from recreational inland fisheries are valued at over US$100 billion; and over 40% of global fish species are found in freshwater ecosystems. These ***statistics*** underscore how critically linked inland fish and fisheries are to the SDGs even if they are absent from the SDG lexicon.

We are optimistic that the indicators used to measure progress towards targets provide the best opportunity to include inland fishery services in SDG implementation. Clarification of the intent of the goals and targets and improvement of the alignment between goals and indicators are key mandates of the High-level Political Forum on Sustainable Development to ensure progress on the 2030 Agenda ([*https://sustainabledevelopment.un.org/hlpf*](https://sustainabledevelopment.un.org/hlpf)). The creation of inland indicators specific to the local environmental, social and economic conditions, as well as consideration of the management resources and capacity, will facilitate attaining SDG goals and targets. Beyond the SDGs, realizing the importance of inland fish and fisheries should also be adopted when defining aspects of the post-2020 Global Biodiversity Framework ([*https://www.cbd.int/post2020/*](https://www.cbd.int/post2020/)) and when reviewing the 2015 Rome Declaration: Ten Steps to Responsible Inland Fisheries.

Powerful prospects exist for sustainably managed inland fishery services to meaningfully contribute to the success in achieving global sustainable development, particularly through Zero Hunger (SDG 2), Clean Water and Sanitation (SDG 6), Responsible Consumption and Production (SDG 12) and Life on Land (SDG 15; Fig. ). However, suitable integration of inland fishery services into freshwater and development policies is essential for this potential to be realized. Also, linking the objectives of the conservation of inland fish and the fisheries they support to the objectives of socio-economic sustainable development will be extremely important. The SDGs already form a framework for doing this; however, the existing trend is that conservation and management of freshwater resources is often overshadowed by the provision of human water security (for example, the delivery of water, as a utility, in support of ***agriculture***, industry and domestic needs). These water-use priorities are almost always at the cost of the environment and potentially at the cost of long-term sustainability of inland fishery services through manipulation and damage to natural habitat (for example, flow modification, in-channel development, overfishing, pollution runoff, invasive species and climate change).

If SDGs are the solution for a sustainable world, then the value of freshwater ecosystems must be elevated. Acknowledging the potential loss of biodiversity and cost to essential inland fishery services is the first step in designing sustainable, intersectoral policies that address drivers and, where necessary, identify possible compromises that either directly mitigate threats or provide opportunities for managing risks that cannot be eliminated. Indeed, tailoring policies and actions to the specific regional conditions where they are to be implemented is critical for sustainability. Management actions that support these services include conserving natural flow regimes, thoughtful management of upland landscapes and well-designed ecological monitoring programs. By recognizing the value of inland fish and the services they provide, governments and development organizations can be better poised to implement the SDGs, balance development with conservation and create ‘the future we want’.

**Acknowledgements**

We thank D. Beard (USGS), S. Cooke (Carleton University), I. Cowx (University of Hull), J. Dalton (IUCN) and other colleagues that we consulted as experts during this exercise; K. Malpeli (USGS) for assistance with figures; S. Carpenter (University of Wisconsin) for feedback on an initial draft; and K. Pope (USGS – University of Nebraska – Lincoln) for conducting an internal USGS peer review. All authors are members of the InFish Research Network ([*http://infish.org/*](http://infish.org/)). No funding sources had any role in the scoring exercise or in the preparation, review or approval of this manuscript. Any use of trade, firm or product names is for descriptive purposes only and does not imply endorsement by the US Government. The content of this publication has not been approved by the United Nations and does not reflect the views of the United Nations or its officials or Member States.

**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s41893-020-0517-6.Publisher’s*](https://doi.org/10.1038/s41893-020-0517-6.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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HINA Digest

February 28, 2020 Friday

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**Length:** 9753 words

**Body**

Zagreb,Hrvatska28 February 2020 (Hina) -

**Economic growth slows down to 2.5% in Q4 2019**

ZAGREB, Feb28(Hina) -Croatia's economy grew by 2.5% in the fourth quarter of 2019 compared to Q4 2018, which is a lower rate than in Q3, when economic growth was at 2.9%.

The national statistical office (DZS) on Friday published its preliminary estimate, which shows that GDP saw an annual increase of 2.5% in Q4 2019, the 22nd consecutive quarter to see an increase in GDP albeit lower than in the previous quarter.

**Growth picks up to 2.9% in 2019**

In 2019 GDP grew by 2.9%, which is more than the year before, when the growth rate was 2.65%.

The faster GDP growth in 2019 was mostly owing to a strong, 4.1% increase in the first quarter, while in the second quarter GDP grew 2.4% and in the third it rose 2.9% on the year.

**Positive contribution of consumption and exports**

The biggest positive contribution to GDP growth in Q4 2019 came from an increase in the export of goods and services and household consumption, the DZS says.

On the other hand, the contribution of net external demand was negative.

Household consumption in Q4 grew by 4% compared to the same period of the year before, which is a faster growth than in Q3, when household consumption grew by 3.1%.

The export of goods and services in Q4 grew by 5.6% on the year, which is higher than the 5.1% growth recorded in the previous quarter.

The export of goods grew by 2.1% and the export of services jumped by 12.1%.

The import of goods and services rose by 0.1% on the year, much less than in the previous quarter, when it rose by 4.3%.

The import of goods rose by 0.8% while the import of services dropped by 3.1%.

In Q4, investments in fixed assets rose by 4% on the year, which is a decrease compared to a5% increase in the previous quarter.

Government spending also grew in Q4, by 3.5% on the year, which is faster than in Q3, when government spending grew at a rate of 2.9%.

**Growth above EU average**

According to seasonally adjusted ***data***, GDP in Q4 grew by 0.3% compared to the previous quarter while on the year it grew by 2.7%.

The GDP growth rate is higher than the EU average considering that ***Eurostat*** recently said that the EU economy in Q4 2019 grew by 1.2% on the year and by 0.1% on the quarter.

**Plenkovic: Croatia's economy growing on sound foundations**

ZAGREB, Feb 28 (Hina) - The national statisticaloffice (DZS) ***data*** thatGDP grew2.9% in 2019 is confirmation that Croatia's economyis continually growing at a rate of about three percent but on sound foundations, Prime Minister Andrej Plenkovic said on Friday.

According to estimates DZS published today, Croatia's GDP in 2019 increased by 2.9% annually, which is a more dynamic growth that in 2018, when it increased by 2.6%.

That growth is almost twice the EU average of 1.5%, which has brought Croatia closer to the average level of development of EU member states. With the growth of 2.9%, Croatia ranks10th among EU member states, the government said in a press release.

"With the simultaneous decrease ofthe public debt to GDP ratio by about threepercentage points annually and thecontinuedsurplus in the current account balance, we are boosting economic growthby reducing borrowing, the taxand administrative burdens, structural reforms, increased investments and better absorption of European funds. The government remainscommitted to implementing structural reforms at all levels," Plenkovic said.

All categories of both domestic and foreign demandrecorded a growth (personal and government spending, investments, export of commoditiesand services). The dynamic of growth compared with 2018 increased the most in fixed capital formation, mostlythanks to the successful absorptionof European funds.

The biggest increase affecting GDP was personal consumption, which was impacted by continuing positive trends on the labour market (the number of insurees increased by 2.4%), continued growth in net wages (nominal increase of 3.4%), and credit activities by commercial banks (total loans issued to households at the end of the year were6.9% higher year on year).

The increase in the export of commodities and servicesmade a strong contribution to economic growth. Commodity exports grew, impacted in particular by theexport of pharmaceutical products, motor vehicles and parts, while better export figures were also generated in shipbuilding. The export of services was mostly boosted by a record tourism season, the press release said.

**FinMin: Growth in accordance with projections**

ZAGREB, Feb 28 (Hina) - Finance MinisterZdravko Maric said on Friday that GDP growth was in line with the government's projections and achieved on a healthy basis, and that efforts should be made to make it even higher.

According to initial estimates published by the National Bureau of ***Statistics*** (DZS) on Friday, Croatia's GDP in 2019 increased by 2.9%, up from 2.6%in 2018.

"We can be satisfied because the annualgrowth of 2.9% was achieved on a good and healthy basis, but we all need to work not just to maintain it but to raise it to an even higher level. That can be seenin the recent country reports by the European Commission which, among other things, identify measures that need to be taken and structural areas that need to be improved," Maric told reporters.

He addedthat the growth of 2.9% is almost identical to the government's original forecast of 2.8%."It's good that we have consistent, credible projections," said Maric.

DZS reportedthat GDP in Q4 2019 grew by 2.5% in real terms compared to Q4 2018, which is a lower rate than in Q3 when the growth rate was 2.9%.

Maric said that the Q4 increase in personal consumptionwas a little higher than the government's projectionwhile investment spendingwas slightly below expectations.

According to DZS, household consumption in Q4 grew by 4% year-on-year, as did gross fixed capital formation.

Exportsof commodities and services grew in Q4 by 5.6% on the year, with commodity exports increasing by 2.1% and services exports jumping by 12.1%. At the same time imports of goods and services increased by 0.1%, with commodity imports rising by 0.8% and services imports dropping by 3.1%.

Maric saidthat it was significant that exports had increased by 5.6%, particularly the 12% rise inservices exports, while imports had fallen.

"Generally, when looking at exports and imports of goods and services,we need to focus on stimulating exports while reducing the economy's dependence on imports," he said.

Asked how he would protect public finances in light of the coronavirus situation and if that was possible at all in a year when the share of tourism in GDP could fall by between 17 and 20%, Maric said that the most important thing was to protect the health of citizens and their lives, adding that it was impossible to estimate the extentand duration of the virus and what its impact on the economy would be.

He added that there were budget reserves for situations like this and that this year HRK 100 million had been set aside in reserves for certain portfolios including the Health Ministry.

**EIZ: Growth rates as expected, further developments depend on coronavirus**

ZAGREB, Feb 28 (Hina) - Zeljko Lovrincevic, an analyst with the Zagreb Institute of Economics (EIZ) told Hina on Friday that the growth rates published by the National Bureau of ***Statistics*** (DZS) were as expected and were likely to continue in the first quarter of 2020, noting that further developments depended on the coronavirus situation.

The Croatian economy grew by 2.5% in the fourth quarter of 2019 compared with the same period in 2018, which was a slower rate than in the third quarter when it had grown by 2.9%, the DZS said on Friday.

In the whole of 2019 GDP grew by 2.9%, up from 2.6% in 2018.

Commenting on the GDP structure, Lovrincevic said that personal consumption had expanded in the final quarter of last year, addingthat this would continue in the first quarter of this year on account of increased non-taxable income and public-sector wages.

He warned that the biggest problem in the GDP structure was the weakening of the manufacturing industry, which he said was also a European problem.This problem is escalating in Croatia and affecting commodities exports. On the other hand, warm weather favoured services exports, even in the final quarter of 2019, he added.

In the fourth quarter of last year, exports grew by 5.6% compared with the same period in 2018, with commodities exports increasing by 2.1% and services exports by 12.1%, while at the same timeimports rose by 0.1%.

Gross fixed capital formation increased by 4% year on year, which Lovrincevic said was its usual annual level and that its main source was EU funding. He said that this was mainly public investment in construction, notably in housing construction, while private-sector investment in technology and production was lacking.

The analyst said that personal consumption would intensify in the first quarter of 2020 and remain the main generator of growth because of increased public-sector wages and non-taxable income.

Lovrincevic said he expected a change in Marchbecause of the coronavirus outbreak. "As of the end of February there will be a completely different situation incomparable with last year. What we are seeing on the global stock exchanges is quite certainly panic," he said, adding that he expected a negative impact that might push some European countries into recession already in the second quarter of this year.

He said it was questionable whether the panic would let up and things would stabilise by the third quarter and whether the virus would at least partly be brought under control. "If that doesn't happen, then Europe and the world will slide into a new recession. The third quarter will actually provide an answer to all our questions in terms of the impact of the coronavirus on the economy. All the scenarios are open," Lovrincevic said.

**HGK: Growth still not at desired levels but Croatia going in right direction**

ZAGREB, Feb28(Hina) - The Croatian Chamber of Commerce (HGK) said on Friday the GDP growth rate was still not at the desired levelbut that it was a good indicator that Croatia was going in the right direction.

In the fourth quarter of 2019, Croatia's economy went up 2.5% on the year. In Q3, the annual growth rate was 2.9%. In all of 2019, GDP grew 2.9%, while in 2018 the growth was 2.6%.

HGK president Luka Burilovic said the 2.9% growth in 2019 was still not at the levels that were desired and must be achieved if Croatia wanted to catch up with competitive countries, notably only now Croatia has reached the real level of GDP from 2008.

"But it's a good indicator that we are going in the right direction because we are growing on the back of all categories of domestic and foreign demand, and the relatively high investment growth dynamic should be highlighted," he said.

Burilovic also noted the slowing of imports in relation to 2018, which he said created more room for growth of the domestic production of goods and services.

He highlighted the fact that last year Croatia was one of only four EU countries that recorded a more dynamic GDP growth in relation to 2018.

**Employers: Stronger economic growth requires swifter reform initiatives**

The Croatian Employers Association (HUP) said the continued growth was positive but that Croatia was still not growingstrongly enough to come close to more developed EU member states.

"For stronger economic growth we need to step up reform initiatives in all areas on the HUP score, which coincide with the areas the European Commission is warning us about too - the judiciary,healthcare,labour legislation, whichis not aligned with the contemporary market, nor isthe education system.It's necessary to improve and downsize the public sector and to continue to work on the elimination of administrative barriers and on the improvement of the business environment for more investments," the HUP said.

**Minister confirms two more cases of coronavirus infection, total of five cases confirmed**

ZAGREB, Feb28(Hina) - Health Minister Vili Beros on Friday confirmed two more cases of novel coronavirus infection (COVID-19), which brings the total number of cases of infection with that virus to five, the latest cases being persons who were in contact with the previous cases.

"One of the two new cases was in contact with the person from Zagreb who was the first case of coronavirus infection and has been hospitalised in Zagreb's Fran Mihaljevic hospital for infectious diseases, while the other one was in contact with an infectedman from Rijeka and is in hospital in Rijeka. Their symptoms are mild," Beros said at a new conference held by the national civil protection authority.

The minister explained that the probability of infection was lower if contact with the infected person hadnot been intensive. The contacts ofthose infected earlier are being monitored.

"Both new cases are close contacts of those who contracted the disease earlier, which proves that disease transfer requires closer contact.All the newly-infected persons had already been quarantined in the hospital, they got infected through contact with those reported as the first and third case of coronavirus infection," said Fran Mihaljevic hospital director Alemka Markotic.

She added that all three patients felt well and had very mild symptoms and that she believed they would soon be released.

She noted that it was good that unlike Italy, which has hospitalised only those gravely infected, Croatia had a more cautious approach, placing under monitoring all contacts of the infected persons.

"This virus behaves like a family virus. Eightsamples are being processed in the country," she said.

The head of the Croatian Public Health Institute, Krunoslav Capak, said that the epidemiological situation in Croatia was very good.

"If we had not hospitalised those persons, we would have had an additional risk of some other persons who were in contact with the patients developing the disease. That is proof that we have to continue implementing the current measures," he said.

Asked if disinfection of means of public transport was necessary, Capak said that there was no need for that for the time being and that it would be done only if it was established that some of those infectedhad spent time on public transport.

Asked if there was a danger that domestic animals and pets could become infected, Assistant ***Agriculture*** Minister Krunoslav Karalic said that domestic animals and pets cannot contract the disease and do not transmit it.

"There is no scientific evidence in Europe that would indicate transmission of the virus from humans to animals and vice versa. If anything changes in that regard, we will let you know," he said.

**Health minister: 156 people tested for coronavirus to date, five confirmed to be infected**

ZAGREB, Feb 28 (Hina) - A total of 156 people have so far been tested in Croatia for the novel coronavirus, six are awaiting results, and five have been confirmed to be infected, Health Minister Vili Beros told a press conference in Zagreb on Friday.

"I think we have achieved good results. We have shown a great dose of responsibility as a society," Beros said, praising the media for objective reporting on the matter.

The head of the Fran Mihaljevic hospital for infectious diseases, Alemka Markotic, said that one of the two newly-infected persons had tested positive only upon being tested a third time.

The patientinitially exhibited only mild symptoms and now this person has almost no symptoms at all, Markotic said, adding that this patient would be detained in hospital for a few more days until testing negative.

Markotic said that one person was still quarantined.

**Parliament dismisses chief state prosecutor**

ZAGREB, Feb 28 (Hina) - Parliament on Friday relieved DrazenJelenic of his duties as chief state prosecutorbya majority vote, butthe 2017 and 2018 reports on the work of the State Prosecutors's Office (DORH) were still given the green light, also by a majority vote.

Jelenic's dismissal was supported by 103 MPs, 2 voted againstand 1 MP abstained.

Jelenic was appointed less than two yearsago and was relieved of duty after it was discovered that he failed to declare that he was a member of a Masonic lodge, because of which heresigned last week.

After Jelenic was dismissed, parliament voted onDORH's report for 2017, whenDinko Cvitan was at itshelm. The report was adopted by 92 MPs voting in favour, 14 against and 1 abstention.

Ahead of the vote on the 2018 DORH report, submitted by Jelenic, Social Democratic Party (SDP) MP Pedja Grbin called for a recess, claiming that DORH should be an independent institution combating crime and not be exposed to pressure by thegovernment. However, this does not appear to be so anymore, he added.

In support of his argument, Grbin noted thatthe ruling majority rejected SDP's motion that the chief state prosecutor should be vetted and that the law should saywhich associations the chief state prosecutor cannot be a member of.

After the recess, a vote was taken on Jelenic's report on DORH for 2018, it was adopted with 67 votes in favour, 22 against and 6 abstentions.

**HDZ whip: Census takers in ethnic minority areas will come from their ranks**

ZAGREB, Feb28(Hina) - The whip of the ruling HDZ partysaid on Friday, in connection with the population census bill, that census takers in areas where ethnic minorities were concentrated would be minority members.

Speaking to the press after aruling coalition meeting, Branko Bacic said ethnic minority MPs would attend today's vote on the bill butthat they were yet to decide if and how they would vote.

"We have established that the ruling majority is stable and that the ethnic minority representatives... will attend the vote and that we will adopt the law with instructions whichthe Croatian Bureau of ***Statistics*** will define in March. The Bureau will see to it thatcensus takers in areas where ethnic minorities are concentrated come from the ranks of the ethnicminorities."

Czech and Slovak minority MP Vladimir Bilek said ethnic minority MPs would vote on the census bill according to theirconscienceand that today they were given certain guarantees that census taking would be precisely defined in the form of a by-law.

Today's ruling coalition meeting was held because ethnic minorities demand that citizens be allowed to say in the census ifthey have more than one mother tongue and that the minority quota among census takers be honoured.

Bilek said the support of minority MPsto the ruling majority was never in question but that they were dissatisfied with how the bill guaranteed the quality ofthe census taking.

As for speculation that the dispute over the bill was a game between the minority MPs and Prime Minister Andrej Plenkovic because of intra-party elections in the HDZ, Bilek said the bill was too important to be part of any game.

**Pupovac: There was not so much hate in society in 2011 as there is today**

ZAGREB, Feb28(Hina) - Milorad Pupovac, leader of the Independent Democratic Serb Party (SDSS), said on Friday that ethnic minorities did not want to accept undefined census conditions and that they insisted on their amendments to the census bill because there had not been so much hate and violence against minorities in 2011as there was today.

"(The HDZ) does not want to accept the amendments and we do not want to accept a lack of defined conditions for conducting censuses," Pupovac told reporters ahead of a meeting of the ruling coalition, at which minorities will insist that members of ethnic minorities be allowed to declare more than one mother tongue in a census and that the minority quota for census takers be respected.

Pupovac said it was important that censuses were conducted in a tolerant atmosphere.

"The atmosphere in parliament is far from being one of tolerance and the situation in society is not the most tolerant either, especially in some regions," he said.

Asked if the census bill would be voted in today, Pupovac said that that remained to be seen after the meeting of the ruling coalition.

"We will talk, we have talked in recent days as well. We will see what the ruling majority's position is," he said.

HDZ whip Branko Bacic said before the meeting that he hoped minority MPs would support the census bill, while Ivan Vrdoljak, leader of the HNS, a junior partner in the coalition government, said that he did not see any reason why his party would not cooperate well with minorities.

Vladimir Bilek, the representative of the Czech and Slovak minorities, said that a parliamentary vote on the bill was very likely but that there was also a possibility that it would not be held.

"Let's talk and then see what happens," he said, adding that he did not know if the census bill could be passed without the votes of minority MPs.

**Parliament adopts 2021 census law**

ZAGREB, Feb28(Hina) - A population census will be taken in Croatia in spring 2021under the Population Census Act which parliament adopted on Friday after a week's delay and this morning's meeting of the ruling coalition.

The census will take place from April 1 to May 7, 2021. Itwill be organised, coordinated and carried out by the national statistical office, for which the government has allocated HRK 177.3 million.

Last Friday, parliament postponed the vote on the bill asethnic minority MPs prevented a quorum after the government, and thenMPs, turned down their amendments that citizens be allowed to say if they have more than one mother tongue and that the minority quota among census takers be honoured.

The Population Census Act was adopted with 72 votesin favour, four against and 24 abstentions.

Hrvoje Zekanovic of the opposition Hrast party urgedopposition MPs not to participatein the vote in order to show, he said, if the Croatian-Serb coalition would survive, how minority MPs would do their job and if Prime Minister Andrej Plenkovic and Serb MP Milorad Pupovac had made a deal.

Bozo Petrov of the opposition Most party said the census would show the consequences of government policies in recent years, i.e. the extent of emigration."Certain politicians demand certain census rights for their minorities in Croatia which don't exist in their home countries."

Arsen Bauk of the opposition SDP said all statements made in parliament today "were insults on ethnic grounds." He asked that the ruling majority say how they resolved their disputes over the bill.

Branko Bacic of the ruling HDZ said the new law was in line with previous censuses. No one's rights are being either reduced or expanded in any way, he said, adding that the opposition's accusations were unfounded and would not succeed in causing a rift in the ruling majority.

**Parliament adopts law proclaiming Vukovar place of special respect**

ZAGREB, Feb28(Hina) - Parliament on Friday adopted a law proclaiming the eastern town of Vukovar a place of special homeland respect and a law whereby the Health Ministry assumes charge oftheVukovar General County Hospital.

The law proclaiming Vukovar a place of special respect was adopted by majority vote. Its aim is to nurturethe memory of what the town went through in the Homeland War as well as encourage its development.

Vukovar hada special role in the establishment of the independent and sovereign democratic Croatia and represents a symbol of resistance, sacrifice, victory and unity in the 1991-95 war.

The law envisages the establishment of a council for homeland respect, peace and development.

Under the second law, the founders' rights oftheVukovar General County Hospital are transferred from the county to the state, the hospital becomes the National Memorial Hospital and the Health Ministry is in charge of running and funding it.

**Parliament appoints commission for citizens' complaints on police work**

Also today, parliamentappointed acommission to deal with citizens' complaints on police work, whose formation was envisaged by the 2015 Police Act.

All nine members of the commission were appointed to a four-year term. They will consider complaints and, if they find them justified, inform the parliamentaryhuman and minority rights committee and the Interior Ministry.

**Daily: Plenkovic files two lawsuits against Conflict of Interest Commission**

ZAGREB, Feb28(Hina) - Prime Minister Andrej Plenkovic is not accepting two decisions by the Conflict of Interest Commission which state that he has violated the principleof conscientious and transparent conductand has filed two lawsuitsagainst the Commission before the Administrative Court in Zagreb, Jutarnji List daily says.

The Friday issueof Jutarnji List daily says that the purpose of one of the lawsuits is to contestthe Commission's decision concerning the appointment of Plenkovic's close friend Igor Pokaz as Ambassador to the United Kingdom.

The daily recalls that the Conflict of Interest Commission in October 2019 decided that Plenkovic had breached the principleof conscientious and transparent conduct by failing to declare that he was Pokaz's best man when proposing him for the position of ambassador.

The other lawsuit is aimed at contesting the Commission's decision in a case related to a trip of a senior government delegation to Helsinki, where they attended the annual assembly of the European People's Party.

The Commission decided in November 2019 that Plenkovic and four other current and former ministers in his government had violated the principle of conscientious conduct because they refused to submit to the Commission documents that it had requested and that would have shown which of the travel costs were covered from the state budget and which by the ruling HDZ party.

The Administrative Court confirmed to Jutarnji List that Plenkovic had filed two lawsuits. Hearings in both cases, of which two different judges are in charge, were requested by Plenkovic and were scheduled for February 27 but in the meantime Plenkovic had changed his mind ,asking that the court deliver rulings inthe two cases without holding hearings.

**Novakovic surprised by speed of judges working on PM's cases**

ZAGREB, Feb28(Hina) - Conflict of Interest Commission chair Natasa Novakovic said on Friday the Commission was surprised by the speed and coordination of the judges working on the Pokaz and Helsinki cases over which Prime Minister Andrej Plenkovic had filed two suits against the Commission.

Novakovic told reportersevery official had the right to take legal action against a decision by the Commission. She was commenting on the two suits Plenkovic filed at the Administrative Court against decisions in which the Conflict of Interest Commission found that heviolated the principle of conscientious and transparent conduct.

Novakovic said she did not consider the suits as pressure on the Commission but as an option for every plaintiff who was dissatisfied with a decision by the Commission. She recommended doing so in court and not by publicly attacking the Commission.

Novakovic said she would insist that a hearing be held. The prime minister, according to the media, asked that a judgment be handed down in writing.

She said a hearing was scheduled for Thursday and the Commission received a summons three days ago, so it requestedthat the hearing be postponed. The same day the Administrative Court informed the Commission there would be no hearing as the plaintiff had opted against it, she said, adding that she hoped a hearing would be held before a judgment was delivered because the Commission hadthe same rights as the plaintiff.

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**Malenica: PM isn't putting pressure on Conflict of Interest Commission**

ZAGREB, Feb28(Hina) - Public Administration Minister Ivan Malenica said on Friday Prime Minister Andrej Plenkovic had the right to file suit at the Administrative Court because he feltthe Conflict of Interest Commission was not authorised to decide when an official violated the principles of conduct, adding that it was not pressure on the Commission.

"Any person who feels that a public legal body has violated a certain material right in adecision may file an administrative suit at the Administrative Court," Malenica told reporters.

Asked if theConflict of Interest Commission should decide when an official violated the principles of conduct, he said that under the Conflict of Interest Act, those principles should be a legal aid in deciding whether an official was in a conflict of interest.

Malenica dismissed assessments that this was a government blow to the Commission or the prime minister's pressure on the Commission's work."The Administrative Court will decide if the Commission did its job as it should, as an independent judicial body."

Asked if the Commission was doing a good job, Malenica said one should take into considerationthe rulings in which administrative courts and the Constitutional Court found that, in certain cases, the Commission did not act in line with theConflict of Interest Act.

"In drawing up the new law, we will take into consideration all those decisions," he said, adding that the Commission should remain an independent and impartial body deciding on state officials' conflicts of interests.

A task force should start working on the bill in a fortnight and the new law is expected to be passed during this government's term, Malenica said.

**HDZ election: Kovac submits over 17,000 signatures in leadership bid**

ZAGREB, Feb 28(Hina) - The candidate for the president of the ruling Croatian Democratic Union (HDZ) party, Miro Kovac, on Friday submitted more than 17,000 signatures supporting his bid, as well as signatures supporting candidates from his team for deputy president and vice-presidents.

The candidate for deputy president, Vukovar mayor Ivan Penava, submitted 16,718 signatures, while the candidatesfor vice-presidents Milijan Brkic,Tomislav Tolusic and Davor Ivo Stier submitted 16,262, 15,976 and 16,283 signatures respectively.

Kovac said that they had received very positive responses on the ground, adding that party members wanted change knowing that in this way the HDZ could not win the forthcoming parliamentary election, due in the autumn.

"The current HDZ leadership and the current president have no coalition potential. The people in my team have a profile that guarantees that we will be able to win the election for the Croatian parliament and form the next government," Kovac told the press.

He said that they were looking forward to a competition within the party, noting that their colleagues from the rival team, led by Prime Minister Andrej Plenkovic, were not their opponents but friends whom they wanted to "defeat in a sportsmanlike fashion."

Kovac said that there was place for all the people in the party and that he would not divide the party. He said he was looking forward to competing with the incumbent party president, Andrej Plenkovic.

Asked if he was satisfied with the number of signatures ***collected***, given that the other team had ***collected*** considerablymore, Kovac said that they did not want to exhaust themselves ***collecting*** signatures, noting that the number of signatures ***collected*** for the last presidential election was not decisive.

**Milanovic: I support Franak association's activities to ensure court rulings are implemented**

ZAGREB, Feb 28 (Hina) - President Zoran Milanovic said on Friday that he supported the activities by the Franak association, whichadvocates the rights ofholders of loans pegged to the Swiss franc, and activities that are aimed at ensuring that court rulings a consistently implemented.

"I've seen the application the Franak association has sent to the European Central Bank and European Commission in which it is continuing to fight for the rights of Croatian citizens who suffered damagebecause theirloans were denominated in the Swiss franc. Seeing that the class action ruling in this case has been final for some time now and many citizens have not been compensated for yet, I support the Franak association's objective to have the court ruling consistently implemented," Milanovic posted on his Facebook profile.

He said that he would always advocate the respect of Croatian laws and independence of the judiciary.

"To be on the side of the underdog - in this case holders of CHF loans - is not only my duty but above alla clear position that I will always advocate the respect of Croatian laws and the independence of the judiciary," Milanovic underlined.

The SNAGA party and Franak association said on Wednesday that they had sent a complaint to the European Central Bank and European Commission seeking the "cessation of unfair practices by Croatian banks which prior to 2013 stipulated unfair interest rates and which weresued in a class action lawsuit over the unfair CHF currency clause."

The complaint notes that "even after a final judgement in the Franak case, banks have not stopped charging annuities based on the unfair terms of a variable interest rate and they have not stopped applying the CHF exchange rate to loans that were not converted even though the class action ruling explicitly prohibits the sued banks from pursuing such or similar conduct in the future."

**Croatian, Hungarian FMs talk fight against illegal migration**

ZAGREB, Feb 28(Hina) - Croatian Foreign Minister Gordan Grlic Radman met with his Hungarian counterpart Peter Szijjarto in Budapest on Friday and they agreed on the need to fight for a new common asylum policy andagainst illegal migration.

"It's necessary to fight for a new common asylum policy and against illegal migration and smuggling," Grlic Radman said."It's necessary to distinguish between refugees, where we are bound by the Geneva Convention, andillegal migration, on which some smuggling rings are making a lot of money."

Budapest and Zagreb also share the same viewson EU enlargement and the EU's ambitious Multiannual Financial Framework, Grlic Radman said.

He reiterated that Zagreb and Budapest had "centuries of uninterrupted ties" and excellent relations, that the two nations were "well-connected" and that, in the European context, the two countries were an example of a good solution concerning minority communities.

The two ministers also talked about Croatia's current presidency of the European Union. Grlic Radman recalled that in 2011, when Hungary chaired the EU, it helped Croatia a lot. "Thanksto Hungary, we completed the negotiations and became an EU member within two years."

**Bosnia will be in trouble if Turkey lets migrants out, officials say**

ZAGREB, Feb28(Hina) - Bosnian officials said on Friday they expected Turkey not to open its borders for migrants, warning that such a turn of events would cause a humanitarian disaster and huge problems in Bosnia and Herzegovina.

"We expect the Republic of Turkey to honour the agreement with European Union member states. Letting out more than three million refugees towardthe EU would lead to an unprecedented humanitarian disaster, in which case a common response by all members of the EU and the region would be inevitable and the only option," BiH Security Minister Fahrudin Radoncic said in Sarajevo.

He added that BiH was using security channels to check the accuracy of information that Turkish authorities have decided to allowmigrants to head toward the Balkans after an escalation of the Syrian crisis.

Radoncic said he expected Turkey to act responsibly and that a mass exodus does not occur. "There have already been such cases and announcements from Ankara, but eventually the Republic of Turkey always acted with responsibility and solidarity. We hope it will do so now too."

The head of the BiH service for aliens, Slobodan Ujic, said the influx of migrants had increased considerably and that this year would be even tougher and more challenging for BiH with regard to illegal migration.

"All neighbouring countries will have problems and you know what BiH's capacity isand how much has been invested," he told Klix portal.

**Police rescue 12 illegal migrants in Glina area**

ZAGREB, Feb 28 (Hina) - Police have rescued 12 illegal migrants held in the storage compartment of a camper vanin the Glina area, about 80 kilometres south of Zagreb, Sisak-Moslavina County Police said in a statement on Friday.

They included three men, two women and seven children, who were all in bad shape and the police "probably saved their lives", the statement said.

They were all tired and exhausted and were immediately given medical attention. They were found in a camper van bearing Polish licence plates during a police check on Sunday February 23 in the village of Prekopa near Glina.

The migrants, all Iraqi nationals,are two families who entered the country illegally and have announced that they will apply for international protection. Five members of one family have been accommodated at the reception centre for asylum seekers in Kutina, while seven members of the other family have been put up in a similar facility in Zagreb.

The van's driver, a 36-year-old Pole and his 34-year-old female companion were arrested for illegally entering the country and wereplaced in police custody.

Last Friday, near the village of Mlaka in Jasenovac municipality, about 100 kilometres southeast of Zagreb, 19 Iraqi nationals, including five men, six women and eight children, were caught after illegally crossing the border from Bosnia and Herzegovina. Those in poor condition were taken by ambulance to hospital in Pakrac and Sisak. They all said they would formally apply for international protection, and after being discharged from hospital, theyhave been accommodated in the reception centre for asylum seers in Zagreb.

**Sport Education for New Life of Asylum Seekers project presented in Zagreb**

ZAGREB, Feb 28(Hina) - The SportEducation for New Life of Asylum Seekers project, worth more than €335,000, was presented in Zagreb on Friday, with the message that sportcreates friendships and connects peopleregardless of their differencesand that it presents an opportunity for everyone to show their skills.

The project was approved by the European Commission, which provided 80% of the funds.

It was designed with the aim of promoting the integration and social inclusion of asylum seekers in Croatia, mostly through football and taekwondo.

As an EU member state, Croatia took on the obligation of accommodating and integrating asylum seekers. The project managers noted that sport was chosen as an important factor for an easier integration in our society because it is frequently referred to as a sporting nation.

**Germany donates 4 vans to Croatia's special police**

ZAGREB, Feb 28 (Hina) - Germany has donated four vans to Croatia's special police force which, with additional communication equipment, arevalued at almost HRK 2.5 million,the Interior Ministry saidon Friday.

Police DirectorNikola Milina and Germany's Ambassador to Croatia Robert Klinke signed the deed of donation. The vehicles were handed overduring a working visit by Germany's riot police directorAndreas Bachoff and associates.

The German delegation underscored that it considers Croatia's police force a reliable partner and that the police forces in both countries have participated in many joint projects, the ministry reported.

The ministry added that the German partnershighlighted the significant progress the Croatian police haveachieved in recentyears and expressed willingness to continue cooperation in transferring their common experiences topolice forces in neighbouring countries that are yet to become members of the European Union.

Cooperation between the police in both countries has continued for almost 20 years, the ministry recalled, and Germany has constantly provided financial assistance and expertise to the Croatian police and has become one of Croatia's key partners in that regard.

**Germany: Eight injured in crash of bus with Croatian passengers**

ZAGREB, Feb28(Hina) - A bus with Croatian passengersswerved off the road and overturned between Ulm and Stuttgart in southwest Germany in the early hours of Friday as a result of which eight persons were injured, including two seriously, Ulm police said.

The bus was on the state road B10 during a hurricane withsnowand the driver, due to the wind, lost control of the vehicle, the police said in a press release.

The 48-year-old male driver and a 53-year-old female passenger sustained serious injuries, while six passengers aged 21-61 were lightly injured. All were taken to local hospitals.

The bus headed for Stuttgart had only seven passengers. Police estimated the damage to the bus at €200,000.

According to unofficial information, the bus belongs to the Plesa company from Augsburg, Germany. According to its website, it has an Osijek-Stuttgart line which departs from Osijek, Croatia every Thursday.

**AmCham proposes postponing regulation of taxation on coffee and non-alcoholic drinks**

ZAGREB, Feb28(Hina) - The American Chamber of Commerce (AmCham) on Fridayproposed a postponementof the regulation on a new methodology to calculatetaxes on coffee and non-alcoholic drinks until 1 January 2021 "in order to ensure the predictability of the business environment."

"We proposea postponement of the entry into force of the Regulation concerning the new methodology and the factors for calculating excise taxes on coffee and non-alcoholic drinksuntil 1 January 2021 in order to ensure the predictability of the business environment," the Executive Director of AmCham Andrea Doko Jelusic emphasised in a press release.

The draft regulation proposes changes to taxes onnon-alcoholic drinks based on their sugar content.

AmCham noted that the first officialdraft of the regulation was published on 15 February, and that it was scheduled to enter into force on 1 March.

AmChamconsiders the act not to beconsistent with the usual practice of the Ministry of Finance, whose laudable practice during the last few years was to adopt legislative measures at the end of a current year, with their entry into force scheduled for the following year.

"That is why we propose a postponementof the entry into force of the Regulationuntil 1 January 2021," Doko Jelusic stated, adding that it was necessary to take into accountthe timely adjustment of business entities that were affected by the legislative change, especially in the case of amendments that involve a greater financial burden.

Business entities need to be given sufficient time to make changes to their business plans and budgets, Doko Jelusic noted.

AmCham supports the efforts of the government to improve the health of the Croatian citizens and calls for the definition of a comprehensive solution concerning the fight against obesity.

Industry-specific taxes without a comprehensive solution for the public health and tax issues needs to be revised, AmCham says, proposing additional changes to theregulation.

"As the variable taxation model will be introduced, the basic flat-rate tax burden should be abolished. The current model, a combination of the fixed and variable tax burden, is in contrast to the declared purpose of the proposed law and contributes to the complexity of application," the AmCham said.

They also proposeabolishing any tax burdens on non-alcoholic drinks containing methylxanthine or taurine since there is no evidence, they stated, of their harmfulness nor doestaxing themcontributeto the achievement of legislative goals.

The non-alcoholic drinks industry representatives want to make a proactive contribution to improving health in Croatia, AmChamemphasised, noting that a partnership between the industry and relevant institutions in public health campaigns can be an example ofgood practice in responsible behaviour in pursuing common goals.

For a productive cooperation between the industry and relevant institutions in achieving common goals and providing necessary funds, a long-term planning of activities and costs is necessary, AmCham points out, calling forthe definition of multi-annual plans related to legislative amendments.

The public consultation on the regulation lasts from 15 February to 29 February.

Minister of Finance Zdravko Maricexplained in mid-February that the regulation would divide excise tax on non-alcoholic drinks in two parts - a flat-rate tax rate would remain, but it would be reduced from HRK 40 to HRK 20 per hectolitre on all non-alcoholic drinks, regardless of the second factor - their sugar content.

"The regulation will precisely define four categories - those non-alcoholic drinks that contain less than 2 gramsof sugar will not have the variable component, those containing 2-5 grams of sugar will be taxed at around HRK 10 per hectolitre, those containing 5-8 grams at HRK 30, and the final category at HRK 60. In other words, when it is all added up, some drinks will become cheaper depending on their sugar content, and excise tax on other drinks will increase," the Minister of Finance stated, adding that energy drinks would be recognised as a special category.

**HUP and HGK: Every new tax in industry should be approached rationally and thoughtfully**

The Croatian Employers' Association(HUP) stated in mid-February that the planned increases of excise taxes on tobacco, alcoholic and non-alcoholic drinks would have a negative impact on domestic industry and facilitate a growth of the black market.

All new taxesin industry should be approached rationally and thoughtfully, taking into account the negative impacts of such decisions on the economy, they stated.

The Croatian Chamber of Commerce (HGK) thinks that excise taxes on particular products/ingredients should be examined within a wider context of other measures aiming at preserving and improving health, primarily those measures connected to educating consumers about balanced diets and healthy lifestyles.

**Around 100 beekeepers attend Honey Days in Pazin**

ZAGREB, Feb28(Hina) - Around 100 beekeepers from Croatia, Hungary, and Slovenia are attending the 15th Honey Days, an international beekeeping event which wasopened on Friday by the Minister of ***Agriculture*** Marija Vuckovic.

At the opening ceremony of the trade fair for beekeeping products and equipment, the minister said that the industry is facing great challenges.

A new three-year National apiculture programme until 2022, worth more then HRK 44 million, was launched at the end of summer last year, Minister Vuckovic said, adding that around HRK 14.8 million per year was provided for the beekeeping sector.

"A drop inhoney imports was registered last year, and I believe that the Ministry's activities contributed to thatfact, especially the introduction of the national honey jar, which has to date been adopted by 1,061 of 8,500 beekeepers. We hope that the number will double with certain subsidies during this year, or next, and our final goal is for all beekeepers to adopt the national honey jar," Minister Vuckovic stated.

As for cooperation with IstriaCounty, she emphasised that so far projects worth around HRK 620 million have been launched through the Rural Development Programme, and that more than HRK 225 million was already paid out.

The minister added that projects worth around HRK 295 million were launched in Istriaas part of the Operative Programme for Maritime Affairs and Fisheries, and that more than HRK 225 million was already paid out.

The head of the County ***Agriculture*** Department, Ecio Pinzan, emphasised that Pazinhad become the centre for Istrianbeekeeping thanks to the Honey Days event which promotes beekeeping, honey, and honey consumption.

"Istria Countydecided to strategically develop Istria as a sustainable region, and beekeeping perfectly fits into thatstrategy. Today we have around 13,000 beehives in Istria, beekeepers are organised in six associations, and they all workon honey promotion. They produce around 300 tonnes of honey in total," Pinzan said.

He pointed out that Istria had the possibility of eco-friendly honey production, as well as product placement through tourism, which would include not only selling products, but also promoting local products and traditions.

The Honey Days event, which takes place today and tomorrow, is organised by the Lipa beekeepers' association from Pazin, whose president, Ranko Andelini, emphasised that the international trade fair also had an educational and expert character. He added that seasonal honey evaluations had been taking place for much longer than the Honey Days trade fair. This year the 24th edition of the seasonal evaluation of Istrian beekeepers' products was held, and 24 honey samples were presented, nine of which won gold medals.

The evaluation is the most convincing proof of quality forIstrian honey, Andeliniemphasised, adding that beekeepers from Istria, Cres, and Losinj work with Slovenian coastal beekeepers on protected designation of origin for Istrian honey.

**DZS: Number of tourists in commercial accommodation up 5% in 2019**

ZAGREB, Feb 28 (Hina) - A total of 19.5 million tourists stayed in commercial accommodation in Croatia in 2019, an increase of 5% compared with 2018, while the number of overnight stays rose by 2% to 91.2 million, the National Bureau of ***Statistics*** (DZS) said on Friday.

A total of 2.2 million domestic tourists stayed in commercial accommodation, up by 9.4%, and generated 7.1 million overnight stays, nearly 10% more than in 2018.

Croatian tourists were the second largest group to stay in commercial accommodation, behind Germans, whose number reached 2.9 million, up 3.5%. German tourists generated by far the largest number of overnight stays - 20 million, which is a slightdecline in relation to 2018. They were followed by Slovenians, with 7.5 million overnight stays (+3.1%), whileAustrians were the fourth largest group, with 7.05 million overnight stays, down by 0.1% from 2018.

Foreign tourists, who came from over 80 countries from around the world, accounted for about 90% of all stays in commercial accommodation, with 17.3 million arrivals (+4.3%) and 84.12 million overnight stays (+1.2%).

Broken down by type of accommodation, the largest number of overnight stays, namely 44.5 million, was generated in various types of private accommodation, which was an increase of 2.6% over 2018. Hotels recorded 20.7 million overnight stays (+1.6%) and campsites 18.2 million (-0.6%).

**Kras group nets HRK 15.6m in profits in 2019**

ZAGREB, Feb28(Hina) - In 2019, the Kras Group netted HRK 15.6 million in profits, down 68.7% on 2018, according to a financial statement released on Friday.

The group's consolidated earnings totalled HRK 1.03 billion, up 5.4% on 2018. Expenditures increased 4.9% to HRK 1.01 billion.

Profit before tax was HRK 19.6 million. EBITDA was HRK 102.8 million.

Sales revenues totalled HRK 1.02 billion, HRK 7.4 million more than in 2018. Thoseon the domestic market went up 1.9% to HRK 557.8 million, accounting for 54.6% of the group's sales revenues. Foreign sales brought HRK 463.9 million, down 0.6% from 2018.

**Podravka Group nets HRK 221.6m in profit in 2019**

ZAGREB, Feb 28 (Hina) - The Podravka Group in 2019 increased its sales revenue by 4.2% to HRK 4.41 billion and net profit by 7.7% to HRK 221.6 million, its financial statement showed on Friday.

Sales revenue increased by HRK 177.3 million, from HRK 4.41 billion in 2018. The growthwas driven by increasesin both business segments - food and pharmaceuticals.

The food segment generated HRK 3.45 billion in revenue, an increase of HRK 118.8 million while the pharmaceuticals segment generated an increase of HRK 955.4 millionor6.5% more on the year.

The group's revenues rose byHRK 118.1 million or 4% in the Adria region, by 6.8% in Western Europe and Transoceanic countries and by 14.5% in Eastern Europe.

**Croatia Airlines posts HRK 79.8 mn loss in 2019**

ZAGREB, Feb 28 (Hina) - According to preliminary estimates, Croatia Airlines generated an operating loss of HRK 55.9 million in 2019, while the net financial results indicate a loss of HRK 79.8 million,the national flag carrier reported in afinancial statement on Friday.

That loss is HRK 3 million lower than in 2018.

Passenger turnover in 2019 amounted to 2.18 million, equal to the turnover in 2018.

Total operating revenue amounted to HRK 1.73 billion, up 2% year on year. The greatest share of that, or HRK 1.52 billion, was generated from passenger transport. Freight transport generated a revenue of HRK 11.5 million, while other revenues wereHRK 195.2 million.

Overall operating costs amounted to HRK 1.78 billion, on par to 2018.

The cost of flights amounted to HRK 517.8 million, air transport services cost HRK 395 million, promotionand sales costs amounted to HRK 229 million, and maintenance costs totalled HRK 219 million.

In 2019 Croatia Airlines flew to 38 destinations in 24 European countries.

Last year the government adopted a decision to launch proceedings to acquire a strategic partner for the national carrier in order to expand the transport network and to inject fresh capital into the airline and renew its fleet.

**Djuro Djakovic Group posts HRK 112.5m loss**

ZAGREB, Feb 28 (Hina) - The Djuro Djakovic metal and mechanical engineering group operated at a loss of HRK 112.5 million in 2019, which is considerably higher than in 2018 when the loss was slightly below HRK 15 million, its financial statement showed on Friday.

Operating revenue fell by nearly 40% to HRK 278.7 million, while exports dropped by 35.3% to HRK 191.8 million.

Problems that dogged the company throughout the year escalated in the final quarter as creditors'loss of confidence in its business resulted in the absence of deliveries by suppliers and of support by financial institutions for further production. Two companies within the group managed to continue operating successfully, while the other three, including Special Vehicles,maintained production at a minimum for a while before their accounts were blocked because of delays in wage payments and a subsequent strike.

The Special Vehicles company posted a loss of HRK 57 million in the fourth quarter of 2019. Its Q4 revenue of HRK 29.7 million and Q3 revenue of HRK 18 million made its operation completely untenable, the group said.

The group turned to the government as a shareholder for support in line with the European Commission's guidelines on state aid for restructuring non-financial companies in trouble.

At the start of this year, a new management board chair was appointed and the government issued a state guarantee for a HRK 300 million loan to unblock the accounts and restart production.As a result, Djuro Djakovic Grupa d.d. and Djuro Djakovic Specijalna Vozila (Special Vehicles) had their accounts unblocked and they paid overdue wages, while Djuro Djakovic Industrijska Rjesenja (Industrial Solutions) continued the restructuring process.

**JANAF reports lower 2019 revenue and profit**

ZAGREB, Feb 28(Hina) - The Adriatic oil pipeline operator JANAF ended 2019 with a net profit of HRK 261.9 million, which is 13.8% less than in 2018, whileoperating revenue decreased by 7.4% to HRK 696 milliondue to overhauls in all refineries, the company reported on Friday.

JANAF'stotal revenue in 2019 amounted to HRK 714,300, which is 8.6% less year-on-year while total expenditure declined by 4.1% to HRK 394.5 million.

Gross profit amounted to HRK 394.5 million, upby a little more than HRK 50 million or 13.7% y-o-y.

The company noted that gross and net profit was about 26% higher than planned.

The bulk of total revenue relates to operating revenue, which reached HRK 696 million, down 7.4% on the year.

Sales revenue on the domestic market amounted to HRK 233.6 million (-0.7%) while foreign sales revenue totalled HRK 435.1 million (-10.2%). Other operating revenue amounted to HRK 27.3 million (-14.9%).

Transport revenue reached HRK 388.2 million, HRK 174.1 million was generated from storage of crude oil, and a further HRK 100.6 million from storage of petroleum products.

JANAF's expenditure in 2019 amounted to HRK 390.8 million (-3.7%).

Investments amounted to HRK 408.6 million, mostly in pipelines (HRK 111.7m) and in safety and environment protection (HRK 109.3m).

**Koncar Group posts 2019 net profit of HRK 52.7mn**

ZAGREB, Feb 28 (Hina) - The Koncar electrical, transport and energy group earned a net profit of HRK 52.7 million in 2019, down by 44% compared with 2018, according to the group's financial statementpublished on Friday.

Total revenue was HRK 2.99 billion, up 9.1%, and total expenditure increased by 11.9% to HRK 2.92 billion on the year.

Operating revenue, accounting for 98.1% of total revenue, increased by 10.5% to HRK 2.93 billion.

The company generated a consolidated revenue from the sale of products and services in the amount of HRK 2.8 billion, up 12.8% year-on-year.

Sales on the domestic market generated a revenue of HRK 1.15 billion, or 10.2% more y-o-y. Sales on foreign markets generated a revenue of HRK 1.65 billion, or 14.7% more than in 2018.Exports accounted for 58.9% of total sales.

Companies within the Koncar Group closed new deals valued at HRK 3.08 billion, which was 16.8% more than the year before.

Of the total number of contracts signed, 37% or HRK 1.1 billion is related to contracts on the domestic market and 63% or HRK 1.9 billion refers to exports.

**ZSE indices drop sharply**

ZAGREB, Feb28(Hina) - The Zagreb Stock Exchange (ZSE) indices dropped sharply on Friday, with the Crobex sinking by 1.95% to 1,863 points and the Crobex10 by 2.06% to 1,118 points.

Regular turnover amounted to HRK 37.6 million, which is around HRK 9 million more than the previous day. Another HRK 3.1 million was generated in block trading in HT telecoms shares.

The highest turnover in regular trading,of HRK 10.1 million, was generated by the HT telecoms stock, which closed at HRK 172.5, down by 2.82%.

The stock of confectioner Kras turned over almost HRK 5 million, closing at HRK 705, down by 0.7%, while the stock of theValamar Riviera hotel company, turned over HRK 4.2 million, closing at HRK 33.3, down by 1.48%.

Of the 51stocks traded today, 30droppedin price, 8 went up, and 13 were stable compared to the previous day.

(€1 = 7.463852)

**THIS BULLETIN INCLUDES NEWS ITEMS RELEASED BY 2100 HOURS FRIDAY.**

(Hina) vm

Masthead Brief News Bulletin is published by the Croatian News Agency HINA Marulićev trg 1610 000 ZagrebCroatia web:[*www.hina.hr*](http://www.hina.hr) mail: [*hina@hina.hr*](mailto:hina@hina.hr) phone: (+385 1) 48 08 660; fax (+385 1) 48 08 822 Publisher: Branka Gabriela Valentić, DirectorEditor in Chief: Serđo Obratov Bulletin Editor: Marija Šestan

**Load-Date:** February 28, 2020

**End of Document**



[***NEWS BULLETIN NO. 11342***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:618R-FNS1-F12K-R32D-00000-00&context=1516831)

HINA Digest

November 12, 2020 Thursday

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**Length:** 9002 words

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Zagreb,Hrvatska12 November 2020 (Hina) - Croatsurged to comply with anti-COVID rules, 3,082 new daily cases ZAGREB, Nov 12 (Hina) - Prime Minister Andrej Plenkovic said on Thursday that Croatia was now at the most difficult stage of the coronavirus epidemic and called on citizens to abide by epidemiological rules to avoid the imposition of tougher restrictions. Over the past 24 hours, Croatia has registered a record 3,082 new cases of the coronavirus infection and 32 related deaths, the national COVID-19 response team said in themorning. The number of active cases in Croatia stands at 16,348, there are 1,598 COVID patients in hospitals, and 178 of them are on ventilators. Since start of epidemic75,922have caught virus, 58,649have recovered Since February 25, when Croatia registered its first coronavirus infection, a total of 75,922 people have contracted the novel coronavirus, 925 of them have died, and 58,649 have recovered, including 2,215 in the last 24 hours. There are currently 35,690 people in self-isolation.

To date, 592,326 people have been tested for coronavirus, including 10,156 in the last 24 hours. Commenting on the latest coronavirus numbers, the PMtold the government that the country was passing through the hardest period of the epidemic. "It is therefore important to call on every citizento comply with the measures adoptedby the national COVID-19 crisis management team. Those are serious and well-thought-out measures which bring results." He said that in the last seven days the number of new infections had risen by 5.5% compared to the previous week. This indicates stagnation in the number of new infectionsand this is what wetalked about when we said that the latest measures would decelerate the rise in new infections, the premier said. However, we must be on high alert, primarily due to hospitalisation numbers and ***data*** on patients in intensive care wards, he said. Plenkovicreiterated the necessary activitiesessential for efforts to curb the virus: keeping a physical distance, hand-washing, and regular airing of rooms, and he underscored that such measures were especially important atprivate gatherings. 1,213 COVID patients admitted to hospitals,744 discharged in last 7 days Health Minister Vili Beros did not attend today's meeting of the government as he underwent testing for the virus, and it was later stated that he was negative. The health ministry's State Secretary, Zeljko Plazonic, told the government that in the last seven days, 1,213 COVID patients had been admitted to hospitals, whereas 744 had been discharged. Commenting on the incidence rate, Plazonic said that even though it was registering a mild increase in the number of active cases, Croatia had a rather low number of active cases compared to neighouring countries. Commenting on the occurrence of the disease among medical professionals, hesaid that about 1,400 healthcare workers were now diagnosedwith the infection, and an additional 913 were self-isolating. The Croatian Institute of Public Health (HZJZ) has prepared a plan for the implementation of mass vaccinationagainst coronavirus, which includes the monitoring of the process and detection of contraindications. Dr Markotic nominated for EU scientific advisory group on COVID-19 ZAGREB, Nov12(Hina) - The Croatian government on Thursday nominated Dr Alemka Markotic as a member of the European Union's future scientific advisory platform on COVID-19. Markotic is the head of Zagreb'sFran Mihaljevic hospital for infectious diseases, a professor at the School of Medicine in Rijeka and a member of the national COVID-19 crisis management team. The platform willsoon be set up at the proposal of European Commission President Ursula von der Leyen. The platform will includea group of respectable doctors and researchers from all EU member states whose task will be toensure a better, faster and coordinatedexchange of scientific ***data*** and expert opinions as well as practical experienceat the EU level. PM unveils Croatia's development strategy until 2030 ZAGREB, Nov 12 (Hina) - Prime Minister Andrej Plenkovic on Thursday unveiled a proposal for the national development strategy until 2030, saying that ten years from now he saw Croatia as a competitive, innovative and stable country of recognisable identity and culture, with preserved resources, good living standards and equal opportunities for all. In circumstances of globalisation, over the next decade Croatia must use its competitive advantages and focus on sustainable economy and society, on increasing resilience to crises, on a green and digital transition, and balanced regional development, the prime minister said. The goals include realising the potential for development, mitigating the consequences of the economic crisis caused by the coronavirus pandemic, promoting sustainable and stable development, improving living standards and ensuring equal opportunities for all people. Plenkovic said that ambitious and realistic indicators were developed for all these components. The proposed national development strategy will be put to public consultation over the next 30 days, after which it goes before the government and parliament. The premier expressed hope that the strategy would be adopted with a broad consensus and support. The 140-page document has been prepared by the government departments and the academic community as well as other interested stakeholders. Plenkovic recalled that upon the adoption of this strategy by parliament, all other documents should be adjusted to it. "In 2017, we launched the preparation of the National Development Strategy, which will mark systematic and strategic progress towards a more successful and more developed Croatia in 2030," Plenkovic said. Four development areas and 13 strategic targets He added that the strategy should be implemented through synergy of public policies in four development areas. There are 13 targets contained in the strategy: a competitive and innovative economy, educated and employed people, an efficient judiciary, public administration and state property management, global recognisability, a stronger international position and role, healthy, active and high-quality life of citizens, demographic revitalisation including a better status of family, security for stable development, ecological and energy transition to climate neutrality, self-sufficiency of food production and the development of bio-economy, sustainable mobility, digital transition of society and the economy, the development of underdeveloped areas and areas with development particularities, and greater regional competitiveness. The target is for GDP per capita to reach 75% of EU average by 2030 Speaking of Croatia's target values by 2030, Regional Development and EU Funds Minister Natasa Tramisak said the target was for GDP per capita to reach 75% of the EU average, up from the 65% in 2019. The target for the employment rate is to reach 75% (66.7% in 2019), for Croatia to rank 45th or higher on the Global Competitiveness Report (63rd in 2019), for exports to account for 70% of GDP (52.3% in 2019), and for outlays for research and development to account for 3% of GDP (1.11% in 2019). Furthermore, the target for both men's and women's healthy life expectancy is to reach 64 years (56.5 for men and 58.5 for women in 2018), for total fertility to rise to 1.8 children (1.47 in 2018), for reading literacy, as measured by PISA, to reach the 2018 Organisation for Economic Co-operation and Development average of 487 points (479 in Croatia). Another target is to reach the EU average in the length of time pupils spend in the teaching process and in adult participation in lifelong learning, which in 2019 was 10.8% in the EU and 3.5% in Croatia. Another target is to reduce the percentage of people at risk of poverty and social exclusion to below 15%. Last year it stood at 23.3% The government also wishes to increase labour productivity in ***agriculture*** from €6,107 per annual unit labour cost to €10,000. Another target is to reduce greenhouse gas emissions and raise the share of renewables in gross energy consumption, to raise the recycled municipal waste rate to 55% (25.3% in 2018), and to reach the EU average of 52.6% in the Digital Economy and Society Index (47.6% in Croatia). National Development Strategy wasn't drawn up by the World Bank Responding to questions from the press, Plenkovic said the National Development Strategy was a framework strategic act, not an operational plan or sectoral strategy, which therefore did not envisage implementing documents. He added that the government was the most responsible for its implementation, that its adoption was not late and that it was adjusted to this year's circumstances. Tramisak said a €4.3 million partnership agreement had been signed with the World Bank in 2017, not for drawing up the National Development Strategy but 16 analyses and the establishment of a strategic planning system. Drawing up the strategy did not cost anything, she said, adding that it was drawn up by working groups comprising representatives of the ministries, the Chamber of Commerce and the Employers Association. Asked if it was realistic to expect Croatia's GDP per capita to reach 75% of the EU average by 2030, Economy and Sustainable Development Minister Tomislav Coric said it had risen by four percentage points over the past four years and that the target for the next decade was to have a faster economic growth than the EU which, he added, was visible in the past four years. As a small and open economy, by successfully absorbing European funds Croatia can make several more steps than the sluggish economies which need much more time to adjust to the Green Agenda and low-carbon development, he said. PM forwards draft development strategy to president, speaker ZAGREB, Nov 12 (Hina) - Prime Minister Andrej Plenkovic on Thursday morning sent copies of a draft national strategy for the period until 2030to President Zoran Milanovic and Parliament Speaker Gordan Jandrokovic, governmentspokesmanMarko Milic said on his Twitter account. The document has been sent to the two top office holders before itis put to public consultation, Milic tweeted. Plenkovic called on Milanovic to nominate his representative to the steering committee for the elaboration of the national strategy, and thus make a contribution to efforts to prepare the strategy, Milic said. The letter sent to Jandrokovic reads that the premier is confident that all members of the parliament will give their contribution to parliamentary discussions on the matter and that the National Development Strategy for the period until 2030 would enjoy asbroad support as possible. Milanovic for including Opposition reps in steering committee Earlier today, President Milanovicsuggested that Plenkovic should include representatives of opposition parliamentary parties in thesteering committee and thetask force in charge of drawing up the National Development Strategy for the period until 2030. The president believes that the strategy is a document of national strategic interest and that it requires the broadest possible consensus, reads a statement issued by the Office of the President on Thursday morning. "Due to the importance of the strategy, the challenges faced by Croatia and the possibilities that will open up in the coming decade, I suggest that youchange your decision on the establishment of the steering committee and task force for the national development strategy for the period until 2030 to make it possible for representatives of opposition parliamentary parties to participate in it as well," the statement reads. Opposition welcomes proposal to include them in preparation of development strategy ZAGREB, Nov 12 (Hina) - Parliamentary opposition parties on Thursday welcomed President Zoran Milanovic's appeal to Prime Minister Andrej Plenkovic to include them in the preparation of the national development strategy as a document that would define Croatia's future over the next decade. The key authority for the development of the strategy is the steering committee which is also responsible for monitoring its implementation. Since the steering committee includes the whole cabinet, representatives of the associations of counties, towns and municipalities and only one representative of parliament, we think that the president's proposal is good, Social Democratic Party (SDP) leader Pedja Grbin told the press. The national development strategy is not being prepared for a term of just one government but will cover the period from 2021 to 2030. It is only logical then that the steering committee should include not just representatives of the current government but also the opposition so that those who now lead the country, as well as those who will lead it in the future, are involved in all the processes, Grbin said. He said he was not surprised that the government did not want any opposition representatives on the steering committee. "I hope the president's initiative will meet with a sympathetic ear and that the government will realise how important it is during the preparation of the national development strategy to be able to hear the voice of those who are not in power," Grbin said, adding that the president's proposal was reasonable and could not be seen as being patronising towards the prime minister. Stephen Bartulica of the Homeland Movement described the president's proposal as a good idea. "It's not easy to reach a consensus in politics, but we should at least try. The development strategy until 2030 is an important document defining long-term consequences for our country. There should be the broadest consensus possible, so I welcome this idea." Tomislav Tomasevic of the green-left bloc said that the national development strategy was key and probably the last chance for Croatia to turn to an economy that would reduce greenhouse emissions while increasing employment and making the economy and society more resilient to new crises, less dependent on tourism and with more healthy foodand green energy. "In a normal country, the government would have included the opposition in the development of such a strategy to reach a consensus already three years ago. We welcome President Milanovic's proposal," Tomasevic said. Bridge's Nikola Grmoja also said that the opposition should have been included in the preparation of such an important document long ago. PM: Opposition can address suggestions to steering committee ZAGREB, Nov 12 (Hina) -Prime Minister Andrej Plenkovicsaid on Thursday that he had sent the President a letter asking himto nominate his representative to the steering committeefor the preparation of theNational Development Strategy, while the opposition can participate with its suggestions which the government will consider carefully. "I sent a letter to the President this morning to nominate his representative. It is important that he has a representativeon the steering committeewho will be able,together with us, after public consultation, to suggestideas, content, modifications, additional elements that we may not havenot noticed during the entire process," Plenkovic told reporters after presenting the draft strategy. NationalDevelopment Strategy until2030 President Zoran Milanovicearlier in the day suggested that Prime Minister Plenkovic should include parliamentary opposition parties in the steering committee and the task force in preparing the National Development Strategy until 2030, underlining that this document was ofnational strategic interest. Plenkovicsent copies of the draft strategy to Milanovic and Parliament Speaker Gordan Jandrokovicprior to releasing it for public consultation, governmentspokesmanMarko Milic said on Wednesday. The prime ministerinvited the president to nominate his representative to thesteering committee for the preparation of the strategy so he can make his contribution to it. In the letter to Jandrokovic, the prime minister expressed his confidence that all legislators would contribute to the parliamentary debate so that the strategy received as much support as possible. Plenkovic: Documentto be released any time now, I expect everyone to contribute The prime minister commented on Milanovic's suggestion to include the opposition onthe steering committee. "As far as dialogue with the opposition is concerned,even prior to forming the second government, in mid-July, we called on opposition leaders at the time to come to a meeting. That was prior to that EU Councilmeeting when we brought €23.5 billion to Croatia. They all rejected it, no one wanted to come," Plenkovic recalled. "And now apparently the opposition wants to be involved more specifically. The same people now want to participate. We absolutely support that. The document will be released any time now. As soon as they go through it during public consultation or in any other way, we will carefully analyse anything they wish to suggest and take that into account. The document will be debated, not just at a plenary sitting but I expect all lawmakers to participate," the prime minister underlined. He added that the document would also be debated with the heads of the associations of counties,towns and municipalities. "Therefore, we will consult everyone who needs to be consulted. This is an inclusive process," the prime minister stressed. "As far as methodology is concerned, that process is open and a lot of people can participate in it. This document is the result of the effort of a lot of people. It is our duty, as the government, to initiate this type of document," Plenkovic explained. He said that once the steering committee heard all suggestions during public consultation, it would discuss the strategy again. "It is a process, it is dialogue," he underlined. Gov't dismisses Oppositionmotion for Coric no-confidence vote ZAGREB, Nov 12 (Hina) - The government on Thursday sent to parliament itsexplanation why it has dismisseda motion of no-confidence vote against Economy Minister Tomislav, which was tabled by 40 Opposition lawmakers. Commenting on the case, Prime Minister Andrej Plenkovic said that the government turned down all the three opposition requests from themotion. The Opposition doubts Coric's trustworthiness due to his decisions concerningthe Krs-Padjene wind park project, the appointment of Nella Slavica as the head of the Krka National Park and possible disrespect of the principle of fairnessin the process of reappointment of Dragan Kovacevic as the CEO of the state-run oil pipeline operator (JANAF). €594.84m for removal of quake consequences to be disbursed by year's end The government also decided on the distribution of EU grantsfor the removal of consequences caused by the 22 March earthquake in Zagreb and its environs. Croatia has already received €88.9 million from EUfunds for that purpose while the total grantallocation is €683.7 million. The remaining €594.84 million will be disbursed to Croatia until the end of this year, after Zagreb informs Brussels how it plans to use that amount, Construction Minister Darko Horvat said. Electronic media bill tabled to parliament ZAGREB, Nov 12(Hina) - The Croatian government on Thursday sent to parliament a bill on electronic media, with Culture and Media Minister Nina Obuljen Korzinek saying the government expected an informed and dynamic debate and was open to proposals to improve the bill. "We remain open to improvement proposals considering the large number of those interested in having the matters the law refers to regulated precisely. We will continue improving the textuntil the second reading," said the minister. The bill has been harmonised with the revised Audiovisual Media Services Directive. "The most important elements refer to new definitions of audiovisual media services, new ways of defining mechanisms of determining jurisdiction over providers of media services," the minister said. The bill has more transparent provisions on making public ***data*** on media ownership and financing. It also introduces the obligation to award funds for the financing of media at the national and local levels via public tenders. Also amended have been provisions on media pluralism, that is, fair competition. The bill regulates electronic publications more precisely. As for the responsibility of publishers for user-generated content on electronic publications, that is, comments under articles, Obuljen Korzinek said on Wednesday that the responsibility for that content had existed previously, but it was now regulated in a more precise way, adding that fines hadnot changed. Gov't sends bill on copyright, related rights to parliament ZAGREB, Nov 12 (Hina) - The government on Thursday sent to parliament a bill on copyright and related rights, which adjusts that area to the digital age,in line with twoEU directives. The purpose of the bill is to adapt the existing legal framework to technological development that has changed the way works protected by copyright and related rights arebeing created, produced, distributed and used. The existing law dates back to 2003 and over the years it has been amended many times, while the new law is aimed at ensuring more efficient protection for creators of online cultural and media content, said Culture and Media Minister Nina Obuljen Korzinek. The bill also definesexceptions and restrictions regarding copyright and the related rights, as well as new measures facilitating licencing for the use of works protected by copyright and related rights to enable broader access to protected content, she said. The minister added that the bill defines rulesfacilitating cross-border distribution of television and radio programmes and introducesa mechanism to facilitate licencing in cases when programmes from other EU countries are re-broadcast. "We consider it as especially important that the bill will ensure a better status for stakeholders in the national cultural, creative and media industries in relation to online platforms, which is particularly important in the context of their revenues which have decreased due to the coronavirus epidemic," the minister said. The bill will also provide a clear framework and facilitate the use of works protected under copyright and related rights in digital and online classes and remote learning. Membership fee in tourism boards 12% lower as of 1 Jan 2021 ZAGREB, Nov12 (Hina) - As of 1 January 2021 the membership fee in tourism boards for all five groups paying the fee should be 12% lower, based on a bill on the membership fee inlocal tourism boards which the government sent to parliament on Thursday. Tourism Minister Nikolina Brnjac said the government's action plan envisaged a reduction in the membership fee to promote the business environment and reduce costs for businesses. FinMin: Tax reform serves to encourage wage growth, better living standards ZAGREB, Nov12(Hina) - Finance Minister Zdravko Maric on Thursday presented in the parliament four bills from the fifth round of tax reform, saying that the proposed taxation policy served to encourage a positive business climate, investments andwage growth as well as improve citizens' living standards. The government has proposed lowering income tax rates from 24% to 20% and from 36% to 30%, with Maric saying that at the moment 1.8 million of 2.8 million workers who are subject to income taxation did not pay that taxdue to the amount of their income. "The total effect (of tax lowering) will be two billion kuna, however,it will not be to the detriment of local government units but the state budget," he said. Maric said that the tax reform increased the amount ofnontaxable allowances fromHRK 2,500 to HRK 13,000 a year, noting that employers wouldbe able to pay the latter amount to their employees without having to pay taxes. Maric noted that the Fiscal Equalisation Fund would stay and that its funds would go to less developed municipalities and counties. As for profit tax, Maric said that the standard rate for all those who have an annual income of up to HRK 7.5 million would be reduced from 12% to 10%, noting that90% of entities subject to profit taxation belonged to that category and describing the lowering of the tax rate as an incentive to businesses and employers to invest and hire. Opposition says tax reform benefits the richest ZAGREB, Nov 12 (Hina) - The Opposition in parliament said during a debate on four bills from the fifth round of the tax reform that the reform would benefit the rich and increase inequalities in society. Social Democrat (SDP) Pedja Grbin said that the tax reform jeopardisedthe functioning of local government units and increased inequalities. "The reform gives money only to the richest. Those withsalaries of between 5,000 and 6,000 kuna will get crumbs while those with above-average salaries will get an extra HRK 1,000 or more," said Grbin. He noted that the income ofpublic authoritieswould be reduced, which would hamper their work in the current health and economic crisis. GLAS MP Anka Mrak Taritas said that the tax reform would leave local government units wihtout two billion kuna and called for a true reform of the system of local government. Hrvoje Zekanovic of HRAST said that the tax reform would neither make life for citizens easier nor facilitate entrepreneurs'operations. He stressed that entrepreneurs were burdened by about 600 parafiscal levies which nobody was considering to abolish. Grozdana Peric of the ruling HDZ party disagreed with the Opposition's assessments, stressing that despite economic problems the government was trying to take care of citizens' income and looking for ways to reduce the tax burden on businesses. She recalled in that context an increase of the nontaxable income to HRK 4,000 and an increase of the minimum wage. The parliament is debating four tax reform bills which envisage cutting income tax from 24 to 20% and from 36 to 30% as well as profit tax from 12 to 10% for enterprises which make up to HRK 7.5 million a year. The government sent to parliament for first reading bills of amendments to the laws on income tax, profit tax, VAT, and fiscalised cash transactions. Opposition says latest tax reform is unjust The ruling majority said the tax bills would make it easier for citizens to deal with the effects of the pandemic, while the opposition said the changes would benefit those with the highest incomes and leave the rest with "crumbs". Ivana Posavec Krives (SDP) said the bills would deepen inequalities and the gap between the small number of people earning a lot and the large number of people who earned little and would now have HRK 15-100 higher monthly salaries. "The richer can put the surplus money away or spend it on luxury goods, while those with the lowest incomes will try to reduce their debts given the end of the stay on loan repayments and debt ***collection***. This heartless government doesn't want to see that," she said. Vesna Nadj (SDP) said the changed tax rates which would significantly raise the highest salaries, including those of cabinet ministers and MPs, could not be called a reform. She said it would be much more just to increase the non-taxable income and that a welfare state should provide social security to all citizens, correcting the imperfections of the market. Katarina Peovic (Workers' Front) noted that Croatia was lowering profit tax, which she said was among the lowest in the EU anyway, and income tax for those with the highest incomes. She said that this would only further disenfranchise the poor, stressing that the minimum wage did not meet people's basic needs. Stephen Bartulica (Homeland Movement) warned that "the huge state apparatus is like an insatiable octopus because expenditures are growing even though the number of inhabitants is on the decline." "In principle, we support tax cuts, but what is being done is too little and too late," Bartulica said, warning that only Greece allocated more for public spending than Croatia. "The government is taking people's money and reallocating it according to its own priorities," he added. Peric said that by cutting taxes since 2017 the government had ensured wage increases and the payment of Christmas bonuses and holiday grants as well as lower taxes for businesses. She said that taxes had been reduced by more than HRK 10 billion. Canadian airline announcesreturn to Croatia, says daily ZAGREB, Nov12(Hina) - ACanadian airline has announced its return to the Croatian market as of May 2021, Vecernji List daily says in its Thursday issue, noting that in 2020 Croatia was left without almost all intercontinental lines. Croatian airports this year saw a huge drop in the number of passengers just like other airports around the world due to the coronavirus pandemic. Airlinesworldwide share the same fate. As many as 11.4 million passengers passed through domestic airports in 2019, and the year was a record one also owing to numerous intercontinental lines. This year the country has been left without almost all intercontinental lines and next year will not be any better either. Aviation expert Gojko Mavrinac, who owns a portal specialising in aviation, croatianaviation.com, believes that next summer Croatia could be connected with Canada again with a direct flight. Until this year, there were as many as two direct flights to Canada during the summer, one operated by AirTransat and the other by Air Canada Rouge. Mavrinac saysthat Air Canada Rouge has released for sale tickets for Zagreb for next summer. He also notes thattalks are underway on the sale of AirTransat to Air Canada and if a deal is closed, the line to Zagreb will be operated only by AirTransat as the company specialises in tourist travel and leisure destinations. AirTransat has told croatianaviation.com that it plans to resume its Toronto-Zagreb service as of 11 May 2021, the daily says. Croatia Airlines stakeholders to decide on stock capital increase on Dec 14 ZAGREB, Nov12(Hina) - An extraordinary assembly of Croatia Airlines shareholders has been called for December 14, when the shareholders will make a decision on increasing the airline's stock capital by HRK 350 million through a new issue of shares, reads a call published on Thursday. The shareholders are suggested to increase the company's equity by HRK 277.88 million to HRK 627.88 million by issuing an additional 35 million ordinary shares in the nominal value of HRK 10 per share. Theincrease will be carried out in line with an investment agreement between the Republic of Croatia and Croatia Airlines (CA). Existing shareholders do not have the pre-emptive right, except for the Republic of Croatia, which will participate in the issue as an investor. The purpose of the rights issue is to restore the state of the company's capital and reserves to the level that existed before the coronavirus pandemic, on 31 December 2019. It is also a measure of financial assistance by the state based on a European Commission document on state aid to the business sector in the current pandemic. In the first nine months of this year CA reported a net loss of HRK 243.5 million. DM Croatia generates HRK 40m net profit ZAGREB, Nov 12 (Hina) - DM-Drogerie Markt Hrvatska,health & beauty retailer concluded the 2019/2020 financial year, which ends in September, with a total turnover of HRK 2.25 billion, 2% more than the preceding financial year, and generated a net profit of HRK 39.86 million, the company reported on Thursday. DM invested more than HRK 33 million in the 2019/2020 financial year for the modernisation of seven retail outlets. It opened three specialised departments for over the counter (OTC) medication and launched an online web shop. "In a year when the entire community is faced with unforeseeable business conditions we maintained our trend in growing turnover and retained the trust of our consumers. During the past financial year DM stores had more than 79,999 buyers visiting its stores every day. We also recorded a sales growthin OTC products of 24.29%," DM Hrvatska director Mirko Mrakuzic underscored. He announced that DM plans to invest HRK 74 million in the 2020/2021 financial year to develop its retail network, expand the range of products and update its stores as well as expand its range for online shopping. DM is focused on protecting the health of its workers, says Mrakuzicadding that the average take-home pay in their stores amounts to HRK10,399. He added that DM hasthanked its employees for their efforts in these extraordinary circumstances by giving them a bonus gift card valued at HRK 1,650 and that 98 days of further training had been organised involving750 employees. DM has 160 retail storesin 61 cities in Croatia and 1,592 employees and is the only drugstore of this kind that has an online shop in Croatia. 13.4% more building permits issued in Septy-o-y ZAGREB, Nov 12 (Hina) - In September 2020, there were 1,031 building permits issued in Croatia which is 13.4% more than in September 2019, the Croatian Bureau of ***Statistics*** (DZS) reported on Thursday. Based on the type of construction eighty-five percent of permits (878) were issued forbuildings and 15% (153) for civil engineering works. Year on year, the number of permits issued in September for buildings increased by 12.3% and for civil engineering worksby20.5%. Compared to August the number of permits issued for buildings was up 40.5% and forcivil engineering works. by 35.4%. The value of construction based on the permits issued in September amount to HRK 3.4 billion or 27.6% more than in September 2019 when they were valued at HRK 2.7 billion. Seventy-six percent (781) of the permits were for new constructions while 24% (250) were for reconstruction work. The permits issued in September envisage the construction of 1,495 flats. In the first nine months of this year 6,748 building permits were issued, down 9.1% on the year, and the works were valued at HRK 19.7billion, down 23.3% from the corresponding period in 2019. Insurers pay over €27m in quake damage, hears conference ZAGREB, Nov12 (Hina) - The insurance industry has promptly responded to the challenges stemming from the coronavirus pandemic and the consequences of the 22 March quake that hit Zagreb and its environs, according to opinions of participants in Thursday's online conference on the insurance industry in Croatia. During the conference, organised by theCroatian Insurance Bureau (HUO) and its partners, the HUO steering boardchairman, Slaven Dobric, said that after the earthquakeinsurance companies responded promptly and settled more than 6,000 property damage reporting forms, paying over 200 million kuna as compensation for the damage. Dobric said that 2020 was a demanding year for this industry. "Regardless of the impact of downward risks on operations, profitability and revenues, we as the industry have addressed those challenges in a stable and rather courageous manner," he said. The finance ministry's state secretary, Zdravko Zrinusic, said that the insurancemarket was a significant factor and important leverin generating the growth and stability, underscoring the importance of the stability of the financial system for the better credit rating of the country. EU industrial production stagnates in Sept as Croatia sees recovery ZAGREB, Nov 12 (Hina) - Industrial production in the European Union came to a sudden standstill in September following four months of recovery spurred by the easing of COVID-19 restrictions, while in Croatia it rose after a decline in August, according to ***Eurostat***. Seasonally adjusted industrial production stagnated in the 27-member bloc in September compared with August, when it increased by 0.9%. In the euro area, industrial production fell by 0.4% from August, when it grew by 0.6%. Production of durable consumer goods fell the most in both zones, by 3.9% in the EU and by 5.3% in the euro area. On the other hand, production of non-durable consumer goods rose the most, by 1.4% in the EU and by 2.1% in the euro area. Compared with August 2020, the largest decreases were observed in Italy (-5.6%), Ireland (-4.7%) and Portugal (-3.8%), while the largest increases were recorded in the Czech Republic (+4.1%), Slovakia (+3.4%) and Poland (+3.1%). In Croatia, Germany and Greece, seasonally adjusted industrial production increased by 1.7% in September. In August, industrial production in Croatia fell by 1.1%. Compared with September 2019, industrial production declined by 5.8% in the EU and by 6.8% in the euro area. Production of capital goods fell the most in both zones, by 11.9% in the EU and by 13.3% in the euro area. In the EU, production of consumer durables grew the most, by a modest 0.7%, while in the euro area all sectors produced less than last year, with production of consumer non-durables decreasing the least, by 1.5%. The largest year-on-year decreases were observed in Ireland (-13.6%) and Germany (-8.7%), while the only increases were recorded in Poland (+3.3%) and Portugal (+2.5%). Croatia saw a drop in industrial production of 1.1% year-on-year, and similar rates were also observed in Hungary and Lithuania. Croatia 53rd in IMD talent rankings 2020 ZAGREB, Nov 12 (Hina) - Croatia ranks 53rd in the latest global talent rankings prepared by the Lausanne-based International Institute for Management Development (IMD). The rankings cover63 countries and theobjective of this publication is to assess the extent to which countries develop, attract and retain talent to sustain the pool that enterprises employ to create long-term value. The IMD World Talent Ranking studies three factors: Investment & Development, Appeal, and Readiness, and those factors include 31 indicators. The findings are based on the ***collected*** statistical ***data*** and on the opinions provided by business people. Croatia has the best performance in theInvestment & Developmentfactor, occupying the 32nd place. Among the top ten countries, eight are European countries, and Switzerland tops the list. Considering new EU member-states, the best performer is Estonia, 19th, while Slovenia and Latvia occupy the 30th and 33rd place, Poland ranks 35th and the Czech Republic 39th. Ivica Mudrinic, the head of the Croatian National Competitiveness Council, which published the results of the latest ranking on Thursday, said that "the current turbulent times have been bringing a lot of change toour lives and the way of functioning of a number of countries and humankind as a whole." "Unfortunately, Croatia's position on the ranking does not reflect anygeneral progress," Mudrinic said, adding that some headway has been made through digitisation and many initiativies, including the "School for Life" plan. Pandemic has affected Croatia-Russia economic relations, forum hears ZAGREB, Nov12(Hina) - The COVID pandemic has affected Croatian-Russian economic relations, with trade dropping 21% in the first seven months of the year, and the focus should be on turning the trend around, the Croatian Chamber of Commerce (HGK) said on Thursday in a press release on a Russian-Croatian banking forum. In the first seven months of 2020, trade between the two countries totalledUS$ 228 million, down 21% on the year. We must focus on turning the trend around and work together on returning to the volume of trade which used to exceed $2 billion, the online forum was told. Banks must play a key role in that, said Josip Zaher, the HGK vice president for commerceand financial institutions. Croatian Ambassador to Russia Tomislav Car said relations between the two countries were slowly becoming dynamic. "Both the interstate andeconomic elements are looking forward, which is a message of encouragement to all of us. However, behind all that are people with their knowledge and ambitions," he said, adding that the embassy and the HGK's Moscow office were always at entrepreneurs' disposal. Russian Ambassador to CroatiaAndrey Nesterenko said all efforts must be focused on the normalisation of relations, with emphasis on banking. In these difficult times it is very important to continue with activities and maintain continuity in relations. It is also important to learn from one another, exchange ideas and thus find new opportunities in this crisis, he said, announcing that the intergovernmental commission on economic cooperation would meet soon. The forum's main topic was banking in conditions ofthe coronavirus pandemic. Zaher said commercial bankassets at the end of June totalled HRK 444.3 billion, up 4.4% from the end of 2019, while bankprofits plunged 48% annually. The forum was organised by the Association of Russian Banksand the HGK, with the support of the Russian and Moscow Chambers of Commerce and Industry. Conflict of Interest Commission opens case against Milanovicover trip to Mljet ZAGREB, Nov 12 (Hina) - The Conflict of Interest Commission has opened a case against President Zoran Milanovic related to his allegedly travelling to Mljet Island in August this year in a military helicopter. "The Commission has opened a case against Milanovic following information in the media and as usual it should ***collect*** the necessary ***data*** and documents from the competent bodies," the commission's spokeswoman Martina Jurisic told Hina on Thursday. After that the commission will decide at a public meeting whether there are any grounds to launch proceedings. The commission has previously opened a case related to the president travelling to Albania and it has also received a complaint that says that the president travelled in a military helicopter to attend the funeral of former prime minister Josip Manolic's wife. After Nova TV reported that Milanovic had travelled to Mljet in a military helicopter, hec avoided answering reporters about the details of that trip. On October 30 Milanovic claimed that he must not be asked about that. Conflict of interest proceedings launched against ex-JANAF CEO, ombudsman ZAGREB, Nov 12 (Hina) - The Conflict of Interest Commissionon Thursday launched proceedings against the former CEO of oil pipeline operator JANAF, Dragan Kovacevic, and ombudsman Lora Vidovic. Proceedings were launched against Kovacevic because before becoming the CEO of JANAF he had not transferred the managing rights over the Finkor company, which is fully owned by him, and the Raseljka company, in which he has a 5% stake. Kovacevic is currently in pre-trial custody on suspicion of corruption at JANAF. Proceedings against Vidovic were launchedbecause she had used a staff car while on summer holidays. Vidovic said in her response to the Commission that it was a car used by staff for field visits and that she was entitled to use it off duty as well. She said she had used the vehicle at the end of July and the beginning of August because in previous years she had to cut short her holidays, and stressed that she had paid for the fuel herself. The Commission said that the fuel was not the only cost of using the car, citing tyres, registration and insurance which annually cost a total of HRK 8,000 (€1,060). Vidovic was reported by her staff who saw the car in the car park with a Thule box mounted on its roof, after which it was gone for two weeks. They inferred that Vidovic had gone on holiday with the staff car and asked the Commission to look into it. Banners against construction of Islamic centre appear in Pula ZAGREB, Nov12 (Hina) - Residents of a Pula neighbourhood on Thursday put up by the city ring-road banners expressing dissatisfaction with aplan to build an Islamic centre in the city's Sijananeighbourhood. The messages on the banners were mostly addressed to Mayor Boris Miletic. Similar messages appeared on Wednesday as well but were quickly removed. The residents of the Sijana neighbourhood say that the Istrian Democratic Party (IDS) promised the construction of a mosque in Pula long ago and claim the project is being made topical again due to coming local elections. They object to what they consider the lack of transparency and secrecy about the project and to being the last to know what would be built in their neighbourhood. In that context, they recalled the original plan for the construction of an Islamic centre in the neighbourhood of Valmade, which was given up due to opposition from local residents. Mayor Miletic, who is currently self-isolating,on Wednesday addressed the public via his Facebook profile, saying that one should act rationally and defuse tension regarding the topic. "The Islamic centre in Pula has existed for more than 50 years and it is nothing new. We are all aware that the space the Islamic Community uses is too small and that they have big problems with parking space," he said. "The city was not aware of the project to build an Islamic cultural centre," Miletic said, explaining that he learned in early November that the Islamic Community had bought private land in Sijanaand that it was an autonomous decision by the community. "Let us calm down, those are people who have lived among us for decades, and a large number of believers were born in Pula. Let's be tolerant and not spread prejudices," he said. Serbian flag put on Croatian embassy gate in Podgorica ZAGREB, Nov12(Hina) - Unidentified perpetrators late on Wednesday evening put a Serbianflag on the gate of the Croatian embassy in the Montenegrin capital of Podgorica, local media reported on Thursday. The Analitika web portal said the flag was put on the gate after 10 p.m., when a curfew is in force in Podgoricadue to the coronavirus epidemic. The portal carried a photo showing two persons putting the flag on the embassy gate and a third one taking a photo of the act. Police have been notified and so far there have been no comments on the incident. The Serbian flag in Montenegro is a symbol of protest walks organised throughout the year after evening prayers by the Serbian Orthodox Churchin protest at the law on religious freedoms which it considers to be a pretext for the confiscation of its property in Montenegro. A pro-Serbian coalition called "For Montenegro's Future" was formed on the energy of those protests. The coalition was led by current Prime Minister-designate Zdravko Krivokapic and together with the other two opposition coalitions, led by Aleksa Becic and Dritan Abazovic,it removed from power after 30 years the Democratic Party of Socialists led by Milo Djukanovic. Soon after the August 30 election, inter-ethnic incidents occurred in Pljevlja, where insulting graffiti was sprayed on houses and businesses owned by local Bosniaks. Montenegrin police find two men involved in incident outside Croatian embassy Montenegrin police said on Thursday that theyhad found and questioned two mensuspected of putting theSerbian flag on the Croatian embassy gate inPodgoricaand were looking for the third person who recordedthe act. "Around 10 p.m. on Wednesday three persons attempted to put a Serbian flag on the Croatian embassy building," the police said, adding that they had arrested a 24-year-old and a 27-year-old while the third person who was in their company fled before the police arrived at the scene. A prosecutor decided that the two men should be released pending further proceedings. There have been no political reactions to the incident so far. Slovenia reports 1,925 new coronavirus infections, 41 deaths ZAGREB, Nov12(Hina) - There have been 1,924 new cases of the coronavirus infection and 41 related deaths in Slovenia in the last 24 hours, the government said on Thursday. The number of new infections is slightly lower than on the previousday, when there were more than 2,200 new cases but the percentage of positive tests is higher, 28.45%. The number of infections since the start of the epidemic has climbed to 50,864, of which 20,151 are active cases. The 14-day incidence has dropped slightly to 961 infections per 100,000 inhabitants, but the number of patients who need hospitalisation and those in intensive care units keeps growing. A total of 1,210 people are hospitalised, 31 more than on Wednesday, including 197 in intensive care wards. With the latest fatalities, the death toll has risen to 686. Bosnia logs over 1,700 new COVID-19 cases, 49 related deaths ZAGREB, Nov12 (Hina) - Slightly more than 1,700 new coronavirus cases and 49 related deaths have been confirmed in Bosnia and Herzegovina in the last 24 hours, the country's health authorities said on Thursday. More than 5,000 tests have been done since Wednesday and infection has been confirmed in 1,120 persons from the Federation entity and 516 from the Republika Srpska entity. Another 92 persons in Brcko District have been infected and two have died. Twenty-one people have died in the Federation entity and 26 in the Serb entity, of whom eight have died in Banja Luka alone. Due to a great influx of patients, theBanja Luka city hospital was forced to accept the assistance of some 60 students of medicine, who have volunteered to help. More than 450 COVID-19 patients are hospitalised, of whom morethan 50 are on ventilators and around 200require oxygen therapy, the hospital's director, Vlado Djajic, said, adding that any help was welcome. The capital Sarajevo has the highest number of new infections, 130, followed by the northeastern town of Bijeljinawith 101 infections. An analysis by the Civil Affairs Ministry shows that the incidence rate is318 per 100,000 inhabitants. The ***data*** refers to the period from 2 to 8 November because statistical indicators, ***collected*** autonomously by different levels of government in the country, are processed slowly. More than 68,000 people have been infected with coronavirus in the country since the onset of the epidemic in early March and 1,750 have died. Serbia reports 3,341 new coronavirus cases, 19 deaths ZAGREB, Nov 12 (Hina) - Serbia confirmed 3,341 new coronavirus cases on Thursday after 13,008 tests carried out and 19 deaths in the last 24 hours. Forty-one percent of the total number of new infections, or 1,368, were recorded in Belgrade. Health Minister Zlatibor Loncar warned that all COVID hospitals in the capital were now filled to capacity. Speaking in parliament during a discussion on proposed amendments to the law on infectious diseases, Loncar said that 250 COVID patients had been discharged from hospitals on Wednesday, while at the same time 600 had been admitted. On Thursday, 3,343 infected people were being treated for COVID-19 in hospitals across the country and 151 of them were on ventilators.Health authorities have warned that COVID wards are filling up quickly. To date, 1,468,164 tests have been carried out and over 70,000 have returned positive. The national COVID-19 response team was expected to announce new epidemiological measures later today. Vucic: Serbia has secured 1.8 million vaccine doses ZAGREB, Nov12(Hina) - Serbia has secured 1.8 million doses of thePfizer BioNtech vaccine for the end of this year and the beginning of the next via the Covax system and is negotiating on more doses with Chinese and Russian partners, President Aleksandar Vucic said on Thursday. Addressing the nation live on TV, he said Serbia would have some doses of the vaccine by the end of December and that the state would try to procure more by the end of January for medical staff, the army and the police, "who are the most affected by the pandemic," and then for at-risk patients and other citizens. Vucic announces compromise with Kosovo Commenting on his meeting today with ambassadors of the US, Italy, Germany, France, the UK and the EU, Vucic told the nation it was "very important" to resolve the Kosovo issue so that it was not left to future generations, relying on one's own strengths and advocating a dialogue and a compromise with Pristina as "that's the best solution." In other news: Milanovic advocates adoptingnational cancer strategy as soon as possible ZAGREB, Nov 12 (Hina) - President Zoran Milanovicon Thursday met with representatives of the Croatia against Cancer initiative, an association of cancer patients, supporting their demands for the adoption of a national cancer strategy as soon as possible. Croatia is the only EU member state that still hasn't adopted a national cancer strategy which would represent a model of true and more than necessary reform of the health system which Croatia has to implement with the aim of improving the outcome of treatment and ensuring patient rights guaranteed bythe Constitution, the meeting was told. The initiative's representatives warned that adopting the strategy would put Croatia in a position to use EU funds intended for the fight against cancer, which now is not possible. Indices back in green ZAGREB, Nov 12 (Hina) - The main Zagreb Stock Exchange indices were both back in the green again on Thursday by about 0.6%, with investors focusing on the Atlantic retail group and the PBZ bank. After it contracted on Wednesday, the Crobex was back in the green again, increasing by 0.58% to 1,644.94 points, its highest value in more than six weeks. The Crobex10 continued its positive streak for the fourth day in a row and increased by 0.63% to 1,031.34 points. This is its highest level since 10 June this year. Regular turnover amounted to HRK 9.2 million or about 6 million less than yesterday. The most traded stock was the Atlantic Group with a turnover of HRK 2.3 million. The price of Atlantic shares soared by 3.15% to HRK 1,310 per share. Privredna Banka Zagreb (PBZ) generated a turnover of HRK 2.2 million and its shares jumped by 3.90% in price and closed at HRK 800. (€1 = HRK 7.560255) THIS BULLETIN INCLUDES ITEMS RELEASED BY 2100 HRS ON THURSDAY (Hina) ms ha Masthead Brief News Bulletin is published by the Croatian News Agency HINA Marulićev trg 1610 000 ZagrebCroatia web:[*www.hina.hr*](http://www.hina.hr) mail: [*hina@hina.hr*](mailto:hina@hina.hr) phone: (+385 1) 48 08 660; fax (+385 1) 48 08 822 Publisher: Branka Gabriela Valentić, DirectorEditor in Chief: Serđo Obratov Bulletin Editor: Marija Šestan

**Load-Date:** November 12, 2020

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[***NEWS BULLETIN NO. 11368***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61G8-T6F1-JDKJ-11T6-00000-00&context=1516831)

HINA Digest

December 8, 2020 Tuesday

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**Length:** 12168 words

**Body**

Zagreb,Hrvatska08 December 2020 (Hina) - 2,613 new coronavirus cases, 65deaths, 2,987 recoveries in last 24 hours ZAGREB, Dec 8 (Hina) - Croatia has registered 2,613 new coronavirus cases after 8,782 tests carried out in the last 24 hours, and 65people have died from COVID-19, the national coronavirus crisis response team reported on Tuesday morning. The number of active cases currently stands at 21,685. It includes 2,660 hospital patients, 278 of whom are on ventilators. Since February 25, when the first case was confirmed in the country, 154,852 people have been infected with the novel virus, of whom 2,299have died and 130,869 have recovered, including 2,987 in the last 24 hours. A total of 825,023 people have been tested to date. Currently, 53,062 people are in self-isolation.

1.6% of Zagreb pupils tested for coronavirus positive ZAGREB, Dec 8 (Hina) - Rapid antigen testing for SARS-CoV-2 in Zagreb schools has revealed the presence of the novel virus in 1.6% of pupils and 3.3% of school staff tested, the city authorities said on Monday evening. The purpose of the testing was to show the current presence of antigens in pupils and staff in selected primary and secondary schools in Zagreb. The testing was conducted in 12 primary schools (Grades 5-8) and seven secondary schools between November 30 and December 4. All pupils in these schools, whose classes were not in self-isolation at the time, were invited to do a test, and 1,925 pupils did so. They included 1,073 primary school pupils (40.1%) and 852 secondary school students (33.1%). Negative results were not additionally verified, while positive results were sent for further verification by PCR testing. The presence of coronavirus antigens was found in 31 pupils (1.6% of the pupils tested), of whom 19 were secondary school pupils and 12 were primary school pupils. In six of the primary schoolsnone of the pupils tested had a positive result, while in the remaining six schools up to three pupils were positive. In two of the secondary schools none of the students had a positive result, while in the remaining five schools up to seven students were positive. Theprimary school pupils tested accounted for 26.9% of the Grade 5-8 pupils in the selected schools, while the secondary school students tested accounted for 20.6% of students in their schools. School staff who were not in isolation or self-isolation at the time were also invited to do a test, and 365 did so. Twelve of them (3.3%) were positive for the coronavirus and most of them were secondary school staff. Sorry about incident but it showed Rijeka Hospital able to cope, says director ZAGREB, Dec 8 (Hina) - Director of the Rijeka KBC Hospital Alen Ruzic on Tuesday said that he was personally very sorry aboutthe incident that occurred in the night between Monday and Tuesday, when someone cut the electricity cable, but added that it showed that the hospital was able to cope in unexpected situations. Ruzic addressed a press conference in relation to the incident that occurred on Mondayat 3.30 am when two mencut the electricity cable powering an air compressor for the COVID ward at the hospital. "We saw that patients were safe because we have a quadrupleprotection against outagesof any kind in the system that deliversoxygenor compressed air, which is the most important therapy for COVID-19," said Ruzic. When the incident occurred, the systemsignalled a loss of air pressure and the anaesthesiologist on callswitched to pure oxygen. The technical service responded immediatelyand repaired the damage to the cable in a very short time and by morning it was completely replaced, Ruzic explained, underscoring that at not one moment was there a disruption in oxygen supply and that patients were completely safe. He added that the stagnation in the number of patients being admitted to the hospital over the past few days provides some hope that the measures have contributed to decreasing the number of people with symptoms in the hospital. He underscored that 23 ventilators in the hospital are active,that 35 are available for COVID patients, while there are 55 overall. If we count portable ventilators and anaesthetic apparatus in operating theatres, the hospital has more than 70 ventilators and that gives us a feeling of security, he said. Ruzic stressed the importance of expert medical staff. Currently about 5% of the hospital's staff is positive forcoronavirus and if we add those in self-isolation, that is about 7%, which is acceptable for the system to continue functioning but it presents additional challenges, he said. The air compressor cable that was cut and stolen was located outside the hospital as the compressoris required to be placed outdoors and protected with a metal cage. Ruzic said that precautionary measures would be stepped up with additional technology and cameras. We also plan to install an additional compressor, he added. Minister: Medjumurje hospot of virus due to its specific position ZAGREB, Dec8 (Hina) - Health Minister Vili Beros said on Tuesday in Cakovec that Medjimurje County had turned into a hospot of coronavirus due to its geographic position, workers commuting to and from neighbouring countries and Zagreb, and due to an intensified incidence rate after the start of the school year. During his visit to this northern county, the minister commended the local healthcare authorities for their efforts to curb the infection and promised them personnel and technical assistance. The head of the Cakovec Hospital, Tomislav Novinscak, said that they had the situation under control. The head of Medjimurje County's Institute of Public Health,Marina Payerl-Pal, underscored the fact that the county conducted the highest number of coronavirus tests per 100,000 inhabitants. For the sake of comparison, in the whole of Croatia240 per 100,000 inhabitants are tested, while in this county this ratio is 340 per 100,000, she said. Nearly 1 in 3inhabitants in Medjimurje County tested for coronavirus to date Prefect Matija Posavec said that to date 31% of residents in the county had been tested for coronavirus. He said that recentlyboth the new coronavirus case numbers and the ratio of positive tests had been falling. Beros:Not good to promote personal or other interests Commenting on the appeal of 26 scientists, researchers and doctors who on Sunday demanded tighter restrictions, Beros said that he could detect in their appeal common points withthe work of the COVID-19 crisis management team and that there was no big difference ofopinion betweenthe crisis management team and the signatories of the appeal. However, it is not good to use some ideas forthe promotion of one's personal or other interestsoutside a certain scientific communication channel, the minister said. PM didn't dismissScientific Council members who signed appeal - spokesman ZAGREB, Dec 8 (Hina) - Government spokesman Marko Milic has rejected claims that the prime minister has dismissed five members of the government's Scientific Council who have signed an appeal expressing their concern about the spread of the COVID-19 epidemic. "Following the false information that the prime minister has decided to dismiss five members of the government's Scientific Council, we consider it unfair for such allegations and articles to be made public without first verifying their correctness. The prime minister did not make such a decision. We thank the members of the Scientific Council who conveyed this incorrect information to the media. That was certainly an 'epidemiological' and not a political move," Milic said in a press release late on Monday. He said that the head of the prime minister's ffice, Zvonimir Frka-Petesic,had contacted three of the scientists on Monday, while the other two had not returned his calls. "He told them that the mutual trust has been eroded and that cooperation, which is on a voluntary basis, makes no sense given that some of the members of the Scientific Council, after several hours of talks with him on the epidemiological measures and restrictionson Saturday afternoon, without any prior notice, issued an appeal to the Croatian public on Sunday morning overtly criticising the government and the national coronavirus response team without giving any specificproposals on measures to be taken in combating COVID-19 and making political accusations," Milic said. Milic said that the government has been managing the crisis transparently from the outset of the epidemic keeping the public fully informed and consulting medical professionals and the interdisciplinary Scientific Council and would continue doing so in the future. He noted that the Scientific Council gives advice and the national coronavirus response team considers its advice and other non-epidemiological parameters and information and proposes measures, and the government then decides and implements them. Twenty-six prominent Croatian medical doctors and scientists from Croatia and abroad issued an appeal to the public on Sunday expressing their concern about the spread of the second wave of the coronavirus pandemic in the country and a large number of deaths. They presented their recommendations on how to overcome this serious public-health and social crisis in Croatia. Head of PM's office sorry for participating in misunderstanding ZAGREB, Dec8(Hina) -The head of the prime minister's office said on Tuesday he was sorry for participating in a "misunderstanding" with the members of the government's Scientific Council who signed a COVID appeal, adding that the prime minister did not fire them and that it was necessary to find a way to overcome this. "I said that I took part in this misunderstanding, that I thanked them for their cooperation and that I thought it was not fair (to sign the appeal) and that it was not conducive to further cooperation, but today I believe we must find a way to continue to cooperate," Zvonimir Frka-Petesic told the press. In the appeal, 26 prominent doctors and scientists expressed their concern about the spread of the second wave of COVID-19 in Croatia and the high number of deaths. Frka-Petesic said he did not know when the council would meet next. "The date of the next meeting hasn't been defined. This is a new moment. I can't answer that question for now." He said the prime minister did not relieve the five members of their duties, but added that cooperation in these conditions was difficult. "I'm sorry about this. Perhaps I wasn't clear in my communication. Perhaps I made them believe that the prime minister had relieved them of their duties. I just said that I didn't think that this cooperation could go on if there was no mutual trust." He said the members of the Scientific Council were encouraged to speak in public and to the media, but that it was one thing to speak to the media and another to call out the government as a member of its council. Recently, the disagreements between the scientists have turned into ones calling out others and requesting that some membersbe expelled from the council, which was unacceptable for the government, said Frka-Petesic. At the last council meeting on Saturday, not once was it mentioned that an appeal had been initiated, he said, adding that the appeal caught him by surprise and that he felt tricked when he saw it. "For me, that undermined our trust a lot. I said so to the prime minister, that I felt tricked, that I was very disappointed and that further cooperation was pointless if there was no mutual trust," he said, adding that after the appealhe called every member of the Scientific Council and spoke with some. "We care about cooperation with excellent experts," Frka-Petesic said, but added that all must find a way to cooperate better given the different viewpoints. When there is no agreement, that should not result in "excessive mutual targeting" because publiccalling out damagesthe government, he said. The Scientific Council was established as an advisory body whose advice doesnot obligethe government,which bases its decisions on recommendations from the national COVID-19 response team and must assume the responsibility for the decisions which it believes are best for citizens at agiven moment, sad Frka-Petesic. "Had we listened to some, today we would have been in a hard lockdown, had we listened to others, we would have had totally relaxed measures, had we listened to entrepreneurs, there would have been no measures. The government should listen to the advice of the response team which proposes and the government makes a decision. End of story." "Neither the prime minister nor the government members nor I should arbitrate and say which council member isor isn't right, but hear their opinions, without anyone being banished for it," Frka-Petesic said. Scientist says was told it's pointless for her to remain part of gov't council ZAGREB, Dec8(Hina) - Molecular biologist Andreja Ambriovic Ristov, a member of the government's Scientific Council, said on Tuesday she received a message from the government that it was pointless for her to remain on the council because of an appeal she had signed. "MrFrka-Petesic called me yesterday and said that the prime minister thanked me for my cooperation which no longer made sensebecause of the appeal I signed," she told Hina, referring to the head of the prime minister's office, Zvonimir Frka-Petesic. "I saw the subsequent retractions but I didn't understand what they were trying to say," she added. Media reported on Monday night thatfive members of the government's Scientific Council were expelled after signingan appeal in which 26 prominent doctors and scientists expressedtheir concern about the spread of the second wave of COVID-19 in Croatia and the high number of deaths. The five are Ambriovic Ristov, Nenad Ban, Petra Klepac, Branko Kolaric and Igor Rudan. Government spokesman Marko Milic dismissed the claims that the prime minister decided to expel from the Scientific Council the five members who signed said appeal. Djikic accusessome Scientific Council members ofconflict of interest ZAGREB, Dec 8 (Hina) - ScientistIvan Djikic on Tuesday again sent an open letter to Prime Minister Andrej Plenkovic, asking him to say why the government did not define rules to regulate the issue of conflict of interest for members ofthe government's Scientific Council as some of them arein a conflict of interest. "It is evident that some of the members of the Scientific Council are in a classicconflict of interest as they have aprivate firm(Gordan Lauc), a private institute (Miroslav Radman) and a private hospital (Dragan Primorac) which they have not declared publicly since the Council was formed," Djikic says, wondering why a code of conduct for members of the Scientific Council for the fight against COVID-19 hadnot been defined. Membership of Council continues despite conflict of interest In his letter Djikic asks PM Plenkovic why he hasallowedLauc and Primorac, who in November declared a conflict of interest, to continue sitting on the Council, noting that the government has failed to comment on the matter. Djikic notes that Lauc owns Genos d.o.o., a company that has validated aPCR test for COVID-19 and sells the GlycanAge biological age test, which is a good predictor of severe forms of COVID-19. Lauc informed other members of the Council of this only on November 14, eight months after the Council was formed, even though during that period hediscussed the types of testing that should be promoted and publicly spoke about these matters, Djikic says. As for Primorac, Djikic says that the private hospital which he heads has been charging HRK 350 (approx. €46) per antigen test since October 17. Thatprice is among the highest in the country, hesays, noting that the government has made it possible for a private business to earn very high amounts on testing without being subject to any rules or restrictions. Suspicion of coronavirus profiteering must be confirmed or dismissed fast "Do you feel any personal responsibility or responsibility on the part of the Croatian government for the fact that your advisers Lauc, Primorac and Radman should have declared a conflict of interest and you should have reacted to it, but did not?," the scientist asks in his letter, noting that citizens need quick answers that can confirm or dismiss suspicion of conflict of interest in healthcare and coronavirus profiteering. In a comment on reports that the government no longer needs the services of five members of its Scientific Councilwho signed a public appeal whilekeeping the three members suspected of conflict of interest on the Council, Djikic says that confusing and contradictory claims about the coronavirus pandemic have been sent to the public for quite a while. "With your latest act you have shown, probably most clearly so far, what you base your choice of advisers on, what you value about them and to what you are indifferent. But regardless of everything, my advice to you is to think wellif the five top experts, who have worked free of charge and wholeheartedly for this country, are the ones who should be replaced," Djikic asks in reference toAndrejaAmbriovicRistov, NenadBan, PetraKlepac, Branko Kolaric and IgorRudan. Researcher N. Ban says no longer member, others without comment Molecular biologist Nenad Ban told the media on Monday that he was no longer a member of the government's Scientific Council for the fight against the coronavirus pandemic, stressing that his statements were based on scientific arguments. He noted that he did not wish to criticise anyone but rather justcommunicate the situation and predictions based on scientific ***data***. There has been no comment so far from the other researchers. Late on Monday evening, the government refuted claims that PM Plenkovic had decided to dismiss the five members of the Scientific Council who had signed a public appeal expressing their concern about the spread of the coronavirus epidemic. Primorac rejects Djikic's accusations about conflict of interest ZAGREB, Dec8 (Hina) - A member of the government's Scientific Council for the fight against COVID-19, Dragan Primorac, on Tuesday refuted accusations by scientist Ivan Djikic that he was in a conflict of interest because he worked in a private clinic. "Neither I nor any of my employees do business with the state, none of us are on the government's payroll and we do not participate in state tenders, we operate on the market and we do not depend on anyone," Primorac said in a statement sent to Hina,adding thathe would continuehelpingthe scientific community overcome the current crisis. Noting that Djikic had not apologised to him for his statements, Primorac said thathe did not respond to previous unjustified criticism for the sake of peace in the scientific community. As for Djikic's accusations that he participated in the testing of Croatian athletes, Primorac said that he and medical workers volunteered to test athletes in order to stop the spread of COVID-19. The Croatian Football Federation (HNS)issued a statement saying that ithad bought the necessary chemicals with its own money and that employees at the Dr Andrija Stampar Teaching Institute of Public Health, the St Catherine Hospital and the Genos laboratory had volunteered outside their working hours to analyse the samples and help Croatian sports, saysPrimorac. He added that the state did not participate in the project andthat Djikic did not apologise to the HNS, athletes or his colleagues for his statement. As for Djikic's criticism that he said that the coronavirus had grown weaker, Primorac said that the media had quoted him correctly as saying: "It is a fact that something has changed. The clinical picture is different. The structure of the virus has not changed." "I explicitly stated that the SARS-CoV-2 is stable and that its structure has not changed," Primorac says in his statement. Grbin: Scientists expelled from Scientific Council as if we lived in 17th century ZAGREB, Dec 8 (Hina) - Social Democratic Party (SDP) leader Pedja Grbin on Tuesday condemned the expulsion of five scientists from the government's Scientific Council for combating the coronavirus pandemic, saying that in dealing with the coronavirus the government was not guided by science but by the political needs of the ruling Croatian Democratic Union (HDZ) party. "Are we living in the 16th or 17th or 21st century? The prime minister expelled the scientists from the Science Council because they insisted on working on the basis of science and scientific facts and not on the political views and convictions of the prime minister," Grbin said in parliament. "You decided to silence the scientists because they gave science priority over politics. This is reminiscent of the 17th century, but it won't change scientific facts," Grbin said, addressing the HDZ lawmakers. Noting that Croatia's response to the coronavirus pandemic was among the worst in the world, Grbin said that this was no surprise because in combating the crisis the government was not guided by science but by "the impressions and daily political needs of the HDZ and its leader Plenkovic, which is bad because this won't help the country overcome this difficult situation." According to media reports, five scientists have been kicked out of the Scientific Council after 26 prominent Croatian medical doctors and scientists issued an appeal to the public expressing concern about the spread of the pandemic and a large number of deaths in Croatia. Late on Monday, government spokesman Marko Milic denied the reports of their expulsion. Opposition MPs comment on scientists' dismissalfrom council ZAGREB, Dec 8 (Hina) - The Bridge party parliamentarian,Nikola Grmoja, claimed onTuesday that the national COVID crisis response team has lost trust because of the disputes that have emerged in the government's scientific advisory council and that citizens no longer believe in the measures being introduced. "The crisis response team has lost its trust and a dispute has erupted in the government's scientific council itself. How then can people have confidence in the decisions it adopts when they are squabbling between themselves and do not want to admit that some things were done poorly. We are not asking for saints or faultless people.There isn't a country that hasn't made mistakes and this is an extraordinary situation where errors are inevitable, however if you make a mistake you say so. People would then have much more faith," Grmoja told the press in the parliament commenting on the government's 'thanking' five members of the advisory council for their help after they signed an appeal to the government criticising it for its actions. "Since the start, I have advocated commonsensicalapproach tothis crisis and that the council includes more experts from various fields, not only epidemiologists, and now we have the situation that onlyone epidemiologist has remained in the council and that is one that was chosen along party lines - Krunoslav Capak - and I think that is not good," added Grmoja. "I think the government has to makepolitical decisions, and this entire time it has been doing so even though its has been hiding behind the experts but it also needs to listen to as many people as possible. If there are more people involved then the government can make sounder decisions," Grmoja believes. Skoro: Govt dismisses anyone with a dissenting opinion The head of the Homeland Movement Miroslav Skoro said that the COVID crisis response team has been politicisedand the message to the experts in the scientific council after their appeal, is that there is no sense in cooperation and the government has excluded all their opinions. "I believe that is just the tip of the iceberg. They will dismiss anyone who has a dissenting opinion. That is Andrej Plenkovic and his government's modus operandi. When we said that the COVID crisis response team was politicisedand that it was a political body, no one believed us then. Now you can be convinced yourselves that only those who are in line with what Plenkovic says meananything, because he probably knows more about everythingincluding how to manage the coronacrisis and the virus itself, so that all those epidemiologists can be removed. I think that it terrible," Skoro told reporters in the parliament. The message is that if you do not think like I do, you will be excluded and that goes for all levels. That isn't anything new and the people are aware of that but it is interesting that even though they know and can see this they still vote for them, said Skoro. Glas: PMand govt absolutely incapable and unwilling to listen to anyone in this crisis The Glas party commented saying that ousting scientists from the government's scientific advisory council was a move in which Prime MinisterPlenkovic showed that he is absolutely incapable and unwilling to listen to anyone else in this crisis. HDZ MP: Opposition is manipulating differing opinions of scientists ZAGREB, Dec 8 (Hina) - Deputy Parliament Speaker Zeljko Reiner of the ruling HDZ party said onTuesday that the Opposition was manipulating the fact that scientists had differentopinionsand was playing politics with that. He went on to say that today "the left and the right have formed a nice unity to attackthe government in an attemptto show that it is badly managing the health crisis." "Once again we have seen that an odd symbiosis between parties that have different ideologies. Some are allegedly very right and some very left but they all agree in the attack, playing politics withthe difference of opinion between scientists in an effort to prove that the government is underperforming and badly managing the health crisis," Reiner said commenting on dissenting opinions in the government's scientific advisory council. Politics is manipulating with the dissenting opinions ofscientists for its own purposes, said Reiner. He addedthat the advisory council provides advice but the government makes the decisions. "Science is a basis of many decisions but it is not the only one. The government led by the prime minister is responsible for making the best decisions for the country and for all segments, not just health but for the economy, psychology, sociology and others too," he said. "If we were to only take science into consideration, I would, for example, be of the opinion that we need to go into lockdown and to sit at home for three months and the epidemic would go away. The virus willdisappear but what would happen to the state in three months' time. Where would our wages come from?Who would work in production? These matters are not black and white and the decision is always up to the government," said Reiner. Ivan Celic of the HDZ added that the statements made by the Opposition "are asheer act of transposing science into the political domain, which has some repercussions." MP Celic underscores that apart from the scientific aspect, there is a wider social and political context, and it is up to the government to assume responsibility in decision-making when it come to more or less restrictive measures to rub COVID-19. Hospitalisations for addiction up during pandemic, round table hears ZAGREB, Dec8(Hina) - Addicts have not been leftwithout healthcare in the epidemic, a round table on addiction prevention heard on Tuesday, with participants saying that the pandemic had brought specific patterns of addictive behaviour and that thehospitalisation numbersincreased after the spring lockdown. Speaking of the reasons for the increased consumption of opiates incoronavirus times, experts for the prevention and treatment of various addictions, from alcoholism and narcotics to gambling, said they expected addiction to account for a significant number of patients seeking treatment and help in the future. Ivan Celic of the Zagreb Vrapce Psychiatric Hospital said "the addiction epidemic crosses with the COVID-19 epidemic." Up to 25%more hospitalisation requests due tostimulant abuse after spring lockdown Celic said the COVID epidemic brought specific patterns of addictive behaviour. The spring lockdown, he said, saw an increase in theconsumption of marijuana, alcohol, sedatives and opiates, while the relaxation of the restrictions saw an increase in the use of stimulants, which resulted in an increase inhospitalisation requests. Consequently, the Vrapce hospital recorded in August, September and October a 20-25% increase in the number of hospitalisations due to stimulant abuse, he said. Mirjana Orban of the Dr Andrija Stampar Teaching Institute of Public Health said that at no point since the start of the pandemic had addicts remained without healthcare and that online help tools were developed during the spring lockdown. The round table was organised by the Vrapce Hospital and the Zagreb City Office for Health on the occasion of the Fighting Addiction Month. Grlic Radman presents report in parliament on status of Croats in BiH ZAGREB, Dec 8 (Hina) - Foreign and European Affairs Minister Gordan Grlic Radmanon Tuesday presentedthe first report on the implementation of the Declaration onthe Status of Croats in Bosnia and Herzegovina (BiH) saying that there is no doubt that a stable and functional BiH is Croatia's strategic national objective. "Croatia's supportfor the territorial integrity and sovereignty of Bosnia and Herzegovina is unquestionable. It is unquestionable that the main precondition for the existence of a functional and stable BiHis satisfiaction with theoverall quality life for all three constituent peoples and other citizens based on the constitutional principles agreed under the Dayton-Paris peace agreement 25 years ago," Grlic Radman underscored. Croats are faced with difficulties in exercising their rights He warned, however, that Croats in BiH are faced with difficulties in exercising their rights, "a sort of institutional violence," as shown bytheir being denied legitimate political representation and other negative social consequences arising fromthis fact. Hence Croatia's institutional support that the Declaration deals with is more than necessary so that Croats can continue to live in BiH where they have lived for centuries, said Grlic Radman, adding that in 2019 Croatia did "quite a lot." The minister said that institutional support forCroats in BiH was provided with the participation of the prime minister and government members as well as other officials and state bodies who, within their remit, offered significant political, financial and operational support to numerous education, science and religious institutions. The issue of facilitating the exercise of rights by HVO personnel who participatedin the Homeland War was resolved as was the issue of obtaining Croatian citizenship, he said and underlined the enhanced cooperation in absorbing available European funds. GrlicRadmaninformed the parliament that Prime Minister Andrej Plenkovic had participated in numerous political and social activities aimed at contributing to stability in BiH, he supported reforms in that country and in fulfillingaccession criteria for the EU and NATO. The Ministry of Foreign and European Affairs was also very active. In all aspects of foreign policy and diplomatic activities, Croatia continued to affirm the principle of equality of all three constituent peoples in BiH, including the necessary reform of its election law, said Grlic Radman. He said that last year BiH received the largest amountof Croatia's development aid of HRK 85.6 million for 106 projects. Trade with BiH amounts to €2.2 billion Grlic Radmanboasted that in 2019 trade with BiH amounted to €2.2 billion, which was 5.9% more than in 2018, noting that Croatia achieved a surplus of €823.7 million in commodity trade. That fact often goes unnoticed in the Croatian public and it is without a doubt that Croats in BiH make a big contribution to that. It is clear that the survival of Croats in BiH and their good economic prospects make a strong contribution to Croatia's economy too, underscored Grlic Radman. He said that the Central State Office for Croats Abroad, as the main state body that operationally implements the Declaration, advertised a tender to finance cultural, education and science projects, allocating HRK 25.8 billion for these projects, the highest amount so far. Grlic Radman listed activities according to ministries noting that the Ministryof Labour in cooperation with the Veterans Ministry regulated pension rights for HVO personnel and their families. I consider those legislative amendments to be of exceptional significance facilitating the regulation of the status of HVO defenders which corrected an injustice, said the minister. He noted that based on bilateral cooperation the Defence Ministry provided military training for Bosnian Defence Ministry personnel, and that as many as22 out of a total of 37 bilateral military activities with Southeast European countries conducted in 2019 related to cooperation with BiH. Minister says Dayton agreement must be amended ZAGREB, Dec 8 (Hina) - Foreign and European Affairs Minister Gordan Grlic Radman said on Tuesday that the Dayton peace agreement should be amended to ensure equality and a constituent status for all of the country's three peoples as well as other citizens. "The Dayton agreement has been transformed beyond recognition,we have been warning about it at NATO and EU meetings and now that we are members of those organisations, our voice is heard much better," Grlic Radman said in a reply to MP Marijana Petir's question while submitting a report on the implementation of the Declaration on the status of the Croat people in Bosnia and Herzegovina in 2019. "Croatia cannot interfere in other countries'internal affairs, but we are following the situation and using EU and NATOmechanisms to point to the existing asymmetriesand anomalies," GrlicRadman told HDZ MP Rade Simicevic who asked what the Croatian government was doing to enable Croats to elect their political representatives the way Serbs and Bosniaks did. "We are listening to what Croats in Bosnia and Herzegovina are saying, if they are dissatisfied, we are conveying their dissatisfaction, that is Croatia's role as a signatory to the Dayton agreement," he said, dismissing criticism fromopposition Bridge and Sovereignists MPs that Croatia was not doing enough for Croats in the neighbouring country. Opposition MPs commend President Milanovic's policy towards BiH ZAGREB, Dec8 (Hina) - During a debate in parliament on the implementation of the Declaration of the Status of Croats in BiH on Tuesday, MP Miro Bulj (Bridge) and MP Ante Prkacin (Homeland Movement) commended President Zoran Milanovic's policy towards Bosnia and Herzegovina (BiH). MP Buljclaimed that Croats in BiH were "a forgotten people" and called out the Croatian Democratic Union (HDZ) for its policy towards Croats in BiH, that it had reduced the number of delegates from BiH from six to three and that it has renounced HVO Croat defenders from the Homeland War. President Zoran Milanovicis a greater sovereignist than you. He had the courage to decorate HVO members, and this act hassent the message that the HVO is part of Croatia's defence forces, said Bulj. MP Prkacin too commended the president saying that Croatia's policy towards BiH was superficial, insufficient, often amateurish with one honourable exception. "That is Zoran Milanovic, who knows and can. There are others who know but very few can," said Prkacin, adding that "a great Bosniak policy" is the main cause for the disorder in BiH. MP Hrvoje Zekanovic(Sovereignists) said that Croatia's assistance to Croats in BiH has been brought down to humanitarian aid, education and protocol while the status of Croats in that country has never been worse. Ruling MPs: Status of Bosnia Croats to be even worse without Zagreb's help On the other hand, lawmakers from the ruling majority commended the government's efforts to protect Croats in BiH, assessing that without Croatia's help their situation would be far worse. If there was no help from Croatia the situation would be worse. Help is needed because Croats' essential human rights are being abused including the right to their own home and their own hometown, MP Marijana Petir (Independent) said underscoring that Croats have to be enabled to return to their homes, to have a television channel in the Croatian language, and to elect their own political representatives. MP Zdravka Busic (HDZ) said that over the past few decades decisions have been made that discriminate against Croats compared to the other two (constituent) peoples even though they too are a constituent people according to Bosnia'sConstitution. That injustice is still ongoing and is best reflected in the imposition of the member to the presidency who, even though formally represents the Croats, was not elected bythe will of the Croat people, she said. The ruling majority believes that a lot has been done to implement the declaration on the status of Croats in BiH but still much remains to be done. SDP says amendments to Local Government Act not a true reform ZAGREB, Dec 8 (Hina) - Social Democratic Party officials on Tuesday warned that amendments to the Local Government Act were no reform but an attempt at deceit because they did not address problems in the functioning of local government units and would not result in greater efficiency, cost-cutting or savings. "This bill will only lead to the abolishment of deputy municipal heads or mayors in a certain number of local government units. As for essential changes in the system of local government, there are none," he said. SDP deputy whip Arsen Bauk said the amendments did not deal with some ambiguities and questions such as how councillors employed with a private company would be able to attend sessions of representative bodies given that a provision on the right to unpaid leave would be removed and they would be forced to enter into an agreement with their employers. Bauk also believes that the situation becomes even more complicated for councillors who work in public companies or in state administration because if they are members of the opposed political camp, their employer can knowingly prevent them from attending council sessions. "We have major objections to the amendments but if they were to regulate that in those local government units that spend more than 20% of directrevenue on salaries, the mayor, too, will be a non-professional, we would be willing to forget about all of our objections. But that won't happen because they lack the will to carry out a true reform," said Bauk. SDP MP Mirela Ahmetovic warned that the amendments would miss the main goal, to ensure efficiency and cost-cutting or a reduction in the share of salaries in local government units' direct revenue, which in many of them exceeds 20%. She noted that even though it had made such announcements in the election campaign, the HDZ-led government no longer spoke about mechanisms to introduce transparency in the spending of public money. SDP Presidency member Jasenka Augustin Pentek said the proposed reform would not leave hundreds of HDZ deputy mayors and municipal heads jobless as they had been promised posts of department heads and directors in various public companies or those of advisors to mayors. Asked if it was acceptable for him that the catalogue of criminal acts which would bar a candidate from running in local elections should be expanded to include charges of domestic violence, Grbin said that the relevant catalogues had not been harmonised and called on the government to harmonise them so they could be expanded to include not only domestic violence but also a set of other criminal acts that are currently not covered by those catalogues. 2021 Zagreb city budget adopted ZAGREB, Dec 8 (Hina) - The Zagreb City Assembly on Tuesday adopted by majority vote the 2021 city budget which totals HRK 13.65 billion amid strong criticism from the opposition that it was an election budget and strong objections to the planned sale of the Paromlin, Gredelj and Zagrepcanka buildings. The budget was adopted with 27 votes for and 17 against. All opposition amendments to the budget were rejected. The revenues are projected at HRK 13.65 billion, up 16.9% (+HRK 1.97bn) from this year's budget. New Assembly president Earlier today, Mislav Herman (HDZ) was elected Assembly president by majority vote. He succeeds Drago Prgomet (HDZ). Herman received 30 votes, while seven deputies voted against him and eight abstained after Prgomet was relieved of duties at his own request, citing professional reasons. After being elected, Herman said he would try to be inclusive and constructive. He would not say if he saw himself as the HDZ's candidate for mayor. DAB: Croatia has one of most stable deposit insurance systems in EU ZAGREB, Dec 8 (Hina) - Croatia has one of the most stable deposit insurance systems in the European Union, the State Agency for Deposit Insurance and Bank Resolution (DAB) said on Tuesday ahead of the entry into force of the new law on deposit insurance and compulsory liquidation of credit institutions on January 1. The new law is aligned with EU directives. It shortens the duration of bankruptcy proceedings for credit institutions and additionally protects depositors. It also provides for the further reform of the banking system in Croatia and the EU, strengthens banks' capacity to withstand financial shocks, minimises costs borne by taxpayers in case of problems with banks, and establishes a single financial fund which will be filled by credit institutions and not private citizens. The law also ensures the security of savings deposits and increases the stability of the financial system, making it more resilient to possible financial crises. Under the new law, DAB will be renamed Croatian Agency for Deposit Insurance. DAB's Chief Executive Director Marija Hrebac said that the EU directive on deposit insurance systems requires all member states to establish a depositinsurance fund and raise at least 0.8 percent of the amount of covered deposits into it by 2024. She recalled that in Croatia such an insurance fund had been established in 1998 and that it now has about 2.5 percent of covered deposits, the fund's minimum target level defined by law, which is why Croatia has one of the most stable deposit insurance systems in the Union. "The target level of available funds makes it possible for customers of a failed bank to be disbursed their funds within seven days of the bank's failure, while the EU directive makes this mandatory as of 2024," Hrebac said. This guarantees that citizens can obtain their funds within a very short period of time if their bank fails, and citizens' trust in the deposit insurance system is a key element of trust in the Croatian banking system, she added. Jutarnji List: HRK 2.88bn in tax debt time-barred ZAGREB, Dec 8 (Hina) - A total of HRK 2.88 billion in tax debt, including HRK 1.710 billion on account of principal and HRK 1.170 billion on account of interest, has been written off in the last three years because the debt became time-barred, Jutarnji List daily says on Tuesday. This debt, which will never be ***collected*** because it has fallen under the statute of limitations, is owed by 202,261 taxpayers whose debt liabilities have been continually decreasing since 2018, but not because they are being repaid but because they are being time-barred, the newspaper says. According to the Tax Administration, 90,778 taxpayers saw their debts systemically written off in 2018, totalling HRK 740 million on account of principal and HRK 540 million on account of interest. In 2019, debt was written off for 56,667 taxpayers, including HRK 510 million on account of principal and HRK 340 million on account of interest, while this year it was written off for 54,816 taxpayers, including HRK 460 million on account of principal and HRK 290 million on account of interest. The Tax Administration says that 96% of taxes are ***collected***. In the period from 2015 to 2019, it ***collected*** HRK 566 billion in taxes, contributions and other charges, according to Jutarnji List. SMEs may apply for COVID-19 loans again ZAGREB, Dec8(Hina) - As of December 9,SMEswill be able again to apply for COVID-19 loans for current assets and HRK 1.3 billion has been set aside for that, the HAMAG BICRO agency for SMEs, innovations and investments said on Tuesday. The agency recalled that the programme is financed from the European Regional Development Fund, and said that SMEs wouldbe able to apply for loans up to HRK 380,000 at 0.25% interest. The programme lasts until December 31 or until the entire amount has been loaned, the agencysaid, adding that in cooperation with the government and the economy ministry, HAMAG BICRO was continuing to implement measures to help SMEs whose business hadbeen affected because of the COVID-19 epidemic. HRK 6.8 bn paid as grants to ***agricultural*** sector YTD ZAGREB, Dec8 (Hina) - ThePaying Agency for ***Agriculture***, Fisheries and Rural Developmentdisbursed a total of HRK 6.8 billion for all types of support from 1 January to 30 November this year, theAgriculture Ministry said on Tuesday. A total of seven billion kuna will have been paid in grants to the ***agricultural*** sector until the end of this year. Of those HRK 6.8 billion, 3.1 billion was allocated for rural development measures, 3.1 billion as direct payments, and HRK 84.5 million was allocated for the so-called wine envelope. The school fruits scheme was supported by 8.5 million kuna and the school milk scheme cost HRK 2.7 million. Beekeepers received 14.8 million kuna. An additional HRK 183.7 million was absorbed from the European Maritime and Fisheries Fund (EMFF). Furthermore, the Croatian ministry also allocated HRK 299 million inadditional grants. AgricultureMinister Marija Vuckovic thanked the agency and its staff for their dedicated work to the benefitof Croatian farmers, fishermen and forest workers. Travel agencies call for urgent government support ZAGREB, Dec 8 (Hina) - Travel agencies are the most affected segment in thetourism and travel industry in Croatia and most of them have virtually had no business for months and in order to survive they need state support and are calling for urgent aid,the Association of Croatian Travel Agencies (UHPA) said on Tuesday. "Business operations and the survival of travel or tourism agencies is absolutely jeopardisedand we have been saying that since the outbreak of the coronacrisisand that without state aidmost agencies will not survive. Hence we are calling for certain measures specifically for agencies, similar to those adopted by other EU member states," UHPA president Tomislav Fain explained. The job-retentionmeasures have helped, he added, for agencies to keep their employees. He explained that the criteria was adapted to the real needs and demands by agencies, however Fain said "they will not stop there." He revealed that last week he metwith Tourism Minister Nikolina Brnjac for the talks onthe problems agencies are experiencing and oncompensation for agencies and tour organisers who are faced with the most difficult situation caused by the pandemic. We discussed extending jobkeeping measures until the spring of 2021, financial support through grants and loans for liquidity along with subsidised interest. "That is exceptionally important for tourism agencies and to assist them in compensating for payments they made to suppliers for travel that could not be conducted and to ensure guarantees in cases of insolvency occurring due to unrealised package arrangements. That is one of the main conditions to restore trust of travellers" said Fain. EU GDP drops 4.2% y-o-y in Q3 ZAGREB, Dec8(Hina) -In the third quarter of 2020, the European Union GDP decreased by 4.2% on the year, with Croatia and Greece recording the sharpest decreases, ***Eurostat*** said on Tuesday. In mid-November, the EU statistical office estimated that the EU economy decreased by 4.3% on the year in Q3. The latest estimatespoint to a partial economic recovery after a record 13.9% annual decrease in Q2. In Q3, the Croatian GDP decreased by 10% on the year, after decreasing by 15.5% in Q2. Greece recorded the sharpest decline (-11.7%) in Q3, followed by Croatia, Malta (-9.2%) and Spain (-8.7%). Lithuania and Poland recorded the lowest decreases, by 1.6% and 1.8% respectively. Record quarterly increase In the third quarter of 2020, seasonally adjusted GDP increased by 11.5% in the EUcompared with the previous quarter, reducing by 0.1 percentage points the mid-November estimate. These were by far the sharpest increases observed since time series started in 1995. In Q2, the EU GDP decreased by 11.3% from Q1. Every member state whose ***data*** were available to ***Eurostat*** recorded a GDP increase in Q3 from Q2.France (+18.7%), Spain (+16.7%) and Italy (+15.9%) recorded the sharpest increases. Croatia's GDP went up by 6.9% after decreasing by 15% in Q2. Greece (+2.3%),Estonia and Finland (both +3.3%) and Lithuania (+3.8%) had the lowest increases of GDP in Q3. Milder employment decrease Compared with the same quarter of the previous year, employment decreased by 2% in the EU in the third quarter of 2020.The mid-November estimate showed a 1.8% decrease. In Q2, employment in the EU decreased by 2.9% year on year and by 2.8% fromQ1. In Q3, it increased by 0.9% from Q2, as estimated in mid-November. Croatia should better promote minority languages, says CoE ZAGREB, Dec8(Hina) -Croatia should better promote minority languages in education, administration and media, the Council of Europe’s Committee of Ministers recommended on Tuesday. The Council made the recommendationsbased on anevaluation report prepared by the Committee of Expertsunder the European Charter for Regional or Minority Languages. Czech, Hungarian, Italian, Ruthenian, Serbian, Slovakian,Ukrainian, Boyash Romanian, German, Istro-Romanian and Slovenian languages are covered by the Charter in Croatia andthey receive varying degrees of protection, the Committee of Ministers said. Teaching in or of some minority languages should be in accordance with Models A, B and C. According to the report, the number of weekly hours of teaching a minority language or in a minority language is "insufficient". For example, Model C foresees two to five hours a week but is often reduced to only two. The history of minority languages and culture are taught through the subject Civic Education, "but it is unclear how this is done in practice." There is interest in education in German and Italian in additional municipalities, but Istro-Romanian is not taughtand because this language is "severely endangered", it should urgently be introduced in education, according to the report. Although some minority languages, such as Italian, are present in the public domain, the other minority languages should be made "more visible in the linguistic landscape"and be used more often in the public domain. "In the case of Serbian, the Cyrillic script is not sufficiently used by municipalities and in signage." As far as media are concerned, two weekly public television programmes, "Prizma"and "Manjinski mozaik", offer content in and about minority languages, the report said. "However, the limited duration, the lack of regularity of the use of particular languages and the absence osome minority languages hamper the fulfilment of this undertaking." "While newspapers in some minority languages exist, articles in the other relevant minority languages should be published at least once a week, including online," the report said. The recommendations call for the introduction of minority languages "in equal and official use"in more municipalities where a sufficient number of minority language speakers live, and they should be used in the work of relevant regional and local authorities as well as by local branches of the state authorities. The Committee of Ministers invitedthe Croatian authorities to submit a reporton the recommendations by 1 March 2023. Croatian fourth graders outperform in Math and Science ZAGREB, Dec 8 (Hina) - Croatia's primary school fourth grade students have achieved above-average results in Math and Science, according to the findings of the Trends in International Mathematics and Science Study (TIMSS) conducted from March to June 2019 in 64 countries worldwide. The results presented online on Tuesday byCroatia's National Centre for the External Evaluation of Education (NCVVO) show that Croatia's students achieved 509 scores in Math and 524 scores in Science. The study covered 3,785 students in 153 schools across Croatia, and 580,000 overall in 20,000 schools worldwide. Croatia ranks 34th in the overall ranking. When it comes to Science, Croatia ranks 20th on the standings covering 64 countries worldwide. Considering the EU member-states, Croatia finishes as the 11th. The NCVVO director Ivana Katvic said that she was happy to see these good results, however, she pointed out a gap between the performance of Croatian boys and girlsin Math, where the former excelled the latter by a margin of ten points. In Science, there was no difference gender-wise. TIMSSprovides reliable and timely trend ***data*** on the mathematics and science achievement of students around the globe.TIMSS ***data*** have been ***collected*** from students at grades 4 and 8 every 4 years since 1995. TIMSS Advanced studies the achievement in advanced mathematics and physics of students in their final year of secondary school. TIMSS and TIMSS Advanced are sponsored by the International Association for the Evaluation of Educational Achievement (IEA). Croatia to decide on fighter jets in early 2021 ZAGREB, Dec 8(Hina) - Defence Minister Mario Banozic said on Tuesday that the government would decide on the procurement of fighter jets at the beginning of 2021 and that a contract to that effect could be signed in late 2021. During his visit to the city of Petrinja today, Minister Banozic recalled that the interdepartmental commission had five more days to make its recommendation on offers forwarded to Croatia regarding its plan to provide the air force with 12 fighter jets. Croatia has received four offers. The United States is offering the new F-16 Block 70, Sweden is offering the new Gripen C/D model, while France and Israel are offering used aircraft - Dessault Rafale and F-16 Block 30 respectively. Banozic today praised the members of the commission for their fair and responsible work. After they make recommendations, the government, in cooperation with the relevant parliamentary committee and the Defence Council, will make a final decision in early 2021, the minister said. He believed that the preparations of the contract would take 6-8 months so the signing of the document could be expected in late 2021. Banozic said that it was high time that the Croatian Air Force is provided with fighter jets so that Croatia could maintain its combat readiness. Vecernji List: Croatia to buy 76 Bradley tracked vehicles ZAGREB, Dec 8 (Hina) - After a week ago the US State Department approved the sale of weapons to Croatia, a major military project that has been talked about for several years is evidently beginning, envisaging the purchase of 76 Bradley tracked vehicles and accompanying weaponry, the Vecernji List daily says on Tuesday. Extensive documentation on the project contains a surprising estimate of the value of the project, which begins with a donation of vehicles, and the entire project, according to claims from the US side, is expected to cost $757 million. Even though this is the project value estimate by the US, eventually the project is expected tocost less. The vehicles to be donated by the US cost around $157 million. The Croatian military budget for 2021 contains an item regarding the purchase of infantry tracked vehicles in the amount of HRK 161 million. TheDefence Ministry expects the government to adopt a relevant decision and sign the agreement with the US by the end of the year. The amount stated in the defence budget would cover the first instalment for the multiannual project for the procurement of Bradley vehicles, ministry officials have said. The first instalment would be used to freshen up the vehicles and prepare them for use. In the subsequent stages, the Bradley M2A2 vehicles would be upgraded, including digitalisation, switching of communications equipment and reinforcing the vehicles' covering. The modernisation kit is expected to cost $2-3 million per vehicle. The ministry expects the Djuro Djakovic Special Vehicles company from Slavonski Brod to be involved in the modernisation project, as a subcontractor for the multinational BAE Systems company, the original manufacturer of Bradley vehicles. The State Department has said that the sale of military equipment to Croatia will support US foreign policy and national security by improving NATO allies' security as well as that the project will not change the basicmilitary balance in the region, Vecernji List says. German far-right political scene bought weapons in Croatia ZAGREB, Dec 8(Hina) - The far-right political scene in Germany obtainedweapons through arms dealers in Croatia, the German ZDF public broadcaster said on Tuesday. Prosecutors in Munich have indicted a 47-year-old Alexander R. for buying weapons in Croatia for the far-right in Germany, says ZDF'sFrontal21 political magazine. The main suspect and several clients have been found to possess a number of weapons, including pump-guns, and more than 200 pieces of ammunition, a representative for the prosecution, KlausRuhland, told ZDF. The persons in whose hands the weapons have ended up can be considered part of the far-right political scene, Ruhland said. Among them are members of the Citizens of the Reich, a movement which does not recognise Germany's constitutional order. German investigators found Alexander R. based on information from Croatian investigators whoduring a search in 2018 discovered a larger quantity of weapons intended for clients in Germany. In a TV report, ZDF reporters talk to a number of people in the eastern Croatian region of Slavonia who have already served a part of their prison terms for possession and sale of illegal arms. In the report, the interviewees saythat the weapons come from Serbia but that some of themoriginatefrom the period of the 1991-95 Homeland War. The main suspect, Alexander R., used to be an active member of the far-right NPD party, and by 2016 at the latest he was a member of the right-wing populist AfD party. Croatian investigators told their German colleagues that Alexander R. was buying weapons in Croatia and that, according to an eyewitness's account, he said that it was intended for the AfD. The Munich AfD branch said in a statement that it had never offered or bought illegal weapons. Before his extradition to Germany in September, Alexander R. lived in a Croatian port city. Slovenian, Israeli PMs discuss closer cooperation, situation in region ZAGREB, Dec8(Hina) - Slovenia and Israel are two advanceddemocracies, technologically capable and forward-looking, Israeli Prime Minister Benjamin Netanyahu said after talks with visiting Slovenian PM Janez Jansa on Tuesday. The two prime ministers discussed the strengthening of bilateral relations, situation in the region, and cooperation in technology, Slovenian media reported. Netanyahu commended Jansa as a friend of Israel, saying in a post on Twitter that his visit was an opportunity for a new beginning in the two countries' relations. This is the beginning of a beautiful friendship, the Israeli PM said in his post. PM Netanyahu also wrote on his Twitter account that he hopes that Sloveniacan facilitate, in its role in the EU presidency, "to have the EU understand that this is a different world and there are different opportunities, different alliances for the good, for the better." He thanked Jansa for the fact that Slovenia recently declared the pro-Iranian Hezbollah a terrorist organisation and supported views Israel has been advocating at international forums. Slovenia is among those European countries that see the situation in the Middle East as it is and not as it is often depicted bythe media, said Jansa. "Weare realists and recognise the real role of Israel here, its importance for peace in the world and the region. We are willing to do our best to strengthen that status," Jansa said. Speaking of cooperation possibilities with Israel, he said that the two countries would sign an agreement on innovation. During his two-day stay in Israel, the Slovenian PM also met with a number of executives of Israeli companies specialising in artificial intelligence and advanced technologies. Slovenia logs 1,627 new coronavirus cases, 66 deaths ZAGREB, Dec 8 (Hina) - Slovenia confirmed 1,627 new coronavirus cases after 6,158 tests performed in the last 24 hours and a record number of 66 infection-related deaths, the government said on Tuesday morning. Currently, 1,304 COVID-19 patients are being treated in hospitals, three more than on Monday, and 193 are intensive care, three fewer than the day before, government spokesman Jelko Kacin told a press conference. He said that the situation with the coronavirus pandemic was concerning because the number of new infections was not decreasing. He said that there was again an increase in new cases in Ljubljana and other major hotspots. The share of positive tests fell slightly from Monday to 26.42 percent, and the number of new infections grewcompared with the situation of seven days ago. The death toll has reached 1,861. Despite tight restrictions that have been in place for a month and half and have been extended to include this week, the numbers are still high, which has resulted in disagreements within the government and between its COVID-19 experts. Epidemiologist Mario Fafangel has recently resigned as chief adviser at the Health Ministry after criticising government measures in the media. ECHR again rules BiH violating its citizens' election rights ZAGREB, Dec 8 (Hina) - The European Court of Human Rights (ECHR) on Tuesday handed downyet another ruling, in acase filed by Svetozar Pudaric, confirming that Bosnia and Herzegovina (BiH) violates the rights of its citizens by discriminating against them based on ethnicity and the territory they live in. Pudaric, a former vice president of Bosnia and Herzegovina's Croat-BosniakFederation entity, wasan ethnic Serb who was prevented from standing for election to the country's ***collective*** presidency due to his place of residence. The ruling, published on the ECHR website, says that it has found that the relevant provision of Article V of the Constitution of Bosnia and Herzegovina does not meet the standards of prevention of discrimination from Article 1 of Protocol No. 1 of theConvention for the Protection of Human Rights and Fundamental Freedoms because it does not ensure the political equality of its citizens. The lawsuit referred to the fact that Pudaric, who hadresidence in the territory of the Federation of Bosnia and Herzegovina and declared himself as Serb, could not run for theBiH Presidency because under the country's constitution, the Serb member of the state presidency is elected exclusively from the territory of the country's Serb entity, Republika Srpska. The Croat and the Bosniak member of the BiH Presidency are elected from the Federation entity, which automatically discriminates against Croats and Bosniaks who live in the Serb entity because they cannot be members of the state leadership either. Pudaric sued Bosnia and Herzegovina in 2018 after the country's central election commission refused to accept his candidacy for a member of the BiH Presidency, referring to the constitution. Pudaric did not live to see the ruling which confirms his human rights were violated because he died of a grave illness in March this year. During his political career, he was a senior official of the Social Democratic Party of Bosnia and Herzegovina (SDP BiH) and chairman of its Main Committee. As an SDP official, in the period from 2011 to 2014, he served as the Serb vice-president of the Federation of Bosnia and Herzegovina. The ruling in this case is the fifth consecutive ruling by the ECHR that confirms that Bosnia and Herzegovina discriminates against its citizens because it restricts, based on their ethnicity and place of residence, their right to run for BiH Presidency and the House of Peoples, the upper chamber of the state parliamentwhich comprises only of representatives ofconstituent ethnic groups and where deputies are elected strictly according to their ethnicity and place of residence. The first and best known ruling of this kind, in the Sejdic-Finci case, was delivered in 2009 and it confirmed that ethnic minorities in Bosnia and Herzegovina are discriminated against. BiH at risk ofdemographic collapse, population could drop to 1.5 mn by 2070 ZAGREB, Dec 8 (Hina) -Bosnia andHerzegovina is threatened with a demographic disaster if the current trends and rapid ageing of the population continue,with realistic estimates indicatingthat by 2070 itspopulation could shrink to only 1.5 million, the UN Population Fund said in an analysis it published on Tuesday. The document,Population Situation Analysisin Bosnia and Herzegovina, includesdifferent projections by an expert team fromCharles University in Prague of what could occur in that country in the next fifty years if it does not urgently change its population and development policy. In the past two and a half decades, BiH has experienced a significant decline in population due to the warbut also migration. The1991 census showed the country had a population of almost 4.2 million while the 2013 census showeda population of only 3.5 million. However, it is assumed that even that number is inflated and that the actual size of the population in 2013 was closer to 3 million because the census recordeda large number of people who only own property in the country and actually live elsewhere. Now, based on the most optimistic scenario,by 2070BiH could have 2.5 million people at the most, and the scenario that demographers consider the most realistic is one of a demographic collapse and a population ofonly 1.5 million. The UN Resident Coordinator in BiH, Ingrid Macdonald, said that it was obvious that human resources in BiH are depleting, which means that the country willprobably not be able to recover from the consequences of the current pandemic and that it lacks anylong-term development prospects. Fewerchildren are being born and more and more people are emigrating. That is a disturbingtrend and concrete steps to stop it are needed immediately, said Macdonald. The UN analysis showsthat the average birth rate hasdecreased steadily, standing at1% between 1981 and 1991 while now it stands at-0.14% with the fertility rate of 1.28, according to the 2013 census. This means that the basic reproduction of the population is not occurring and BiH is at the bottom of the scale in the region. It is estimated that at least 23,000 people will have emigrated from the country by the end of 2020, and they will continue to emigrate bythe thousands in the years to come. If the current trend continues, by 2070 more than half the country's population will be older than 65. Bosnia reports one thousand new cases, 69 deaths ZAGREB, Dec8(Hina) - Bosnia and Herzegovina on Tuesday reported a little over 1,000 new coronavirus cases and 69 COVID-related deaths. In the last 24 hours,about 3,500 tests for coronavirus have been conducted. The totalnumber of people who have been infected in the country since the outbreak of the epidemic has grown to more than 96,000 while 3,100 people have died. The current anti-epidemicmeasures will probably remain in force during the Christmas and New Year holidays. Serbia reports 7,818 coronavirus cases, 57 deaths ZAGREB, Dec8(Hina) - Serbia has been recording an increase in COVID-19 hospitalisations for ten days now and doctors warned on Tuesday that they were receiving more and more patients with medium or serious symptoms. The number of hospitalisations surpassed 6,000 on November 21 and has been rising since, surpassing 7,000 onNovember 28. In the past 24 hours, Serbia has registered 57 COVID-19 deaths and 7,818 infections out of 20,514 tests. According to the Health Ministry, 8,318 COVID-19 patients are currently hospitalised, including 289 on ventilators, which is the highest daily number since the outbreak of the epidemic on March 6. To date, Serbia has confirmed 234,027 coronavirus cases, 1,936,157 tests and 2,062 deaths. In other news: Chief-Of-Staff: Army ready to resume search for missing offshore gas platform ZAGREB, Dec8(Hina) - The military Chief-Of-Staff said on Tuesday an aircraft joined in the search for the Ivana D gasplatform as soon as its disappearance in the northern Adriatic was reported but that it found nothingdue to bad weather, adding that it was ready to resume the search if called. Speaking to the press in Petrinja, Admiral Robert Hranj said the Coast Guard aircraft, which took off at dawn on Monday, did not notice any pollution at the search location 50 km northwest of Pula either. He said bad weather, including strong winds, showers and huge waves, made it possible to reach the location only by air. He said no new flights were planned for today and that two Coast Guard vessels were ready to participate in the search if called. "No human lives are in danger as the platform did not have a crew, so we will regulate the engagement of our forces accordingly," the admiral said. Pula Port Captain Dolores Brenko Skerjanc told Hina this morningthe search for INA'sgas platform, which disappeared in a storm on Saturday morning, would resume as soon as the weather allowed. INA: Boat search for missing platform later this week The INA oil company said the weather still did not allow for a safe inspection of the offshore platform's location and that a vessel would most likely sail there in the second half of the week. INA said arobot diver would also be employed in the search and reiterated that the event with the platform would not damage the environment as theEmergency Shut Down system was activated on it. Ivana D was last inspected in October and certified assafe, the company added. Chamber of Commerce calls for buying Croatian Christmas trees ZAGREB, Dec8(Hina) - The Croatian Chamber of Commerce (HGK) on Tuesday called on consumers to support domestic production and buy domestic Christmas trees. In Croatia, there are 1,000 producers who sell their Christmas trees on the domestic market, the HGKsaid. "According to State Bureau of ***Statistics*** ***data***, our producers put more than 200,000 trees on the market last year," said Dragan Kovacevic, the HGK vice president for ***agriculture*** and tourism. Given the high number of domestic producers, the export potential is significant, notably when one considers that only 310 trees were exported last year, and only to Bosnia and Herzegovina, at the total value of €3,100, he said. At the same time, more than 28,000 Christmas trees were imported, about two thirdsfrom Denmark, Europe's biggest Christmas tree exporter, Kovacevic said. He called on consumers to buy live Croatian trees this year. Christmas trees can be produced and sold only by natural and legal persons entered into the register of Christmas tree suppliers, the biggest being the Hrvatske Sume forest management company, the HGK said. Hrvatske Sume CEO Krunoslav Jakupcic said the company grew Christmas trees, with 140,000 European spruce and blue spruce seedlings planted on 40 hectares and a little less pine andSerbian spruce. About 7,300 trees were sold last year, mainly to domestic shopping malls, he said. ZSE main indices decrease ZAGREB, Dec8(Hina) - The main Zagreb Stock Exchange decreased on Tuesday, the Crobex by 0.01% to 1,757.92 points and the Crobex10 by 0.21% to 1,094.93 points. Regular turnover was HRK 6.8 million. The most traded stock was the preferred share of the Adris tourism and insurance group, generating HRK 1.6 million, closing at HRK 382, down 1.29%. The only other stock to cross the million kuna mark was the Valamar Riviera tourism company, turning over HRK 1.3 million. It closed at HRK 29.70 per share, down 0.34%. Thirty-six stocks were traded today, 15 recording price increases, 14 decreasingand seven staying the same as on Monday. (€1 = HRK7.542904) THIS BULLETIN INCLUDES NEWS ITEMS RELEASED BY 2100 HRS TUESDAY. (Hina) ms Masthead Brief News Bulletin is published by the Croatian News Agency HINA Marulićev trg 1610 000 ZagrebCroatia web:[*www.hina.hr*](http://www.hina.hr) mail: [*hina@hina.hr*](mailto:hina@hina.hr) phone: (+385 1) 48 08 660; fax (+385 1) 48 08 822 Publisher: Branka Gabriela Valentić, DirectorEditor in Chief: Serđo Obratov Bulletin Editor: Marija Šestan

**Load-Date:** December 8, 2020

**End of Document**



[***Influence of land tenure interventions on human well-being and environmental outcomes***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2M1-JCWX-C2CC-00000-00&context=1516831)

Nature Sustainability

December 2020

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**Section:** Pg. 242-251; Vol. 4; No. 3; ISSN: 2398-9629

**Length:** 8013 words

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**Body**

Main

With nearly half of the world’s population living in rural areas of low- and middle-income countries, policymakers increasingly recognize that clear, secure and equitable access and rights to land are foundational for strengthening land governance systems, social stability, economic growth, environmental conservation and human development,. As a result, land tenure security (LTS) has increasingly gained prominence with the rise in global sustainability agendas, such as the Paris Agreement and the United Nations Sustainable Development Goals, as many of these agendas now articulate both human well-being and environmental targets. Yet, globally, the effect of LTS on human well-being and environmental outcomes is still uncertain. For example, evidence on the role of land rights for achieving desired climate goals remains “established but incomplete”. Given the prominent role of LTS in global sustainability agendas, understanding its relationship to human well-being and environmental conditions is essential. These two outcomes are jointly important precisely because they are the central metrics by which a diverse set of sectors judge various sustainability goals.

Contemporary land tenure insecurity often stems from colonial imprints of property systems that were established for extractive purposes to benefit colonial settlers. These systems were usually carried over by post independence governments, making legal pluralism the reality for most of the world. Recent policies to strengthen LTS, such as decentralization, often have goals of clarifying or enforcing existing tenure arrangements,, or ameliorating historical power imbalances through interventions to empower women, and indigenous groups, often through titling and formalization–.

In general, policies that strengthen LTS to advance sustainability goals are based on the assumption that recognizing rights will benefit the landholder by ‘unlocking’ capital (for example, by providing access to credit or by enabling full utilization of production factors), reducing uncertainty,, providing opportunities and empowerment, and incentivizing the sustainable use of natural resources (see Supplementary Information). These rationales have fuelled substantial investments in policies that depend on LTS to achieve their goals, with over US$2.5 billion spent on land titling efforts alone in the past two decades ([*https://www.aiddata.org/*](https://www.aiddata.org/)). The confluence of interests that seeks to strengthen LTS highlights the urgency of understanding the state of knowledge, to guide both research and sustainability policies.

In the past three decades, there has been a notable increase in assessments of interventions that address LTS (Supplementary Fig. ). This emerging body of work has given rise to several reviews of LTS that examined its impacts on deforestation, women’s rights,, ***agricultural*** investment, and food security (Supplementary Table ). The study that is closest to the present work examined the social and environmental outcomes of LTS across 36 qualitative and 23 quantitative studies (although they were affiliated with a particular donor agency and their search yielded a smaller set of studies). However, these existing reviews focused on specific geographies, biomes, interventions or outcomes, which prevent a broader perspective on how the existing evidence supports the various policy efforts.

Building on these previous efforts, we review 117 quantitative studies that attempt to isolate the causal relationship between LTS interventions and human well-being or environmental outcomes (see the methods described in the Supplementary Information). We do not limit our search to geography, biome, intervention type or outcome. Using categories developed by the International Fund for ***Agricultural*** Development (IFAD) and the Global Land Tool Network (GLTN), we define tenure interventions as distinct efforts (policies or programmes) that aim to strengthen the LTS of the landholder. Using Kaplan-Hallam and Bennett’s human well-being framework, we examine any outcomes that would fall within social, cultural, economic, health and governance domains. We aggregate and summarize the evidence for how LTS interventions affect human well-being and environmental outcomes, uniquely track temporal aspects of intervention studies, and catalogue changes in land tenure characteristics pre and post intervention. We find that interventions that enhance LTS are, on average, associated with positive human well-being and conservation outcomes, although the effects are not universal. We also find that the existing literature focuses heavily on land ownership formalization and titling, which results in crucial gaps in understanding the impacts of other types of intervention (such as capacity building, awareness raising and devolution of rights).

Results

Characteristics of studies reviewed

We identified 117 studies that estimated the causal impact of tenure interventions on human well-being and environmental outcomes ( and Supplementary Fig. ). The studies included those with causal study designs (for example, randomized controlled trials (RCTs) and instrumental variables), counterfactual techniques (for example, difference-in-differences (DiD) models), or control and comparison groups. We excluded studies that focused exclusively on urban communities. The methodological, geographical and intervention characteristics of our selected studies are shown in Fig. .

Global distribution and characteristics of the studies and land tenure interventions included in this analysis.

a, Characteristics of the studies and interventions. Numbers in parentheses indicate the number of studies for all of the characteristics coded, except for the LTS measurement category and the LTS measurement scale. For these two characteristics, numbers in parentheses indicate the number of variables out of a total of 255 variables. Some studies fell into more than one category for a characteristic (including characteristics such as biome, methodology and unit of observation). A study was coded as having a counterfactual group if it employed RCTs, before-after-control-impact, DiD, PSM or statistical matching, or regression discontinuity designs. Studies were coded as having a comparison group if there was a clearly identified group that received no treatment, an alternative treatment, treatment of a different intensity, or a group that received treatment at a different time point. To meet our inclusion criteria, a study needed to have either a counterfactual or a comparison group. Supplementary Table provides a detailed description of superscripts a–f. b, Global distribution of studies, colour-coded according to the number of studies for each country. PSM, propensity score matching.

Of the 117 studies, 54 (46%) were of ‘high rigour’ (for example, the RCT and DiD studies) in that they analysed panel ***data*** sets and included a counterfactual or control group (Fig. , top, column 6). Of these, 33 studies identified the counterfactual groups with statistical matching (Fig. , top, column 1), and 34 used DiD models. We found four published assessments of RCTs.

There was high geographical and demographic variation among the studies in this analysis. The studies covered 42 countries, with overrepresentation from Ethiopia and China (Fig. ). The number of studies meeting our inclusion criteria increased by year (Fig. , bottom, column 1), which suggests broad advances in methodological standards. Working landscapes, usually ***agricultural*** lands, were the predominant landscape type (96 studies, 82%), followed by forests (28 studies, 24%) and grasslands or wetlands (3 studies, 2.6%) (Fig. , bottom, column 2). Almost all of the studies (104 studies, 89%) examined the effects of LTS on ***agricultural*** households (Fig. , bottom, column 3), and most of the studies (81 studies, 69%) included a gender analysis (Fig. , bottom, column 4).

The study duration (the years between the baseline and the post-intervention measurements) and the duration of the exposure period (the years after the intervention) were closely correlated with the type of assessed outcomes (Supplementary Table ). The duration of the studies varied widely, ranging from 1 to 75 (ref. ) years (median 8 years) (Fig. , bottom, column 7). Studies that evaluated only environmental outcomes typically had longer study durations (median 11 years) than those that evaluated only human well-being outcomes (median 7 years). Seventy-eight studies (67%) assessed interventions that were implemented between 1990 and 2009 (Fig. , bottom, column 8). Half of these (39 studies) evaluated the effects of titling and formalization (such as when government-recognized land documentation had been issued), perhaps reflecting the rise of land titling efforts in the 1980s and their subsequent decline.

Studies predominantly focused on titling and formalization

We coded intervention types on the basis of the five intervention categories created by the IFAD and the GLTN (Table ): titling and formalization (for example, official rights recognition and boundary clarifications), planning (for example, land use planning), policy (for example, legal or policy reforms), capacity building (for example, administrative capacity building), and awareness raising (for example, land rights literacy campaigns). Fifty-seven studies (49%) evaluated efforts that used more than one kind of intervention (Fig. , bottom, column 6). Formalization programmes were by far the most commonly assessed tenure intervention (70 studies, 60%). Studies in Ethiopia, China, Peru and Vietnam together represented more than half of these formalization programmes (37 studies, 53%). Forty-nine studies evaluated the impact of issuing state-recognized land documents to landholders, with the most commonly studied policies being Ethiopia’s land certification programme (11 studies), Peru’s Programa Especial de Titulación de Tierras (7 studies), and Vietnam’s Đổi Mới land reform programme (7 studies). The remaining formalization efforts clarified property rights and boundaries, or increased land access for marginalized or vulnerable groups. Changes in land use planning and management, commonly in conjunction with either policy reforms or land rights clarification and formalization, were the second-most common intervention (49 studies; 42%). Interventions that involved capacity building of land administration offices and awareness raising of land rights received less attention (7 and 5 studies; 6 and 4%, respectively).

Categories of land tenure security intervention inputs evaluated by studies reviewed

| **Intervention type** | **Included interventions** | ***n*** | **Assessed human well-being outcomes (*n*)** | **Assessed environmental outcomes (*n*)** |
| --- | --- | --- | --- | --- |
| Titling and formalization | Clarification of landholders' property rights and boundaries, official recognition of de facto rights, land access | 70 | 61 | 26 |
| Planning | Land use planning and natural resource management | 49 | 31 | 28 |
| Policy | Legal, regulatory and policy dialogue; advocacy and reform at government administration levels | 42 | 29 | 17 |
| Capacity building | Capacity building of offices in land administration, planning, valuation and conflict resolution | 7 | 6 | 4 |
| Awareness raising | Awareness raising (literacy) of land rights and regulations | 5 | 4 | 2 |
| Other | Land tenure insecurity as a result of invasions | 1 | 0 | 1 |

Fifty-seven studies (49%) combined different intervention types. As a result, the total sample size (n) exceeds the 117 reviewed papers. Categories of intervention type and included interventions are from the IFAD and the GLTN.

Government agencies were the most common organization to implement interventions (84 studies, 72%) (Fig. , bottom, column 5), and primarily aimed to increase LTS through titling and formalization, land redistribution, or by introducing statutory laws to protect marginalized populations or the environment. In 18 studies (15%), interventions were managed by government agencies with implementation support from intermediary organizations, such as civil society or private sector organizations. These collaborative cases mainly focused on providing land access or formalizing land rights, with only three studies looking at the devolution of rights or the recognition of customary tenure regimes. Only three studies (2.6%) in our review evaluated interventions implemented by non-governmental organizations, and these interventions involved the devolution of rights to communities and/or the strengthening of their capacity to manage land. Only two studies (2%) assessed interventions led by communities (for example, the rural shareholding cooperatives in China facilitated land distribution and access).

Studies mostly assessed de facto to de jure tenure changes

Tenure insecurities are often resolved by the formalization of land rights, a process whereby the state formally recognizes (and documents) previously informal ownership, access or trade of land resources. This process confers rights from a de facto, or customary, status to a de jure, or legal, status recognized by a governing authority. For each study, we recorded whether the rights were recognized statutorily (‘de jure’) or customarily (or in practice; ‘de facto’). When rights in practice (de facto) and rights by law (de jure) were aligned, so that there was no gap between formal and informal tenure, we denoted the case as ‘de jure + de facto’. Thus, we recorded which of these three contexts applied to a study at both the baseline (pre-intervention) stage and again at the post-intervention stage: de jure (legally defined rights), de facto (socially defined rights) and de jure + de facto (rights that exist both legally and socially).

Given the substantial multilateral efforts to formalize property rights, we might expect most studies to have evaluated the move from de facto to de jure + de facto rights, or studies that conducted cross-sectional analyses to have compared one group with de facto rights against another group with de jure + de facto rights. Indeed, at baseline, most situations were characterized as de facto (74 studies, 63%) and only one-fifth were characterized as having both legal and social tenure, or de jure + de facto (25 studies, 21%) (Fig. ). Post intervention, almost 90% of the studies (105 studies) were characterized as de jure + de facto, which reflects a predominant focus on formalization. All landless or land-poor populations (Fig. , ‘none’) (14 studies, 12%) gained de facto and/or de jure status, most often through a redistribution of the land and/or the provision of formal titles. Naturally, it was less common (6 studies, 5%) for interventions to assign de jure rights without also aligning de facto rights (that is, changing from de facto to only de jure, or from de jure + de facto to just de jure) (Supplementary Table ). This could happen, for instance, if a new inheritance law gave women inheritance rights, but the law was not fully enforced and recognized within communities. Still fewer studies (3 studies, 2.6%) investigated interventions that aligned de facto rights with pre-existing de jure rights to ensure that communities were aware of and enforced the rights that existed by law. These three studies investigated land boundary demarcations. Tenure status remained unchanged in almost a quarter of studies (26 studies, 22%). These 26 studies focused on contrasting populations with different levels of existing LTS resulting from local or customary practices, or were cases that sought to strengthen LTS without formalizing land rights (for example, by conducting awareness campaigns about property rights).

Changes in de jure and de facto tenure status and in tenure form before and after interventions of the studies reviewed.

a, Proportion of studies in which the recognition of rights was de jure, de facto, or both, before and after an intervention. Proportions are of the 117 studies reviewed. ‘None’ indicates the study populations that were landless or land poor, sometimes in combination with populations that had de jure and/or de facto status. b, Proportion of cases in which land tenure form (that is, whether land is public, protected, customary, communal, private or ‘none’) transitioned between the baseline and after the intervention. Proportions are of the 180 transition cases from the 117 studies reviewed.

Studies largely assessed land privatization

In addition to looking at the de facto and de jure status of land tenure, we separately considered land tenure form (that is, whether land is private, communal, customary, public or protected). We recorded transitions of land tenure form before and after interventions. In cases where a study assessed multiple forms or had instances of overlapping tenure forms, such as when private land is embedded within a protected area, we coded each transition type separately, resulting in 180 transition cases from the 117 studies.

Shifts in tenure form reflect the dominant transition toward privately held land (Fig. ). While private land was the most prevalent at baseline (69 cases, 38%), post-intervention private land had increased to 62%. Communal and customary lands (38 and 36 cases; 21% and 20%, respectively) were the next most common baseline conditions, and both of those categories either stayed the same or became private landholdings post intervention. All landless cases (16 cases, 9%) transitioned to some form of tenure, and nine of these cases became private land. Most cases in protected areas (5 out of 8 cases from baseline) did not transition to other categories. Post intervention, customary and public tenure forms saw the largest decreases (42% and 61% fewer cases than at baseline, respectively).

In total, 47 cases (26%) had a change in tenure form to private land (Supplementary Table ). Some shifts to private lands focused on specific marginalized populations. For instance, 10 of the 19 cases that recorded shifts from customary tenure to private tenure examined the recognition of women’s land rights through joint titling and inheritance law reform. Fifteen cases examined privatization of community lands, of which ten examined de-collectivization in China, Vietnam and Eastern Europe. Nine cases assessed the effects of provisioning private land to landless and land-poor populations through land allocation and redistribution programmes. Only one case focused on privatization of a protected area, in which formal rights were granted to squatters in forest reserves.

Compared with de jure and de facto rights, most cases showed no change in tenure form (111 cases, 62%). Of the 111 cases with no change in tenure form, 65 examined populations that had private land pre and post intervention. Of these 65 cases, 44 cases involved formalization efforts (that is, providing de jure recognition for private landowners who already had de facto status), and four cases involved the loss of de facto rights by private landowners as a result of threats of land expropriation. The other 46 cases examined situations in which landowners had varying strengths of rights (for example, those who owned versus those who rented land) but with the same tenure form (private), or were cases in which LTS improved without a change in tenure form (for example, land boundary clarifications, capacity building and education programmes).

Land tenure security largely led to positive outcomes, but trade-offs existed

We report the distribution of effects in three categories: studies that assessed the impact of LTS on human well-being outcomes, studies that assessed the impact on environmental outcomes, and studies that assessed the impact of LTS on both outcomes together.

Human well-being outcomes were assessed in 92 studies (Fig. and Supplementary Table ). Economic aspects of human well-being (for example, access to credit, participation in land rental markets, and land productivity) were the most common (70 studies) and were generally positively associated with LTS interventions. Studies that evaluated outcomes related to governance (24 studies) largely used subjective perceptions of land security, with mostly positive impacts, although some studies showed no clear direction of effects. Fewer studies assessed other governance-related outcomes evaluating common property resources or access to public goods and services, and the direction of impact was mixed. Other socially related outcomes were evaluated in 21 studies, most of which examined women’s empowerment (for example, women’s participation in household decisions). Women’s empowerment was examined across nine countries (Ethiopia, Kenya, Rwanda, Tanzania, Zambia, India, Nepal, Vietnam and Peru), and the distribution of effects indicates strong support for the positive effects of LTS (72% positive). We found little consistent support for LTS improving other social outcomes (such as interpersonal disputes, investment in education, land-related attitudes and knowledge). Health-related outcomes were assessed in just 11 studies, all of which looked at family planning and food security. Two-thirds of the studies on food security reported positive links to improved LTS.

Distribution of human well-being and environmental outcomes from the reviewed studies.

Distribution of studies that reported positive, negative, or unidentified (no or undetermined) effects from studies that investigated human well-being outcomes (n = 92) (a), environmental outcomes (n = 48) (b), and both human well-being and environmental outcomes (n = 23) (c). A study may have examined more than one domain and outcome, or used multiple indicators to evaluate one category, therefore the total number studies in ‘All’ does not always equal column sums. Supplementary Table provides descriptions of our categorization scheme, which is based on ref. .

Forty-eight studies evaluated the effects of LTS on environmental outcomes (Fig. and Supplementary Table ), and most of these focused on ***agricultural*** practices, such as soil and water conservation (23 studies). Other outcomes included changes in biophysical or ecological indicators such as natural forest conditions (19 studies), investment in agroforestry (11 studies), and investment in forest conservation (6 studies). About two-thirds of these studies reported positive effects. Proxies for biodiversity received less attention; only two studies were found on this topic, one on land abandonment and another on tree species and primate populations. Given that the effects of LTS on biodiversity outcomes are understudied, the overall impact is difficult to assess.

In aggregate, more studies found positive impacts on human well-being and environmental outcomes than found negative or unidentified impacts, combined. Of the 92 studies that assessed human well-being outcomes, 82% included at least one positive outcome, 14% included at least one negative outcome, and 45% contained unidentified effects. Of the 48 studies on environmental outcomes, 73% showed positive effects, 15% had negative outcomes, and 29% had cases in which no effect was identified. These proportions were roughly reflected in the subset of studies that examined both types of outcome (23 studies) (Fig. ). After stratifying outcomes from all studies on the basis of intervention types, we found that the distribution of effects for the three most commonly assessed interventions (land formalization, planning and policy) also reflected similar distributions (Supplementary Table ). Six studies evaluated capacity-building interventions and reported positive effects on human well-being. However, this was not reflected in the effects of capacity-building interventions on environmental outcomes (three of four studies reported unidentified results). The effect of awareness raising on strengthening LTS was mixed for both types of outcome, with roughly equal proportions of positive, negative and unidentified impacts.

On examination of the subset of studies (23 studies) that jointly investigated the effects of LTS on human well-being and environmental outcomes (Fig. ), there were ten instances in which tenure interventions seemed to result in ‘win–win’ situations (Supplementary Table ). Only one study on Zimbabwe’s fast-track land reform programme reported a ‘lose–lose’ situation. About half of the studies (12 studies) showed trade-offs and reported on some combination of both positive and negative impacts. In contrast to ‘win–win’ cases, these studies tended to have among the most rigorous research designs, and they evaluated interventions such as capacity building and awareness raising campaigns as opposed to land formalization and privatization. These studies also examined a greater number of human well-being outcomes and focused largely on changes in natural environmental conditions. Taken together, efforts to strengthen LTS generally contributed to improved human well-being and environmental outcomes, although, perhaps unsurprisingly, tenure interventions are not a silver bullet to societal problems.

Discussion

The elevated importance of LTS in sustainability agendas highlights an urgent need to better understand whether the existing evidence supports current and planned policy efforts. Our analysis helps to fill this gap by synthesizing the results from studies that cover a broad set of geographies, biomes, interventions and outcomes. Although publication and geographical bias could affect the distribution of effects of LTS –, they reflect the best available evidence from the scientific and policy community. We found strong support that strengthening LTS is, on average, positively associated with human well-being outcomes, particularly through land formalization, land use planning and policy reforms. Efforts to formalize property rights (that is, titling programmes) in particular had a strong relationship with economic outcomes on ***agricultural*** lands, broadly supporting findings from past reviews on similar topics,,,,. We found positive but weaker support that strengthening LTS improves environmental outcomes, although this was mainly related to short-term land investments and management outcomes, and mostly over forest conditions. Evidence was limited for long-term effects on environmental outcomes, which are ultimately the environmental outcomes of interest. Therefore, it is important to consider more long-term effects of tenure security on land, biodiversity or ecosystem services. We also found some trade-offs between the impact of LTS on human well-being and environmental outcomes. In the subset of studies that assessed both outcomes jointly, 52% found negative or unidentified impacts on either social or environmental outcomes. For example, in the Republic of Congo, a study examining the implementation of sustainable forest management-based policies that increased LTS found an increase in legal timber production, but also higher deforestation rates. Although only a few studies jointly examined social and environmental outcomes, these are important for understanding social-ecological system dynamics. New measurement technologies, such as remote sensing and communication technologies, that reduce the cost of monitoring and evaluation should make integrated evaluation studies more feasible in the future.

Our analysis highlights several knowledge gaps and additional ***data*** needs. First, although a wide range of geographies and demographic groups were represented in our study set, several countries are overrepresented (for example, Ethiopia and China, in which the state is always the formal landowner), and this may colour our understanding of the impacts of tenure security. Many studies also focused on ***agricultural*** communities, so our analysis may have limited external validity among nomadic, pastoralist, indigenous and other populations; those living in understudied biomes such grasslands and wetlands; or those involved in emerging but important issues (for example, small-scale artisanal miners). Given our search approach, we may have missed some newer or locally focused studies. Many studies lacked information on measurement contexts, such as distributional impacts (that is, impacts on inequality) and spatial aspects of land that might affect or mediate tenure (for example, relationships between plots, land attributes and land prices).

Second, most studies examined titling or formalization programmes, perhaps reflecting general trends in implementation,, but also potentially because titling is, in general, a ‘cleaner’ intervention to evaluate (that is, individuals either receive or do not receive title). The emphasis on titling programmes leads to several issues, including knowledge gaps for other interventions, such as the devolution of rights, information campaigns, conflict resolution and strengthening the governance of customary systems. Indeed, large efforts such as the ‘reducing emissions from deforestation and forest degradation-plus’ (REDD+) often rely on strengthening tenure security through non-titling interventions. The focus on titling also underlies widespread use of land title as a proxy for tenure security despite a growing literature arguing that title should not be equated with tenure security,. Furthermore, although conceptually simple, titling programmes often involve the resolution of long-held land disputes and can be fraught with political challenges that are ultimately unsuccessful due to multiple challenges. Sometimes, these interventions have little effect on a population’s perceived security, even if the programme was ‘successfully’ implemented. For instance, customary rights may be sufficiently secure in some areas, and titling or formalization may have little effect on perceived LTS.

Third, our analysis revealed that few studies examined changes in longer-term environmental conditions, such as changes in biodiversity. Extrapolating short-term effects on environmental outcomes may not always be appropriate, as increased LTS may also lead to intensified ***agriculture***, which could have longer-term negative environmental effects. Such temporal dynamics are rarely studied. More work is also needed to articulate the indirect impacts of strengthening LTS and recognize its role in complex systems. In ***agricultural*** settings, for instance, LTS may improve land management, leading to improved soil quality, and then to greater food security and farm income, but can also increase ***nutrient*** runoff from intensification. LTS can confer benefits to landholders in ways that provide them voice, such as enabling ‘defensive environmentalism’ when land becomes subject to external pressures. A better understanding of the causal pathways through which LTS operates may be especially important for the support of biodiversity conservation programmes and, in general, the sustainable use of natural resources.

Less than half of the studies (54 studies, 46%) met the most rigorous impact evaluation criteria of having both a counterfactual group and covering more than one time period, indicating opportunities to advance knowledge through more rigorous research designs. Our analysis also found that many studies examined programmes that involved more than one intervention, and in some cases, involved more than one implementing actor. This can create several challenges for evaluating evidence supporting the efficacy of LTS interventions, as studies may oversimplify interventions, miss synergies unique to a combination of interventions, miss implementation challenges, and may have difficulty estimating the marginal contribution of each actor or intervention. We organized interventions into tidy categories, potentially masking the on-the-ground reality and politics that shaped, motivated or otherwise mediated the effectiveness of most LTS interventions.

There is broad consensus that LTS is foundational for sustainability on a crowded planet. Most, though not all, investments in LTS result in positive social and environmental impacts. LTS affects many land-based decisions and provides opportunities to leverage capital, invest in livelihood opportunities, or improve land and housing quality characteristics that relate to health and well-being. Despite this, we still have a poor understanding about the returns on investing in tenure relative to other policy or investment alternatives, as well as the conditions under which LTS interventions lead to positive impacts. Future impact evaluations and studies should help to fill the geographical, thematic and programmatic gaps in our knowledge and to better understand the dividend on LTS investments. Any new evidence should be disseminated to practitioners and policymakers to maximize evidence-informed policies.

Methods

Our goal was to identify empirical studies that estimated the causal effect of interventions to strengthen LTS on human well-being and environmental outcomes in low- and middle-income countries. To do so, we employed a standard review protocol. Our protocol built on previous review efforts that examined the effects of LTS,,. Each stage of the review framework was reviewed by all authors.

Selection criteria

We predefined inclusion criteria for the populations, interventions, comparators, outcomes and study designs for the literature reviewed, following PICO protocol standards,. We looked for studies conducted in low- and middle-income countries (as classified at the time when these studies were conducted) that assessed the human well-being of rural populations and environmental outcomes in relation to interventions that alter the security of their land tenure and property rights. We targeted quantitative studies that used plausible causal identification strategies with counterfactual or comparison groups and assessed human well-being or environmental outcomes with ***data*** at the subnational scale.

We included studies that accounted for the counterfactual scenario and evaluated changes in human well-being or environmental outcomes over time. These methods identify the causal impact of tenure interventions by accounting for other time-invariant unobservable characteristics of the study population that might affect outcomes of interest–. We deemed a study to be a counterfactual case when the study design used an RCT, a before-after-control-impact design, a DiD approach, or a statistical (for example, propensity score) matching techniques. We also included studies that had comparison groups, which are clearly identified groups that receive no treatment, an alternative treatment, a treatment of a different intensity, or a treatment at a different point in time. Although these studies with comparison groups that adjusted for confounders are not as robust at drawing causal inference about longitudinal studies with counterfactuals, they provided broader insights about the effects of tenure interventions and tended to yield similar results,.

Search strategy

We conducted our search in Scopus, ProQuest and the Web of Science on the same day and with the same search strings. Our search strings looked for studies that included land, tenure interventions and impact evaluation terms (see the Supplementary Information for our exact search strings and filters, and their iterations) in the title, abstract and keywords. We used exclusion terms related to urban and peri-urban settings and environmental impact assessments. We limited our search to research articles written in English and published after 1990. We supplemented our database search with other published studies and grey literature included by authors of past reviews,–,, as well as other studies identified by the authors of the present work. All bibliographic references were stored in the citation management software EndNote (version X8, Clarivate Analytics).

Screening

The database search yielded 1,761 publications. After deleting 392 duplicates, we conducted abstract screening by two reviewers (B.E.R. and Y.J.M.), using the Rayyan software platform, and included studies if they met the criteria discussed above in their abstracts. This first step narrowed our database to 113 studies. We then conducted a full text screening by reviewing the entire text to ensure that the studies met the above criteria and included human well-being or environmental outcomes. This resulted in 62 studies. We supplemented our literature catalogue with 49 other studies from five reviews,–,, and six studies from expert guidance that met our inclusion criteria. In the end, 117 original studies published between 1990 and May 2018 were included in the final set of studies that we reviewed. A flow diagram was constructed to show the search and screening process (Supplementary Fig. ).

Coding

For each study, we extracted ***data*** on methodology, tenure interventions and contextual factors related to programme implementation, and human well-being or environmental outcomes. To ensure consistency of coding, T.-W.J.T. initially drafted all codes for the reviewed literature. To limit bias that may come with a single coder, the core analysis group (T.-W.J.T., B.E.R. and Y.J.M.) iteratively reviewed coding results during the coding process. Coding took place from June 2018 to June 2019, during which time the core analysis group reviewed results up to several times per week and approximately 100 times in total.

We first recorded the methodologies that a study employed in one or more of the following categories: RCT, before-after-control-impact, DiD, propensity score matching or statistical matching, regression discontinuity, instrumental variable approach, inverse probability weighting, panel ***data*** regression analysis, time-series method and cross-sectional regression analysis. We coded the year(s) of assessment and documented the unit of observation (if unstated, we used the description of statistical models or outcome ***data*** to determine the unit of observation).

We extracted all variables that measured some form of LTS from the main statistical or econometric analyses. LTS-related variables that were purely descriptive, or that were exclusively used for calculating propensity scores, developing matching groups, considering time or geographical effects, or conducting robustness checks were excluded. We assigned LTS variables into the following four measurement categories: institutional arrangements, landholder and land characteristics, subjective perceptions, and land rights activities and qualities. Institutional arrangements refer to formal and informal institutions that influence land use rights. Landholder and land characteristics refer to exogenous features of landholders or land that might differentially influence LTS or interventions. Subjective perceptions refer to the perceptions of study participants of their own LTS, including predictions of current and future tenure status and land rights. Land rights activities and qualities refer to enforcement and governance of land tenure interventions or policies and landholders’ adoption and experience of land rights. We coded whether the measurement scale was binary, categorical or continuous.

We recorded the types of land tenure intervention and other tenure-related contextual factors. We first created open-ended codes for tenure interventions to capture nuances in programme implementation. In cases in which studies were unclear or contained multiple interventions, we coded what appeared to be the main land tenure comparison(s). Following the categories developed by the IFAD and the GLTN, we categorized interventions according to five groups of land tenure intervention types: (1) legal, regulatory and policy dialogue, advocacy and reform; (2) property rights and boundaries clarification, official rights recognition and access to land; (3) capacity building of land administration and of conflict resolution offices; (4) awareness raising (or literacy) of land rights and regulations; and (5) land use planning and natural resource management. We then coded the number of intervention(s) in each study. We also added a category for other types of intervention, which included studies that compared pre-existing differences in land rights rather than an explicit programmatic intervention. We extracted the type of organization implementing the intervention (for example, a government or a non-profit organization), the year the intervention was implemented, and the period of exposure to the intervention. The exposure period was calculated by using the year of assessment for cross-sectional studies and the last year of assessment for longitudinal studies. We further coded study population characteristics, whether women were identified separately in the sample, the study location, and the predominant biome type (prior to intervention) using the habitat classification scheme of the International Union for Conservation of Nature.

We recorded tenure rights status as a combination of the following categories: de jure, de facto, and none (for landless populations) on the basis of the intended objectives of the interventions and the study descriptions. De jure refers to formal, legally recognized tenure status, whereas de facto refers to non-legally recognized or enforced tenure status and perceived land security. We considered customary laws as de facto unless studies mentioned that they were formally recognized by the state using a statutory law. A study at one point may have more than one tenure rights status in association with more than one tenure form (for example, private land in a protected area with de jure and de facto tenure arrangements).

We then coded whether tenure interventions were associated with changes in tenure form and tenure rights status. We classified tenure form before and after interventions according to the following categories: public, protected, customary, communal, private, and none (that is, landless). When there were instances of multiple tenure types (for example, communal and public land) or overlapping tenure forms (for example, indigenous communities living in protected areas), we separated all tenure types and coded transitions separately to capture the heterogeneity of tenure forms and transitions. A single study may therefore describe one or more tenure transition cases. Although the distinction between customary and communal is not always distinct in the literature, we described tenure forms as customary when studies described traditional customs influencing local tenure practices (for example, gender bias in land rights) and as communal when studies broadly described land being under ***collective*** or communal ownership. Additionally, literature from countries such as Ethiopia and China often emphasized that land is owned by the state, or that ***collective*** and rural households have only usufruct rights to land for a certain amount of time. Although the bundle of rights of private ownership in this context is more restricted relative to private land under less authoritative governance, government entities in other countries also tend to have the ultimate control over private land, even if not explicitly discussed, and we therefore grouped them together. Cross-sectional studies that used comparison groups were coded as not having a transition (that is, pretreatment and post-treatment tenure categories are the same).

Last, we recorded the directionality of the impacts of tenure interventions on human well-being and environmental outcomes. We categorized whether each human well-being and environmental outcome had improved (positive impact), deteriorated (negative impact), or remained unchanged or was unidentified (no or undetermined impact) for the more secure tenure condition relative to the less secure tenure condition. We focused on extracting main effects and left out subgroup effects, as the latter are often surreptitiously reported or exploratory, with sample sizes that are often too small to provide conclusive evidence. When a study used multiple methods to estimate marginal effects, we extracted results from the most robust causal inference method.

As an example, Deininger et al. assessed the impacts of land certification on the perceived tenure security of farm households, rental market participation, and investment in soil and water conservation in Ethiopia. They used household- and plot-level panel ***data*** ***collected*** from 1999 to 2007 and estimated the effect of the policy using a DiD model. We coded variables measuring land certification and perceived tenure security in the LTS measurement categories ‘Land rights activities and qualities’ and ‘Subjective perceptions’, respectively, both on binary scales. Prior to the intervention, landholders held de facto usufruct rights to land, and women were described as being marginalized in the customary tenure system. Implemented by the Ethiopian government in 2003, the intervention issued use rights certificates to rural households that emphasized joint land ownership by including both spouses on certificates. This programme therefore falls under the intervention type ‘property rights and boundaries clarification, official rights recognition and access to land’. We categorized the pretreatment tenure form as customary and private with de facto status, and the post-treatment tenure form as private with both de jure and de facto status. This resulted in two tenure-form transition cases: customary to private, and private to private. Relative to households that had not received certificates, those that did receive certificates perceived their land to be more secure (a governance-related human well-being outcome), participated more in the rental market (an economically realated human well-being outcome), and invested more in soil and water conservation (an environmental outcome). In this case, all the outcomes were coded as positive.

Analyses

We summarized coded information on study characteristics, land tenure interventions, and their contexts by calculating the number and/or proportion of studies corresponding to each variable of interest. For most summary ***statistics***, a publication was our unit of analysis. In instances in which a study contained multiple types of variables (for example, a study with multiple biome types, study methodologies, units of observation, implementing institutions, interventions, and tenure form transition cases), we either created categories to capture multiple ***data*** points so that the denominators would be the total number of relevant studies, or we calculated the number or proportion of studies (or cases for tenure form) pertaining to each variable category so that the denominators would be the total number of ***data*** points for that variable.

For outcome ***data***, we calculated the number of studies that examined first human well-being outcomes, then environmental outcomes, and then both. We assigned each coded outcome a category and a direction. A study may have assessed multiple outcomes relating to more than one category. We created our categories to maximize the resolution of outcomes seen in the land tenure literature. We further grouped human well-being categories into domains defined by Kaplan-Hallam and Bennett to identify gaps in outcome assessment in the land tenure literature. While a study may have measured the same category using multiple indicators and found the same direction of results, we collated them and only kept one category–direction combination for each study. If there was disagreement, we kept all outcomes relating to the same category but included the different directions of results. We tabulated the number of studies reporting positive, negative, or unidentified outcomes. For studies that investigated both human well-being and environmental outcomes, we calculated the number of studies that reported jointly positive (‘win–win’), negative (‘lose–lose’), or trade-offs (win–lose or undetermined) in outcomes.

We performed all quantitative analyses and visualizations in Microsoft Excel, R (version 3.6.1), QGIS (version 3.12.3), and SankeyMATIC.

**Acknowledgements**

This research was supported by the David and Lucile Packard Foundation (2018-67261). W.Z. is supported by the CGIAR Research Program on Policies, Institutions and Markets.

**Notes**

Supplementary informationis available for this paper at [*https://doi.org/10.1038/s41893-020-00648-5.Peer*](https://doi.org/10.1038/s41893-020-00648-5.Peer) review informationNature Sustainability thanks Tim Balint and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

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HINA Digest

March 31, 2020 Tuesday

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**Length:** 8516 words

**Body**

Zagreb,Hrvatska31 March 2020 (Hina) - Croatia confirms 77 new coronavirus cases, 867 in total ZAGREB, March 31(Hina) - Seventy-seven new COVID-19 cases have been confirmed in Croatia, putting the total at 867, and there have been no new deaths, the national civil protection authority said on Tuesday. "The number of (new) cases is the same as yesterday and indicates that there is no major increase in new patients, which indirectly indicates that our measures are effective," Health Minister Vili Beros said at a daily press conference. A total of 7,015 persons have been tested, including 611 in the last 124 hours, and32 patients are on ventilators. The death toll is still six and 67 persons have recovered. Emergency medical staff have treated 1,124 persons suspected to have COVID-19. Beros said the healthcare system was going back to normal after theinitial shock of the epidemic outbreak.

No surge in COVID-19 cases after Zagreb quake ZAGREB, March 31 (Hina) - Croatia's COVID-19 crisis management team said on Tuesday that there was no surge in the number of coronavirus cases that could be connected with the aftermath of the 22 March strong quake that hit Zagreb and its surroundings, claiming one life and causing extensive damage. The head of the CroatianInstitute of Public Health (HZJZ), Krunoslav Capak, told a news conference that first analyses did not show a higher number of newinfectionsdue to the developments in Zagreb on 22 March when largergroups of shocked people fled their buildings to be outside. Age cohort between 50 and 59 with most positive cases Broken down by age, of thetotal of 867 Croatians diagnosed with COVID-19, as many as 187are aged between 50 and 59. They are followed by those aged between 40 and 49(165). In Croatia, 41 patients diagnosed with COVID-19 are under the age of 20, and 100 are above the age of 70, Capak said. He informed the news conference that 50 doctors, 10 dentists, 41 nurses, five pharmacists and seven hospital administration staff were among the positive cases. Also 1,200 employees inthe healthcare system arein self-isolation. The head of Zagreb's Fran Mihaljevic Hospital for Infectious Diseases, Alemka Markotic, said that currently there were more patients with moderate to serious symptoms and that32 were on respirators, which was as expected considering the fact that the share of elderly patientswith underlying medical conditions and people with chronic diseases was also rising. She underscored that currently none of those patients onrespirators was in a critical condition. 41 Croats under age of 20 test positive to COVID-19 ZAGREB, March 31 (Hina) - Croatian Institute of Public Health head Krunoslav Capak said on Tuesday that 17 children under the age of 9 were among a total of 41 people younger than 20 who had tested positive to the coronavirus, and all of them had only mild symptoms. He expressed satisfaction with the fact that there is no pronounced spread of the virus in Croatia, as is the case in some of the neighbouring countries, adding that the infection is under control. Capak told the national broadcaster HRT that this is also visible in the same number of those newly infected on a daily basis, namely that a cumulative curve showing the total number of those infected is on a mild ascending line, but that it was nearly horizontal and that we need to be happy about it. The situation in Istria is under control as there were no newly infected on Tuesday. Capak said the situation with the coronavirus has been stabilised on the island of Murter, where a quarantine has been declared, as well as the situation in the coastal town of Biograd. Capak also pointed out a mild descending trend in the number of newly infected cases in Zagreb, stressing that the 22 March quake had not caused a local transmission among Zagreb residents. Andrija Stampar institute introduces drive-in COVID-19 tests ZAGREB, March 31 (Hina) - The Andrija Stampar Teaching Institute of Public Health has introduced drive-in testing for coronavirus, the first in Croatia to do so, which will speed up the diagnosis process and increase the number of tests. "An increased number of tests is the best measure for early diagnosis and prevention of coronavirus infection, hence thenew method of testing at the institute will greatly contribute to faster identification of infected persons," the institute said on Tuesday. This method of testing means thatpeople do not need to get out of their vehicles, which increases the safety of both the person undergoing the test and the health worker. The institute added that testing will continue to be conducted at the referral of family doctors. This is just one of the measures the institute and City of Zagreb have taken to additionally protect citizens and part of the numerous activities being implemented each year to improve the quality of life and citizens' health. 970 in breach of self-isolation measures, says minister ZAGREB, March 31 (Hina) - The Minister of the Interior, Davor Bozinovic, who heads the national COVID-19 crisis management team, said on Tuesday that there had been 3,000 reports aboutbreaches of self-isolation measures and that law enforcement authorities established 970 cases of violations. Bozinovic said that to date seven police officers had tested positive for coronavirusand 98 had been placed in self-isolation, while for 59 police officers the 14-day self-isolation had expired. He also added after the 22 March strong earthquake, 450 residents of Zagreb were accommodated in the Cvjetno Naselje student dormitory. He thankedfire-fighters from ten cities and towns who had come to Zagreb to help their colleagues and the residents of the capital city to clean the rubble in the quake aftermath. Minister says police on frontline of defence just as during war ZAGREB, March 31(Hina) - Minister of the Interior Davor Bozinovic on Tuesday paid tribute to Josip Jovic, the first Croatian police officer killed in the Homeland War, as well as to other police officers and soldiers killed in the 1991-95 war. Bozinovic lit a candle at a monument commemorating Jovic at Plitvice Lakeson the occasion of the 29th anniversary of his death. Jovic, 22, was killed and nine other police officers were wounded in a police operation on 31 March 1991 after Serb insurgents occupied the Plitvice Lakes National Park and blocked the D1 state road that connects the country's north and south.Jovic was a member of the Lucko Anti-Terrorist Unit. Bozinovic, who heads the national team managing the current coronavirus crisis, said that police, together with other services, were today onthe first line of defence against coronavirus, just as they had been on the first line of defence during the war. President Milanovic pays tribute to police officer Josip Jovic President and Armed Forces Supreme Commander Zoran Milanovic on Tuesday lit a candle at a monument at Plitvicka Jezera commemorating Josip Jovic, the first Croatian police officerkilled in the Homeland War, on the occasion of the 29th anniversary of his death. Milanovic's envoy, Brigadier DarkoPodrug, head of the Croatian Navy commander's office, laid a wreath at Jovic's grave in Arzano. Croatia, Hungary relax border regime for residents of border area ZAGREB, March 31(Hina) - Croatia and Hungary have agreed to relax the border regime in orderto enable citizens of both countries who haveresidence within the area of 30 kilometres from the border or work in a company based in that area to cross the border, the Croatian Ministry of the Interior said on Tuesday. People living or working in the border area will be allowed to cross the border every day or when necessary. Upon their return home, they will have to obey self-isolation rules and they can continue doing farm and other work. If this exemption did not exist, Hungarian nationals would have to self-isolate for 14 days already upon their first return home, the ministry explained. The relaxed sanitary measures refer only to those nationals of the two countries who have a justified reason to cross the border in order to do the work that is considered economically important as well as to persons who can prove ownership of land in the other country for the purpose of farm work. All other personswho live in the border area but cannot prove that they need to cross the border are not exempt from the sanitary measures in force. Workers who need to cross the border will be issued with a pass by their employers while other passes, for example, for farming purposes, will be issued by local civil protection authorities. The agreed regime will be in force on all border crossings between Croatia and Hungary as of 7 a.m. March 31. No need for action regarding const. powers, says court ZAGREB, March 31 (Hina) - The Constitutional Court said in a press release on Tuesday that it has been carefully monitoring what the relevant bodies are doing in curbing the coronavirus pandemic and that at the moment, there is no need for action "regarding the Court's constitutional powers." The press release, signed by Constitutional Court Chief JusticeMiroslav Separovic, ensued after Constitutional Court Judge Andrej Abramovic released an article on constitutionality at the time of an epidemic on theprofessional web site iusinfo.hr,in which, among other things, he claims that the national crisis management authority did not have the right to ban people from leaving their place of residency. "This is Judge Abramovic's personal opinion to which he has a right, however, the Constitutional Court does not stand behind this opinion nor does itreflect the Constitutional Court's stance" Separovic said in the press release. In general, Constitutional Court judges may publish expert and academic articles,"however, this concrete caserefers to the stance that Judge Abramovic advocated in an internal debate between Constitutional Court judges as to whether the Constitutional Court should send a report to the parliament oncases of unconstitutionality and unlawfulness regarding Article 104 of the Constitutional Law on the Constitutional Court. The vast majority of Constitutional Court judges did not support his stance. "The Constitutional Court is carefully following all measures and actions that the relevant state bodies are undertaking to curb the coronavirus pandemic and has assessed that at the moment there is no need for the Constitutional Court to take any action related to its constitutional powers," the press release said. Judge Abramovic believes that the national authority was not authorised to ban people from leaving their place of residency andthat the Law on the System of Civil Protection and its amendments, adopted by the Sabor on 18 March, did not give the national authority that power. Abramovic notes that the amendments cannot transfer the powers of all state bodies to the national authority as that would mean the suspension of democracy. NGOs: Mobile phone tracking is human rights breach ZAGREB, March 31(Hina) - Forty-four civil society organisations haveissued a joint statement in a comment on draft amendments to the Electronic Communications Act, warning that tracking any mobile phone in the country is not a measure designed to protect against coronavirus but rather an unnecessary breach of human rights. "We have all been giving up on activities that are important for our lives on a daily basis, showing patience, responsibility and trust in the competent institutions. But the trust given to politicians will be betrayed if the measures that are being adopted are not geared towards preventing the disease and its consequences but are rather misused by the authorities through unrestricted tracking of every person's mobile phone," the organisations say. They warn that some of the government's actions, including a recent failed proposal by Prime Minister Andrej Plenkovic for the parliament to transfer its powers to the government, as well as plans for amending labour legislation to restrict workers' rights, leave room for doubt in the government's measures and could bring into question everything good made so far. The last worrying proposal is the government's bill of amendments to the Electronic Communications Act which envisages the possibility of tracking any mobile phone in the country, which, the associations say, goes beyond the protection of public health. "Also, the measure is ineffective because it can be bypassed by simply leaving one's mobile at home. The amendments also do not include any regulations on the duration of the tracking nor do they regulate the handling of ***collected*** ***data***, that is, their storing and destruction, or supervision of ***data*** ***collection***," the association say. They also recall that in emergency situations, such as the current coronavirus pandemic, Article 17 of the Constitution says that temporary restrictions of constitutional rights must be adopted by a two-thirds majority and not asimple majority, which is how the ruling coalition wants to have them adopted. In extraordinary situations such as the coronavirus pandemic, when room and time for a broad democratic discussion arerestricted, temporary restrictions of human rights should be introduced by a broad consensus of parliament members, the associations stress. FinMin says new set of measures also focused on liquidity, jobs ZAGREB, March 31 (Hina) - Finance Minister Zdravko Maric said on Tuesday that the focus of a second set of measures designed by the government to mitigate the fallout fromthe coronavirus crisis would be placed on maintaining liquidity and employment. Since the introduction of the first set of measures we still cannot know the crucial variable: how long all this will last. Nevertheless, the focus is again put on maintaining liquidassets and preserving jobs, Maric said before the start of a meeting of partners in the ruling coalition. Hesaid that to date, 52,000 requests had been submitted for the deferral of payment of taxes. Asked whether the government was ready to grant requests ofnon-food shops that call for a relaxation of confinement measures, Maric said that the main focus was on preserving the public health and lives, however,all appeals should be considered. All businesses that can operatewithout undermining the epidemiological situation in Croatiashould be recognised,the minister said. He added that under the current circumstances it was necessary to strike a balance, considering the expenditure and revenue sides of the budget. "A balanced approach is important," Maric said. New measures on government's agenda on Thursday ZAGREB, March 31, 2020 (Hina) - HDZ whip Branko Bacic stated on Tuesday that a new set of government measures designed to prop up the economy would be unveiled at the cabinet's session on Thursday, adding that the new measures were also still focused on saving jobs and the solvency of entrepreneurs affected by the coronavirus crisis. "We familiarised ourselves in broad terms with the new set of measures which will be on the government's agenda on Thursday. The aim of the measures will be to help entrepreneurs to conduct their business, as well as save every job, and to improve the solvency of entrepreneurs whose businesses were negatively affected by this crisis," Bacic stated to the press after a coalition meeting at Government House Speaking about the first set of measures which are being already implementing, Bacic said that around 60,000 entrepreneurs with over 330,000 employees had applied for the government scheme of payment of minimum wage, and that over 30,000 entrepreneurs had requested the deferral on paying taxes. HNS chief: Write-off of dues unquestionable ZAGREB, March 31 (Hina) - The Croatian People's Party (HNS) chief said on Tuesday it was beyond doubt that businesses that were banned from operating due to the coronavirus epidemic could count on write-offs of dues, and measures should be elaborated on how to compensatebusinesses operating at10%, 20% or 30% of their capacity. Ivan Vrdoljak, the leader of thatjunior partner in the ruling coalition, said todaythat businesses that could not be activecould not "create a deficit" either and they should be exempted from paying dues. Now it remains toelaborate rescue measures for the businesses that engage 10%, 20% or 30% of their capacities only, he said. Vrdoljak believes that every country should make up the measures in accordance with the specificities of their economies. Macroeconomic and financial measures will be crucial in the aftermath of the crisis, he added. Minister announces support for independent artists ZAGREB, March 31 (Hina) - The Culture Ministry is implementing measures to cushion the fallout fromthe COVID-19 pandemic and recent earthquake in Zagreb and as of April 1 applications will be invited for support to independent artists, Minister Nina Obuljen-Korzinek said on Tuesday, adding that new measures were being prepared. This week the ministry is continuing to implement measures which apply to artists whose social contributions are paid from the state budget. "Those who have lost engagements because of the coronavirus pandemic will be eligible for support amounting to HRK 1,625, i.e. HRK 3,250 for a period of three months," the minister said, adding that applications would be invited as of Wednesday. The ministry is also preparing measures to support artists and cultural workers who are not covered by any of those measures, specifically those who work part-time but are not self-employed, eligible for the payment of mandatory contributions or are registered only as members of guilds. 8,000 people out of work, 300,000 receive minimum wage ZAGREB, March 31 (Hina) - Eight thousand jobless and around 300,000 workers who receive the minimum wage are the first visible consequences of the blockade of economic activity caused by the coronavirus, says the Tuesday issue of the Vecernji List daily. Aside frombusinesses which have been banned from working, other entities with a drop in income of more than 20%, including the self-employed and free-lancers, can count on state support regarding the payment of wages. By Monday, atotal of 39,047 requests for a deferral of tax and other paymentswere filed with the Tax Administration by businesses and crafts. One in three such requests came from the hospitality sector, the daily says. After Prime Minister Andrej Plenkovic announced that this week a new set of measures will be adopted to help alleviate the impact of the crisis on businesses, the first meeting on the matter was held at the government on Monday. According to Vecernji List, the meeting discussed the possibility of abolishing the payment of all administrative fees and contributions in the sector covered by the Economy Ministry for a period of three months or longer if necessary. New intervention on exchange market by central bank ZAGREB, March 31 (Hina) - The Croatian National Bank (HNB) once again intervened on the foreign exchange market on Tuesday with the aim of maintaining exchange rate stability by selling banks just over €618 million, wherebyHRK 4.7 billion was withdrawn from the system. The HNB sold €618.5 million at the middle exchange rate of HRK 7.608529. This is the fifth intervention and so far the largest by the central bank in an effort to maintain exchange rate stability and ease the pressure of the depreciation of the domesticcurrency, the kuna. HNB first intervened on the exchange market on March 9 followed by further interventions during the month, selling a total amount of €1.63 billion to commercial banks. With today's intervention that amount has been increased to almost €2.25 billion. Today, on the last day of March, the €/HRK middle exchange rate was7.609231, which is just over 2% more than it was at the start of March when it was7.456909. AmCham: Ensure liquidity, maintain supply chain ZAGREB, March 31 (Hina) - Maintaining liquidity for enterprises, retaining jobs, ensuring the supply chain and tax reliefs aresome of the measures that are urgently needed to assist the economy in the wake of the coronavirus epidemic, the American Chamber of Commerce in Croatia (AmCham) said on Tuesday. We believe that in this situation it is essential to maintainliquidity for businesses, retain employment and jobs, ensure the supply chain for enterprises, stimulate consumption after the crisis and introduce tax reliefs,AmCham's director for Croatia, Andrea Doko Jelusic, said. AmCham has prepared measures that are in line with the government's measures and good practices in other countries. AmCham's measures include the introduction of state loans and guarantees through the Croatian Bank for Reconstruction and Development (HBOR) (in the amount of about 10% of GDP, similar to experiences in other countries), the establishment of funds for the industrial sectors affected the most by the crisis (e.g. tourism), securing funds for SMEs whose liquidity has been affected through interest-free loans with a two-year repayment period (based on the example of the Czech Republic). In order to keep jobs, AmCham proposes shorter working hours, obligatory annual leave for the duration of the crisis, subsidised wages in the private sector (Austrian, Slovenian models), andwriting off income taxand contributions during the crisis. AmCham is already working on measures that could ease the negative impact on the economy and assist enterprises to better weather the coming period. Considering the current circumstances and the disaster that struck Zagreb, AmCham also proposes that a decision be made to exempt deliveries to hospitals and scientific and educational institutions from VAT, which would motivate entrepreneurs to make donations more readily as support during and after the crisis as well as contributing to reconstruction efforts, said Doko Jelusic. HOK calls for clear stance on loan moratorium ZAGREB, March 31 (Hina) - The Croatian Chamber of Trades and Crafts (HOK) on Tuesday askedthe relevant institutions to takea clear stance on the type and manner of implementing a moratorium on loansand what that will mean for craft businessesonce the coronavirus pandemic is over. HOK appealed to the Croatian National Bank and the Croatian Banking Association regarding announcements of agovernmentmeasure for a moratorium on loans, askingfor their clear stance on the type ofmoratorium on loans and how itwould be applied. "If the moratorium on loans means suspending the payment of annuities while at the same time interest is calculated during the period that repayments are not made and ifinterest is later attributed to the principal, craft businesses will not be able to resume workafter the pandemic," HOK underlined. HOK added that a large number of craft business ownerswill have to close and register for the dole. HOK demands the relevant institutions adopt adecision according to which the moratorium would mean deferring repayment of the principal and regular interest as well as default interest or any other additional fees. Once the moratorium is lifted, craft business ownerswould continue paying their loan liabilities as though there had been nosuspension. Association calls for measures to salvage family-run farms ZAGREB, March 31 (Hina) - The Croatian Farmers' Association has asked the government and the ***Agriculture*** Ministry to urgently adopt measures to help salvage family-run farms and small and medium-sized farm businesses in the current crisis causedby the coronavirus epidemic. Among other things, the association calls on the state to organise the purchase of produce from family-run farms, whicharecurrently unable to sell their products on the market, to write off contributions on net wages for all family-run farms and small farm businesses, establish a national wholesale market and exchange of ***agricultural*** produce, and write off farmers'dues for the lease of state-owned farmland. SDP proposes one-year moratorium on loan repayments ZAGREB, March 31 (Hina) - Social Democratic Party (SDP) MPs Pedja Grbin and Boris Lalovac on Tuesday presented a bill proposing the introduction of a year-long moratorium on loan liabilities for debtors due to the coronavirus epidemic, during which interest would not be charged either. "After the epidemic ends, the focus will be on the struggle for the economy and how to help citizens to survive financially... that is why we propose a moratorium on loan liabilities for debtors for a period of one year," Lalovac told a press conference. The moratorium would refer to households and businesses alike. "Today we are hearing that two to three months will be sufficient to resolve the current problems, however, we believe that they needto be dealt with by a law," Lalovac said, adding that household indebtedness is high and amounts to HRK 110 billion, with cash loans accounting for HRK 53 billion and housing loans for HRK 57 billion. "If in the next few months a high rate of unemployment and the suspension of all economic activities is expected, we believe that three months will not be sufficient and citizens will feel pressure as to how they will manage to repayloans," Lalovac said, adding that that waswhy a moratorium wasimportant. Grbin, too, believes that it is necessary to regulate the matter by law to ensure all citizens and entrepreneurs are treated the same way. The measures announced by the Croatian Banking Association are not the same for everyone because they definecategories of debtors who could be eligible, he said. Under the SDP's bill, deferring repayments would not be obligatory because those citizens who feel that they do not need it and have a stable income can continue paying their loans, he said. Grbin criticised the government for not putting forward concrete measures to mitigate the crisis. There are currently five bills on the parliament's agenda this week andonly one has some connection to the current crisis, he said. Croatian Sovereignists: Crisis can be milestone for ***agriculture*** ZAGREB, March 31 (Hina) -The Croatian Sovereignists party on Tuesday proposed measures to bail out ***agricultural*** production and family farms in Croatia, saying that the crisis caused by coronavirus could be a milestone for the country's ***agricultural*** sector. "If the government's current policy is not changed soon, ***agriculture*** will certainly be on the path to ruin. Products by small and medium-sized farms will rot if they are not sold ontime at farmers' markets and their owners will not have the funds to start new production. Products by large producers are equally in question," the Sovereignists said. They propose that farmers' markets be opened to sell Croatian products with full compliance with the recommendations by the National Civil Protection Authority and callfor regulations to protect local production. The Sovereignists claim that Croatia's annual needs for ***agricultural*** products should be determined as soon as possible as should how much of those products is produced in Croatia and how much is imported. They also call for determining main ***agricultural*** producers for each county. The party calls for a legal framework that would define that at least 60% of ***agricultural*** products in retail chains haveto be domestically produced. Other measures include granting unused state-owned land to farmers to cultivate along with financial subsidies, facilitatingaccess to EU funds, lower interest rates and the introduction of taxation on idle land, as well asstricter controls on imported products. Self-sufficiency in producing food is one of the features of a sovereign country andCroatian governments have made the country dependent on import food lobbies, the party says. The coronavirus crisis raises the question of what will happen if food can no longer be imported to Croatia and does Croatia have sufficient food reserves. "In any case this crisis can be a milestone for Croatia's ***agriculture***," said the Sovereignists. Pensioners' associations call for allowances to be delivered by post ZAGREB, March 31 (Hina) - A pensioners'union and association on Tuesday called for urgent steps so pension allowances can be delivered by post in an effort to protect the elderly and ensuretheir survival while confinement measures are in force. We are urgently launching an initiative to introduce the temporary possibility of delivering pension allowances by post based on phone requests. Every day we are receiving requests from pensioners or their relatives warning of the problem of pension allowances being delivered to the majority of pensioners, particularlythose who live alone, exclusively in banks, because with the obligatory confinementfor the elderly and suspension of public transport they have no way of obtaining their pension allowances, the associations said in a press release. Theyhave been warning about this problem since 2014 when the possibility of pension allowances delivered by post was abandoned for everyone retired since then. The pensioners' associations consider this to be an urgent matter so that the survival of the elderly can be ensured without them causing any threats to health. Stromar: Structure up to authorities, owners responsible for interior repairs ZAGREB, March 31 (Hina) - Construction Minister Predrag Stromar on Tuesday said that a billon repairs following the earthquake in Zagreb is aimed at helping owners whose houses need to be demolished and atinvestingin fortifying the structure of apartmentbuildings, while interior repairs will have to be borne by their owners. Stromar held a meeting on Tuesday with relevant stakeholders in the reconstruction of Zagreb and its environs after a recentearthquake and, in a statement to the press after the meeting, he said that thelaw is being prepared. As he claimed, the primary aim of the law isto ensure a replacement propertyfor all those whose homes were damaged in the earthquake and that experts have determined need to be demolishedor, if possible, for a pre-fabricated or other house be built on their property. There is also thepossibility of partly indemnifyingfamilies so that they can resolve their housing issue, said the minister. On the other hand, not one apartmentbuilding has been determined for demolition, however if that should be determined later, there will be a model to assist those people to be able to live in normal conditions. The bill, said Stromar, categorisesbuildings into three categories - family homes, apartmentbuildings that are mostly located in Zagreb'scentre, and public buildings. He noted that most enquiries are related to privately owned apartmentbuildings and that it was on the most part confirmed that the structure of these buildings needs to be fortified so that they can withstand even stronger earthquakes than the magnitude 5.5 one that struck Zagreb. He said that without quality structures and raising the level of stability of buildings, nothing can be repaired and that the meeting today discussed in detail how and under which conditions experts can prepare those projects. After that is done, detailed reconstruction of interiors can begin, however the current opinion is that repairs like new parquetry, tiling and so on should not be up to city or government authorities but owners themselves. Stromar saidthat everything is being done through joint and intensive effort with the cityauthorities and other stakeholders to ensure conditions for structural engineers to complete the task of inspecting buildings. Opposition: Mayor not up to job of rebuilding Zagreb after quake ZAGREB, March 31(Hina) - The opposition in the Zagreb City Assembly on Tuesday strongly condemned the statements and conduct of Mayor Milan Bandic aftera recent earthquake which damaged more than 26,000 buildings, saying he was not up to the job of rebuilding Zagreb. Bandic said on Monday the citywould reconstruct the city-owned property damaged in the 22 March earthquake, while privately owned property would have to be rebuilt by owners, accusing them of failing to invest and properly maintain their buildings. Anka Mrak Taritas of GLAS told Hina such statements were "absolutely unacceptable, shameful and hypocritical." Bandic has been the mayor for 20 years and seismologists have been warning for years that Zagreb is in an earthquake areaand that it is necessary to prepare for one as much as possible, said Matej Misic of the Social Democratic Party. "The mayor ignored all those warnings and shifting responsibility to citizens is at the very least an insult to the intelligence of the people of Zagreb," he added. Tomislav Tomasevic of Zagreb Is Ours said that in his statements after the magnitude 5.5 earthquake, Bandic was continuing his war with citizens by telling them they were to blame because they did not invest in private property, although it was evident that public property sustained heavy damage too. Esplanade Zagreb Hotel damaged in earthquake ZAGREB, March 31 (Hina) - Esplanade Zagreb Hotel, one of the oldest hotels in Zagreb, is closed due to extensive damage caused by the March 22earthquake, exacerbating the difficult situation concerning the coronavirus, which has been adversely affecting business since January, the hotel's managing director has told Hina. "In the earthquake, the hotel suffered extensive damage, on the facade, onthe floors, in public spaces, and in many rooms. Therefore, it's with a heavy heart that Idecided to close Esplanade for the foreseeable future, as a precaution," revealed Ivica Max Krizmanic. He added that the last few guests had been evacuated and put up in other hotels in Zagreb, and that the staff, apart from a few who are taking care of the hotel, had been sent home. Krizmanic added that a detailed inspection conducted by structural engineers established that the building was structurally sounddue to the fact that the hotel was built as an exceptionally stabled, high-quality, and massive luxury building back in 1925. However, Krizmanic noted that it would take a lot of time and money to repair the damage. The managing director remarked that the last large renovation took place 16 years ago, and that the biggest challenge in the renovation after the earthquake would be finding wallpaper, tiles, lamps, and decorations identical to the unique ones that were damaged in the earthquake. When asked about the way they were coping with the coronavirus crisis, Krizmanic stated that they had closely followed developments since the epidemic broke out in China, the rest of the world, and in the region. Since the epidemicreached Croatia, they kept implementing stricter measures, from cleaning and disinfecting the hotel's public spaces and areas and implementing obligatory hand disinfection for guests and staff, to procuring masks, thermometres, disinfectants, and increasing caution in preparing and serving food, complying with mandatory distance, allowing work from home, etc. "Esplanade is famous for its high standards and first-rate service in every segment of its business, which is confirmed by numerous certificates and strict standards for staff, and our guests felt safe the whole time. However, due to the earthquake, we had to close," Krizmanic said. He emphasised that the hotel registered business disruptions as early asJanuary, when the epidemic broke out in China, and that it was obvious even then that 2020 would be a very hard year for tourism. Slovenia reports 46 new COVID-19 cases, 809 in total ZAGREB, March 31(Hina) - The number of COVID-19 cases in Slovenia has increased by 46 and now stands at 802, government spokesman Jelko Kacin said on Tuesday. So far, 15 people infected with coronavirus have died, of whom two died on Monday and two on Tuesday morning. Kacin said that 1,125 people were tested for coronavirus on Monday and 46 tested positive. He said that so far, 22,474 people had been tested for the virus. In an effort to curb the spreading of the disease, the Slovenian authorities on Monday introduced new confinement measures, including a ban onleaving one's place of residence. Serbia: Seven more deaths, 115 new cases of coronavirus ZAGREB, March 31 (Hina) - Today is the worst day for Serbia - seven new deaths, 23 in total, and 115 new cases of coronavirus infection, said the head of the infectious and tropical diseases hospital, and member of the health crisis authority,Goran Stevanovic. At a regular press conference, Stevanovic stated in a dramatic tone that 23 deaths from the coronavirus had been confirmed in Serbia up to now, and made a pessimistic estimate of the further developments of the epidemiological situation, comparing it with Italy and Spain. "This is the worst day for Serbia, and I am afraid that even worse days will come. This is the result of breaching the measures we have given, begged, and implored. If we continue behaving irresponsibly to ourselves and others, the situation could reach the proportions of Italy and Spain. We have taken the danger this disease poses too lightly," concluded Stevanovic. He resented his fellow people and citizens the fact that they continue to "socialise extensively" and try to evade measures which are necessary to stop the further spread of the disease. The Ministry of Health subsequently stated that 900 cases of COVID-19 were registered in Serbia by 3 p.m. on Tuesday. Since the last report from Monday at 7 p.m., 477 individuals were tested, 115 of whom tested positive for coronavirus, and 362 negative. Since 6 March, the official beginning of the epidemic, to 31 March at 3 p.m., the national referential laboratory at the Torlak Institute tested 3,561 persons in total. Montenegro imposes two-week curfew ZAGREB, March 31(Hina) - Montenegrin authorities have imposed a curfew in the fight against the coronavirus pandemic, so citizens will not be able to leave their homes from 7 p.m. to 5 a.m. on workdays, and from 1 p.m. on Saturday to Monday morning on weekends. The curfew will last two weeks and it does not refer to people who work in public services and provide services of public interest. Gatherings in private apartments and houses have been banned as well, except in cases when the people concerned belong to the same household, and also banned are outdoor sports and recreationalactivities. As no state of emergency has been declared, the government says that it bases its decision to impose a curfew on the Act on Protection Against Infectious Diseases which says that after an epidemic has been declared, the government can impose a ban on movement. Fourteen new cases of coronavirus were registered in Montenegro during the night, and the country now has 105 COVID-19 cases, the public health institute said. A total of 6,262 people are under medical supervision and two people have died. This week, two more contingents with medical and protective equipment, provided by foreign and domestic investors, will arrive in Montenegro. A plane with three and a half tonnes of medical equipment, provided by Greek investor Petros Stathis, arrived in Podgorica from Dubai on Monday. The Montenegrin government has thanked via Twitter the Greek investor as well as former Thai Prime Minister Thaksin Shinawatra, who was givenMontenegrin citizenship in2009. Ten health workers in Montenegro infected, over 200 in self-isolation Almost ten percent of the 105 confirmed cases of coronavirus in Montenegro are medical workers while 237 health workers are in self-isolation, the country's public health institute said on Tuesday. The institute said that six doctors and four nurses are among those infected. It was underscored that the medical staff infected with COVID-19 were exposed to the disease outside their work place. "The fact that health workers are in isolation is related to their behaviour. They are the most exposed to infections. This number of infected health workers is not the result of contracting the disease atworkor lack of equipment but through contacts at home," the institute's director, Boban Mugosa, said. According to Mugosa, of the237medical staff who are in self-isolation, half had returned to Montenegro after travelling abroad and were forcedto spend two weeks in isolation. He underscored that Montenegro is managing to keep the epidemic under control and that the days ahead are key to preserving the health of citizens. According to the latest information, of the 105 cases of the disease, 26 were imported from abroad and 79 were through personal contact. Commenting on the measure banning movement from 7 pm to 5 am on working days and weekends from 1 pm Saturday until Monday morning, Mugosa said that the measure was essential because a certain number of citizens were not adhering to themeasures. Police in the country said in a press release that not one citizen should nurture the idea that there will be any precedents or exceptions in the fight against the virus. Just how serious the police aretaking this situation can be seen in a tweet which notes that during the weekend three people who had violated the banon more than two people in a vehicle were placed incustody for 30 days. 2 more elderly man with underlying medical conditions die of COVID-19 in Bosnia ZAGREB, March 31(Hina) - The hospital in the northwestern Bosnian city of Banja Luka on Tuesday reported that two elderly men, who had tested positive for COVID-19, had succumbed to this disease. Bosnia and Herzegovina's coronavirus fatalities now stand at 12. The hospital in Banja Luka reported thatboth victims had suffered from chronic illnesses. In Banja Luka, there have been 150 confirmed COVID-19 cases out of slightly more than 400 cases throughout Bosnia and Herzegovina. Security Minister Fahrudin Radoncic on Tuesday called oncitizens tocomply with confinement and other protective measures. The more respect for the measures, the fewer deaths, he said. More than 400 COVID-19 cases in Bosnia The number of people infected with coronavirus in Bosnia and Herzegovina on Tuesday increased to 411 after new cases were confirmed in Sarajevo, Tuzla and Banja Luka, and the parliament of the Federation entity has stopped working due to the epidemic. Twelvepeople have died of the disease so far. They were all elderly people suffering from chronic conditions. The Serb entity capital of Banja Luka, which is the epicentre of the disease, has 150 cases of infection. The city authorities have decided that restrictions on movement and social contactwill remain in force until April 13 at the earliest. Restrictions have been relaxed for people older than 65 who until now could not leave their homes at all,so now they will be able to go out twice a week for the most basic errands. In the Federation entity, people aged above 65 and those aged under 18 are still strictly forbidden to leave their homes despite increasingly frequent warnings that that measure is unconstitutional as well as untenable because the entity authorities have not found a way to ensure food and drug deliveries for the elderly or enabled them to ***collect*** their pensions. Due to a decision by the Sarajevo cantonal authorities to ban gatherings of more than 20 people, a session of the Federation entity parliament, scheduled for Tuesday, was cancelled. This provoked strong criticism from the Opposition, as well as the Croat HDZ BiH party, which is part of the ruling coalition. Theparty believes that the Party of Democratic Action (SDA), whose member Mirsad Zaimovic,speaker of the lower house of the entity parliament, made the decision to suspend the parliament's work, is using the current situation to transfer the parliament's powers onto the entity government. The Social Democratic Party (SDP) said that it would insist that the parliament continue holding sessions while complying with all the safety measures that have been imposed and a similar request was made by the HDZ BiH. Bosnia starts constructing new Svilaj border crossing to Croatia ZAGREB, March 31 (Hina) - Bosnia and Herzegovina started constructing a new border crossing to Croatia, located by the bridge over the Sava River in the village of Svilaj, near Slavonski Brod, it was announced on Tuesday by the Indirect Taxation Authority (UNO) of Bosnia. The UNO and three Bosnian companies signed a€9.5 million contract on building the border crossing, which should be completed within 300 days. Thethree companies that won the tender are "Niskogradnja" from Laktaši "Alfa term" from Mostar, and "Tehton" from Banja Luka. Four lanes will be built at the entrance to the border crossing Svilaj, and three at the exit, which will facilitate the separation of passenger transport from freight transport. The new border crossing is a prerequisite for opening the new bridge over the Sava River located in Svilaj, which would take some traffic away from Slavonski Brod, one of the busiest border crossings to Bosnia at the moment. The Svilaj bridge is one of the key structures on the route of the future motorway in the Vc corridor, which will connect the Hungarian capital ofBudapest and the Croatian southern seaport of Ploce. The Croatian section of the motorway from Hungary to Bosnia stretches over 59 kilometres, going via Beli Manastir, Osijek, and Djakovo. At the Bosnian side of the border, a ten-kilometre stretch of the motorway from the bridge to the town of Odzak was built earlier, but it will only have a purpose after the remaining seventy kilometres of motorway to Zenica are built. No deadlines have been yet given for finishing this infrastructural project Bosnia. Volume of construction works in Jan up ZAGREB, March 31(Hina) - In January 2020, the volume of construction works was up 8% on the year and 2.6% on the month, the Croatian Bureau of ***Statistics*** said on Tuesday, citing provisional ***data***. The volume of works on buildings increased by 6.3% year on year and by 4% month on month and on civil engineering works by 10.9% year on year and by 8.4% month on month. Civil engineering works include the construction of roads, railways, pipelines, bridges, dams etc. In January 2020, 55.6% of man-hours was spenton new constructionand 44.4% on reconstruction, repair and maintenance -52.7% of man-hours was spenton buildings and 47.3% on civil engineering works. Industrial production in Feb drops 2.1% ZAGREB, March 31 (Hina) -In February 2020,industrial production in Croatiadecreased by 2.1% on the year, down for the fourth straight month, while increasing 0.9% on the month, the national statistical office said on Tuesday. In January 2020, the annual decrease was 5.5%. In February 2020, as compared to February 2019, intermediate goods decreased by 4%, energy by 3.6% and capital goods by 2.1%, while durable consumer goods increased by 5.9% and non-durable consumer goods by 4.8%. Month on month,non-durable consumer goods increased by 8.5% and energy by 2.2%, while intermediate goods decreased by 3.2%, durable consumer goods by 1% and capital goods by 0.4%. In manufacturing, which accounts for almost 82% of industrial production, production decreased 0.6% on the year, while increasing 3.1% on the month. INA Supervisory Board appoints new Management Board members ZAGREB, March 31(Hina) - The INA Supervisory Board on Tuesday appointed three new Management Board members - Barbara Doric, Darko Markotic and Niko Dalic - at the government's proposal, the energy company said in a press release. Their five-year term begins on April 1. Dalic has been reappointed as he has been on the Management Board since February 2011. The other members of the Management Board arepresident Sandor Fasimon, Akos Szekely and Zsolt Petho. Their terms expire on 30 June 2021. Croatia among EU members states with lowest hourly labour costs in 2019 ZAGREB, March 31 (Hina) - In 2019, Croatia was among EU member states with markedly low hourly labour costs, which amounted to less than half of the EU average (€27.7), according to a report by the European statistical office (***Eurostat***) published on Tuesday. According to ***Eurostat*** ***data***, the lowest hourly labour costs in 2019 were recorded in Bulgaria (€6.0), followed by Romania (€7.7), Lithuania (€9.4), and Hungary and Latvia (€9.9). In Croatia, hourly labour costs in 2019 were €11.1 (HRK 82.5), similar to Poland, where it was €10.7. Slovakia, Estonia, and the Czech Republic, with the hourly labour costs ranging from €12.5 to €13.5, are also in the group of member states with markedly low hourly labour costs. According to ***Eurostat*** ***data***, the highest hourly labour costs last year were registered in Denmark (€44.7), followed by Luxembourg (€41.6), and Belgium (€40.5). France, the Netherlands, Sweden, Germany, and Austria are also at the higher end of the scale, with hourly labour costs ranging from €36.6 to €34.7. In 2019, average hourly labour costs were estimated to be €27.7 in the European Union of 27 member states, and €31.4 in the euro area. In the EU, the highest hourly labour costs were in services (€27.5), and in the euro area, the highest hourly labour costs were in industry (€34.1). Highest share of non-wage cost in France In the EU and in the euro area, non-wage costs (e.g. employers' social contributions) comprised around 25% of the total labour costs. The lowest share of non-wage costs in the total labour costs was registered in Lithuania (5.3%), and the highest in France (32.9%). In Croatia, the share of non-wage costs in the total labour costs was 14.7% in 2019, which positioned it in the same group with Denmark, Ireland, and Slovenia. ZSE main indices surge ZAGREB, March 31 (Hina) - The Zagreb Stock Exchangemain indices surged on Tuesday following gains onEuropean stock exchanges but compensated only a little for the losses generatedin the first quarter, which exceed 20%. The Crobex increased 2.1% to 1,480 points after contracting 0.5% on Monday following a four-day positive streak. The Crobex10 increased 1.76% to 917 points, up for the sixth consecutive trading day. Since the start of the year, the Crobex dropped26.6% and the Crobex10 23.6%. The biggest losses were generated this month as the COVID-19 epidemic affected Croatia. In March, the Crobexdropped 20.6% and the Crobex10 18%. Today's regular trading was HRK 16.44 million, 5 million more than on Monday. The most traded stock was the Valamar Riviera tourism company, turning over HRK 5 million. It closed at HRK 24.1 per share, up 7.11%. The HT telecom turned over HRK 2.53 million, closing at HRK 162.5, the same as on Monday. Ericsson Nikola Tesla was also stable at HRK 1,120 per share, turning over HRK 1.4 million. Another stock crossed the million kuna mark, the preferred share of the Adris tourism and insurance group, which turned over HRK 1.1 million. It closed at HRK 350, up 1.74%. (€1 = HRK7.609231) THIS BULLETIN INCLUDES NEWS ITEMS RELEASED BY 2100 HRS TUESDAY. (Hina) ms Masthead Brief News Bulletin is published by the Croatian News Agency HINA Marulićev trg 1610 000 ZagrebCroatia web:[*www.hina.hr*](http://www.hina.hr) mail: [*hina@hina.hr*](mailto:hina@hina.hr) phone: (+385 1) 48 08 660; fax (+385 1) 48 08 822 Publisher: Branka Gabriela Valentić, DirectorEditor in Chief: Serđo Obratov Bulletin Editor: Marija Šestan

**Load-Date:** March 31, 2020

**End of Document**



[***European Court of Human Rights Judgment: HUDOROVIC AND OTHERS v. SLOVENIA - 24816/14 (Judgment : Preliminary objection joined to merits : Second Section) [2020] ECHR 211 (10 March 2020)***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YF8-R5G1-F0YC-N3RM-00000-00&context=1516831)

Baltic Legal Updates

March 14, 2020 Saturday

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**Length:** 24999 words

**Body**

Brussels: European Court of Human Rights has issued the following Judgment on (10 March 2020):

STRASBOURG

10 March 2020

This judgment will become final in the circumstances set out in Article 44 § 2 of the Convention. It may be subject to editorial revision.

In the case of Hudorovič and Others v. Slovenia,

The European Court of Human Rights (Second Section), sitting as a Chamber composed of:

Robert Spano, President, Marko Bošnjak, Valeriu Griţco, Egidijus Kūris, Ivana Jelić, Arnfinn Bårdsen, Darian Pavli, judges,and Hasan Bakırcı, Deputy Section Registrar,

Having deliberated in private on 4 February 2020,

Delivers the following judgment, which was adopted on that date:

PROCEDURE

1. The case originated in two applications (nos. 24816/14 and 25140/14) against the Republic of Slovenia lodged with the Court on 26 March 2014 under Article 34 of the Convention for the Protection of Human Rights and Fundamental Freedoms (“the Convention”) by sixteen Slovenian nationals (“the applicants”), whose details are set out in the annex to this judgment.

2. The applicants were represented by Ms N. Zidar Klemenčič, a lawyer practising in Ljubljana, and the European Human Rights Law Institute, based in Nicosia. The Slovenian Government (“the Government”) were represented by their Agent, Ms J. Morela, State Attorney.

3. The applicants alleged that the State had failed to provide them with access to basic public utilities, such as drinking water and sanitation, contrary to the requirements of Articles 3 and 8 of the Convention. Relying on Article 14, they further submitted that, as members of the Roma community, they were unable to effectively enjoy the same rights as the majority population owing to the authorities’ discriminatory attitudes towards them.

4. On 8 April 2015 the Government were given notice of the applications. In addition, leave to intervene in the written procedure (Article 36 § 2 of the Convention and Rule 44 § 3 of the Rules of Court) was granted to the European Roma Rights Centre and the Human Rights Centre of the University of Ghent.

THE FACTS

I. THE CIRCUMSTANCES OF THE CASE

A. The applicants in case no. 24816/14

5. Mr Branko Hudorovič (the first applicant) was born in 1959 and lives in the informal Roma settlement of Goriča vas in the Ribnica Municipality. Mr Aleks Kastelic (the second applicant) is the first applicant’s son, born in 2007, who initially applied to the Court under the name Aleks Hudorovič. Following the Government’s objection, lodged on 2 November 2015, his name was corrected to Aleks Kastelic.

6. On 26 May 2011 the first applicant and the second applicant’s mother, Ms Marija Kastelic, reached a court settlement whereby the second applicant resides in the custody of his mother at a different address from that submitted by the first applicant. According to the information about the first and second applicants’ family situation provided to the Government by the Ribnica Social Work Centre on 22 June 2015, the first applicant maintained contact with the second applicant under the terms agreed upon with the latter’s mother. According to the first applicant, the second applicant lives mostly with him in the Goriča vas settlement.

7. More than 10% of the population residing in the Ribnica Municipality do not have access to drinking water from the public water-distribution system. The public sewage system for the discharge of urban wastewater was built solely in the town of Ribnica and the Hrastje area, while all other housing facilities must be equipped with their own septic tanks or individual water treatment plants installed at the expense of each facility or investor.

8. On 31 December 2014 there were forty-three public housing units at a subsidised rent rate provided to people with low incomes in the Ribnica Municipality. Another fourteen public housing units were provided at the market rate.

9. The land on which the Roma community settled thirty years ago is owned by the Republic of Slovenia. This marshy ***agricultural*** land is categorised in the Municipal Spatial Plan of the Ribnica Municipality as the best category of ***agricultural*** land, where construction of residential buildings is not allowed. Moreover, the Goriča vas settlement is located outside of settlement areas under high-voltage power lines where construction is not allowed due to electromagnetic radiation.

10. In the early period of the settlement, the inhabitants lived there in tents, but later some more permanent dwellings were constructed. Today most residents live in wooden huts, some of which have stonework or brick inside. Today some eighty people reside in the settlement. Demolition orders were issued in respect of five such illegally constructed huts, including one built by the first applicant. He received an order to remove the building then under construction in 2000, which came into effect in 2005. None of the demolition orders was, however, executed, one of the reasons being that alternative accommodation would have had to be provided to the Roma children living on the premises.

11. The buildings in the Goriča vas settlement are not equipped with plumbing, nor is there any sewage piping. As regards electricity, the residents rely on illegal connections to electricity poles. The ***collection*** and transport of municipal waste is regularly performed by the public municipal utility service, and it is no longer charged to the residents since they have failed to pay their bills.

12. The first applicant initially submitted that he lived in a caravan. He subsequently informed the Court that he had moved into a simple wooden hut where he lives with his son. The hut has no access to water, sewage and sanitation. According to the first applicant, they ***collect*** water from the cemetery or the nearby polluted stream or else they acquire it from other houses. Moreover, owing to the lack of sanitation services, the applicants use the area around the caravan for defecation.

13. The applicants, together with other inhabitants of the settlement, have for a number of years been seeking to obtain access to public utilities. They attended a number of meetings with the Mayor of the Ribnica Municipality and the governmental Office for Minorities (Urad za manjšine). However, as the Goriča vas settlement was established in an irregular manner, the residents have no possibility of acquiring building permits and the other documents necessary for obtaining access to the public infrastructure.

14. In 1996, the Ribnica Municipality drew up a plan to relocate the residents of the Goriča vas settlement to the Lepovče Roma settlement. Several terraced houses were to be constructed and equipped with the necessary infrastructure. The Roma from the Goriča vas settlement initially agreed to the Municipality’s plan and expressed their readiness to contribute their labour to the project. However, in May 1997 the non-Roma residents of Lepovče expressed their opposition to the enlargement of the Roma settlement in their village, fearing that the proximity of the settlement would cause “further complications”. Subsequently, in May 1997, the first applicant, in his capacity as representative of the Roma living in Goriča vas, declared in writing that the group was not willing to move to the proposed location. It follows from the internal communication of the Municipality that the opposition to the proposed plan partly resulted from the fact that two separate Roma groups were to be settled in Lepovče, between whom disagreements existed. The Municipality subsequently abandoned the resettlement plan.

15. On 14 April 1999 the first applicant met the Mayor of Ribnica and requested that basic utilities, specifically drinking-water supply and an electricity generator, be provided for the Goriča vas Roma settlement. The first applicant and the Mayor concluded that a diesel generator and a water tank of 2,000-3,000 litres were to be purchased and placed in the Roma settlement; a regular water supply was to be provided by the local fire brigade, with the cost of the water deliveries being borne by the residents. According to the minutes of the meeting, the Roma residents would bear the costs of adequate sanitation (chemical toilets) and arrange for the clean-up of the surrounding area.

16. Subsequently, on 26 July 1999 the Ribnica Municipality and the first applicant, representing the Roma residing in Goriča vas, signed a co‑financing agreement whereby each of the parties undertook to cover 50% of the costs of the purchase of a water tank and a diesel generator. The pro forma value of the two infrastructure items, as set out in the agreement, amounted to 294,546 Slovenian tolars (SIT) (which according to the then applicable exchange rate amounted to 1,504 euros (EUR)). The Municipality committed itself to carrying out the purchase and delivering the water tank and the generator to the Goriča vas settlement. The individual Roma residents who had financially contributed to the purchase assumed ownership of the infrastructure items, and all the Roma residents of the Goriča vas settlement acquired the right to access water and electricity. In addition to the purchases, the Ribnica Municipality provided some landfill material used for the rehabilitation of the environment in the settlement.

17. It is undisputed between the parties that the water tank was purchased as part of a co-financing agreement. However, they disagreed on the subsequent course of events and the current situation as regards access to drinking water in the settlement.

18. According to the applicants, after a number of years the water tank became unusable due to mould and other fungi and they had no choice but to replace it. The tank had not been dug into the ground and therefore was not protected from the weather. Also, the applicants did not know whether the quality of water was being monitored at all. The Government, however, relying on the written testimony of a local resident, submitted that both the diesel generator and the water tank had subsequently been sold. The applicants contested that submission, arguing that “most of [the tanks]” could not have been sold as they had become inappropriate for use.

19. Regarding the water deliveries, in the period from 30 January 2010 until 1 January 2016 there were thirty-one deliveries of water to the Goriča vas settlement; each time the residents so requested 5,000 litres of water were delivered and the cost of an individual delivery amounted to EUR 35. The Roma residents were obliged to pay the costs of water transportation, while the costs of the water itself were borne by Ribnica Municipality. The Government, relying on information provided by the Ribnica fire brigade, submitted that the supplies of water had been poured into a large water tank installed in the settlement; when the tank was full, other containers had also been filled.

20. According to the applicants, the water delivered by the Ribnica Fire Brigade was used to fill private water tanks and pools where children bathed in the summer.

21. The Government further submitted that the Roma from the Goriča vas settlement had supplied themselves with water at the nearby Hrovača Cemetery, which was approximately 1 km away from the settlement. The applicants confirmed that they ***collected*** water wherever they could, including at cemeteries.

22. As regards the financial situation of the applicants, in the period from 1 May to 31 October 2015 the first applicant was entitled to monthly social assistance in the amount of EUR 269.20 The second applicant, in his mother’s custody, was financially supported through her monthly social security allowance amounting to EUR 331.12, and a monthly child allowance in the amount of EUR 114.31 In addition, based on a friendly settlement between the parents, the first applicant had a duty to pay monthly child support to the second applicant in the amount of EUR 61.99

23. On 13 October 2015 the Human Rights Ombudsman submitted a request to the Government to urgently adopt all necessary measures for the Goriča vas settlement to be connected to the public water supply system. In the meantime, a water tank had to be installed in the settlement. The Government replied that a water tank had already been installed and that spatial planning at the local level was the responsibility of the Ribnica Municipality. In reply, the Human Rights Ombudsman, noting that the Goriča vas residents had not reported the presence of a water tank, critically assessed the situation and took the view that the Ribnica Municipality had not effectively engaged with the Roma community to ensure them water and sanitation. The Ombudsman considered that the Government were violating the Roma residents’ human right to water and sanitation and noted that a violation would persist until a connection to the public water supply and sanitation system was ensured.

B. The applicants in case no. 25140/14

24. The applicants, a family of fourteen, live in the informal Roma settlement at Dobruška vas 41 in the Škocjan Municipality, which is composed of approximately twenty housing units for two hundred and fifty people. Mr Ljubo Novak (the first applicant) was born in the settlement, Ms Dunja Kočevar (the second applicant) has been living there for twenty years and all of their children were born there, too.

25. The Dobruška vas 41 settlement is located on land belonging mostly to the Škocjan Municipality and the local Krka ***Agricultural*** Cooperative. According to the Roma residents and a report of the Human Rights Ombudsman, members of the Roma community were moved to the area by the local authorities of the then Novo mesto Municipality in 1963, and have lived there ever since. Construction of residential houses in the Dobruška vas 41 settlement is possible under certain conditions and subject to approval by two environmental agencies related to the fact that the land is located partially in a flood area and an area of natural value. However, the Škocjan Municipality spatial plan provides for construction of a wastewater treatment plant and the transformation of the entire area in question into a business zone. The municipal authorities have on several occasions expressed expectations that the Roma residents of Dobruška vas 41 settlement should be relocated, while arguing at the same time that there was no appropriate area for an alternative settlement in the Škocjan Municipality.

26. In the period from 2004 until 2015 several residents of Dobruška vas 41, but not the applicants, were ordered to suspend construction and remove all structures already built in the settlement. Demolition orders were also issued in respect of a few of them; however, they were not executed.

27. In 2013 the Municipality lodged criminal complaints against a number of Roma residents, including the first applicant, for unlawful occupation of real property under Article 338 of the Criminal Code. In the first-instance criminal proceedings, the defendants were found guilty and given suspended sentences of three months’ imprisonment, with three years’ probation. The first applicant did not provide any information on whether he had appealed and whether that conviction had become final.

28. At the date of the lodging of the application, the applicants lived in an illegally built wooden hut located on land owned by the Krka ***Agricultural*** Cooperative, without access to water, sanitation or electricity. Subsequently the applicants informed the Court that they had moved into a wooden hut they had built approximately 200 m away from the previous dwelling owing to disagreements with their neighbours which had escalated into destruction of their property and physical aggression against them. They continued to live without a proper water supply and sanitation. The Government supplemented this information, adding that the first and the second applicants had bought two plots of land and illegally constructed a building and two animal sheds without a building permit.

29. In discussions between the Škocjan Municipality and the relevant State authorities it was decided that the Municipality could not ensure individual water connections to illegally built buildings, since such a solution would contravene the domestic legal order. However, in order to comply with the national and international standards of access to water, it was decided that a group water-distribution connection would be built in the settlement, on land belonging to the Municipality. The residents would be able to instal individual water connections at their own expense, as provided by the relevant legislation. As regards water bills, it was agreed to engage a local commission on Roma issues in a process of mediation to find a suitable solution.

30. The Dobruška vas 41 settlement where the applicants reside has been connected to the public water supply system since 2011. The water supply system consists of one group water-distribution connection (a group water‑access point) installed on the initiative and at the expense of the Škocjan Municipality. Nine individual connections were installed from the distribution connection to the individual users’ homes. In 2015, water was supplied to seven individual connections.

31. Initially, nineteen households were interested in obtaining individual connections, including the applicants’. Only nine households subsequently joined the water supply system by committing to pay their respective shares of the total consumption. In 2015, the average monthly cost of water for a household amounted to approximately EUR 9.

32. The applicants did not apply to join the water supply system. According to them, while living at a previous location, they had been denied access to the group water-distribution connection by their neighbours, who had not allowed them to lay a water pipe under “their” land. This issue had also been raised in a letter sent to the Mayor of the Škocjan Municipality by the Human Rights Ombudsman in December 2012. The Government submitted that the applicants could have avoided the neighbours and placed the pipes along the road. The applicants responded that they had not been informed of this possibility to connect to the water system. Also after the move to the new location, the applicants had not applied for an individual water connection, nor did they clarify whether their new building could be connected to the group water-distribution connection.

33. The residents of the Škocjan Municipality also have drinking water available from the village fountain. The fountain, where the applicants obtain their drinking water, is approximately 1.8 km away from the applicants’ hut; it is fitted with a tap and the water has a constant temperature of 14˚C. According to the analysis by the National Laboratory for Health, the Environment and Food, the water complies with the applicable standards and is considered safe, that is to say fit to use for drinking, cooking or washing. Some residents of the Škocjan Municipality (Vinji Vrh), whose households are not connected to the public water‑distribution system, supply themselves with water from the fountain, while for sanitary purposes they use rainwater or water supplied by the fire brigade.

34. As regards the sewerage system, at the material time the Škocjan Municipality had no public discharge or facility for treatment of urban wastewater. Buildings producing urban wastewater were equipped with septic tanks or cesspits, while newer buildings had small wastewater treatment plants. Septic tanks and small wastewater plants were funded by the owners of buildings where urban wastewater was produced. The public municipal utility service carried out the emptying of cesspits and small wastewater treatment plants (taking out mud and sludge). A wastewater treatment plant was under construction.

35. As regards the financial situation of the applicants, at the material time the first and the second applicants were receiving monthly child benefit in the amount of EUR 1,556.97, social assistance in the amount of EUR 868.80, and a parental benefit in the amount of EUR 252.04 Their two adult daughters, Ms Pamela Novak (the third applicant) and Julija Novak (the fourth applicant), were receiving monthly social assistance in the amount of 269.20 EUR each. The applicants were therefore receiving social benefits in the monthly amount of EUR 2,947.01 In 2016, however, those benefits were increased to EUR 3,299.85 per month. Moreover, the applicants were receiving EUR 120-130 per month as reimbursement for the costs of transporting their four children from their home to a bus station about 10 km away, from where they continued their journey to school by local bus.

II. RELEVANT DOMESTIC LAW

A. The Constitution

36. The relevant provisions of the Constitution provide as follows:

Article 14\*

(\*As amended by the Constitutional Act Amending Article 14 of the Constitution of the Republic of Slovenia, 15 June 2004 (Official Gazette of the Republic of Slovenia No. 69/04).)

(Equality before the Law)

“In Slovenia everyone shall be guaranteed equal human rights and fundamental freedoms irrespective of national origin, race, sex, language, religion, political, or other conviction, material standing, birth, education, social status, disability, or any other personal circumstance.

All are equal before the law.”

Article 65

(Status and Special Rights of the Romany Community in Slovenia)

“The status and special rights of the Romany community living in Slovenia shall be regulated by law.”

Article 70a\*

(\*As newly introduced by the Constitutional Act Amending Chapter III of the Constitution of the Republic of Slovenia, which was adopted on 17 November 2016 and entered into force on 25 November 2016 (Official Gazette of the Republic of Slovenia No. 75/16).)

(Right to Drinking Water)

“Everyone has the right to drinking water.

Water resources shall be a public good managed by the State.

As a priority and in a sustainable manner, water resources shall be used to supply the population with drinking water and water for household use and in this respect shall not be a market commodity.

The supply of the population with drinking water and water for household use shall be ensured by the State directly through self-governing local communities and on a not-for-profit basis.”

B. Relevant legislative and regulatory acts

1. Spatial development, spatial planning and the provision of public utility services in respect of construction land

37. Spatial development and spatial planning at the local level falls within the competence of municipalities, which, in accordance with the Local Self-Government Act, are independent in managing local matters in the public interest. In terms of spatial planning, that involves first and foremost land-use allocation in order to ensure rational and efficient use of land. To that end, municipalities adopt municipal spatial plans and detailed municipal spatial plans based on the Spatial Planning Act.

38. Under this legal framework, an area must be identified as construction land before any construction project can be submitted for a building permit. The power to determine the types of public utility infrastructure to be built in individual areas is conferred upon municipalities. The latter are also responsible for constructing the public utility infrastructure, which is financed from municipal budgets, the State budget and the community infrastructure levy. This levy is a contribution to the costs of construction of the public utility infrastructure paid by individual investors. By paying the community infrastructure levy, the person liable for payment, usually the owner of the construction land, is guaranteed connection to the already built infrastructure.

39. The Construction Act provides that any construction of a new structure, a re-built edifice, a replacement building, and so forth, cannot commence until a final building permit has been obtained. Before a building permit can be issued, the relevant administrative body verifies, inter alia, whether the relevant structure will be provided with the minimum level of public utility services; those include drinking-water supply, electricity supply, wastewater discharge and access to public roads. The investor must also show that a request for an assessment of the community infrastructure levy has, or will, be lodged.

40. The Construction Act explicitly prohibits the installation of public utility connections to illegally built structures.

41. As regards legalisation of illegally built buildings and structures, they are considered as new constructions requiring a building permit. Therefore, all of the above-mentioned conditions must be met in order to legalise a building, including the provision of the minimum level of public utility services.

2. Safe drinking water and sanitation

42. There is a comprehensive regulatory framework governing the use of water in Slovenia. Water as a public good and public services related to its use, to water facilities and equipment are regulated by the Water Act. Different types of checks on water with the aim of ensuring its safety and therefore its suitability for domestic use are provided for in the Regulation of Sanitary Suitability of Foodstuffs (Products and Materials Coming into Contact with Foodstuffs) Act. Furthermore, the Rules on drinking water define the requirements to be satisfied with regard to drinking water in order to protect human health from adverse effects, and the Decree on the Methodology for Determining Prices of Municipal Utility Services for Environmental Protection provides the methodology for determining prices of obligatory public municipal utility services, such as the drinking-water supply.

43. Individual tasks to be performed within the scope of the municipal utility service of water supply are determined in the Decree on Drinking-Water Supply. In principle, the municipal service of water supply is provided throughout the area of a municipality to buildings occupied by people and structures where drinking water is used for watering animals. By way of exception, private supply of drinking water may be ensured in respect of settlements and individual buildings or structures where the municipality does not provide the public utility service. Pursuant to the Decree, settlement areas with fifty or more permanent residents and a population density of more than five residents per hectare are to be equipped with a public water-distribution system. Subject to certain derogations, also settlement areas with less than fifty residents should be equipped with such a system.

44. The planning and construction of the connection to the public water‑distribution system should be ensured by the owner of the building or other structure that is to be connected. The Decree prohibits the provider of the public utility service from connecting to the public water-distribution system any buildings or structures that do not comply with the applicable rules on the discharge and treatment of urban wastewater. Both the Ribnica and Škocjan municipalities have adopted ordinances on drinking-water supply that are, in all essential provisions, aligned with the Decree and other relevant regulations.

45. As regards sanitation, the tasks performed within the scope of obligatory municipal utility service are determined in the Decree on the Discharge and Treatment of Urban Wastewater and Run-off Rainwater. The public utility service consists of discharging the wastewater into the public sewerage system, treating the discharged water, ***collecting*** urban wastewater and sludge from cesspits and from small urban wastewater plants, treatment of such wastewater and sludge in an urban or combined wastewater plant, and so forth.

46. Municipalities have a duty to provide the public utility service of sanitation throughout their respective areas; however, certain derogations regarding the scope of the service are allowed. Specifically, owners of buildings outside the designated settlement areas and where there is no public sewerage system must ensure that urban wastewater is discharged and treated in small urban wastewater treatment plants. Specific obligations related to the scope and methods of the public utility service provision are regulated by the municipal acts. Both the Ribnica and Škocjan municipalities have adopted ordinances on the discharge and treatment of urban wastewater that provide in detail the scope of the respective public municipal utility services and the locations where the urban wastewater is treated. For an owner of a property to be connected to the public sewerage system, he or she must be in possession of a final building permit and/or proof of the right to build.

3. Situation of the Roma community

47. Members of the Roma community in Slovenia are entitled to individual and community rights in the same way as all other citizens of the Republic of Slovenia. Their status is defined as a “special ethnic community” entitled to ***collective***, special rights. In 2007, the Roma Community in the Republic of Slovenia Act was adopted. It acknowledges the special status of the Roma community in Slovenia and its successful integration into Slovene society. The Act further defines the special rights of the Roma community which are accorded to its members in addition to the rights and obligations appertaining to all Slovenian citizens. Pursuant to section 3, the State is to provide for the implementation of the special rights of the Roma community in the areas of education, culture, employment, spatial planning and environmental protection, health and social security, as well as notification and participation in public affairs pertaining to the Roma community. Moreover, the Act determines the competences of national and local authorities for the implementation of those rights and provides for cooperation of the representatives of the Roma community in implementing their rights and obligations as provided by law.

48. Section 5 of the Act provides that the national and local authorities must include Roma settlement issues and improvement of living conditions of the Roma community members in their spatial plans. Pursuant to this section, the system of spatial planning in respect of Roma settlements is to be realised through appropriate local planning solutions. However, the initiative for planning of those settlements may under certain conditions be transferred to or taken over by the Government. The Government themselves may enact spatial planning regulations concerning Roma settlements in cases where a lack of legal regulation or municipal infrastructure could result in a serious threat to health, a long-standing disturbance of the public order or a permanent threat to the environment. In such cases, the tasks taken on by the State are carried out with State funds.

49. The interests of the Roma community in relation to the national authorities are represented by the Roma Community Council of the Republic of Slovenia, an umbrella organisation of the Roma community (section 9 of the Act). The Council consists of representatives of the Roma Association of Slovenia and the representatives of the Roma community in municipal councils. Pursuant to the Roma Community Act, the Government have a duty to adopt, in cooperation with the Roma Community Council and the municipalities, a programme of measures providing for obligations and tasks to be carried out at the national and local levels (section 6 of the Act). At the national level, the monitoring and protection of the special rights of the Roma community are primarily ensured by the Office of the Government of the Republic of Slovenia for National Minorities (Urad Vlade Republike Slovenije za narodnosti).

50. In March 2010 the Slovenian Government adopted a National Programme of Measures for Roma for the Period 2010-15 in which it defined priority areas - housing, education, employment and health care - which required specific short-term and long-term measures to improve the situation. The Government stated that the Roma settlements had not been subject to permanent regulation or controlled development. The absence of comprehensive measures and the lack of investment funds had resulted, inter alia, in poor public utilities. The Government pointed out that under the Spatial Planning Act, the municipalities were required to prepare municipal spatial plans, and encouraged them to include Roma settlements in those strategic plans, so as to provide for the redevelopment of such settlements which were mostly unlawfully occupied and the result of haphazard construction.

51. In the Fourth report on the situation of the Roma community in Slovenia (2015), in which the Government presented the implementation of the Roma Community Act and the National Programme of Measures for Roma, they noted that some municipalities had not yet adopted municipal spatial plans, which had prevented the Roma settlement in those areas from benefiting from legalisation and spatial development. Neither had some municipalities opened calls for submission of applications for public rental housing which would have allowed the members of the Roma community to apply for it, should they so wish. The Government submitted that the State did not have any means of coercing the municipalities into action. They did note, however, that housing issues were closely related to the enjoyment of human rights such as access to safe drinking water and sanitation. The State had a duty to provide for the enjoyment of those rights at all levels, as provided in a number of international documents, and the municipalities should act in accordance with those instruments.

III. RELEVANT INTERNATIONAL AND EUROPEAN LAW MATERIAL

A. United Nations instruments

1. Convention on the Rights of the Child

52. This Convention recognises the right of the child to clean drinking water in the context of the right to health as follows:

Article 24

“1. States Parties recognize the right of the child to the enjoyment of the highest attainable standard of health and to facilities for the treatment of illness and rehabilitation of health. States Parties shall strive to ensure that no child is deprived of his or her right of access to such health care services.

2. States Parties shall pursue full implementation of this right and, in particular, shall take appropriate measures:

...

(c) To combat disease and malnutrition, including within the framework of primary health care, through, inter alia, the application of readily available technology and through the provision of adequate nutritious foods and clean drinking-water, taking into consideration the dangers and risks of environmental pollution;

...”

2. Resolution 64/292 on the human right to water and sanitation adopted by the General Assembly (28 July 2010)

53. The Resolution recognises the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights, and calls upon States and international organisations to provide financial resources, capacity building and technology transfer, through international assistance and cooperation, in particular to developing countries, in order to scale up efforts to provide safe, clean, accessible and affordable drinking water and sanitation for all.

3. Resolution 18/1 on the human right to safe drinking water and sanitation adopted by the Human Rights Council (12 October 2011)

54. The Human Rights Council expressed its concern that approximately 884 million people lacked access to improved water sources and more than 2.6 billion people did not have access to improved sanitation. Affirming the need to focus on local and national perspectives in considering the issue, the Human Rights Council reaffirmed the primary responsibility of States to ensure full realisation of all human rights. It held that they should take steps, nationally and through international assistance and cooperation, especially economic and technical, to the maximum of their available resources, to achieve progressively the full realisation of the right to safe drinking water and sanitation by all appropriate means, including particularly the adoption of legislative measures in the implementation of their human rights obligations.

55. The Resolution thus calls upon States to, inter alia, continuously monitor and regularly analyse the status of the realisation of the right to safe drinking water and sanitation; assess existing policies, programmes and activities in the sectors of water and sanitation, giving due consideration to waste-water management, including treatment and reuse, and to monitor resources allocated to increase adequate access, as well as to identify actors and their capacity; assess whether the existing legislative and policy framework is in line with the right to safe drinking water and sanitation, and to repeal, amend or adapt it in order to meet human rights standards and principles; ensure free, effective, meaningful and non-discriminatory participation of all people and communities concerned, particularly people living in disadvantaged, marginalised and vulnerable situations.

4. General Comment no. 15 (2002) on the right to water adopted by the Committee on economic, social and cultural rights (“the CESCR”)

56. In its twenty-ninth session from 11 to 29 November 2002, the CESCR adopted General Comment no. 15 (2002) on the right to water (Articles 11 and 12 of the International Covenant on Economic, Social and Cultural Rights) which, in so far as relevant, provides:

“II. NORMATIVE CONTENT OF THE RIGHT TO WATER

...

12. While the adequacy of water required for the right to water may vary according to different conditions, the following factors apply in all circumstances:

(a) Availability. The water supply for each person must be sufficient and continuous for personal and domestic uses. These uses ordinarily include drinking, personal sanitation, washing of clothes, food preparation, personal and household hygiene. The quantity of water available for each person should correspond to World Health Organization (WHO) guidelines. Some individuals and groups may also require additional water due to health, climate, and work conditions;

(b) Quality. The water required for each personal or domestic use must be safe, therefore free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person’s health. Furthermore, water should be of an acceptable colour, odour and taste for each personal or domestic use.

(c) Accessibility. Water and water facilities and services have to be accessible to everyone without discrimination, within the jurisdiction of the State party. Accessibility has four overlapping dimensions:

(i) Physical accessibility: water, and adequate water facilities and services, must be within safe physical reach for all sections of the population. Sufficient, safe and acceptable water must be accessible within, or in the immediate vicinity, of each household, educational institution and workplace. All water facilities and services must be of sufficient quality, culturally appropriate and sensitive to gender, life-cycle and privacy requirements. Physical security should not be threatened during access to water facilities and services;

(ii) Economic accessibility: Water, and water facilities and services, must be affordable for all. The direct and indirect costs and charges associated with securing water must be affordable, and must not compromise or threaten the realization of other Covenant rights;

(iii) Non-discrimination: Water and water facilities and services must be accessible to all, including the most vulnerable or marginalized sections of the population, in law and in fact, without discrimination on any of the prohibited grounds; and

(iv) Information accessibility: accessibility includes the right to seek, receive and impart information concerning water issues.

...

Non-discrimination and equality

...

14. States parties should take steps to remove de facto discrimination on prohibited grounds, where individuals and groups are deprived of the means or entitlements necessary for achieving the right to water. States parties should ensure that the allocation of water resources, and investments in water, facilitate access to water for all members of society. Inappropriate resource allocation can lead to discrimination that may not be overt. ...

15. With respect to the right to water, States parties have a special obligation to provide those who do not have sufficient means with the necessary water and water facilities and to prevent any discrimination on internationally prohibited grounds in the provision of water and water services.

...

III. STATES PARTIES’ OBLIGATIONS

General legal obligations

17. While the Covenant provides for progressive realization and acknowledges the constraints due to the limits of available resources, it also imposes on States parties various obligations which are of immediate effect. States parties have immediate obligations in relation to the right to water, such as the guarantee that the right will be exercised without discrimination of any kind (art. 2, para. 2) and the obligation to take steps (art. 2, para.1) towards the full realization of articles 11, paragraph 1, and 12. Such steps must be deliberate, concrete and targeted towards the full realization of the right to water.

...

Specific legal obligations

20. The right to water, like any human right, imposes three types of obligations on States parties: obligations to respect, obligations to protect and obligations to fulfil.

...

(c) Obligations to fulfil

25. The obligation to fulfil can be disaggregated into the obligations to facilitate, promote and provide. The obligation to facilitate requires the State to take positive measures to assist individuals and communities to enjoy the right. The obligation to promote obliges the State party to take steps to ensure that there is appropriate education concerning the hygienic use of water, protection of water sources and methods to minimize water wastage. States parties are also obliged to fulfil (provide) the right when individuals or a group are unable, for reasons beyond their control, to realize that right themselves by the means at their disposal.

26. The obligation to fulfil requires States parties to adopt the necessary measures directed towards the full realization of the right to water. The obligation includes, inter alia, according sufficient recognition of this right within the national political and legal systems, preferably by way of legislative implementation; adopting a national water strategy and plan of action to realize this right; ensuring that water is affordable for everyone; and facilitating improved and sustainable access to water, particularly in rural and deprived urban areas.”

5. Report of the special rapporteur on the human right to safe drinking water and sanitation on her mission to Slovenia (24-28 May 2010)

57. The then special rapporteur, Catarina de Albuquerque, noted in her Report that at the time of her visit, nearly 100% of the population in Slovenia had access to safe water and 86% of the population were connected to the public water supply system. A comprehensive system of water-quality testing was implemented at the national and municipal levels and tap water in Slovenia met European Union and WHO standards. Slovenia had established strict water-protection zones to prevent the contamination of water sources by ***agriculture***, industry and other activities. Regular tests were conducted by 300 monitoring stations throughout the country to assess water quality. Overall, the special rapporteur concluded that Slovenia had a good framework and system in place for ensuring the provision of safe water to the general population.

58. Concerning sanitation, over half of the population were connected to a wastewater treatment facility, and the Government was making significant efforts to increase this number further. Where people were not connected to sewerage, they generally had cesspools.

59. As regards the situation of the Roma and their access to safe water, the special rapporteur noted at the outset that while official ***statistics*** reported over 3,000 Roma people were living in Slovenia, some estimates were as high as 10,000, not taking into account those Roma people who were not settled. According to the findings of an analysis on the theme “Territorial issues of Roma settlements in Slovenia” prepared by an expert group tasked to deal with the spatial problems of Roma settlements, about twenty-one of ninety-five settlements in Prekmurje and Dolenjska had no access to water, either from public water works or from a local water source. Many of them also had no access to sanitation.

60. In order to be connected to the water and sanitation networks in Slovenia, one had to apply to the municipality and present evidence of ownership and a building permit, among other documentation. Although Roma communities had been present in Slovenia for centuries, their settlements had frequently been established in an irregular manner. According to the Report, the authorities had used the “illegality” of the settlements as a principal justification for not connecting these communities to water and sanitation services.

61. The special rapporteur noted with appreciation that some municipalities had found positive solutions to addressing the sometimes difficult and complex problems associated with the Roma community in Slovenia. For example, some municipalities had waived the requirements outlined above in order to facilitate access to water and sanitation.

62. With regard to water, the special rapporteur pointed out that while household connections were the ideal solution, in the meantime efforts should be made to find interim solutions. Such solutions could include extending the network to a public water point that would be available to all people living in the settlement, or delivering safe water in tankers. Additionally, urgent measures were necessary to improve the current status of sanitation in many Roma settlements. As with water, interim measures were critical. The special rapporteur pointed out that there were an increasing number of sanitation technologies to choose from that did not require connection to the network.

B. Council of Europe instruments

1. Recommendation Rec(2001)14 of the Committee of Ministers to member States on the European Charter on Water Resources

63. Paragraph 5 of the European Charter on Water Resources recognises the right to water in the following terms:

“Everyone has the right to a sufficient quantity of water for his or her basic needs.

International human rights instruments recognise the fundamental right of all human beings to be free from hunger and to an adequate standard of living for themselves and their families. It is quite clear that these two requirements include the right to a minimum quantity of water of satisfactory quality from the point of view of health and hygiene.

Social measures should be put in place to prevent the supply of water to destitute persons from being cut off.”

2. Resolution 1693 (2009) of the Parliamentary Assembly on water: a strategic challenge for the Mediterranean Basin

64. The Parliamentary Assembly, stressing that access to water should be recognised as a fundamental human right because it is essential to life on earth and is a resource that must be shared by humankind, and acknowledging that primarily drinking-water resources will become increasingly rare, at a time when needs are increasing, recommended member and non-member States to, inter alia, (a) take the measures needed to ensure that everyone has access to water and sanitation; (b) decentralise water management systems to make them the responsibility of local and regional authorities, and give the latter the necessary legal powers and financial resources; and (c) take steps to make water sanitation techniques more generally available.

3. Resolution 1809 (2011) of the Parliamentary Assembly on water - a source of conflict

65. The Parliamentary Assembly pointed out that access to safe drinking water and sanitation was recognised as a human right by the United Nations, and noted that fresh water is a limited, fragile resource, but one which is vital for humankind. Regretting that one in six of the world’s inhabitants still did not have access to water and that almost one person in two had to live without a waste-water drainage system, the Parliamentary Assembly recommended that member and non-member States, inter alia, recognise that access to water is a fundamental human right, in line with the United Nations General Assembly Resolution 64/292 of 28 July 2010 and United Nations Human Rights Council Resolution 15/9 of 30 September 2010.

4. European Commission against Racism and Intolerance (“the ECRI”)

66. In its Report on Slovenia (fourth monitoring cycle) adopted on 17 June 2014, the ECRI noted with concern the lack of access to a safe water supply in or near some settlements. Referring to a study according to which 17% of Roma obtained water from springs or neighbours, 2% from cisterns and 2% had no access to running water at all, the ECRI emphasised that the lack of access to safe drinking water had a direct negative impact on the health of the Roma communities concerned, as well as indirect repercussions on their everyday life in other areas, such as education and employment.

67. Observing that provision of water was the competence of municipalities, the ECRI established that most of them had waived the obligatory requirement of prior legalisation and had provided access to piped water for informal settlements. However, the Roma settlement of Goriča vas in Ribnica, home to approximately seventy people, around twenty-two of them children of school age, had no water supply, no electricity and no sewerage system.

68. The ECRI urged the national authorities to take immediate action to ensure that all Roma obtained practical access to a safe water supply in or in the immediate vicinity of their settlements.

69. In its Conclusions on the Implementation of the Recommendations in Respect of Slovenia Subject to Interim Follow-up adopted on 23 June 2017, the ECRI noted that the Slovenian authorities had opened a public tender for projects relating to utility infrastructure, including water collector wells and pipelines connecting Roma settlements to the distribution system. The amount of EUR 2 million in total was budgeted for the years 2016 and 2017.

70. The authorities also informed the ECRI that in September 2016 they had provided exceptional funding of EUR 30,000 to ensure access to safe drinking water for the Goriča vas settlement in Ribnica, as well as for two premises in Dobruška vas in Škocjan. However, according to NGOs, only one settlement received water cisterns; as they were not insulated, the water froze in winter. No water was supplied to other informal settlements.

71. Despite some efforts made by the Slovenian authorities, the ECRI found that the lack of practical access to a safe water supply continued to be a problem for many Roma. It concluded that its recommendation on the provision of safe water supply had not been implemented.

5. Report of the Commissioner for Human Rights of the Council of Europe on his visit to Slovenia (20-23 March 2017)

72. The then Commissioner for Human Rights, Nils Muižnieks, noted in his Report that while the authorities had installed water cisterns in Dobruška vas at the end of 2016 as a short-term solution to ensure access to drinking water, the inhabitants complained that the cisterns were not filled regularly and the water did not stay in them. Most people therefore obtained their water from a stream polluted with sewage and waste from a meat‑processing plant nearby. Drinking from or bathing in contaminated streams caused illnesses, such as diarrhoea and skin rashes, to which the children were particularly prone. The lack of water prevented the inhabitants from maintaining basic hygiene. As a result, children were mocked and avoided in school, and adults found it difficult to obtain or keep employment.

73. In discussions with the Commissioner, various interlocutors agreed that there was a lack of political will on the part of certain local municipalities in the Dolenjska region to resolve the legal status of Roma settlements and to improve the inhabitants’ living conditions. They further noted that the State was not putting adequate pressure on the municipalities regarding the matter.

74. The Commissioner for Human Rights made a general recommendation to the national authorities with regard to poverty reduction and social inclusion. He encouraged the Government to define more clearly the targets of their social policies, so as to enable an assessment of the results, and not simply the level of their implementation. Social policies should be grounded on the relevant national and international human rights framework ensuring that all persons are protected in an equal and non‑discriminatory manner.

C. Statistical ***data*** on European population connected to public water supply and to urban wastewater ***collecting*** systems

75. Access to improved drinking water sources is increasing, rising from 76% of the global population in 1990 to 91% in 2015. Nevertheless, according to the available ***Eurostat*** ***data*** in 2015, the percentage of European resident population which had access to drinking water through a connection to a public water supply system varied substantially from one country to another, ranging from less than 64% to 100%.

76. Also connection to the urban wastewater treatment has improved throughout Europe over recent decades. According to the European Environment Agency, in central European countries, connection rates are now at 97%, with about 75% receiving tertiary treatment, the final stage of treating wastewater before it is discharged to the environment. The rates of connection to the urban wastewater systems are generally lower in Southern, South-East and Eastern Europe, with levels at about 71%.

THE LAW

I. JOINDER OF THE APPLICATIONS

77. In view of the connection between the applications as regards the facts and the substantive questions that they both raise, the Court considers it appropriate to join them in accordance with Rule 42 § 1 of the Rules of Court.

II. THE RESPONDENT GOVERNMENT’S PRELIMINARY OBJECTIONS

A. Anonymity, abuse of the right of application, lack of victim status, and failure to observe the six-month time-limit in respect of Aleks Kastelic, the second applicant in case no. 24816/14

1. The parties’ submissions

78. The Government asserted that no person by the name of Aleks Hudorovič, born on 24 December 2007, could be found in the official records. They suggested that the second applicant’s real name was Aleks Kastelic, who had been born on 24 December 2007 and was the son of the first applicant and Ms Marija Kastelic. The second applicant had had that name since birth; therefore the Government argued that his application had been lodged under a false identity and should be considered anonymous and an abuse of the right of application. In support of the latter grounds for inadmissibility, the Government further submitted that the second applicant lived with his mother, in accordance with a custody agreement between his parents. In this connection, the Government claimed that the second applicant’s place of residence was connected to the public water-distribution system and had a septic tank. Arguing that he thus had access to drinking water and sanitation facilities, the Government also maintained that he could not claim to be the “victim” of a violation of the Convention within the meaning of Article 34.

79. Furthermore, the Government challenged the validity of the power of attorney signed by the first applicant on behalf of the second applicant. According to the Government the first applicant had no standing to act on behalf of the second applicant, since his mother had custody of the child. Noting that the present case does not involve a conflict between the parents over the second applicant’s interests, the Government argued that the first applicant’s position as a father could not be regarded as a sufficient basis to bring an application on behalf of the second applicant.

80. The applicants disputed the Government’s allegations of an abuse of the right of application, submitting that they had merely given the incorrect name by mistake and that they had had no intention to mislead the Court. In their view, the identity of the second applicant was not in dispute; therefore, his application could not be considered anonymous. The representatives of the applicants pointed out that the applicants’ lack of education and illiteracy, coupled with the language barriers, made communication with them very challenging.

81. As regards the second applicant’s residence, the applicants submitted that despite the formal custody agreement granting custody to his mother, he spent much of his time with his father.

82. Lastly, enclosed with their observations on the applications in question, the applicants submitted a new power of attorney on behalf of the second applicant signed by his mother, Ms Marija Kastelic.

2. The Court’s assessment

83. The Court observes that although the respective positions of the Government and the applicants differ, they both relate to the application of Article 34 of the Convention, taken alone or in conjunction with Article 35 § 2 (a). These provisions, in so far as relevant, are worded as follows:

Article 34

“The Court may receive applications from any person, non-governmental organisation or group of individuals claiming to be the victim of a violation by one of the High Contracting Parties of the rights set forth in the Convention or the Protocols thereto. The High Contracting Parties undertake not to hinder in any way the effective exercise of this right.”

Article 35

“1. The Court may only deal with the matter ... within a period of six months from the date on which the final decision was taken.

2. The Court shall not deal with any application submitted under Article 34 that

(a) is anonymous ...

3. The Court shall declare inadmissible any individual application submitted under Article 34 if it considers that:

(a) the application is ... an abuse of the right of individual application ...”

84. The Court has held that an application is to be regarded as anonymous if the case file does not contain any information enabling the Court to identify the applicant (see “Blondje” v. the Netherlands (dec.), no. 7245/09, ECHR 2009). In the present case, the Court notes that the applicants correctly stated most of the facts pertaining to the second applicant’s identity, notably his first name, date of birth and family relationship with Mr Branko Hudorovič, the first applicant in case no. 24816/14. However, they made an error by attributing to the second applicant an incorrect surname. He was improperly designated by the surname of his father, whereas in fact he bears the surname of his mother.

85. Nevertheless, as is evident also from the Government’s objection in which they identified the correct name of the second applicant, the incorrect naming did not prevent his identification. The Court considers that despite this error on the part of the applicants, the facts and circumstances set out in the application sufficed to dispel any doubts as to the second applicant’s identity. His identity as Aleks Kastelic was subsequently explicitly confirmed by the applicants’ representatives, who submitted that the incorrect name had appeared on the application owing to the difficulties in communicating with the applicants.

86. In the Court’s opinion the case therefore contained sufficient information enabling it to identify the second applicant (contrast “Blondje”, cited above). Furthermore, none of the elements in the case file, nor the attitude of the applicants, imply that an attempt was made to mislead the Court and pass the second applicant off under a false identity. Therefore, the Court finds that the application cannot be regarded as anonymous or an abuse due to an incorrect indication of the second applicant’s surname in the initial application.

87. Secondly, the Government disputed the second applicant’s victim status and claimed that he had abused the right of individual application on account of the fact that he had been resident with his mother and had had access to drinking water and sanitation facilities at her place of residence. The Government further challenged the validity of the power of attorney signed by the first applicant on behalf of the second applicant, arguing that it should have been given by the second applicant’s mother, who had been granted custody of him and was therefore his legal representative.

88. As regards the first limb of this objection, the Court observes that the Government’s argument focused on the second applicant’s place of residence; however, it was not disputed that the first applicant had contact with the second applicant, as confirmed also by the report on the family situation prepared by the Ribnica Social Work Centre (see paragraph 6 above). Neither did the Government dispute that the second applicant spent a considerable amount of time at the first applicant’s residence. Therefore, the Court can accept the applicants’ submission that the second applicant, while maintaining his primary residence with his mother, at the material time also spent time at the first applicant’s residence. In the Court’s opinion, while the possibly limited amount of time spent there can affect the assessment of certain aspects of the second applicant’s complaints, it cannot be decisive for the decision on his victim status, nor can it constitute an abuse of the right of application. The Court considers that, to the extent that the second applicant actually lives at the first applicant’s residence, he endures the same living conditions as the first applicant and is therefore entitled to complain about them to the Court.

89. As to the second limb of the Government’s objection, namely the alleged invalidity of the power of attorney, the Court observes that the case before it does not raise a question of family law, but, rather, hinges on the second applicant’s living conditions. It therefore takes the view that any person who is entitled under domestic law to represent the second applicant in that type of proceedings can also act on his behalf before the Court (see, mutatis mutandis, Scozzari and Giunta v. Italy [GC], nos. 39221/98 and 41963/98, § 138, ECHR 2000‑VIII, with further references). The Government submitted evidence that the second applicant’s mother had been granted custody of him and argued that she was therefore his only legal representative. The applicants did not dispute this, but submitted another power of authority on the second applicant’s behalf, signed by his mother. The Court is therefore satisfied that the applicants have rectified any error regarding the question of which of the parents was entitled to represent the second applicant in the proceedings before the Court. It accordingly finds that the second applicant is entitled to claim to be a victim of the alleged violations of the Convention.

90. Furthermore, the Court notes that the shortcomings in the application such as examined above may, in principle, also have implications within the meaning of Rules 45 and 47 of the Rules of the Court, which set out the formal requirements regarding, inter alia, a duly completed power of attorney or authority form (Rules 45 § 3 and 47 § 1 (c)) and the indication of the applicant’s name on the application form (Rule 47 § 1 (a)). Failure to comply with the requirements regarding the application form may have direct consequences for the determination of the date of introduction of the application for the purposes of Article 35 § 1 of the Convention (see, with regard to the authority form, Kaur v. the Netherlands (dec.), no. 35864/11, § 13, 15 May 2012, and Kokhreidze v. Georgia and Ramishvili v. Georgia (dec.), nos. 17092/07 and 22032/07, § 17, 25 September 2012). Specifically, the latter date is in principle decisive for the purpose of assessing whether an application has been lodged within a period of six months of the date on which the final decision was taken in the domestic proceedings.

91. In the present case, however, the Court does not find the date of the introduction of the application to be decisive for the assessment in question. Thus, the situation complained of concerns inadequate living conditions coupled with an alleged continued failure of the authorities to act to improve them. In this connection, the Court observes, without prejudging the merits of the present case, that in the case of Moldovan and Others v. Romania (no. 2) (nos. 41138/98 and 64320/01, §§ 107-109, ECHR 2005 VII (extracts)), comparable complaints of poor living conditions, albeit in combination with a number of other factors pertaining to the applicants’ rights to respect for their private and family life and their homes, were found by the Court to amount to a violation of Article 8 of the Convention of a continuing nature. The Court considers that in this case also the alleged prolonged failure of the authorities to ensure access to water and sanitation, which according to the applicants persists to date, amounts to a continuing situation. The Court further reiterates that in cases where there is a continuing situation against which no effective domestic remedy is available, the six-month period runs from the cessation of that situation (see Oliari and Others v. Italy, nos. 18766/11 and 36030/11, §§ 96-97, 21 July 2015, with further references). Given that no objection of non-exhaustion of domestic remedies was raised by the Government, in the context of the present case this means that irrespective of the deemed date of introduction of the application the latter cannot be rejected as out of time.

92. The Government’s objections with regard to the second applicant in case no. 24816/14 must therefore be rejected.

B. Lack of victim status and failure to observe the six-month time-limit in respect of Pamela Novak, the third applicant in case no. 25140/14

1. The parties’ submissions

93. The Government pointed out that Ljubo Novak and Dunja Kočevar, the first and the second applicants in case no. 25140/14, had signed a power of attorney for all twelve of their children, although Pamela Novak, who had been born on 31 October 1994, had already reached the age of majority by the date the application had been lodged. Arguing that the third applicant should have signed the power of attorney by herself, the Government challenged its validity and, in substance, the third applicant’s victim status.

94. Enclosed with the applicants’ observations on the applications in question, the third applicant submitted a new power of attorney bearing her own signature. In addition, the applicants’ representatives, reiterating the same argument as the one set forth above in respect of Aleks Kastelic (see paragraph 80 above), argued that the applicants’ lack of education and poor command of the Slovene language made communication with them very difficult.

2. The Court’s assessment

95. The Court finds that its considerations with regard to the rectification of errors in the application form and their implications for the applicant’s status as a victim and the fulfilment of the six-month requirement, as set out in the above case of Aleks Kastelic (see paragraphs 89 and 91 above), equally apply to the third applicant. The Court therefore finds that the third applicant is entitled to claim to be a victim of the alleged violations of the Convention. Likewise, her application cannot be rejected as out of time.

96. The Government’s objection with regard to the third applicant in case no. 25140/14 must therefore be rejected.

C. Abuse of the right of application and lack of victim status in respect of all applicants, relating to access to drinking water and sanitation

1. The parties’ submissions

97. As regards the applicants from the Goriča vas settlement, the Government submitted that the applicants had failed to inform the Court that the Ribnica Municipality had co-financed the purchase of a water tank for the Goriča vas settlement and that the Ribnica fire brigade had regularly supplied water to the residents of the settlement. Moreover, regarding sanitation facilities it had been agreed that the residents would buy and instal them at their own expense. Furthermore, the Government claimed that the Ribnica Municipality had intended to build several terraced houses in the Lepovče Roma settlement and relocate the Roma from the Goriča vas settlement to the newly built settlement, but they had refused to move there, without stating any reasons for their decision.

98. Secondly, as regards the applicants from the Dobruška vas 41 settlement, the Government submitted that they had failed to inform the Court of the existence of a public water-distribution system in the settlement. According to the Government, the applicants could have been connected to the distribution network at any time since 2011, and were still able to apply for an individual connection if they so wished. In addition, drinking water was also freely available from a village fountain throughout the year.

99. The Government argued that the aforementioned omissions on the part of the applicants constituted an abuse of the right of application. Furthermore, since in the Government’s opinion the applicants had sufficient access to drinking water, they could not claim to be victims of the alleged violations of the Convention.

100. In response, the applicants from the Goriča vas settlement asserted that they did not have a reasonably accessible water supply or sanitation, which had been confirmed by the UN special rapporteur on the human right to safe drinking water and sanitation (see paragraph 59 above) and the Council of Europe Commissioner for Human Rights (see paragraph 73 above). The deliveries of water to the water tanks had not been mentioned since they had been rare and had had only a negligible effect on the applicants’ daily life. As for the possibility of resettlement, the applicants argued that it had never been a realistic possibility owing to the opposition of the local majority population.

101. The applicants from the Dobruška vas 41 settlement alleged that they had been unable to connect to the public water-distribution system owing to their neighbours’ obstruction, which had been well known to the Government, as had been mentioned in several documents as well as in a report by the Human Rights Ombudsman. As for the village fountain, it had been located 2 km away from their home, so the applicants had not considered it as providing reasonable access to water.

102. The applicants argued that the Government’s allegation of the abuse of the right of application was unfounded and a misinterpretation of the concept. They had merely presented facts they had considered relevant for their applications. Their ultimate claim had been that they had not had access to water and sanitation and, as a result, had lived in conditions unworthy of human dignity. In the applicants’ opinion, the information provided by the Government was either inaccurate or irrelevant to their personal situations; hence they contested both objections raised by the Government.

2. The Court’s assessment

103. The Court observes that the main point of controversy between the parties concerns the interpretation of what constitutes adequate access to drinking water and sanitation and, in this connection, what is the scope of the obligations borne by the State and whether the respondent State fulfilled those obligations. The Government based their objections on the premise that the measures already taken for the purpose of providing the applicants with access to drinking water had been sufficient, whereas the applicants considered them wholly inadequate, arguing that the marginal importance of those measures had led them to not even mention them in their submissions to the Court.

104. The Court considers that the question of what constitutes adequate access to drinking water and sanitation is also the core issue to be examined on the merits.

105. Accordingly, the Government’s objections in this regard must be joined to the merits.

III. ALLEGED VIOLATIONS OF ARTICLES 3, 8 and 14 OF THE CONVENTION

106. The applicants, relying on Articles 3 and, a fortiori, 8 of the Convention, complained that their homes did not have access to basic public utilities, notably drinking water and sanitation. They further submitted that they had been subjected to a negative and discriminatory attitude by the local authorities, who had refused to address their disadvantaged situation in any meaningful manner. In this regard, they relied on Article 14 of the Convention in conjunction with Articles 3 and 8. These provisions provide as follows:

Article 3

“No one shall be subjected to torture or to inhuman or degrading treatment or punishment.”

Article 8

“1. Everyone has the right to respect for his private and family life, his home and his correspondence.

2. There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others.”

Article 14

“The enjoyment of the rights and freedoms set forth in [the] Convention shall be secured without discrimination on any ground such as sex, race, colour, language, religion, political or other opinion, national or social origin, association with a national minority, property, birth or other status.”

A. As regards the alleged violation of Article 8 of the Convention, and Article 14 taken in conjunction with Article 8

107. The Court notes that the applicants’ complaints concern, first and foremost, an alleged failure by the State to provide them with adequate access to drinking water and sanitation, with consideration to their specific needs as members of the Roma community and their different lifestyle. In the Court’s opinion, the present case raises mainly issues under Articles 8 and 14 of the Convention. These complaints will therefore be examined first.

1. Admissibility

(a) The parties’ submissions

108. Referring to the relevant case-law of the Court, the Government asserted that Article 8 of the Convention does not acknowledge a right to be provided with a home. They pointed out that the applicants themselves had chosen the locations where they had settled and set up their residences, and that they were free to change those locations at any time. The social benefits they received (see paragraphs 22 and 35) enabled the applicants to live a decent life, which meant that if they were dissatisfied with their living conditions, they could change them, either by building sanitary facilities or by resettling.

109. The applicants disputed the Government’s submissions, claiming that the lack of basic infrastructure such as running water and sanitation had resulted in hygiene problems and frequent diseases; they asserted that their discomfort, embarrassment and pain related to their living conditions, which were relevant to their enjoyment of Article 8 rights, in particular the right to respect for their private and family life. Moreover, their children were stigmatised, humiliated and unable to integrate into mainstream society because of the lack of the most basic amenities.

(b) The third-party intervener

110. The Human Rights Centre of the University of Ghent took the view that deplorable living conditions may raise an issue under both Articles 3 and 8 of the Convention. According to the third party, living conditions without access to water and sanitation fell within the scope of Article 8 in so far as they prevented individuals from enjoying their homes and affected their well-being, health and quality of life (see Costache v. Romania (dec.), no. 25615/07, 27 March 2012). Referring to the Court’s case-law pertaining to environmental pollution and individuals’ living conditions, the third party pointed out that private and family life could be affected even where an individual’s health was not seriously endangered (see López Ostra v. Spain, no. 16798/90, § 51, 9 December 1994).

(c) The Court’s assessment

111. The Court notes that certain questions with respect to the applicability of Article 8 of the Convention, taken alone and in conjunction with 14, may arise in the present case. It notes in this regard that the Government maintained that Article 8 of the Convention does not acknowledge a right to a home, while the applicants took the view that their living conditions fell within the scope of Article 8 (see paragraphs 108 and 109 above).

112. As regards the question whether an individual’s living conditions may fall within the scope of Article 8, the Court reiterates that in the case of Moldovan and Others (no. 2) (cited above, § 105) the applicants’ overcrowded and unsanitary living conditions, which were caused by the authorities’ actions, fell within the scope of their right to respect for family and private life, as well as their homes.

113. With respect to the applicants’ complaint concerning access to safe drinking water, the Court also has regard to its case-law on health and environmental risks resulting from water pollution. It notes that it has already had an opportunity to pronounce judgment on the actual or potential risks related to, inter alia, contaminated water sources, and their link to an individual’s private life and home. In the cases of Dubetska and Others (no. 30499/03, §§ 109-123, 10 February 2011) and Dzemyuk v. Ukraine (no. 42488/02, §§ 77-84, 4 September 2014), even in the absence of direct evidence of actual damage to the applicants’ health, the Court accepted that the respective applicants may have been affected by the water pollution at issue (see Dubetska and Others, cited above, § 111, and Dzemyuk, cited above, § 82). Furthermore, upon examination of the environmental concerns in question, the Court found that the elevated risk to the applicants’ health had constituted an interference with their private lives and homes which had attained a sufficient degree of seriousness to trigger the application of Article 8 of the Convention (see Dubetska and Others, cited above, §§ 118‑119, and Dzemyuk, cited above, §§ 83-84). In the two above-mentioned cases the Court acknowledged a direct link between the enjoyment of clean water sources and an individual’s health.

114. The Court recalls that Article 8 does not in terms recognise a right to be provided with a home (see Chapman v. the United Kingdom [GC], no. 27238/95, § 99, ECHR 2001‑I), let alone a specific home or category of home - for instance, one in a particular location (see, mutatis mutandis, Ward v. the United Kingdom (dec.), no. 31888/03, 9 November 2004). It recalls that the scope of any positive obligation to house the homeless is limited (see, mutatis mutandis, O’Rourke v. the United Kingdom (dec.), no. 39022/97, 26 June 2001).

115. Furthermore, the Court refers to the case of Denisov v. Ukraine ([GC], no. 76639/11, §§ 103-114, 25 September 2018), where the Grand Chamber outlined, in the context of an employment dispute, two different approaches the Court employs when examining whether cases involving Article 8 complaints fall within the ambit of “private life”. In particular, it distinguished between the reason-based approach, under which the Court examines whether there is a private life issue in the underpinning reasons for the impugned measure, and the consequence-based approach, under which the Court analyses the effects of the impugned measure on the individual’s private life. If the latter approach is at stake, the threshold of severity assumes crucial importance and it is for the applicant to show convincingly that the threshold was attained in his or her case. The Court reiterates in this connection that the consequence-based approach applies also in the context of positive obligations incumbent on the State under Article 8 of the Convention (see, for example, Fadeyeva v. Russia, no. 55723/00, §§ 68-69, ECHR 2005‑IV, where the Court stated that a certain minimum level of adverse effects of pollution on the individual’s health or quality of life must be demonstrated to engage Article 8).

116. The Court makes clear that access to safe drinking water is not, as such, a right protected by Article 8 of the Convention. However, the Court must be mindful of the fact that without water the human person cannot survive. A persistent and long-standing lack of access to safe drinking water can therefore, by its very nature, have adverse consequences for health and human dignity effectively eroding the core of private life and the enjoyment of a home within the meaning of Article 8. Therefore, when these stringent conditions are fulfilled, the Court is unable to exclude that a convincing allegation may trigger the State’s positive obligations under that provision. Existence of any such positive obligation and its eventual content are necessarily determined by the specific circumstances of the persons affected, but also by the legal framework as well as by the economic and social situation of the State in question. The Court considers that the question whether any positive obligations were triggered in the present case and the scope of such obligations, which are the core issues to be examined on the merits, are closely linked to the specific circumstances of the case and their level of seriousness. There is therefore a strong tie between the question of applicability and the merits in the assessment of whether or not a private life issue is raised in the present case.

117. Accordingly, the Court decides to join the issue of applicability of Article 8 and Article 14, taken in conjunction with Article 8, to the merits of the case.

118. That said, the Court considers that the applicants’ complaints under Article 8 and Article 14, taken in conjunction with Article 8, are not manifestly ill-founded within the meaning of Article 35 § 3 of the Convention. As no other grounds for declaring these complaints inadmissible have been established, the Court declares them admissible.

2. Merits

(a) The parties’ submissions

(i) The applicants

119. Claiming that the lack of water and sanitation had serious repercussions on privacy and intimate life, the applicants took the view that the margin of appreciation accorded to the State under Article 8 should be particularly narrow in the specific circumstances of their cases.

120. The applicants, relying on the Court’s case of Winterstein and Others v. France (no. 27013/07, § 142, 17 October 2013), submitted that the way of life of the Roma community was to be considered an integral part of their identity. Their vulnerable position as a minority should have prompted the authorities to give special consideration to their needs and different lifestyle, both in the relevant regulatory planning framework and in concrete decisions in individual cases. The applicants furthermore argued that the national authorities had at least implicitly acknowledged the need for special measures to address the long-standing discrimination against the Roma community. They pointed out that various policy papers and research had been prepared favouring various types of legalisation in respect of Roma settlements, given that in Slovenia the Roma had not been nomadic, but rather had lived a settled life.

121. Those strategic documents had been implemented in some municipalities, with many successful projects in organising Roma settlements in Slovenia, either through amendments to land planning and legalisation of existing settlements, through purchases of land from private owners for the purpose of resettlement, or through practical improvements in living conditions in the settlements. None of those solutions had, however, been employed by the municipalities of Ribnica and Škocjan, where the applicants lived.

122. The applicants from the Goriča vas settlement did not have access to any regular and reasonably accessible source of clean water, nor did they have any plumbing or sanitation, while the applicants from the Dobruška vas 41 settlement argued that, in view of their difficulties in accessing the only group water-distribution connection (see paragraph 32 above), the municipality should have installed at least three such connections to ensure effective access to safe drinking water. Furthermore, all applicants asserted that they had not been provided with a meaningful alternative, such as appropriate resettlement. As to the Government’s submission that the Roma inhabitants of Goriča vas had refused to be resettled to a location in Lepovče, the applicants alleged that the resettlement had been blocked by the majority non-Roma population of Lepovče.

(ii) The Government

123. Referring to the relevant case-law of the Court, the Government asserted that the fact of belonging to a minority with a traditional lifestyle different from that of the majority did not exempt the members of such a minority from general laws intended to safeguard the assets of the community as a whole.

124. The Government submitted that a comprehensive regulatory framework was in place in Slovenia governing spatial development and planning, the utility infrastructure facilities, as well as the construction of buildings. Access to such utilities was provided under equal conditions to all inhabitants, including the Roma, irrespective of their personal or other circumstances. Given that the provision of water and sanitation fell within the scope of public municipal utilities, those services were not provided for profit; the charges only covered the costs of their provision. Moreover, under the applicable legislation, all buildings which required access to drinking water needed to be connected to the public water supply system, unless such a public water network did not exist in the area. Residents who applied to be connected to the public water supply system had to install individual house connections at their own expense.

125. The Government further asserted that many Slovenian residents living in remote areas had no access to drinking water from the public water supply system and had arranged access by ***collecting*** rainwater, setting up water tanks or finding similar solutions. Under Slovenian legislation, if a household does not have a possibility to connect to the public water supply system, the owner of the building must install a water tank. The public utility service provider is then obliged to supply the water tank with water. According to the Government, at least 163,000 inhabitants did not have access to the public water supply system and relied on other means of private water supply based on a water permit. Moreover, 15,000 inhabitants obtained drinking water by harvesting rainwater, for which no water permit was necessary.

126. Similarly, the discharge and treatment of wastewater and run-off rainwater was in principle a municipal utility service; however, in dispersed settlement areas inhabitants had installed individual systems such as small urban wastewater treatment plants or septic tanks. As was the case with water connection, sewerage connection to the public sewerage network had to be installed and paid for by the owners of the buildings, and so were individual treatment plants and septic tanks.

127. The Government pointed out that illegally constructed buildings were not allowed to be connected to public utility infrastructure facilities such as drinking-water supply and the discharge of wastewater, emphasising in this regard that the applicable laws applied uniformly to everyone and further arguing that any provisions to the contrary would amount to discrimination against the majority vis-à-vis the Roma community. In the Government’s opinion, such regulation did not entail an interference with the exercise of an individual’s right to respect for private and family life. Assuming, however, that the Court did not accept such a position, the Government further submitted that the interference in the case at hand had been justified under Article 8 § 2 of the Convention.

128. As regards the status of the applicants’ settlements, the Government claimed that they had not been tolerated, referring to the relevant decisions of the Inspectorate for the Environment and Spatial Planning (see paragraphs 10 and 26 above), whereby inhabitants of both Roma settlements had been ordered to remove illegally constructed buildings and restore the land to its previous state. Although those decisions had been enforceable, they had not subsequently been enforced, since many of the buildings had housed families with children who would have had to be provided with alternative accommodation in the event of demolition. Nevertheless, the Government pointed to the fact that all the applicants had constructed buildings on land that was not owned by them, and therefore must have known that those buildings had been illegally constructed. Given the non-residential purposes of the land in question (see paragraphs 9 and 25 above), their respective buildings could not be legalised.

129. In this context, the Government further pointed out that the applicants themselves had chosen the locations where they had settled and set up their residences, and that they were free to change those locations at any time. The social benefits they received (see paragraphs 22 and 35) enabled the applicants to live a decent life, which meant that if they were dissatisfied with their living conditions, they could change them, either by building sanitary facilities or by resettling. In this connection, the Government referred to the plans of the Ribnica Municipality to build a Roma settlement in Lepovče, a possibility allegedly refused by the Roma community. Also, according to the Government the applicant Branko Hudorovič could have, but had not, applied for public rental housing which was available in the Ribnica Municipality (see paragraph 8 above).

130. Lastly, the Government submitted that appropriate positive measures had been taken to improve the living conditions of the Slovenian Roma community. Referring to the strategic framework set out in the National Programme of Measures for Roma (see paragraph 50 above) and a number of specific programmes and projects, the Government asserted that they had been focused on preservation of the existing Roma settlements and their legalisation, followed by investment in basic utilities and other infrastructure. Under the 2010-15 National Programme a number of tenders in the amount of several million euros had been awarded for co-financing of basic community infrastructure projects in Roma settlements. Spatial planning projects had been planned and implemented in collaboration with the Roma community. The Government further submitted that another National Programme was to be adopted for the period 2016-21. In terms of concrete measures benefiting the applicants, the Government referred to the plans for relocation of the Roma community from Goriča vas (see paragraph 14 above) and the co-financing of the water tank and the diesel generator (see paragraph 16 above), and to the group water-distribution connection installed in the Dobruška vas 41 settlement (see paragraph 29 above). The Government also submitted that the Škocjan Municipality had been actively examining the possibilities for relocating the family of Ljubo Novak and Dunja Kočevar; however, they had as yet been unsuccessful in their efforts.

(b) The third-party interveners

(i) Human Rights Centre of the University of Ghent

131. This third party referred to the findings of several international human rights mechanisms, including the Council of Europe Commissioner for Human Rights, whereby forms of unequal treatment in Slovenia included preferential treatment of non-Roma in the development of infrastructure and the systemic failure to develop infrastructure in Roma communities.

132. As regards the protection afforded by Article 8, in the view of this third party a crucial question as to the State’s compliance with the provision was whether it had provided for an adequate legal framework; if so, it should further be assessed whether an individual’s living conditions were not linked to any unlawfulness in domestic terms (see, for example, Costache, cited above, § 23). The third party pointed out that the areas of urban planning and water and sanitation services were inherently within the remit of the State, especially since the operation of water and sanitation services were generally managed by national or local authorities. Therefore, in cases where access to those services was impeded by urban planning issues, redressing the situation necessarily depended on the steps taken by the State.

133. Moreover, where it had been shown that the State knew or ought to have known of health risks resulting from individuals’ living conditions, it should be verified whether necessary and sufficient operational measures had been taken to protect the individuals concerned against those risks (see Öneryıldız v. Turkey [GC], no. 48939/99, § 93, ECHR 2004-XII). This obligation, while applying primarily to Articles 2 and 3 of the Convention, should in the opinion of this third party also apply in the context of Article 8. Furthermore, it should also be assessed whether the absence of water and sanitation services could be explained by a discriminatory attitude on the part of the authorities, which should be considered as aggravating circumstances under both Articles 3 and 8 of the Convention.

134. As regards the Court’s consideration under Article 14 of the Convention, this third party pointed to the entrenched discrimination and socio-economic disadvantage faced by the Roma community, emphasising that the lack of access to basic utilities perpetuated stigmatisation and discrimination against Roma. It further pointed out that the Roma had been recognised as a vulnerable minority and an underprivileged social group in the Court’s case-law (see, for example, Connors v. the United Kingdom, no. 66746/01, § 84, 27 May 2004; Chapman, cited above, § 96; and Yordanova and Others v. Bulgaria, no. 25446/06, § 129, 24 April 2012). Therefore, in the opinion of this third party, in applying Article 14 to the present case it should be assessed whether being prevented from accessing water and sanitation, access which was available to the vast majority of the population, on account of living in an informal but tolerated Roma settlement, amounted to de facto discrimination in the enjoyment of the right to respect for private and family life and the home, and the prohibition of degrading and inhuman treatment.

(ii) European Roma Rights Centre

135. This third party provided an overview of its research from 2014 in which it had ***collected*** evidence on access to safe and affordable drinking water and sanitation in ninety-three Romany settlements and neighbourhoods in Albania, France, Hungary, Moldova, Montenegro, Slovakia and North Macedonia (formerly “the former Yugoslav Republic of Macedonia”). Without claiming to be representative of the situation of the Roma in any given country, the research had been designed to demonstrate that a significant number of Roma communities had suffered problems in relation to access to water, and that those conditions had often amounted to racial discrimination. An earlier research paper, “The Housing Situation of Roma Communities: Regional Roma Survey 2011”, conducted by the United National Development Programme (UNDP), had shown that a high proportion of Romany households in selected European countries had not been connected to a public water supply system: in Romania it had been 72%, in Moldova 66%, in Slovakia 38%, in Croatia 35%, in Hungary 30%, and in Albania 30%.

136. The research of this third party had produced similar results; significant numbers of Roma in the examined settlements had had no access to running water in their homes, and many Roma, especially those in segregated settlements, had suffered disproportionately from the failures of the authorities to secure their access to water and sanitation. Their water sources had often been far from home, with the burden to secure water falling disproportionately on women and girls. The water sources had often not been tested to ensure their safety and had been exposed to a wide range of contaminants, including dry toilets (pit latrines), insects, and wild animals. Roma often had not been able to afford public water service pipes and water charges, even if they had been otherwise available. In seventy‑five of the sites investigated (81%), the Romany settlements had not been connected to the public water supply systems. Moreover, in sixty-three places (68%), none of the Romany households in the neighbourhood or settlements had been supplied with tap water and a functioning sewerage system. If the houses had been built on land with unclear ownership or the occupants had lacked a construction permit or similar documents, the local authorities had generally refused to connect them to the public water system.

137. In more than half of the places visited, the nearest water source had been more than 100 m away, and in some places Roma had had to walk several kilometres. Distant water resources had resulted in a high risk to public health from insufficient sanitation. According to the World Health Organization (WHO), when a water source required a walk of between 100 m and 1,000 m from home or five to thirty minutes total ***collection*** time, the quantities of water ***collected*** are unlikely to exceed 20 litres per person daily and hygiene practice may therefore be compromised, resulting in a high risk to public health from poor hygiene. When the water source was more than 1 km away from the home or required more than thirty minutes ***collection*** time, the likely volumes of water ***collected*** were very low, typically less than 5 litres per person per day; basic consumption and hygiene practice were compromised to an extent that the risk to public health from poor hygiene was very high.

138. Many Roma communities had enjoyed access to water only thanks to private donations. In two thirds of the sites surveyed, this third party had established a prima facie case of race discrimination: there had either been clear evidence that Roma had experienced less favourable conditions for accessing water due to their ethnicity (direct discrimination), or it had not been possible to objectively justify the less favourable conditions which they had disproportionately experienced (indirect discrimination).

(c) The Court’s assessment

(i) Article 8

(α) General principles

139. The Court has consistently held that, although the object of Article 8 is essentially that of protecting the individual against arbitrary interference by public authorities, it does not merely compel the State to abstain from such interference. In addition to this primarily negative undertaking, there may be positive obligations inherent in an effective respect for private or family life and the home (see X and Y v. the Netherlands, 26 March 1985, § 23, Series A no. 91).

140. The principles applicable to assessing a State’s positive and negative obligations under the Convention are similar. Regard must be had to the fair balance that has to be struck between the competing interests of the individual and of the community as a whole, the aims in the second paragraph of Article 8 being of a certain relevance (see Gaskin v. the United Kingdom, 7 July 1989, § 42, Series A no. 160, and Roche v. the United Kingdom [GC], no. 32555/96, § 157, ECHR 2005-X). In both contexts the State enjoys a certain margin of appreciation in determining the steps to be taken to ensure compliance with the Convention (see Hatton and Others v. the United Kingdom [GC], no. 36022/97, § 98, ECHR 2003-VIII; Rees v. the United Kingdom, 17 October 1986, § 37, Series A no. 106, and Leander v. Sweden, 26 March 1987, § 59, Series A no. 116). Furthermore, even in relation to the positive obligations flowing from Article 8 § 1, in striking the required balance, the aims mentioned in Article 8 § 2 may be of relevance (see Rees, cited above, § 37; see also López Ostra, cited above, § 51).

141. In socio-economic matters such as housing the margin of appreciation available to the State is necessarily a wide one (see James and Others v. the United Kingdom, 21 February 1986, § 46, Series A no. 98, and Mellacher and Others v. Austria, 19 December 1989, § 45, Series A no. 169). The Court takes the view that in issues involving an assessment of the priorities in the context of the allocation of limited State resources, the national authorities are in a better position to carry out this assessment than an international Court (see O’Reilly and Others v. Ireland (dec.), no. 54725/00, 28 February 2002, and Sentges v. the Netherlands (dec.), no. 27677/02, 8 July 2003).

142. In addition, it is necessary to take into account the vulnerable and disadvantaged position of the Roma population which requires some special consideration to be given to their needs and their different lifestyle both in the relevant regulatory planning framework and in reaching decisions in particular cases (see Connors, cited above, § 84, and Chapman, cited above, § 99). Social groups such as the Roma may need assistance in order to be able effectively to enjoy the same rights as the majority population. As the Court has stated in the context of Article 14 of the Convention, that provision not only does not prohibit a member State from treating groups differently in order to correct “factual inequalities” between them but, moreover, in certain circumstances a failure to attempt to correct inequality through different treatment may in itself give rise to a breach of Article 14 (see D.H and Others, cited above, § 175; Thlimmenos v. Greece [GC], no. 34369/97, § 44, ECHR 2000-IV; and Stec and Others v. the United Kingdom [GC], nos. 65731/01 and 65900/01, § 51, ECHR 2006-VI). In the context of Article 8, the applicants’ specificity as a social group and their needs has been considered one of the relevant factors in the assessment of the proportionality that the national authorities are under a duty to undertake (see Yordanova and Others, cited above, § 129).

(β) Application of those principles to the present case

143. The Court notes that the applicants did not argue that their living conditions can be deemed to have resulted from any activity of the authorities that would restrict their access to safe drinking water or pollute any existing water resources in respective settlements. They complained of insufficient provision of basic infrastructure; accordingly, the present case will be considered as concerning the State’s positive obligation to take reasonable and appropriate measures to secure respect for their homes and their private and family life. The Court considers that the key consideration in its assessment concerns the scope of the State’s positive obligation to provide access to utilities, especially to a socially disadvantaged group. In this connection, the domestic and international materials referred to by the parties (see paragraphs 50-51, 59-62 and 66-71 above) show that a considerable part of the Roma population in Slovenia, who live in illegally built settlements that are often removed from the densely populated areas with a public water-distribution system, face greater obstacles than the majority in accessing basic utilities. Accordingly, these factors and the possible need for concrete measures tailored to the applicants’ specific situation will form part of the Court’s assessment of the circumstances of the present case.

144. That said, the Court considers that the level of realisation of access to water and sanitation will largely depend on a complex and country-specific assessment of various needs and priorities for which funds should be provided. In the Court’s view, the States must be accorded wide discretion in their assessment of those priorities and the legislative choices they make, given their wide margin of appreciation in socio-economic matters. That discretion must also apply to the concrete steps aimed at ensuring everyone has adequate access to water, such as the adoption of a national water strategy, national and local implementation projects of any such strategy, or, indeed, the provision of water from the public water-distribution system to individual households.

145. The Court notes that in Slovenia spatial development and planning and public utility infrastructure are subject to a comprehensive regulatory framework (see paragraphs 37-46 above) which lays down the conditions of legality for a building to benefit from public infrastructure (see paragraph 40 above) and distributes the responsibilities related to the costs of water and sanitation public utilities between the State - or municipalities - and consumers (see paragraphs 44 and 46 above).

146. The Court considers it reasonable that the State, or its local authorities, assume the responsibility for the provision of this service, while it is left to the owners to install individual house connections at their own expense (see paragraph 29 above). Likewise, given the inherently progressive nature of the development of a public water supply system, which is dependent on the financial resources of an individual State, it appears reasonable that alternative solutions such as installation of individual water tanks or systems for harvesting rainwater are proposed in those areas that are not yet covered by a public water supply system.

147. In the Court’s opinion, it is possible that such legislation could produce disproportionate effects on the members of the Roma community, in so far as, similarly to the applicants, they live in illegal settlements and rely on social benefits for their subsistence. However, as submitted by both parties, the domestic authorities recognised the vulnerability of the Roma community and acknowledged the need for positive measures aimed at improving their precarious living conditions. To that end they adopted and financially supported a comprehensive strategy and specific programmes and projects focused on the legalisation of the illegally constructed Roma settlements and on the provision of basic public utilities to their inhabitants (see paragraphs 50 and 130 above). It furthermore appears, according to the undisputed submissions of the applicants, that many Roma settlements have been regularised and benefited from practical improvements in their living conditions (see paragraphs 120 and 121 above). The Court takes note of all the affirmative action measures already taken by the domestic authorities with a view to improving the living conditions of the Roma community in Slovenia.

148. As regards the applicants’ personal situations, it is not clear from the parties’ submissions whether the applicants had a realistic possibility of relocating to settlements with better infrastructure (see paragraph 14 above) or obtaining alternative accommodation, such as public housing units at subsidised rent rate available in the Ribnica Municipality. While the Government mentioned this possibility in their submissions, official documents submitted by the parties show that, for such accommodation to be effectively made available, a municipality was required to issue a notice inviting applications for such housing units (see paragraph 51 above). In the present case, no information was submitted on whether such a notice had been issued. Nevertheless, irrespective of whether public housing was available, the Court can only conclude that the applicants remained in their respective settlements by choice.

149. Secondly, it is not disputed between the parties that at the material time, the applicants were receiving social benefits (see paragraphs 22 and 35 above). It would appear, based on the fact that the applicants from the Goriča vas settlement co-financed the purchase of the water tank and agreed to bear the costs of water deliveries and chemical toilets (see paragraph 16 above), and the applicants from the Dobruška vas 41 settlement bought land near the settlement and built a wooden hut, where they moved in the course of these proceedings (see paragraph 28 above), that the applicants were not living in a state of extreme poverty (contrast M.S.S v. Belgium and Greece [GC], no. 30696/09, § 254, ECHR 2011). Therefore, in so far as the applicants relied on State support for their subsistence, the Court considers that the national authorities recognised their situation and, through their system of social benefits, ensured that they were guaranteed a certain basic level of subsistence which was, or could have been, used, inter alia, for improving their living conditions.

150. Furthermore, the Court observes that the municipal authorities of Ribnica and Škocjan also undertook some concrete actions to ensure the applicants had access to safe drinking water. In this connection, the Government argued that the applicants’ respective buildings could not be legalised because they were erected on land not intended for residential use (see paragraph 128 above). In the absence of legalisation, the buildings could not be connected to water and sanitation services. Instead, the Court notes that a water tank, co-financed by the Ribnica Municipality, was purchased in 1999 for Goriča vas settlement, and water was delivered there by the local fire brigade upon request, while the costs of the water itself were borne by the Municipality (see paragraph 19 above). Although it is not clear whether there were any such periods when no tank was available in the settlement, the applicants asserted that several water tanks had eventually become inappropriate for use (see paragraph 18 above). On this basis, as well as on the basis of the information provided by the Government concerning water deliveries for the period of 2010-16 (see paragraph 19 above), the Court accepts that one or several water tanks were installed in the settlement in the period from 1999 to 2016 into which supplies of drinking water were placed.

151. The Court notes that there is a dispute between the parties as to the reasons why the water was not delivered more often to the Goriča vas settlement. While the applicants assert that the water tank became unusable due to mould and other fungi, the Government claim that the tank was subsequently sold by the members of the Roma community (see paragraph 18 above). Be that as it may, it is worth noting that no financial or other assistance, such as the purchase of another water tank, appears to have been requested by the applicants from the municipal authorities since 1999 for the purpose of acquiring a more regular water supply. Furthermore, the applicants did not assert that their own investment in the solution provided by the Municipality constituted a disproportionate financial burden that they could not afford. Neither did the applicants allege that the water delivered to the Goriča vas settlement by the local fire brigade (see paragraphs 18-20 above) was not safe for drinking, or complain of any specific dangers to health or diseases in this respect. In the light of this, the Court concludes that the above arrangement provided the applicants from the Goriča vas settlement with the possibility of accessing safe drinking water.

152. The Court considers that a similar conclusion can be reached with regard to the applicants from the Dobruška vas 41 settlement, where the Škocjan Municipality installed and financed a group water-distribution connection from which individual connections could be installed for supplying water to individual households. Nine individual connections were installed from the distribution connection to the individual users’ homes in the settlement, supplying water to seven of them (see paragraph 30 above). The applicants did not join the water supply system, allegedly owing to obstruction by hostile neighbours. However, it must be noted that they did not even apply to have water installed in their previous home (see paragraph 32 above). Neither is it clear from the applicants’ submissions whether they took any steps towards obtaining an individual water connection after moving to a new location (ibid.). In this connection, given that the applicants not only chose their new location, but had also bought the land on which they built their home, even if only to avoid further disputes with their neighbours, in the Court’s opinion they were themselves responsible for verifying whether they would be able to connect to the public water supply system and for taking steps to ensure their individual connection.

153. Setting up a common water tank for an entire settlement or a public water point available to everyone in the settlement may be considered an interim rather than a permanent solution (see paragraph 62 above). However, in the Court’s opinion these positive measures did provide the applicants with the opportunity to access safe drinking water. Moreover, in the absence of any evidence to suggest the contrary, the Court considers that the domestic authorities have taken those measures in good faith. The Court also notes in this respect that the applicants failed to show any shortcomings in the measures already taken by the authorities regarding their quality of life in relation to other, more permanent, solutions.

154. The Court further notes that the applicants failed to explicitly address the issue of what measures should have been adopted by the State to constitute compliance with its obligation to provide access to basic public utilities. The applicants from the Goriča vas settlements made no submissions in that regard, while the applicants from the Dobruška vas 41 settlement argued that at least three water-distribution connections should be installed in the settlement to ensure effective access to safe drinking water (see paragraph 122 above), without, however, explaining whether they had taken any actions to acquire a connection to the existing group water-distribution connection, either at their previous location or after moving to the new location, or how additional water-distribution connections would impact their personal situation.

155. Neither did the applicants provide any information which would allow the Court to assess whether the municipal authorities of Ribnica and Škocjan, respectively, de-prioritised their interests in the regulation of their settlements and access to safe drinking water in favour of other, less urgent measures and projects aimed at improving the infrastructure of the majority population. In the absence of such submissions, the Court can only refer to the information supplied by the parties, whereby more than 10% of the population residing in the Ribnica municipality do not have access to drinking water from the public water-distribution system (see paragraph 7 above), and also some residents of the Škocjan Municipality do not have such access, but instead supply themselves with water from the village fountain (see paragraph 33 above). In this connection, the Court further notes that undisputed information provided by the Government shows that a non-negligible proportion of the Slovenian population living in remote areas do not have access to the public water supply system and have to rely on alternative means of private water supply, such as water tanks (see paragraph 125 above).

156. In the present case, the respective municipal authorities undertook measures that, as already found, provided the applicants with the opportunity to access drinking water, notwithstanding the irregular status of their settlements and the nature of the land the applicants’ respective buildings had been built on (see paragraph 128 above). In the Court’s opinion, the positive steps taken by the respective municipalities allow for the conclusion that they have acknowledged the disadvantages suffered by the applicants as members of a vulnerable community and shown a degree of active engagement with their specific needs. It is true that those steps did not entail the provision of household connections that are generally considered the ideal solution (see paragraph 62 above), or, in the case of the water tank installed in the Goriča vas settlement, even made that possible. However, the applicants were not prevented from making use of their social benefits that allowed them to provide for their essential needs (see paragraph 149 above) to employ alternative solutions such as installing private water tanks or systems for ***collecting*** rainwater. As regards the State’s own legal and financial obligations in this regard, the Court takes the view that, while it falls upon the State to address the inequalities in the provision of access to safe drinking water which disadvantage Roma settlements, this cannot be interpreted as including an obligation to bear the entire burden of providing running water to the applicants’ homes.

157. Lastly, the measures taken by the municipalities did not include any steps to ensure sanitation for the applicants; however, the Court notes that a considerable part of the population in Slovenia does not as yet benefit from a public sewerage system; in fact, it would appear that both relevant municipalities are significantly better equipped with public water supply than sanitation (see paragraphs 7, 33, 34 and 58 above). According to the undisputed submissions of the Government, in the Ribnica Municipality only the town of Ribnica and the Hrastje area were at the material time connected to such a system, while the Škocjan Municipality had no public discharge or facility for treatment of urban wastewater. Considering the limited access to sanitation in the two municipalities, it would be difficult, in the absence of proof to the contrary, to conclude that the applicants’ respective situations were accorded less importance than those of the majority population. Furthermore, taking account of the inherently progressive nature of the development of public infrastructure and the State’s wide discretion in the prioritisation of resources for urban planning (see paragraph 144 above), in the Court’s opinion only particularly convincing reasons such as a serious risk to health could justify imposing a burden on the State to take any steps with regard to the applicants’ respective situations. However, while the applicants complained of frequent diseases (see paragraph 109 above), they neither made any concrete submissions to that effect nor presented evidence in support of their claims (see, mutatis mutandis, Denisov v. Ukraine, cited above, § 114). In that connection, it is worth noting that the applicants did not argue that they were in any way, financially or otherwise, prevented from installing their own septic tanks or employing other solutions alternative to the public sewerage system.

158. Reiterating, firstly, that the applicants received social benefits which could have been used towards improving their living conditions, secondly, that the States are accorded a wide margin of appreciation in housing matters, and thirdly, that the applicants have not convincingly demonstrated that the State’s alleged failure to provide them with access to safe drinking water resulted in adverse consequences for health and human dignity effectively eroding their core rights under Article 8 (see paragraphs 115 and 116 above), the Court finds that the measures adopted by the State in order to ensure the applicants access to safe drinking water and sanitation took account of the applicants’ vulnerable position and satisfied the requirements of Article 8 of the Convention.

159. The Court accordingly concludes that, even assuming that Article 8 is applicable in the instant case, there has been no violation of that provision. In these circumstances the Court finds it unnecessary to decide on the issue of applicability of Article 8 (see paragraph 117 above).

(ii) Article 14 in conjunction with Article 8

160. The applicants essentially complained that the State had failed to sufficiently consider their specific needs as members of a disadvantaged Roma community in the provision of basic utilities, notably water and sanitation. According to the applicants, in the two municipalities in question, discriminatory attitudes, prejudice and stereotypes had played a major role in the local authorities’ inactive approach to resolving the applicants’ lack of basic infrastructure. The parties’ submissions are summarised in paragraphs 119-130 above.

161. The Court notes that it has dealt with the applicants’ core grievance in the context of its assessment of the scope of the State’s positive obligation to provide access to basic utilities to a socially disadvantaged group and concluded that the respondent State in the present case has not violated Article 8 of the Convention (see paragraphs 143-159 above).

162. In light of this, the Court finds it unnecessary to decide on the issue of applicability of Article 14 of the Convention, as it considers that, for the reasons stated above and assuming that Article 14 applies, there has been no violation of Article 14 of the Convention in conjunction with Article 8.

B. As regards the alleged violation of Article 3 of the Convention, taken alone and in conjunction with Article 14

163. The applicants complained that the discomfort and pain resulting from their lack of basic amenities amounted to degrading and inhuman conditions contrary to Article 3 of the Convention. The Government argued there has been no action or practice on the part of the State which would fall within the scope of Article 3 of the Convention and would be prohibited under that Article. The parties’ submissions are substantially the same as the ones made under Article 8 of the Convention and are summarised in paragraphs 119-130 above.

164. The Court notes at the outset that this complaint is linked to the one examined above and must therefore likewise be declared admissible (see paragraph 118 above).

165. In this connection and with respect to the issue of applicability of Article 3 of the Convention, the Court cannot exclude the possibility that State responsibility could arise for “treatment” where an applicant, in circumstances wholly dependent on State support, found himself or herself faced with official indifference when in a situation of serious deprivation or want incompatible with human dignity (see O’Rourke, cited above, and Budina v. Russia (dec.), no. 45603/05, 18 June 2009).

166. However, in the present case the Court has established that the positive measures undertaken by the domestic authorities provided the applicants with the opportunity to access safe drinking water, irrespective of how and whether it was realised (see paragraph 151 above).

167. For this reason, even assuming that the alleged suffering reached the minimum threshold and that Article 3 is applicable in the present case, there has been no violation of this provision, taken alone and in conjunction with Article 14.

IV. CONCLUSION

168. In view of the above conclusions, it is not necessary for the Court to examine the Government’s objections of abuse of the right of application and lack of victim status in respect of all applicants.

FOR THESE REASONS, THE COURT

1. Decides, unanimously, to join the applications;

2. Joins to the merits, unanimously, the Government’s objections of abuse of the right of application and lack of victim status in respect of all applicants, relating to access to drinking water and sanitation;

3. Joins to the merits, by a majority, the issue of applicability of Article 8 and Article 14, taken in conjunction with Article 8;

4. Declares, unanimously, the applications admissible;

5. Holds, by five votes to two, that there has been no violation of Article 8 of the Convention in respect of the applicants in application no. 24816/14;

6. Holds, unanimously, that there has been no violation of Article 8 of the Convention in respect of the applicants in application no. 25140/14;

7. Holds, unanimously, that there has been no violation of Article 14 of the Convention in conjunction with Article 8;

8. Holds, unanimously, that there has been no violation of Article 3 of the Convention, taken alone or in conjunction with Article 14;

9. Holds, by five votes to two, that, as a consequence, it is not necessary to examine the Government’s objections and the issue of applicability of Article 8 and Article 14 taken in conjunction with Article 8, which have been joined to the merits.

Done in English, and notified in writing on 10 March 2020, pursuant to Rule 77 §§ 2 and 3 of the Rules of Court.

Hasan Bakırcı Robert SpanoDeputy Section Registrar President

In accordance with Article 45 § 2 of the Convention and Rule 74 § 2 of the Rules of Court, the separate opinion of Judge Pavli, joined by Judge Kūris, is annexed to this judgment.

R.S H.B

APPENDIX

List of applicants

File no.

Case name

Date of lodging

Name of Representative

Introduced by

1.

24816/14

Hudorovič v. Slovenia

26/03/2014

N. Zidar Klemenčič

Branko HUDOROVIČ

Aleks KASTELIC

2.

25140/14

Novak and Kočevar v. Slovenia

26/03/2014

N. Zidar Klemenčič

Ljubo NOVAK

Dunja KOČEVAR

Pamela NOVAK

Julija NOVAK

Matjaž NOVAK

Mojca NOVAK

Milena NOVAK

Gabrijela NOVAK

Aleksander NOVAK

Tatjana NOVAK

Žan NOVAK

Žarko NOVAK

Urška NOVAK

Damjan NOVAK

PARTLY DISSENTING OPINION OF JUDGE PAVLI, JOINED BY JUDGE KŪRIS

“Water is a commodity with a social value, one that is necessaryfor meeting the basic needs of every human being.” [1]

1. The present case involves a dispute regarding the respondent State’s failure to ensure access to clean water and sanitation to members of two Roma communities over an extended period of time. The majority hold that, even assuming that Article 8 of the Convention is applicable in the circumstances - a question that has been left open - the respondent State has done enough to fulfil its positive obligations and therefore has not violated the applicants’ Article 8 rights. I am unable to agree with this conclusion with respect to the applicants in the first application (no. 24816/14).

2. The two applications raise a novel question in that the Court, apparently for the first time, has been called to decide to what extent, if any, Article 8 of the Convention guarantees a right of access to clean water in circumstances where families have been legally unable to connect to the regular public water supply. It is also significant, in my view, as it raises complex questions related to the treatment of historically marginalised communities, and to whether Article 8 or other Convention provisions impose any special obligations in this respect.

A. Applicability of Article 8: denial of access to the public water supply for an extended period of time

3. The majority hold that Article 8 does not guarantee “access to safe drinking water ... as such”, but that a “persistent and long-standing lack of access to safe drinking water can, by its very nature, have adverse consequences for health and human dignity effectively eroding the core of private life and the enjoyment of a home” (see paragraph 116 of the judgment). In reaching this conclusion, the majority judgment recalls our established case-law regarding State obligations to ensure that individual applicants - who hitherto happened to have access to water, normally by virtue of being connected to the public water supply - are protected from threats to their clean water, for example as a result of industrial activities or other types of environmental pollution (see paragraph 113 of the judgment).

4. I do not disagree with the first part of the threshold test proposed by the majority, namely that a long-standing lack of access to a safe water supply, which “by its very nature” affects health and human dignity, comes under the scope of Article 8. It is not clear whether the second part of the proposed test - “effectively eroding the core of private life and enjoyment of a home” - is meant simply as rhetorical emphasis or, conversely, as imposing a burden on applicants to show that the adverse consequences for their health or dignity are so severe that they have “eroded the core” of their Article 8 rights. If the latter, this would be hard to reconcile with our case-law or the nature of the rights at stake. An indication of adverse consequences stemming from a lack of access to clean water and basic sanitation for an extended period of time would be sufficient in my view.

5. The majority judgment seems compelled to adopt a test of “stringent conditions” in order to avoid imposing an unreasonable burden on States in an area that has historically been seen as falling under the head of socio-economic rights. But putting aside the debatable matter of the strict dualism of rights, what precise burden would be imposed on States by recognising a right of access, in principle, to the public water supply, or comparable alternatives? Such a right cannot, of course, be absolute - very few Convention rights are - and could be restricted on reasonable grounds of balancing against competing public interests, such as the remoteness of a particular dwelling or settlement, or other factors that may render the applicants’ connection to the public water supply (assuming one is available in the first place) unreasonably burdensome on the public purse or otherwise impractical. The grounds for restricting Article 8 rights, as listed in the second paragraph of that provision and which ought naturally to inform the scope of any positive obligations imposed on States, include “the economic well-being of the country”, “public safety” and other relevant considerations. In conducting its assessment, the Court might even confine itself to reviewing the national legal framework on access to water, ensuring that it is generally consistent with Article 8 obligations and that it has not been applied in an arbitrary or discriminatory fashion in the individual case before us. Where a sufficient public water supply is not available in the vicinity of a particular settlement, it may be reasonable to expect its inhabitants to rely on other sources of clean water and sanitation, possibly with support from the national authorities or on a cost-sharing basis.

6. This approach is mandated, in my view, by the fact that access to clean water is one of the few things that are actually essential to human survival and has therefore been increasingly recognised, including by the member States of the Council of Europe already twenty years ago, as belonging to the category of fundamental rights (as the judgment recognises, inter alia, in paragraphs 63 and 113). It is, after all, very hard to accept that noise pollution or unpleasant smells can be significant enough nuisances to interfere with a person’s personal and home life [2], but that living without safe water for decades is somehow not as significant.

7. Lack of access to a clean water supply and basic sanitation for extended periods of time is, by definition, a predicament that adversely affects core private life interests and basic human dignity. One does not need to prove that this is so. Our established line of case-law on environmental pollution holds, as the majority acknowledge, that water pollution raises an issue under Article 8 “even in the absence of direct evidence of actual damage to the applicants’ health” (see paragraph 113 of the judgment). What matters is whether the environmental hazard has caused “significant impairment” to one’s ability to enjoy one’s home, considering aspects such as the intensity and duration of the nuisance (see Udovičić v. Croatia, no. 27310/09, §139, 24 April 2014), and its physical and mental effects on health and quality of life (see Fadeyeva v. Russia, no. 55723/00, § 69, ECHR 2005-IV). I consider that these principles are fully applicable, perhaps with even greater force, to the situation of applicants who never had a proper clean water supply in the first place. There is no meaningful, real-life difference between having one’s water supply contaminated by a nearby cemetery (as in the case of Dzemyuk v. Ukraine, no. 42488/02, 4 September 2014) and being forced, like the current applicants, to ***collect*** water from cemeteries and other unsafe sources for very long periods.

8. A qualified right of access to water is also supported by our existing jurisprudence on prolonged denial of essential public services, such as urban waste removal. Thus, in Di Sarno and Others v. Italy (no. 30765/08, 10 January 2012) the Court held that the Naples local government’s failure to ***collect*** and process urban waste over several months - even though some of these services had been outsourced to private companies - created a sanitation crisis that adversely and significantly affected the residents’ private and home lives, in violation of Article 8. Having no access to clean, running water for prolonged periods produces a permanent sanitation crisis, and especially so for families with small children.

9. In conclusion, I consider that a long-standing denial of access to safe water, especially when the persons involved live in the relative vicinity of the public water supply, amounts to an interference with the right to respect for private and family life, and the enjoyment of one’s home, under Article 8 of the Convention. The claim would be stronger where the barriers to access are primarily of a legal or administrative nature, rather than based on public finance or other socio-economic considerations. The former situation has more in common with a standard negative interference with Convention rights than a positive obligation imposed on national authorities.

B. Justification for the interference with the applicants’ Article 8 rights

10. It is, in my view, of significance that the applicants in the present case belong to the Roma ethnic community, which is recognised in Slovenia (as well as many other countries) as having a special status and special needs, due to its plight of historical marginalisation and disadvantage (see paragraphs 47-51 and 142 of the judgment). In this respect, the Court, without prejudging the merits of a particular case, cannot ignore the fact that the denial of access to basic public services to Roma settlements has been used historically by less-than-friendly local authorities as a method of pressuring the Roma to move elsewhere, or with similar discriminatory motives. This point was made forcefully by Judge Pettiti in his dissenting opinion in Buckley v. the United Kingdom (no. 20348/92, 29 September 1996), the first case decided by this Court involving Roma rights. The third-party brief of the European Roma Rights Centre in the present case makes similar arguments from a more recent, comparative perspective (see paragraph 138 of the judgment), suggesting that these discriminatory practices against the Roma continue to persist. Finally, the applicants have specifically claimed in the present case that discriminatory attitudes played “a major role” in the refusal of the local authorities to connect them to the public water supply (see paragraph 160 of the judgment). In view of this historical context, the Court should apply close scrutiny to any justifications put forward by national authorities for the denial of basic public services to Roma communities. With these considerations in mind, let me now turn to the merits of the case.

1. With respect to the applicants in the first application

11. The applicants in the first application, Mr. Hudorovič and his son, live in the informal Roma settlement of Goriča vas, which is located about one kilometre from the centre of Ribnica Municipality. The settlement is located outside the formal residential area of Goriča vas, which includes non-Roma families. The Government’s submissions and the record before us do not specify exactly how far the Roma settlement is from the main residential area of Goriča vas, but the locality as a whole is quite small and the terrain is flat, ***agricultural*** land. Even though this small Roma community has lived there for three decades, it has never been allowed to connect to the public water supply, whether through individual or ***collective*** connections. Importantly, in my view, both the centre of Ribnica municipality and the non-Roma residences of Goriča vas itself appear to be connected to the public water supply, a fact about which the Government’s submissions are silent. In addition, the applicants do not claim a right to be provided with water free of charge.

12. The respondent Government have advanced a long line of arguments, largely endorsed by the majority judgment, as to why the authorities have done enough to grant the first applicants adequate access to water over the years. These include claims related to possible resettlement of the applicants in a more adequate location; the level of social assistance from which the applicants benefit; the ability of the individual applicants to afford better housing elsewhere [3]; and the alternative water supply solutions provided by local government. None of these arguments explains, however, why the first applicants were never offered any form of direct access to the nearby public water supply, which would have provided a sustainable and adequate solution for safe water. This is not a remote community by any reasonable definition of the term, and the Government have not argued that connecting them to the water grid would require any considerable expenditure. In addition, the settlement appears to meet the basic eligibility requirements for connection to the public water supply under Slovenian law, in view of its size and density (see paragraph 43 of the judgment).

13. The only argument put forward by the Government in this respect is a formal one: that the Roma settlement of Goriča vas is “informal” and therefore national law prohibits its connection to any public services. In general terms, there is nothing objectionable about a State seeking to discourage illegal constructions and preserve public order by legally restricting their access to public utilities. However, in the specific context of Roma communities, other vulnerable groups (including children) or even the general population in some respects, the legality argument has been repeatedly rejected by this Court as not constituting sufficient justification, on its own, for serious interferences with Article 8 rights (see e.g in the context of evictions, Ivanova and Cherkezov v. Bulgaria, no. 6577/15, 21 April 2016). States are required to take into account the vulnerabilities of Roma communities and even take positive measures to try and accommodate their specific needs and lifestyle (see, among others, Chapman v. UK, [GC], no. 27238/95, ECHR 2001-I, and Yordanova and Others v. Bulgaria, no. 25446/06, 24 April 2012).

14. Conversely, lack of access to clean water and sanitation tends to perpetuate the stigmatisation and segregation of Roma communities and does nothing to counter existing prejudice against them. There are, therefore, good reasons for rejecting strict informality justifications in this context, and those reasons include questions of historical fairness - since Roma communities, including those in the present case, may not have had a genuine choice in settling in certain informal locations in the past (see paragraph 25 of the judgment) - as well as general proportionality considerations.

15. In fact, Slovenian legislation on the status of the Roma is largely built around the same principles and, in practice, a lack of formal legality of dwellings has not prevented local authorities from finding ways of connecting long-tolerated Roma settlements to the public water supply. The situation of the applicants in the second application is a case in point. As a result, the reliance of the Ribnica municipal authorities on a strict reading of the legality requirement rings hollow in the circumstances of the first application.

16. Finally, the majority judgment discusses in some detail whether the water tanks purchased with the partial assistance of the municipality provided a satisfactory alternative to the first series of applicants. According to the ***data*** provided by the Government, the fresh water deliveries into these tanks, when they were available, occurred on average every two months. Since the tanks were exposed to the elements year-round, the applicants and other independent sources have asserted that they developed mould, froze in winter and became generally unsafe for human consumption in between fresh deliveries. It is, of course, not a simple matter for an international court to make factual findings on the adequacy of water deliveries, especially in the absence of any judicial findings at national level. In such circumstances, the Court might prudently choose to give some weight to the findings of independent expert missions which had examined, or received reports from, the situation on the ground at the relevant time - such as those of the European Commission against Racism and Intolerance, the Council of Europe Commissioner for Human Rights and the Slovenian Human Rights Ombudsman (see, respectively, paragraphs 67, 72 and 23 of the judgment). Going against the practically unanimous conclusions of these respected expert bodies, the majority find today that the water tank deliveries were adequate enough.

17. The “practical and effective rights” doctrine requires this Court to scratch below formal justifications in order to assess the genuine impact of interferences with the fundamental rights and freedoms guaranteed by the Convention to individual human beings. If one looks beyond formalities, the case of the first applicants from Goriča vas is ultimately a tale of two communities, one Roma and one belonging to the majority, living a stone’s throw from each other - one of them has running water coming out of their taps, and the other has never had it at all for over thirty years. This in a country with an annual GDP per capita upwards of 20,000 euros.

2. With respect to the applicants in the second application

18. The applicants who lodged the second application are a family of fourteen who live in the informal Roma settlement of Dobruška vas 41 in Škocjan Municipality. This small settlement appears to be somewhat more remote than Goriča vas and more isolated from neighbouring non-Roma communities. They also live in informal housing and complained of a long-standing lack of access to clean water and sanitation.

19. There are, however, some significant factual differences between their situation and that of the first series of applicants. The most important one, in my view, is the willingness shown by the local authorities to go some way towards providing a sustainable and safe water solution for the settlement, namely by installing a ***collective*** water-distribution connection as of 2011, that is some three years before the lodging of the second application. While the family is in principle eligible to install an individual connection to the ***collective*** access point, it appears that they have not been able to do so, in part due to conflicts with their neighbours, which forced them to relocate within the settlement. The Government have indicated that it is nevertheless possible for them to establish an individual connection through alternative routes. While one ought to be sympathetic to their ongoing predicament, I agree with the majority conclusion that, on the basis of the record before us, the second series of applicants have not sufficiently established the existence of any prohibitive barriers in this respect that can be imputed to the national or local authorities. There has therefore been no violation of the Article 8 rights of the second series of applicants.

C. Alleged violations of Article 14 of the Convention

20. The applicants have alleged that discriminatory attitudes and prejudice have played a “major role” in the local authorities’ failure to grant them access to a sustainable clean water supply over an extended period of time. This amounts to a claim of either direct or indirect discrimination, on the ground of their ethnic minority status, which, if proven, would be incompatible with Article 14 of the Convention, read together with Article 8.

21. It seems clear from the multiple national and international sources cited in the judgment that the applicants are not alone, among the Slovenian Roma population, in experiencing serious challenges in terms of access to clean water and sanitation. Furthermore, there are indications that discriminatory attitudes, including de facto discrimination, may have contributed to some extent to this state of affairs [4]. Be that as it may, in view of my conclusion under Article 8 that the authorities did not sufficiently take into account the special needs and situation of the applicants in the first application, as members of a Roma community, in their decision to deny them access to the nearby public water supply, I do not find it necessary to consider whether there has been a separate violation of Article 14 of the Convention.

D. Alleged violations of Article 3 of the Convention

22. The applicants have also alleged that the discomfort and pain resulting from their lack of access to safe water and basic sanitation over an extended period of time amounted to inhuman and degrading conditions, contrary to Article 3 of the Convention. Of particular relevance in this respect are the applicants’ claims that the lack of access to basic sanitation and related amenities had an especially serious impact on their children, who as a result felt ostracised, stigmatised and rejected by the general community, to the point that it affected even their ability to attend school. The psychological impact on Roma children of being treated as less than equal members of society with respect to something as elementary as access to water may, in itself, generate feelings of humiliation which could rise to the threshold of degrading treatment. Therefore, I would not exclude that a denial of, or a failure to provide, access to clean water and sanitation for extended periods of time might, in principle, constitute treatment prohibited by Article 3, especially where families with children are involved.

23. In its case-law on Articles 3 and 8 of the Convention, the Court has emphasised the States’ positive obligations to protect, in law and in practice, children and other vulnerable members of society from threats to their physical and mental well-being, e.g as a result of treatment by other individuals or State employees (see, in the context of corporal punishment, Wetjen and Others v. Germany, nos. 68125/14 and 72204/14, 22 March 2018; Tlapak and Others v. Germany, no. 11308/16 and 11344/16, 22 March 2018; A and B v. Croatia, no. 7144/15, 20 June 2019). Furthermore, in Moldovan and Others v. Romania (no. 2) (no. 41138/98, 12 July 2005), the Court found a violation of Article 3 in circumstances where the applicants, whose houses had been destroyed by anti-Roma mob violence, were left to endure for over ten years poor living conditions with detrimental effects on their health and well-being, coupled with a discriminatory and dismissive attitude of the authorities. It does not require a great leap to extend these rationales to State action or inaction - including due to a flawed legal framework - that exposes children and other vulnerable persons, including those belonging to disadvantaged communities, to prolonged distress and humiliation as a direct result of lack of access to safe water and basic sanitation.

24. This notwithstanding, I voted with the majority to find no violation of Article 3 in this case - although, as should be clear from the above, on somewhat different grounds - on the basis that the current applicants have not sufficiently shown that the treatment they were subjected to reached the threshold of gravity required by Article 3 of the Convention, including in terms of its effects on their physical and mental well-being.

25. In conclusion, I consider that the applicants’ access to water claims come under the scope of Article 8 and that there has been a violation of that Article with respect to the applicants who lodged the first application. The finding of no violation by the majority in this novel and important case will contribute little, I fear, to alleviating the plight of inequality and disadvantage that many European Roma continue to face. “Separate but equal” access to water is, simply, not good enough.

[1] Recommendation Rec(2001)14 of the Committee of Ministers on the European Charter on Water Resources.

2 See, e.g , Moreno Gomez v. Spain (no. 4143/02, ECHR 2004-X).

[3] Incidentally, this argument appears to ignore the community aspects of Roma rights as an ethnic and cultural minority. While some Roma may choose to live among the majority communities, many of them may consider it important for the preservation of their identity and lifestyles to live among fellow Roma.

[4] For example, the UN Special Rapporteur on the human right to safe drinking water and sanitation, in her conclusions from the 2010 visit to Slovenia, called on the authorities to “[e]liminate all forms of discrimination, including de facto discrimination, which deprives certain segments of the population of access to safe drinking water and sanitation” (at para. 58(c)). Available at [*https://digitallibrary.un.org/record/709553?ln=en*](https://digitallibrary.un.org/record/709553?ln=en).

**Load-Date:** March 16, 2020

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HINA Digest

May 29, 2020 Friday

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**Length:** 8959 words

**Body**

Zagreb,Hrvatska29 May 2020 (Hina) - Croatian economy grows by 0.4% in Q1 ZAGREB, May 29 (Hina) - In Q1 2020 Croatia's economy grew by 0.4% compared to the same period of 2019, which is the slowest growth rate in the last six years and a result of the impact of the coronavirus pandemic. According to preliminary figures from the national statistical office (DZS), released on Friday, GDP saw an annual increase of 0.4% in Q1, which wasthe 23rd consecutive quarter GDP hadgrown albeit at a much slower pace than in the previous three months, when it went up by 2.5%. The 0.4% growth rate is also the slowest growth rate since the last quarter of 2014, when the economy saw an annual growth of 0.7%. Consumptionslows down, export and import down The slowing down of GDP growth is due to a slowing down of household consumption growth and a decline in the export of goods and services, theDZS report shows. The coronavirus pandemic and restrictions imposed to curb its spread started negatively affecting economic activity in the second half of March, which led to a decrease in consumption. Retail turnover in March dropped 7% year-on-year, the greatest decline since 2010. Industrial output dropped by close to 5% for the fifth consecutive month while exports and imports decreased due to restrictions on economic activity and transport, for example in Italy, introduced to prevent the spread of the disease.

Household consumption grew in Q1 by 0.7% compared to the same period of last year, which is a slower growth than in Q4 2019, when household consumption grew by 4%. The export of goods and services in Q1 dropped by 3% year-on-year while in Q4 2019 it rose by5.6%. The export of goods rose by 0.3% while the export of services dropped by 9.4%. The import of goods and services dropped by 5.8% on the year while in the previous quarter it went up 0.1%. The import of goods dropped 1.6% while the import of services dropped by 25.1%. In Q1 gross investments in fixed assets grew by 3.1% on the year, which is less thana 4% increase in the previous quarter. In Q1 state spending grew as well, by 4.8% on the year, faster then in the previous quarter, when state spending went up 3.5%. ***Statistics*** better than EU average According to seasonally adjusted ***data***, GDP in Q1 dropped 1.2% compared to the previous quarter while on the year it grew by 0.3%. These ***statistics*** are better than the EU average. ***Eurostat*** ***data*** show that in Q1 the EU's economy dropped by 3.3% compared to Q4 2019 and by 2.6% compared to Q1 2019. Govt sees Q1 GDP growthas encouraging ZAGREB, May 29 (Hina) - A GDP growth of 0.4% in the first quarter of this year is an encouraging signal to continue implementing reforms and measures taken that will strengthen the Croatian economy's resilience to this crisis, the government said in a press release on Friday. According to the State Bureau of ***Statistics***, Croatia's GDP in Q1 2020 grew 0.4% compared to the same quarter in 2019. That is the continuation of the trend of economic growth since Q3 2014, the government underscored. The latest growth has been recorded despite the lockdown measuresintroduced on March 19 to curb coronavirus and in circumstances when at the level of the EU 27, Q1GDP contracted. "The fact that despite the circumstances of the coronavirus epidemicwe recorded an increase in GDP of 0.4% in the first quarter is an encouraging signal for the continuation of reforms and measures taken to strengthen the resilience of Croatia's economy in this crisis," says the government. "Croatia hasintroduced prompt and strong support measures to the private business sector and achieved a good epidemiological situation. In the current term, we have shownwhat it means to responsibly manage public finances, improve our credit rating to investment level, ensure a healthy economic growth, and increase employment and decrease unemployment. That is why we braced ourselves for this crisis in a much better shape than during the global crisis in 2008," Prime Minister Plenkovic said as cited in the press release. The press release adds that the government will analyse and monitor the effects of reactivating the economy and subsequently continue with support measures for the most vulnerable sectors. In that regard and considering that the epidemiological situation in Croatia is good, the government has lifted the temporary ban on the entry in Croatia for citizens from several countries and opened Croatia up for tourism. Atthe same time the European Commission's programme - Next Generation EU - isan important instrument that we will use for the speedy recovery of the economy and investments. The programme is exceptionally generous for Croatia and envisages an allocation of €10.013 billion over the next four years, which is almost 20% of Croatia's GDP. It will be used to step up jobkeeping efforts,support small and medium-sized businesses, digital transformation and to assist sectors, the press release said. HUP: Alleviating GDP drop in Q2 requires continuing gov't aid scheme ZAGREB, May 29(Hina) - The Croatian Employers Association (HUP) said on Friday that the significant slowing down of GDP growth in Q1 was as expected, and that mitigating that trend would require the continuation ofgovernment measures aimed atensuring the long-term liquidity of businesses, savingjobs and stimulating demand. According to preliminary figures from the national statistical office (DZS), released on Friday, GDP saw an annual increase of 0.4% in Q1, which wasthe 23rd consecutive quarter GDP hadgrown albeit at a much slower pace than in the previous three months, when it went up by 2.5%. HUPsaid it was encouraging that the quarterly drop in real GDP in Q1 was below the EU average while Croatia's annual GDP growth had enabled the country to joina club of just nine EU members that did not see a year-on-year GDP decline. Toalleviate the expected GDP decline to some extent at least, measures designed to salvage the economy, primarily those geared towards ensuring long-term liquidity for businesses, keeping jobs and stimulating demand, must be continued, HUP says. HGK: Q1 ***statistics*** herald drastic fall in Q2 Croatian Chamber of Commerce (HGK) president Luka Burilovic said that ***statistics*** for Q1, which were as expected, heralded a drastic fall in Q2. The epidemiological situation in Croatia is better than in most of the EU but more favourable economic trends in Croatia require a better epidemiological situation in the rest of the EUas well, said Burilovic. Employers to return jobkeeping grants if they pay dividend by2021's end ZAGREB, May 29(Hina) - The Croatian Employment Service (HZZ) Steering Committee has amended the terms and conditions for eligibility for jobkeeping grants in 2020, and one of the most important changes is that employees will be required to pay back grants in the event of receiving a dividend or profit share before the end of 2021. Employers with more than 50 workers on their payrollswho submit requests for this grantfor the first time based on their business results in May, are supposed to prove that a plunge in their revenues this May was at least by 20% compared to May 2019. That proof can be in the form ofValue Added Tax forms forMay 2020 and May 2019 and they should be submitted to the tax administration for this purpose. In the event that employers concerned, pay out dividend or any other incomeperceived as the profit sharing until 31 December 2021 will be required to reimburse the jobkeeping grants to the state. Grants will also have to be returned in the event of awarding rights for the optional purchase of shares. HBOR to grant loans for operating costs in farm sector ZAGREB, May 29(Hina) - The ***Agriculture*** Ministry and the Croatian Bank for Reconstruction and Development (HBOR) have launched a new financial instrument worth HRK 130 million, to be expended forloans for ruraldevelopment, tobe granted at an interest rate of 0.5% without any relatedfees. The programme is intended for farmers and farm producers and businesses in the forestry sector whose operations have been affected by the COVID-19 pandemic. The minimum loan amount is HRK 190,000 and the maximum 1.52 million. Applications for loans, to be used to cover operating costs, may be submitted with HBOR as of June 1. The HRK 130 million financial instrument has beensecured by repurposing a part of the financial instrument "Investment loansfor rural development". Consumption sees record drop in April, industrial outputfalls too ZAGREB, May 29 (Hina) - In April 2020, retail consumptionin Croatia dropped a record 25.5% on the year and industrial production recorded a large decrease as well, heralding asharp economic downturn in the second quarter. The national statistical office on Friday released a report on the retail trade turnover. According to working-day adjusted ***data***, consumption in April dropped 19.8% on the month and 25.5% on the year. Aprilwas the second month in a row that consumption dropped due to the COVID-19 crisis. In March 2020, it dropped 7% on the year. In April 2020, industrial production dropped 11% on the year, which was its largest decrease since June 2009, when it plummeted 13.3%. April was the sixth month in a row that production decreased. The sharp declines inconsumption and production are due to the epidemiological measures introduced in the second half of March to prevent the spreading of COVID-19. The measures slowed the economy already in Q1, resulting in a 0.4% GDP rise year on year, which was the slowest growth since the end of 2014. The economy is expected torecord a sharp downturn in Q2, followed by a recession, i.e. two consecutive months of economic decline. In arecent Hina poll,analysts predicted that GDP wouldplunge 20.5% year on year in Q2, their predictions ranging from 15% to 25%. The largest GDP decrease, of 8.8%, was recorded in Q1 2009 at the start of a financial crisis. Several officials and business people arrested by police on suspicion of graft ZAGREB, May 29(Hina) - The Interior Ministry confirmed toHina on Friday that a number of state officials and business people were being arrestedsince morning on suspicion of corruption. The police office for the suppression of corruption and organised crime began an operation early this morning in the Zagreb, Split, Knin and Gracac areas following months of investigation, ministry spokeswoman Marina Mandic said. Sources close to the investigation told Hina that among those arrested were Josipa Rimac, state secretary at the Public Administration Ministry and former Knin mayor, and Krunoslav Jakupcic, chairman of the Croatian Forests management board. Croatian Forests CEO arrested for influence peddling Croatian Forests management board presidentJakupcic was taken into custody on Friday morning on suspicion of abuse of office and influence peddling, sources close to the investigation told Hina. The premises of Croatian Forests and Jakupcic's flat are being searched, the source said. Jakupcic is expected to be questioned at the USKOK anti-corruption office in the afternoon. Allegedly, his arrest is part of a large operation by the Interior Ministry and USKOK, and more arrests are expected during the day. Lawyer says Jakupcic arrested as part of wind park investigation Attorney Vladimir Teresak said later that his client Jakupcic, was arrested today as part of an investigation into wind farms near Knin, which were advocated in the past by then Knin mayor Josipa Rimac, who was also arrested. "Jakupcic's arrest is connected to an investigation into wind farms... I only know that Croatian Forests, represented by another lawyer, sued a company for trespassing," Teresak told Hina, adding that the suspects arrested today were expected to be questioned at the USKOK anti-corruption office in the afternoon. Lawyer Zeljko Gulisija, who represents Rimac, the state secretary at the Public Administration Ministry, told Hina he assumed his client was arrested in connection with the wind farm probe. The Interior Ministry confirmed forHinathat a number of state officials and business people were being arrested since morning on suspicion of corruption. Sources close to the investigation told Hina that among those arrested were also Ante Sladic, an entrepreneur from Sibenik, and Natasa Turbic, the ruling HDZ party's head of Gracac municipality. Croatian Forests management: Jakupcic's arrest has caused corporate damage Croatian Forests management board member Igor Fazekas said that the arrest of Jakupcic had caused damage to the company's reputation but that it would definitely not affect its business operations, which, he said, were continuing normally. Fazekas said that management board members did not know the reason for Jakupcic's arrest. Gov't fires 2 officials arrested on suspicion of corruption ZAGREB, May 29 (Hina) - The government held a conference call on Friday to dismissJosipa Rimac, who was until now a state-secretary in the Public Administration Ministry as well as Assistant Economy Minister Ana Mandac, the government informed in a press release. The two office-holders were among several other officials and business people arrested earlier in the day as part of an investigation by the Police anti-corruption office (PNUSKOK) on suspicion of committing white-collar crimes, including corruption, in connection with a project of wind farms near Knin. CEO of the state-run forest management company - Hrvatske Sume -Krunoslav Jakupcic was also among those arrested today. The governmentendorsed Annex III to the ***Collective*** Agreement for state administration employees. PM says nobody is above the law, end must be put to corruption ZAGREB, May 29(Hina) - Commenting on the arrestsof state officials, including Croatian Forests CEO Krunoslav Jakupcic and Public Administration Ministry State Secretary Josipa Rimac of the HDZ party, Prime Minister Andrej Plenkovic said on Friday that nobody was above the law and that one had to put an end to corruption. "I know about it from what police have reported. In any case, this is an operation of independent prosecutorial and police authorities, as it should be," Plenkovic told Media Servis, an agency specialising in makingradio programmes, which published parts of its interview with Plenkovic on its web site. "If the investigation proves that someone has committed a criminal offence,they should answer for it, regardless of their identity and party affiliation. No one can be above the law and our message is clear: An end must be put to corruption," said Plenkovic. He added that a continued and uncompromising fight against corruption was part of his personal, his government's and the HDZ's policy. Aladrovic: Rule of law functions, arrests not due to intraparty wrangling ZAGREB, May 29(Hina) - Labour and Pension System Minister Josip Aladrovic said on Friday the police arrests of the HS forest management companyCEO and a Public Administration Ministry state secretary wereproof that stateinstitutions did their job and that the rule of law functioned. "I see (the arrests) as proof that stateinstitutions are doing their job, that the rule of law is functioning. This iscertainly something that reflects the political willto address corruption. The outcome of the judicial proceedings will be known in the future," Aladrovic said, adding that the latest arrestshad nothing to do with the currentelectioneering period in the run-up to the 5 July parliamentary elections. Although some of the arrestees are perceived as people close to former Croatian Democratic Union(HDZ) leaderTomislav Karamarko, Aladrovic dismissedinterpretations that this could be anintraparty tug of war. Earlier on Friday, the Interior Ministry confirmed to Hinathat a number of state officials and business people were being arrested since morning on suspicion of corruption. The police office for the suppression of corruption and organised crime began an operation early this morning in the Zagreb, Split, Knin and Gracac areas following months of investigation, ministry spokeswoman Marina Mandic said. Attorney Vladimir Teresak said later in the day that his client, Croatian Forests management board president Krunoslav Jakupcic, was arrested today as part of an investigation into wind farms near Knin, which were advocated in the past by then Knin mayor Josipa Rimac, who was also arrested. Rimac is currently a state secretary atthe Public Administration Ministry. C.E.M.P. dismisses irregularities in wind park project ZAGREB, May 29 (Hina) - The C.E.M.P. company, specialised in energy production, on Friday dismissed the allegations implicating this investor in any wrongdoings during the project of Krs-Padjane wind park. The company, registered in Zagreb, issued a press release dismissing those speculations after media reports on the police arrests of a few officials and business people on suspicion of white-collar crime in connection with the said project. As for the claims that the state-run Hrvatske Sume forest management company favoured this investor in the project, C.E.M.P. responds that quite contrary, the HS's decisions made the implementation of the project difficult and inflicted financial damage to the investor. C.E.M.P. says that it possesses the documentation that can show how the investor was actually imposed to blackmailing and how the forest-operator procrastinated the procedure for awarding the necessary permits and licences to the investor and how it prolonged the procedure to okay forest roads built by the investor as a precondition for the implementation of the project of the wind park concerned. In its lengthy press release, C.E.M.P. gives an account of the events and obstacles it has met during the implementation of the project, accusing the national forest management company of all those problems and of extortion. C.E.M.P has always warned in a timely manner and without hesitation about irregularities it has been faced with during the development of the project, primarily on the part of the Hrvatske Sume company. Possibly, therefore C.E.M.P. is in someone's disfavour. The truth will be established during these proceedings, however, this project and individuals are exposed to such process and negative media campaign, which is why the importance of the project and definitely entrepreneurial climate in Croatia are also adversely affected, says the company. Opposition accuses HDZ of performing show with arrests ahead of elections ZAGREB, May 29 (Hina) - Democrats leader Mirando Mrsic on Friday said that the arrests of Public Administration Ministry state secretaryJosipa Rimacand CEO of the state-run forest management company - Hrvatske Sume- Krunoslav Jakupcic, is yet another Croatian Democratic Union(HDZ) paradeahead of a parliamentary election. "Corruption in our society is a plague and pandemic to such extent that this latest approved prosecutionwill certainly not stop it. Nothing happens as far as corruption is concernedwithout the approval of HDZ's leadership. Everything is planned and organised tactically," said Mrsic. He recalled that Rimac's deeds have been known for a longtime, however, she has survived behind HDZ's shield. When arrests occur during electioneering time then the lambs are sent to the slaughter for the good of the herd and the herd of corruption in Croatia is huge, Mrsic believes. "Unfortunately, the Social Democratic Party's (SDP) and Restart coalition's platform will not stop corruption becausethey are not offering any solutions. The fight against corruption has to be real and wanted and not stop at words. That requiresresponsibility, resoluteness and strength so Croatia can grow into a state that can stimulate necessary economic growth," Mrsic said. Homeland Movement says wary about show with arrests Miroslav Skoro's Homeland Movement saidthat it was pleased that state institutions were doing their job but that it believed that it was evident that arrests and indictments were timed to coincide with elections to create an impression that corruption was fought againstall the time. "Quite the contrary, we believe that what happened in the parliament, regarding(former SDP MP Tomislav) Saucha, the formation of an artificial majority with the help of Mr (Milorad) Pupovac and Mr (Ivan) Vrdoljak, and MPs who crossed over to (Milan) Bandic's party group, also constitutescorruption," the Homeland Movement said in a Facebook post. It noted that one should be wary about the current show with arrests of state officials as one should have been with many other investigations in the past, and that one should not waste time commenting on the autonomy of the Croatian judiciary and legal security. Croatia is at the bottom of EUrankings in many regards, and responsibility for that rests with the HDZ, the SDP as well as foreign power centres which exerted pressure only when their globalist demands had to be met."Crime and corruption were tolerated," the party said. Conflict of interest commission launches proceedings against ex-minister, fines MP ZAGREB, May 29 (Hina) - The Commission for the Prevention of Conflict of Interest on Friday fined HDZ MP Franjo Lucic HRK 8,000 for failing to enterin his declaration of assets the fact that his wife has a tax debt, and it also launched proceedings against former state assets minister Goran Maric. Maric, a former HDZ MP and state assets minister, will face proceedings by the commission for violating the principle of impartiality and transparency in holding office. He was reported over a case involving a state-owned villa in Zagreb which was sold to a company ownedby businessman Zvonko Saric. Commission member Tatijana Vucetic said that Maric and Saric had been friends for morethan 30 years and that it was visible from land registry ***data*** that Maric and his wife had bought real estate from Saric and his company. Vucetic said that Maric should have exempted himself from signing a decision on the sale of the villa to Saric's company, given his private and business relationshipwith Saric. State administration employees initial annex to ***collective*** agreement ZAGREB, May 29 (Hina) - Minister of Labour and Pension System Josip Aladrovic and unions representing state administration employees on Friday signed an annex to the basic ***collective*** agreement. "Today we held a fourth meetingwith state administration employees' unions. What we hoped for and expectedwas achieved -a compromise, whichis the same as the compromise with public sector employees. This closes our negotiations. On Monday we expect the signing of the annex after the government approves it," Aladrovic said after the meeting. He reiterated that the same annexwas signed with public servants, envisaging the deferral of the base pay rise that was to have occurred on 1 June and 1 October. A representative of a union of interior ministry employees, Zdravko Loncar, said that they had decided to initial the annex because they wanted to be stakeholders in the process so as to meet their obligations towards union members. "This is damage control. We did not wish to leave it up to some new government to take everything from usafter the election. This is our contributionat this moment,we empathise with everyone, we are part of the people and live with the people. We believethat we are in a much better position," said Loncar. Local and state administration employees' union leader Iva Suskovic, too, said that union bodies had agreed to accept the government's offer. She expressed hope that the negotiations with the government would continue. "We hope to sit at the table with the new government in the autumn and discussall the problems in state administration services, not only the low salaries but primarily working conditions, material rights and ways of improvingthe status of state administration employees. We do not want tonegotiate only aboutthe suspension of the base pay increase and Christmas bonuses because the problem in state administration is much deeper," said Suskovic. Police union leader Dubravko Jagic said that the membership of his union had also decided to sign the annex. Croatia reports no new daily cases of COVID-19 ZAGREB, May 29 (Hina) - There havebeen no new cases of the infection with COVID-19 in the last 24 hours in Croatia, however, a 69-year-old man, who was treated in a hospital for the infection and underlying conditions, has died, bringing the total number of fatalities to 103, the national crisis management team said on Friday. Since the outbreak of the infectious disease on 25 February, there have been 2,245 positive cases in the country, while a total of 65,509 tests have been conducted. Currently 28 coronavirus patients are being treated in hospitals and four of them are on ventilators. All other informationis available at the[*www.koronavirus.hr*](http://www.koronavirus.hr). website. Flego: Austrian decision un-European and discriminatory ZAGREB, May 29 (Hina) - A Croatian Member of the European Parliament and Deputy Leader of the Istrian Democratic Party (IDS)Valter Flego on Friday reacted to a decision by Austria not to include Croatia among safe countries for its citizens to travel to, saying that this was un-European and discriminatory. "Our country is among those countries in Europeaand the world with the best epidemiological situation. Each day we are drawing closer to being corona-free however, it is not on the list of safe countries where Austrian citizens may spend their annual vacation as of mid-June, which I consider to be incomprehensible," said Flego. He considersthat the Austrian government's decision "is simplynot in a European spirit - it is discriminatory and in no way solidary and it is illogical." On the one hand, he underscored, the European Commission is proposing a record large budget to bail out the European economy and on the other hand member states are sabotaging each other and putting up obstacles. "We must not allow politicking about the tourism season. We know where politics belongs and where not," said this Croatian MEP Flego togetherwith two Slovenian MEPs Irena Joveva and Klement Gorselj sent a letter to the European Commission and they expect anurgent response from the EC PresidentUrsulavon der Leyen. They also sent a copy of the correspondence to Croatia's Prime Minister Andrej Plenkovic, Interior Minister Davor Bozinovic and Tourism Minister Gari Cappelli. PM finds it odd that president disrespects law on Statehood Day ZAGREB, May 29 (Hina) - Prime Minister Andrej Plenkovic has said that he finds it regrettable and oddthat President Zoran Milanovic has shown anattitude that almost amounts to an act of disrespect for the law adopted by the Croatian parliament when it comes to the observance of Statehood Day on 30 May. Asked by the press on Friday whether the head of state would come to the central events prepared to mark Statehood Day in Zagreb on Saturday, PM and HDZ leader Plenkovic answered that the programme of the celebration starts with wreath-laying ceremonies in Zagreb's Mirogoj cemetery on Saturday morningand after that a solemn mass will be said in the Church of St. Blaise, and as far as he knows, Milanovic will not attend. Also some events will be held in St.Mark's Square and I have been informed that he will not come to those either, and in the evening a gala concert is scheduled in front of the Croatian National Theatre (HNK), and I have not heard that he will come, Plenkovic said. As for Milanovic's statement that he might not go to the polls for the parliamentary elections on 5 July, Plenkovic said that this was a telling message to Milanovic's successor at the helm of the Social Democratic Party (SDP),Davor Bernardic, and to those who had voted for him in the presidential election. Parliament speaker issues Statehood Day message ZAGREB, May 29 (Hina) - Parliament Speaker Gordan Jandrokovic issued on Friday a message on the occasion of Statehood Day, May 30, recalling that 30 years ago the first multi-party parliament was constituted, which paved the way tothe democratic change, freedom, and statehood and independence of Croatia. "That was the first step towards the establishment of the modern Croatian state and that is why the date was chosen as the 'all-Croatian day of celebrating Croatian statehood'," Jandrokovic noted in his statement. He recalled that just before 30 May 1990 and the constituting of the Parliament, the first free, direct, and multi-party election had been held, and the Croatian people elected their true leadership after a long time. Jandrokovic also emphasised the historic role the Saborplayed. "During its history as a representative body of the Croatian people which guarded Croatian statehood and protected the interests of the Croatian people, the Croatian Parliament, along with the first Croatian president, Dr Franjo Tudjman, played the key role in establishing the modern, democratic state with deep roots in the Central European and the Mediterranean areas and a strong Christian identity," Jandrokovic pointed out. The parliament speaker expressed special gratitude toHomeland War veterans and their families, noting that the Homeland War was the strongest foundation of the present-dayCroatia. He recalled that even today we witnessed "times of numerous contemporary challenges", and that we areobserving Statehood Day in changed life circumstances due to the global health crisis. "A lot of times in its history Croatia has proven that it can successfully weather difficult times. And this time, first of all owing to the strength, responsibility, seriousness, courage, solidarity and togetherness of our citizens, we have managed to overcome this hardship," Jandrokovic noted, pointing out the parliament's contribution as well. Milanovic: Croatian army is part of tradition ZAGREB, May 28(Hina) - President and Armed Forces Commander In Chief Zoran Milanovic said on Thursday, on the occasion of the 29th anniversary of theArmed Forces, that the Croatian army was part of a tradition and that Croatia would not exist without it. "Twenty-nine years in the life of a young nation with deep roots is already a bit of a tradition. The Croatian army is not just an institution but,such as it is, by the wayit looks, the way it is dressedand by the weapons it carries,it is already slowly part of Croatian tradition," Milanovic said at a reception organised to mark Croatian Army Day andCroatian Ground Army Day. A tradition should not be invented, we have both the ancient and the new one, and we can be not only proud of it, but also satisfied with what we have done, thoughnever completely. We must remember and be eternally grateful to those who laid down their lives for our country, he said. Croatia would exist without diplomacy, regardless of its importance, but not without the army. People werenot killedin diplomacy orwounded in offices, but people werekilled in the army, he added. "The Croatian army is here first and foremost to defend Croatia, the people, the territory and interests in the way set out by the democratic Croatian authorities, elected democratically, with the participation of all social stakeholders, and as the citizens of this country decide." Democracy, the modern Western society, its values and traditions, the army, family, but also faith and Church for those who believe, each in their own way, but connected, make up Croatia's totality and specificity, Milanovic said, adding that one must invest in the army, equipment andits people so that they could be the best possible. Commenting on the observation of Statehood Day, he said that "whatever day it is, they are all somehow the same days from the same period in which the modern Croatia and the Croatian army were created." Military tradition does not start from scratchbut it should not be sought in past times "because that divides the Croatian people and there will never be agreement on that," Milanovic said. "Our statehood, when it comes to the army, begins when you were established," he told those present at thereception, where he also promoted active generals. Chief of Staff: The Croatian army was created from nothing Armed Forces Chief of Staff Robert Hranj said 29 years had passed from the day when the Croatian army, then the Croatian National Guard, lined up and made the first report to the commander in chief. "The Croatian army was created practically from nothing,developingin war times, succeeding in defending the country and in winning in an imposed war," he said, adding that the development and modernisation of the army continued through NATO and the EU where, he said, it made an immeasurable contribution to the realisation of strategic goals. "The Croatian army will continue to modernise despite all the difficulties we encounter on a daily basis. All modernisation projects continue to be valid and we will probably delay them a little because of this crisis, but we are not scrapping anything," Hranj said, adding that army's biggest value were its people and that it was necessary to invest in them. Present at the reception were 150 state and military guests. Bozinovic: Active work under way on US visa waiver for all EU states ZAGREB, May 28(Hina) - EU and US ministers on Thursday discussed security and judicial issues during the pandemic as well as visa reciprocity, which is being actively worked on "in this format, but also bilaterally," Croatian Interior Minister Davor Bozinovic said after a video conference. UScitizens can travel to all EU countries withoutvisas, whereas four EU member states - Croatia, Bulgaria, Romania and Cyprus - still need visas to enter the US. "We are working on that issue very actively in this format, but also bilaterally. We hope for progress when it comes to the visa waiver programme," Bozinovic said. He presided over the EU-US virtual meeting together with Justice Minister Drazen Bosnjakovic. The meeting was held online instead of physically in Dubrovnik as planned before the health crisis. Ministers of the interiortalked about cyber crime, terrorism, the spread of extremist propaganda, disinformation, travel restrictions and other security challenges. "Cross-border challenges in the current conditions, I would say, not only haven't decreased but are even more pronounced than before in some areas," said Bozinovic. The dialogue with the US should continue and itis necessary to "further strengthen the transatlantic partnership to which the EU has always attached high importance," he added. Ministers of justice discussed contact tracking apps and urgent and extraordinary measures for ensuring the functioning of judicial systems in emergencies, quarantines and isolation. HNB says national reference rate continues to decline ZAGREB, May 29 (Hina) - The Croatian National Bank (HNB) on Friday published for the first time the national reference rate (NRR), which has continued falling as most of itsindices have dropped, between 0.01 and 0.04 percentage points. Due to alignment with EU regulations, the HNB earlier this year took over from the Croatian Banking Association (HUB) the calculation and publication of the NRR, which serves primarily as the index to determine the variable interest rate in consumer loan contracts. The HNB calculates and publishes the NRR in line with a methodology that has been slightly changed compared to the methodology used by the HUB. NRR continuing to fall A comparison of ***data*** on the NRR for the first quarter of 2020 and ***data*** for Q4 2019 shows that the NRR has continued to decline, and the decline has been going onever since early 2013,the central bank's analysts have said. HNBvice-governor Roman Subic has said that the continued decline in the NRR logically leads to a decrease in interest on consumerloans. He notes that considering the still high level of liquidity and generally low interest rates, the same can be said when observing NRR movement trends. "Depending on which of the NRR indices we observe, the intensity of the rate change has been different but historically a drop in the reference rate has been observed in all indices," said Subic. He warns that the current favourable trends for consumers do not guarantee that the situation will continue into the future as trends depend on market developments. NRR indices will be regularly updated and published quarterly on the HNB web site. The NRR represents the averagefinancing cost of the Croatian banking sector. It isone of the reference rates used for financial products and contracts in Croatia, including credit contracts concluded with consumers. EC proposes Solvency Support Instrument ZAGREB, May 29(Hina) - Enterprises in the European Union will need at least €720 billion this year tooffset the lost capital due to the coronavirus pandemic this year, and many viable enterprises could turn insolvent, the European Commission Vice President Margrethe Vestager said in Brussels on Friday. In order to help businesses to overcome the crisis, the Commission has prepared asolvency support instrument, which is based on the existing European Strategic Investment Fund n order to mobilise private resources for emergency relief to sustainable European businesses in the sectors, regions and countries which have been hardest hit by the pandemic. Vestager explained today thata €31 billion support instrument, that is part of the EU’s proposed recovery plan, could be put into operation this year. The plan aims to support businesses which, although viable, are experiencing serious solvency problems due to the coronavirus crisis. €26m contracts inked for improved water utility infrastructure in Dubrovnik County ZAGREB, May 29 (Hina) - Nine contracts,worth HRK 197.5 million, for developing the water utility infrastructure in the Dubrovnik-Neretva County were signed in the southern town of Opuzen on Friday. Attending the contract-signing-ceremony, the Minister of Environmental Protection and Energy, Tomislav Coric,stated that the projects in question would improve the quality of life for the inhabitants of the Dubrovnik-Neretva County. "We will not stop there. We want all citizens to have access to the public system. I am pleased that even in the times of the coronacrisis, the construction sector will have enough work," Minister Coric emphasised. The managing director of the Croatian Water Management company, Zoran Djurokovic, said that at this moment, ongoing projects in the southern-most area of Croatia were worth around HRK 1 billion. The new projects envisage building 21.9 kilometres of pipelines in total into the water supply system, as well as seven kilometres of the main delivery piping, and a hydro-station and a pumping station with the flow of 12.5 litres per second. As for the drainage system, 12.2 kilometres of the sewer system will be built, as well as 10.1 kilometre of gravitational andpressure pipelines and collectors, 13 pumping stations, one wastewater treatment plant (UPOV) with the capacity of 1,400 equivalent per inhabitant, and one biological wastewater treatment plant with the capacity of 1,000 equivalent per inhabitant. The projects will increase the security of water supply in the period of droughts and boost the economic activities, especially in the tourism sector. Minister tours road construction sites in Istria ZAGREB, May 29(Hina) -Transport and Infrastructure Minister Oleg Butkovic on Friday toured road construction sites in Istria County, saying that at the moment the state-owned HC road operator was building and upgrading roads in Istria in projects worth around HRK 80 million. "It is good that roads in Istria are being built and renovated. During the coronavirus crisis we did not suspend those projects regardless of the fact that some of HC's revenues were cut, but the most important thing is that the investments in Istria are continuing," he said. The minister said thatcurrently the biggest local investment was a project to build the full profile of the Istrian Y motorway, noting that the 11-kilometre section from Rogovic to Cerovlje should be completed by the end of June, while the section running to the Ucka tunnel was expected to be completed by the start of the 2021 tourist season. Asked by reporters if the cancellation of the toll for the Ucka tunnel was likely after the road toll for the Krk bridge was recently cancelled, the minister said that that was not realistic as work on the tunnel's second tube was under way, i.e. the investment was ongoing. Minister hands in first 16 certificates for alternative housing ZAGREB, May 29 (Hina) - State Assets Minister Mario Banozic on Friday handed in 16 certificates to Zagreb residents whose flats were made unlivable by the March 22 earthquake and are currently staying in a Zagreb student dormitory, to confirm that they have the right to alternative housing and to have their rent covered by the state. Banozic said that based on a public call his ministry had so far received 146 requests for alternative housing. "I would like us to close all cases here at the Cvjetno Naselje dormitory in two to three weeks," the minister said, adding that there were a lot of specificities in many of the cases. Some of the cases will be dealt with in cooperation with the Demography Ministry and some in talks with the Zagreb city authorities, he said. Residents who have applied for alternative housing have been given a list of flats, i.e. people who have contacted the State Assets Ministry and are willing to rent their apartments, and they are now expected to find the apartment that suits their needs. As for requests by people whose property was damaged in the quake and who for various reasons nowwish toexchange it for a flat, Banozic said that the bill on the post-quake reconstruction of Zagreb was under public consultation and that a way would be found to include in it a solution that would make it possible for unusable properties to be exchanged for substitute real estate. Prime Minister Andrej Plenkovic said recently that the State Assets Ministry would invite applicationsfor grants to cover the cost of rent for people whose homes were made unlivable by the March 22 earthquake and that allpeople left without a roof over their heads would have appropriate accommodation. The public call is based on the government's decision to cover the cost of rent forresidents of the city of Zagreb and Zagreb and Krapina-Zagorje counties who own houses or flats or are protected lessees and who at the time of the earthquake lived in properties that have been assessed as unfit to live in. The public callalso refers topotential renters who were invitedto expresstheir interest with the ministry to rent their flats. Noting that applications would be processed under fast-track procedure,Plenkovic recalled that around 1,000 buildings in Zagreb had been assessed as unlivable, around 4,000 as temporarily unlivable and 14,500 as livable but partly damaged. There are about 500 more damaged or temporarily unlivable buildings in Krapina-Zagorje and Zagreb counties, mostly family houses, he said. RBI awarded project within NATO's Science for Peace and Security programme ZAGREB, May 29(Hina) - The Rudjer Boskovic Institute (RBI) has been awarded a projectto upgrade a sophisticated detector for detecting hazardous materials and cargo within NATO's Science for Peace and Security(SPS) programme. Project ManagerIvana Capan, who is the head of an RBI laboratory, has beentasked with working on the upgrade of the detector in the next three years. Once upgraded, the new detector is expected to use, apart from neutrons, also gamma and X-rays, which will expand its use and make it more efficient. Another five researchers from theCroatian institute as well as several researchers from Japan, Portugal and Slovenia are engaged in thenew project, called e-Sicure2. Arms exports drop 50%, paper says ZAGREB, May 29(Hina) - 2019 was the worst year for Croatia's arms industry in over five years, Vecernji List daily said on Friday. Last year'sarms industry exports were only HRK 493 million, down 50% on 2018 and three and a half times worse than in the record year 2016, when Croatia exported nearly HRK 1.7 billion worth of arms, according to an annual report which Economy Minister Darko Horvat presented to the government on Thursday. The report is secret given that it does not statenames of manufacturers nor types of product. Until now, HS Produkt has accounted for over half of Croatia's arms exports. In 2016, Croatia exported €224 million worth of arms, mainly because HS Produkt sold a record 575,000 handguns in the US, which ranked Croatia third among handgunsuppliers forthe US. When Donald Trump was elected president, sales dropped 20%. Vecernji List said that whenever the US had a Republican president, HS Produkt sold much less arms, which made2019 a record bad year. CEOZeljko Pavlin said turnover dropped over 50% to HRK 340 million, whereas in 2016 it stood at HRK 921 million. "Fortunately, in 2020 handgun production increased so much that in July already we will probably achieve a better result than in all of last year," he was quoted as saying. NGOssay police systematically expel migrant children ZAGREB, May 29(Hina) - The Centre for Peace Studies and the Welcome Initiative on Friday accusedthe prime minister and the interior minister of ignoring accusations of violent and unlawful pushbacks onthe border, notably of children, and demanded that those who use violence be punished. The two organisations presented outside the government the sixthreport on the violent and unlawfulexpulsion of children and unaccompanied children, which containstestimonies from children who asked for Croatia's protection but, they claim, Croatia responded with violence. Tea Vidovic of the Welcome Initiative said PM Andrej Plenkovic and Interior Minister Davor Bozinovic "have been looking away for years from the testimonies and accusations, silently pursuing a policy to curry favour with the European Union. Those most vulnerable, children, are not sparedviolence." The two organisations demandthe government and the Interior Ministry take responsibility so that those ordering and carrying out systematic violence are punished. The report brings testimonies of children and their families as well as unaccompanied children about methods which break national and international laws as well as human rights and prevent access to international protection. Children speak of police brutality and beingunlawfully detainedfor hours, without water or food, the organisations say. "The government is using every opportunity to underline the importance of border protection, but how exactly are police protecting our border by beating children, taking their personal belongings, closing children in police vans for hours during which they are exposed to extremely high or extremely low temperatures, firing shots or using tasers?" said Ana Cuca of the Centre for Peace Studies. No one knows the exact number of children who are victims of police brutality and since 2017, the Border Violence Monitoring network has recorded 209 cases of violent and unlawful expulsions of children from Croatia, Cuca said. In the first nine months of 2019, Save the Children recorded 2,969 pushbacks of children on Western Balkan borders, she added. She recalled that there were two cases against Croatia at the European Court of Human Rights over unlawful pushbacks. The first concerns the family of Madine Hussiny, a six-year-old girl who died, and the second concernsthe expulsion, unlawful detention and inhumane treatmentby Croatian policeof a 17-year-old Syrian boy who was expelled to Bosnia and Herzegovina despite seeking asylum in Croatia. "Responsible institutions have the duty to investigate those who use violence and unlawfully expel children who need protection. All children who suffered violence deserve justice and protection," said Vidovic and Cuca. WB: 400,000will fall into poverty in W. Balkans due to COVID-19 pandemic ZAGREB, May 29 (Hina) - The World Bank has warned that the COVID-19 pandemic could have dire consequences for the economies of the Western Balkans and that recovery would depend on measures to be taken by the authorities. In an analysis published on its web site on Friday the World Bank recalls that in its regular economic report for the region in the autumn of 2019 it had warned that regional economy could face serious risks due to an anticipated drop in growth rates both globally and regionally, and that the situation had now been made worse by the pandemic. WB analysts say that many jobs were expected to be lost in the Western Balkans and that without an appropriate response by the governments, at least 400,000 people could fall into poverty, with the middle class being the most affected financially. A large number of jobs are temporary or in the informal sector. As the COVID-19 crisis unfolds, those jobs are likely to be most affected by closures and the progress achieved in previous years will be annulled. What is worst, many of those workers will not be able to benefit from social welfare, the World Bank analysis says. It notes that careful management of liquidity is an important challenge for governments to prevent the crisis from further escalating while providing assistance to those who need it the most. How big that challenge will be depends on how long the economic standstill willlast as the future will be significantly determined by the pace of depletion of capital and liquidity reserves. Wherever there is space for monetary or fiscal policy, now is the time to use it to maintain the economy's productive capacity and market functioning and for support to and salvaging of the economies and existence, say the WB analysts, calling on Western Balkan governments to focus on relaunching the economy as soon as possible. Central Bosnian town still epicentre of COVID-19, 11 new cases ZAGREB, May 29(Hina) - The central Bosnian town of Tesanj remains the latest hotspot of COVID-19 in the country, with 11 new cases confirmed in the last 24 hours, hospital sources said on Friday. There are now 63 infections in that town in the Croat-Bosniak Federation entity, where the disease broke out on May 21. Fourteen new cases were reported on Thursday and 19 on Wednesday. Local authorities have said that the disease has spread from the Koza-komerc protective clothing factory, which employs around 80 people, but patient zero has not beenidentified. All the infected are workers or members of their families. Around 100 local residents are in self-isolation. The situation in other parts of the country is still favourable, as it has been over the past two weeks. Shopping malls reopened on Thursday, and the government has decided to open the border to nationals of all neighbouring countries, including Croatia, on June 1. Bosnia's federation lifts a state of natural disaster ZAGREB, May 29 (Hina) - The government of the Federation of Bosnia and Herzegovina declared on Friday the end of a state of natural disaster, assessing that the epidemiological situation was stable enough to continue with regular activities. The decision was reached at a teleconference presided by Deputy Prime Minister Jelka Milicevic, as Prime Minister Fadil Novalic has been detained since Thursday in connection with an investigation concerning the suspicious procurement of ventilators for hospitals. The state of natural disaster was in force since March 16 in the Federation entity. In accordance with the Bosnian government's decision, the country opens its borders to inhabitants of neighbouring countries on June1. In other news: Vukovar donates HRK 200,000 to Zagreb ZAGREB, May 29 (Hina) - The eastern city of Vukovar has decided to donate HRK 200,000 (approx. €26,700) to Zagreb to help it remove the consequences of an earthquake that hit the capital city on March 22. Offering Zagreb congratulations on the occasion of its day, May 31, and the Feast of Our Lady of the Stone Gate, Vukovar City authorities said they hoped reconstruction work in Zagreb would be completed as soon as possible and the city would emerge even more beautiful and stronger than it was before the quake. ZSE indices close week with five-day winning streak ZAGREB, May 29 (Hina) - The Zagreb Stock Exchange (ZSE) indices on Friday increased for more than half a percent, realising gains for the fifth consecutive day, and owing to that they rose by more than 4% compared to the previous week. On Friday, the Crobex increased by 0.52% to 1,635 points, while the Crobex10 rose by 0.87% to 1,015 points. Both indices increased for the fifth consecutive day, reaching the highest levels since mid-March. The ZSE main indices thus increased for the third consecutive week, with the Crobex up by 4.18% and the Crobex10 up by 4.29%. Regular turnover reached HRK 10.12 million, which is HRK 5.4 million more than on the previous day. The largest turnover in regular trading, of HRK 3.55 million, was generated by the Valamar Riviera hotel company shares. Its share price increased by 3.37% to HRK 27.6. The HT telecommunications operator shares generated a turnover of HRK 1.39 million, while its price increased by 0.6% to HRK 168.5 per share. The Ericsson Nikola Tesla telecommunications company share turned over HRK 949,000, and its price increased by 1.64% to HRK 1,240. (€1 = HRK 7.584233) THIS BULLETIN INCLUDES NEWS ITEMS RELEASED BY 2100 HRS FRIDAY. (Hina) ms Masthead Brief News Bulletin is published by the Croatian News Agency HINA Marulićev trg 1610 000 ZagrebCroatia web:   [*www.hina.hr*](http://www.hina.hr) mail: [*hina@hina.hr*](mailto:hina@hina.hr) phone: (+385 1) 48 08 660; fax (+385 1) 48 08 822 Publisher: Branka Gabriela Valentić, DirectorEditor in Chief: Serđo Obratov Bulletin Editor: Marija Šestan

**Load-Date:** May 30, 2020

**End of Document**



[***Register of Commission documents: REPORT on competition policy – annual report 2019 P9\_A(2020)0022 / FULL / EN26/02/2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:5YB9-KY41-JDG9-Y05C-00000-00&context=1516831)

Impact News Service

February 29, 2020 Saturday

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**Length:** 16969 words

**Body**

Brussels: Public Register European Parliament has issued the following document:

RR\1199837EN.docx PE641.227v03-00EN United in diversity ENEuropean Parliament2019-2024Plenary sittingA9-0022/202025.2.2020REPORTon competition policy – annual report 2019(2019/2131(INI))Committee on Economic and Monetary AffairsRapporteur: Stéphanie Yon-CourtinPE641.227v03-00 2/42 RR\1199837EN.docxENPR\_INICONTENTSPageMOTION FOR A EUROPEAN PARLIAMENT RESOLUTION.............................................3OPINION OF THE COMMITTEE ON INTERNATIONAL TRADE....................................20OPINION OF THE COMMITTEE ON ***AGRICULTURE*** AND RURAL DEVELOPMENT26LETTER OF THE COMMITTEE ON THE INTERNAL MARKET AND CONSUMERPROTECTION..........................................................................................................................36INFORMATION ON ADOPTION IN COMMITTEE RESPONSIBLE.................................42FINAL VOTE BY ROLL CALL IN COMMITTEE RESPONSIBLE ....................................43RR\1199837EN.docx 3/42 PE641.227v03-00ENMOTION FOR A EUROPEAN PARLIAMENT RESOLUTIONon competition policy – annual report 2019(2019/2131(INI))The European Parliament,– having regard to the Treaty on the Functioning of the European Union (TFEU), inparticular Article 101 to Article 109 thereof,– having regard to the relevant Commission rules, guidelines, resolutions, publicconsultations, communications and papers on the subject of competition,– having regard to the Commission report of 15 July 2019 on Competition Policy 2018(COM(2019)0339) and to the Commission staff working document published as asupporting document on the same date,– having regard to its resolution of 31 January 2019 on the Annual Report on EUCompetition Policy1,– having regard to the mission letter of 10 September 2019 from President-elect Ursulavon der Leyen to Margrethe Vestager,– having regard to the written and oral replies given by Commissioner-designateMargrethe Vestager at the hearing by the European Parliament on 8 October 2019,– having regard to the Commission Communication on the recovery of unlawful andincompatible State aid (2019/C 247/01), having regard to Directive (EU) 2019/1 of the European Parliament and of the Councilof 11 December 2018 to empower the competition authorities of the Member States tobe more effective enforcers and to ensure the proper functioning of the internal market2,– having regard to Regulation (EU) 2019/1150 of the European Parliament and of theCouncil of June 2019 on promoting fairness and transparency for business users ofonline intermediations services3;– having regard to the opinion of the European Economic and Social Committee of 11December 2019 on the Commission report of 15 July 2019 on Competition Policy 2018, having regard to the opinion of the Committee of the Regions of 5 December 2019 onthe Commission report of 15 July 2019 on Competition Policy 2018, having regard to the report of 4 April 2019 entitled ‘Competition policy for the digitalera’ by high-level experts from the Commission, having regard to the Preliminary Opinion of 26 March 2014 from the European Data1 Texts adopted, P8\_TA(2019)0062.2 OJ L 11, 14.1.2019, p. 3.3 OJ L 186, 11.7.2019, p. 57.PE641.227v03-00 4/42 RR\1199837EN.docxENProtection Supervisor on ‘Privacy and competitiveness in the age of big ***data***: Theinterplay between ***data*** protection, competition law and consumer protection in theDigital Economy’ and the Opinion 8/2016 of 23 September 2016 from the EuropeanData Protection Opinion on ‘Coherent enforcement of fundamental rights in the age ofbig ***data***’, having regard to the Statement of 29 August 2018 from the European ***Data*** Protection f29 August 2018 on the ***data*** protection impacts of economic concentration, having regard to the letter of 4 February 2020 sent to Commissioner MargretheVestager by France, Germany, Italy and Poland’s Economic and Finance, having regard to the proposal of 4 July 2019 by France, Germany and Poland entitled‘For a modernised European Competition Policy’, having regard to the 2019 report by the European Consumers’ Organisation (BEUC) on‘The Role of Competition Policy in Protecting Consumers’ Wellbeing in the DigitalEra’, having regard to the Commission's decision of 7 January 2019 to prolong seven setsof EU State aid rules (State aid modernisation initiative for 2014-2020) until the end of2022 and to launch evaluations in the meantime, having regard to the Council conclusions of 22 March and 27 May 2019, having regard to the statement of 18 December 2018 issued by 18 Member States at the6th Friends of Industry ministerial meeting, having regard to the report from report of the Strategic Forum for Important Projects ofCommon European Interest entitled ‘Strengthening strategic value chains for a futurereadyEU industry’, having regard to the ongoing revision of the guidelines on horizontal cooperation, having regard to the public consultation on horizontal block exemption regulations, having regard to the opinion of the European Economic and Social Committee of 12July 2018 entitled ‘Towards an appropriate European legal framework for socialeconomy enterprises’ (INT871),– having regard to Rule 54 of its Rules of Procedure,– having regard to the opinions of the Committee on International Trade and theCommittee on ***Agriculture*** and Rural Development,– having regard to the letter from the Committee on the Internal Market and ConsumerProtection,– having regard to the report of the Committee on Economic and Monetary Affairs (A9-0022/2020),RR\1199837EN.docx 5/42 PE641.227v03-00ENA. whereas competition and effective enforcement of competition policy must benefit allEU citizens, especially those in a weak consumer position, while promoting innovationand fair competition among businesses operating in the single market, in particular byensuring that small and medium-sized enterprises (SMEs) have the opportunity tocompete on a fair basis;B. whereas competition policy must be adapted to tackle digital, ecological, geopolitical,industrial and social challenges, and must be in line with the priorities outlined in theEuropean Green Deal and the objectives of the Paris Agreement, in order to ensure alevel playing field in all sectors as a cornerstone of the EU social market economy,while taking into account social economy enterprises;C. whereas global cooperation on competition enforcement helps to avoid inconsistenciesin remedies and in outcomes of enforcement actions and helps businesses to reduce theircompliance costs;D. whereas in fast-moving digital markets, competition policy could in some cases beexcessively slow and therefore be at risk of being ineffective when it comes toremedying systemic market failures and reinstating competition; whereascomplementary ex-ante regulation and monitoring could prove beneficial to ensuremore effective oversight;E. whereas European competition authorities should be equally attentive in order to avoidunder-enforcement in digital markets, as the latter are wary of over-enforcement;F. whereas the primary objective of EU competition policy is to prevent the distortion ofcompetition in order to preserve the integrity of the internal market and to protectconsumers;G. whereas given that recent ***data*** scandals, investigations and evidence have shown howpersonal ***data*** is being ***collected***, used and sold to third parties by platforms and howdominant techology players and platforms have been tracking consumers onlinesystematically;The role of competition policy in globalised markets1. Points out that, in a globalised world, international cooperation is crucial to ensureeffective competition enforcement; calls on the Commission to further develop theinfluence of EU competition policy in the world, in particular by continuing pertinentdialogue and stepping up cooperation with the USA, China, Japan and other thirdcountries, where possible, via second-generation cooperation agreements that allow fora more effective exchange of information between competition authorities; supports theactive participation of the Commission and the national competition authorities in theInternational Competition Network; encourages the Commission to seek at all times theinclusion of competition rules (covering also State aid) in EU free trade agreements(FTAs) and in the World Trade Organisation (WTO), in order to ensure mutual respectfor fair competition; notes with regret the negative effect on the Commission of theparalysis within the WTO’s Dispute Settlement Body;2. Calls on the Commission to develop tools to facilitate better monitoring of foreignPE641.227v03-00 6/42 RR\1199837EN.docxENdirect investment (FDI) in all Member States, to ensure a rapid implementation of thescreening mechanism for FDIs and to propose a tool to strengthen the currentmechanism, while ensuring that the European Union remains open and attractive forFDI; draws the Commission’s attention to the fact that companies in third countriesbenefit from favourable treatment in their home market, which may distort competitionwhen investing in the single market;3. Calls on the Commission to ensure reciprocity with third countries in publicprocurement, State aid and in investment policy including taking into account social andenvironmental dumping; recalls the need to open up public procurement markets inthird countries to which access does not yet exist; urges the Commission to worktowards the accession of key third countries, such as China, to the WTO Agreement onGovernment Procurement with an acceptable initial offer; stresses that any instrumentaimed at improving international market opening, such as the EU’s InternationalProcurement Instrument that are to be finalised by 2021 must avoid additionalbureaucracy and new market distortions that have adverse effects on EU companies;4. Calls on the Commission to guarantee fair competition between the European Unionand the United Kingdom following its departure from the EU in order to ensure a levelplaying field and avoid dumping;5. Fully supports the implementation of Important Projects of Common European Interest(IPCEI) such as the European Battery Alliance; calls on the Commission to furtherpromote major IPCEIs in disruptive technologies, to simplify the relevant provisionsand to streamline its requirements so that smaller industrial research projects are alsoapproved;6. Recalls the need for the Commission to apply State aid control equally to EU and non-EU operators to avoid asymmetries with foreign competitors and pay increased attentionto foreign-based state-owned companies that are subsidised by their governments inways that the EU single market rules prohibit for EU entities; invites the Commission tolook at the recent proposal of the Dutch Government and investigate the option to add apillar to EU competition law that gives the Commission appropriate investigative toolsin cases where a company is deemed to have engaged in distortionary behaviour due togovernment subsidies or to have made excessive profits based on a dominant marketposition in its home country ( e.g by introducing state-aid checks on companies fromthird countries in EU public procurement rules);7. Reiterates its request for the Commission to examine whether possible distortions ofcompetition arise from the corporate support purchase programme, especially betweenSMEs and multinational corporations;8. Calls on the Commission to adopt a more favourable approach for strong EU industrialpolicy to ensure and maintain high competitiveness in global markets; stresses that theCommission and the Member States should promote and support EU projects ofstrategic interest and remove barriers and obstacles to enable the emergence ofinnovative EU leaders in specific priority sectors for the EU, while respecting theindependent application of competition rules that safeguard a level playing field;clarifies that this approach should not be to the detriment of SMEs and consumersRR\1199837EN.docx 7/42 PE641.227v03-00ENinterests, should focus on the transition towards a more sustainable economy and acompetitive EU ***data*** industry and digital infrastructure, such as the development of 5G;9. Calls on the Commission to seize the opportunity of the revision of the guidelines onhorizontal cooperation agreements to create a more flexible framework and increaselegal certainty for companies; calls on the Commission to communicate more timelyand efficiently to the holders of cooperation projects of a certain magnitude, and allowfor the possibility of asking new questions as part of a voluntary fast-track notificationprocedure;10. Welcomes the Commission’s commitment set out in its notice of 9 December 19974 toreview its definition of the relevant market so as to take into account a longer-termvision encompassing the global dimension, digitalisation and potential futurecompetition; invites the Commission to continue to rely on sound economic and legalprinciples in its investigations, by following proportionality principles and due process,when looking into new types of markets;11. Emphasises that an international level playing field in a rules-based multilateral tradingsystem safeguarding states’ policy-making scope is key for Europe, including Europeancompanies and in particular SMEs, as well as for workers and consumers; considers thatit contributes to boosting sustainable economic development, ensuring a stable andpredictable environment, pursuing enhanced competitiveness and reciprocity, securingand creating decent jobs in the EU and third countries, and ensuring high labour andenvironmental standards, since an increasing number of jobs are dependent on globalvalue chains; stresses in this regard the importance of increased transparency,sustainability and corporate accountability in global value chains, and calls on the EU toconsider, among other measures, establishing a legal framework for mandatory duediligence in global value chains as a necessary step for achieving this;12. Invites the Commission, in the light of the growing debate, to reconcile the EUcompetition rules, industrial policy and international trade, which must go hand in handwith sustainability and respect for the environment; underlines the specific need forresearch funding as the basis of innovation and development for European businessesand as a key element for boosting trade and competitiveness;13. Underlines that SMEs play a vital role in international trade, accounting for anestimated 30 % of the EU’s goods exports to the rest of the world5; considers that theinternal market continues to be, by far, the most important market for SMEs; recallsthat, in order to help SMEs cope with the greater challenges of entering new marketsand enable them to compete on their own merits, EU trade and competition policyshould contribute to economic diversity and an SME-friendly trade environment, andthat this should include considering modernising the EU’s definition of SMEs, inparticular by adding qualitative criteria;14. Fully supports the Commission’s efforts in the context of the ongoing reform of theWTO, including its Appellate Body, to update and make effectively enforceable the4 OJ C 372, 9.12.1997, p.5 5 [*https://ec.europa.eu/****eurostat****/****statistics****-explained/index.php/International\_trade\_in\_goods\_by\_enterprise\_sizePE641.227v03-00*](https://ec.europa.eu/eurostat/statistics-explained/index.php/International_trade_in_goods_by_enterprise_sizePE641.227v03-00) 8/42 RR\1199837EN.docxENmultilateral rules on subsidies or sectoral initiatives in order to adequately address theissue of subsidies at international level, with particular reference to industrial subsidies,state-owned enterprises and forced technology transfers, and to act to counter nonmarket-oriented policies and practices of third countries; calls on the Commission tofully involve Parliament and the Member States in this area;15. Stresses that effective enforcement of the sustainable development provisions of tradeagreements is important for ensuring fair competition and environmental and socialstandards; welcomes, in this perspective, the introduction of environmental and socialcriteria in the reform of anti-subsidy and anti-dumping measures; considers that thepossible inclusion of precise, justiciable International Law Organisation (ILO) corestandards under WTO law could also be explored in the context of the ongoing WTOreform and in order to contribute to a global level playing field;16. Welcomes, in this context, the ongoing plurilateral WTO negotiations on e-commerce,and calls for a comprehensive and ambitious set of rules that will address digital tradebarriers, ensure that companies can compete worldwide in a level playing field, andenhance consumer trust in the online environment without detriment to European dataprotection standards; emphasises that the EU should take a leading role in theseinternational negotiations, with close consultations that involve the EuropeanParliament, Member States and stakeholders, including civil society;17. Considers that access to the EU internal market is to be contingent on compliance withsanitary, phytosanitary and environmental standards; calls on the Commission to ensurethe EU trade and competition policy doesn’t undermine the respect of EU social andecological standards or undermine the development of more ambition standards;18. Welcomes the modernisation of trade defence instruments (TDIs) and the developmentof new instruments to protect European companies from unfair competition arising fromdifference of social and environmental standards with third countries; points out,however, that there are inconsistencies between these defence instruments and EU tradepolicy – in particular the Commission’s signature of an FTA with Japan, even thoughJapan has not ratified two of the eight ILO conventions; calls on the Commission toexamine whether the TDIs are consistent with EU trade policy, and with FTAs inparticular;19. Calls on the Commission to properly analyse and study the public procurement marketsof the third countries with which it has or is negotiating a free trade agreement, in orderto negotiate the best access conditions for European companies;20. Calls on the Commission to coordinate the necessary action by the Directorates-Generalinvolved – DG Trade and DG Competition – to ensure that the competition rules andtheir implementation guarantee fair competition for European companies in thirdcountrymarkets, and vice versa;21. Calls on the Commission to pay particular attention to the role of international standardsettingfor fair competition; insists that the EU should strengthen its multilateralapproach to standard-setting, in particular in the context of the InternationalOrganisation for Standardisation (ISO) and the International ElectrotechnicalCommission (IEC); warns against the nationalisation of standard-setting approaches,RR\1199837EN.docx 9/42 PE641.227v03-00ENparticularly in the context of China’s Belt and Road Initiative and other connectivityenhancingstrategies; calls on the Commission to establish a high-level coordinator forstandardisation policy in this context;22. Highlights the importance of incorporating a gender-based perspective both atmultilateral and bilateral level, including gender chapters in trade agreements anddesigning gender-sensitive measures (e.g ensuring that both ex ante and ex post impactassessments include the gender impact of EU trade policy and agreements), in order toboost competition and promote inclusive economic growth;Adapting competition to the digital age23. Calls on the Commission to review merger and acquisition rules and strengthen antitrustaction and to take into account the effects of market and network power associated withboth personal and financial ***data***; calls, in particular, on the Commission to adjudge thecontrol of such ***data*** as a proxy for the existence of market power under its guidance onArticle 102 of the TFEU; invites the Commission to learn from the merger betweenFacebook and WhatsApp and adapt its criteria accordingly; proposes, therefore, thatevery merger in the market for such ***data*** should be subject to prior informal declaration;24. Calls on the Commission to review the notion of ‘abuse of a dominant position’ and the‘essential facilities' doctrine to ensure that they are fit for purpose in the digital age;suggests a broader analysis of market power in connection to conglomerate andgatekeeper effects to fight the abuse of dominance of large operators and lack ofinteroperability; calls on the Commission to carry out a stakeholder consultation toreflect the evolution of the digital economy, including its multi-sided nature;25. Calls on the Commission to consider revising the thresholds for a merger review inorder to include factors such as the number of consumers affected and the value of therelated transactions as part of its ongoing evaluation of the Merger Regulation6;26. Calls on the Commission to assess higher levels of concentration due to horizontalownership by large asset management companies in its ongoing evaluation of theMerger Regulation and consider providing guidelines on the use of Article 101 andArticle 102 of the TFEU in this respect;27. Notes that in several specific markets for financial ***data*** (e.g equity trading, ratings andbenchmarks), oligopolistic concentration may lead to cases of abuse of dominantpositions by suppliers with investors and consumers of financial ***data***; calls on theCommission to take resolute action against such abuses of dominant positions, whichare harmful to the fluidity of financial markets and run counter to the interests ofsustainable development;28. Stresses that, while a number of start-ups are created in the hope of an acquisition by alarger firm, the buying-out of start-ups by dominant players, including big technologycompanies and platforms, might stifle innovation and threaten sovereignty; calls on theCommission and the national competition authorities to look into the practices of suchacquisitions and their effects on competition, especially with regard to ‘killer6 OJ L 24, 29.1.2004, p. 1.PE641.227v03-00 10/42 RR\1199837EN.docxENacquisitions’, as defined in its high-level expert report of 4 April 2019 entitled‘Competition policy for the digital era’; calls on the Commission to conduct a study onthe reversal of burden of proof as per the Act on Digitalisation of German CompetitionLaw (‘GWB-Digitalisierungsgesetz’) published in October 2019;29. Asks the Commission to assess how more demanding regimes of ***data*** access, includingdata interoperability, can be imposed in particular when ***data*** access opens up secondarymarkets for complementary services or when ***data*** is confined to dominant firms;30. Stresses that some entities, which benefit from dual status as both platforms andsuppliers, abuse their position to impose unfair terms and conditions on competitors,independently of whether they are active online or offline; calls on the Commission tolook into the issue of self-preferencing and enforce the necessary laws and use theinstruments required on those entities that practice self-preferencing; calls on theCommission to assess the possibility of imposing ex ante regulatory obligations wherecompetition law is not enough to ensure contestability in these markets, thereforeavoiding competitors’ foreclosure and ensuring that emerging bottlenecks are notperpetuated by the monopolisation of future innovation;31. Notes that the Commission is reflecting on the need for targeted ex ante regulation onspecific systemic issues that may arise in digital markets; calls, therefore, on theCommission to introduce a centralised ex ante market monitoring system (while takinginto account the results of an impact assessment), to provide EU and nationalcompetition and regulatory authorities with the necessary means to gather dataanonymously so as to be able to better detect market failures in due time, and – whereappropriate – to introduce targeted regulation when practices become systemic;32. Invites, therefore, the Commission to identify the key digital players and establish a setof indicators to define their systemic nature; stresses that the following indicators couldbe considered: abuse of practices of certain extensive networks, control of a significantvolume of non-replicable ***data***, an unavoidable situation on a multifaceted market or theplayer’s ability to define market rules themselves;33. Draws the Commission’s attention to acquisitions carried out by foreign monopolies ofdigital ***data*** operators, including health, financial and educational ***data***, and to theprivacy risks involved, which extend far beyond the already damaging effects oftransactions of this kind on competition; calls on the Commission to take those aspectsinto account regarding the upcoming European strategy for ***data*** and to investigate thecross-usage of ***data***, where ***data*** originating from one service is used to expand theplatforms’ offering to new services;34. Calls on the Commission to draft up EU best practice guidelines on ***data*** ethics thatcompanies and businesses can apply to their business models; underlines that such dataethics would complement ***data*** protection rules and would increase consumer safety andtrust; proposes that these EU guidelines on ***data*** ethics include the following as keyprinciples:a) transparency- the consumer is fully informed about and co-controls which ***data*** is being usedand whether such ***data*** is accurate;RR\1199837EN.docx 11/42 PE641.227v03-00EN- transparency as to whether the company shares ***data*** with public authorities orbusiness partners;b) ***data*** safety- consumers must be reassured that ***data*** kept remain safe, meaning thatcooperation across the board on ***data*** safety needs to be prioritised- a clause on not selling ***data*** to third parties;35. Stresses that, while intermediation platforms play a major role in providing access toconsumers for online services, some abuse their privileged position by acting asgatekeepers, including in closed ecosystems and online marketplaces; calls on theCommission to give explicit attention in its competition policy to these gatekeepers andto conclude its ongoing investigations as soon as possible;36. Urges the Commission to increase freedom of choice for consumers and to strengthenthe role of the European Consumers Centres Network (ECC-Net) in the spirit of theECN+ Directive7 , with a view to setting up a proper EU consumers authority; notes, inthat context, that competition policy is not only about ensuring fair prices for consumersbut also providing quality, variety and innovation;37. Stresses that it is in the interest of the European Union to have pan-European paymentsystems; calls on the Commission to support initiatives that meet this objective and torecognise that their success is contingent both on the innovative nature of the system forconsumers and businesses and on the viability of its economic model;Effectiveness of competition policy instruments38. Stresses that fines can have an impact on the reputation of the companies penalised;points out, nevertheless, that even when heavy fines are imposed, they often are notenough of a deterrent and may ultimately be passed on to consumers; calls on theCommission to also make use of alternative behavioural and, if need be, structuralremedies in order to fully ensure the effectiveness of EU competition policy; stressesthat the cease-and-desist order should be much more prescriptive in upcoming remedies;39. Recalls that abuse of market power can take place even when products or services aresupplied for free; believes that the passing on of private ***data*** to third parties formarketing or commercial purposes is frequently done without the consumer’s properconsent, as alternatives to sharing ***data*** are often not provided; considers that in thedigital economy, the concentration of ***data*** in a small number of companies leads tomarket failures, excessive rent extraction and a blocking of new entrants;40. Recalls that the online search market is of particular importance when ensuringcompetitive conditions in the digital single market; notes with regret that one searchengine that has over 92 % of market share in the online search market in most of theMember States has become a gatekeeper of the Internet; calls for input from allstakeholders, covering the past nine years of antitrust history, to be used to urgentlyassess if remedies proposed truly benefit consumers, internet users and onlinebusinesses in the long term; calls on the Commission to consider a proposal aimed atunbundling search engines –as outlined in Parliament’s resolution of 27 November 20147 OJ L 11, 14.1.2019, p.3 PE641.227v03-00 12/42 RR\1199837EN.docxENon supporting consumer rights in the digital single market8 – from their commercialservices in order to end the status quo, which could be a potential long-term means ofachieving fair and effective competition in the European digital market;41. Stresses the slowness of the antitrust investigations, such as the Google Shopping case,compared to the fast-moving digital markets; stresses the damaging effect resultingfrom this situation and the financial and structural risks to which some actors areexposed if they initiate lengthy and costly proceedings; stresses that due process mustbe respected, but calls on the Commission to make use of fast-track antitrust proceduresand to find new incentives, such as the leniency programme, to make companies morecooperative when it comes to tracking down cartels across the EU;42. Stresses the need to regularly look at the possibility of using interim measures to stopany practice that would seriously harm competition; calls on the Commission to relaxthe criteria for these measures, while respecting the rule of law, in order to avoid anyirreversible damage; calls on the Commission to revise the Notice on Remedies (2008/C267/01)9 by taking into account the developments and evolution of the digital sectorover the last years;43. Welcomes the Commission’s continued efforts to address abusive behaviour by largeplatforms; calls on the Commission to revisit cases where the remedies offered haveclearly been ineffective at restoring competition to the market, as in the case of GoogleShopping; stresses that, in the absence of targeted and effective behavioural remediesthat have been tested in advance with the affected undertaking, a complete structuralseparation of general and specialised search services, including local search, may benecessary; underlines that compared with structural remedies, behavioural remediescould offer a time-efficient solution, mitigating the possibility that competitors areforced out of the market during prolonged discussions on divestiture;44. Points out the need for the Commission to allocate adequate resources to be able toeffectively enforce EU competition rules; notes the need to ensure specific expertise,especially on growing issues such as dominant positions of online platforms or artificialintelligence;45. Calls on the Commission to issue guidance on the interpretation of ‘significantimpediment to effective competition’, as set out in the Merger Regulation, so that incases of mergers, the Commission does not only look at prices, output and innovationbut also pays attention to the social and environmental costs of such transactions in lightof TFEU principles, and to pay particular attention to environment protection;46. Calls on the Commission to inquire about this new checking account service that will beprovided to consumers by some of the world’s biggest tech companies in forthcomingyears; urges the Commission to give particular focus to their entry into this new digitalfinancial market and the huge amount of ***data*** they will gather from their consumers andthe potential use of it;8 OJ C 289, 9.8.2016, p.65 9 OJ C 267 , 22.10.2008, p.1 RR\1199837EN.docx 13/42 PE641.227v03-00ENCompetition rules supporting the European Green Deal47. Supports the Commission’s review of the State aid guidelines in all relevant sectors,such as in transport, including air and maritime, in line with the objectives of theEuropean Green Deal by applying the just transition principle and acknowledging thecomplementary role of the Member States’ governments to support investments indecarbonisation and clean energy while ensuring a level playing field and that there isno market distortion; calls on the Commission to examine, in the context of the reviewof the Energy Taxation Directive10, whether the current tax exemptions provide forunfair cross-sector competition conditions;48. Stresses the need for the Commission to prevent any potential negative side-effects wherelarger companies use public aid granted in view of ‘greening’ their business models forother objectives such as reinforcing its dominant position in a given sector;49. Calls on the Commission to provide further guidance and an enabling framework forfurther investments in energy efficiency and building renovation, as well as onrepowering, hybrid projects and electricity storage;50. Underlines in this regard that in order for the European Green Deal to be successful,European producers of sustainable products and services need to see the advantages of itand not face unfair competition from companies in third countries;51. Notes that the European Green Deal must ensure policy consistency betweenagriculture, climate action, environment and trade;Sectoral policies52. Calls on the Commission to make more systematic use of investigations in sectors thatare essential to the everyday life of citizens, such as health, mobility, online advertising,energy, tourism, including monitoring price caps of online accommodation platforms,culture, financial and payment services, and the media, in the digital age, whilemaintaining the EU’s high standards;53. Calls on the Commission to take note of the presence of national monopolies andoligopolies as a potential signal of the existence of weaknesses in the single market orbarriers to fair competition;54. Requests that the Commission carry out a preliminary study on the concentration ofmedia ownership in Europe, also in the context of multinational corporations buying outEuropean media providers;55. Reiterates that taxation is sometimes used to grant indirect State aid, creating an unevenplaying field in the internal market; calls on the Commission to update its existingguidelines on the notion of State aid to ensure that the Member States do not grant Stateaid in the form of a tax advantage; deplores the abuse of tax rulings and welcomes therecent judgments of the General Court confirming that examination by the Commissionof a tax ruling under a State aid point of view does not constitute tax harmonisation;observes that Commission rulings are often challenged in court and therefore need to be10 OJ L 283, 31.10.2003, p.51 PE641.227v03-00 14/42 RR\1199837EN.docxENthoroughly prepared; insists that the Commission have access to the informationexchanged between the Member States’ tax authorities so as to better detect violationsof competition rules; calls for the adoption of the proposal on the CommonConsolidated Corporate Tax Base (CCCTB) and the public country-by-countryreporting;56. Calls on the Commission to look into the possibility to fine countries found in breach ofState aid rules;57. Calls on the Commission to examine swiftly the discrepancies between the rules on Stateaid in the area of liquidation aid and the resolution regime under the Bank Recovery andResolution Directive11, and to revise its Banking Communication of 30 July 201312accordingly, including in light of recent cases, taking into account the need to protecttaxpayers;58. Calls the Commission to have a close look at cases in the banking sector with potentialcompetitive relevance in certain Member States where consumers currently face highinterest rates13 and a lack of transparency when it comes to loans, potentially due toconcentration of ownership in the banking sector, which could lead to deceptive sellingpractices of mortgages;59. Calls on the Commission to re-evaluate on an annual basis whether the requirements forthe application of Article 107(3)(b) of the TFEU in the financial sector continue to befulfilled;60. Calls, further, on the Commission to follow the example of the UK Competition andMarkets Authority to investigate thoroughly and to propose further measures to addressthe quasi monopoly of the ‘Big Four’ accountancy companies auditing the largest listedcompanies; highlights, in this respect, the recommendations of the UK Competition andMarkets authority recommending for the separation of audit from consulting services, aswell as the setting up of mandatory ‘joint audit’ to enable firms outside the Big Four todevelop the capacity needed to review the biggest companies;61. Calls on the Commission to guarantee fair competition and greater transparency inoffline platforms’ commercial practices, including supermarket and hypermarkets, so asto ensure that EU producers receive fair conditions and prices for their products; callson the Commission to continue its in-depth analysis on the extent and effect of buyingalliances, related to both pricing and non-pricing strategies, on the economicfunctioning of the ***agricultural*** and food supply chain, taking particular account of theeffects on small-scale suppliers and farmers; regrets the fact that selling at a loss is noton the list of practices that are prohibited at EU level; highlights that the Farm to Forkstrategy and EU competition law must recognise the important contribution made byprimary producers in supplying high-quality food and delivering public goods tosociety,62. Calls for a clearer, more flexible and more predictable application of competition rules11 OJ L 173, 12.6.2014, p. 190.12 OJ C 216, 30.7.2013, p. 1.13   [*https://****data****.worldbank.org/indicator/FR.INR.LNDP?locations=RO&most\_recent\_value\_desc=falseRR*](https://data.worldbank.org/indicator/FR.INR.LNDP?locations=RO&most_recent_value_desc=falseRR)\1199837EN.docx 15/42 PE641.227v03-00ENto producers and producer organisations (POs) so as to increase legal certainty; calls,therefore. on the Commission to assess the implementation and clarify the provisions ofSingle Common Organisation of the Markets (CMO) Regulation14, in particular withregard to the exceptions to competition rules granted to certain agreements and practicesof farmers in association; encourages the establishment of more POs as a way forfarmers to strengthen their position and effectively negotiate on price and tackle theimbalances in power within the food supply chain;63. Calls on the Commission to exempt from State aid rules tax provisions specificallyintroduced by Member States to encourage farmers to set up voluntary precautionarysavings with a view to coping better with the upsurge in climate-driven and health risks,as well as economic crises; welcomes the completion of the review of the De MinimisRegulation15, which will help farmers to address climate challenges while preventingany market distortions; highlights the particular need for clear guidelines for theagricultural sector owing to the environmental and sustainability requirements;welcomes the ongoing fitness check of the 2012 State aid modernisation package andthe ongoing revision of the ***Agricultural*** Block Exemption Regulation16;64. Calls on the Commission to assess the implementation and clarify the scope ofArticle 209 of the Single CMO Regulation, specifically with regard to the exceptions tocompetition rules granted to certain agreements and practices of farmers in associations,in order to provide those concerned with greater clarity and legal certainty when thisarticle is implemented, and to give the Commission greater flexibility in implementingthis article;65. Recognises the role of interbranch organisations in the chain, which serve as a platformfor dialogue, research and development, best practices and market transparency;66. Calls for the role of interbranch organisations to be strengthened in order to promotemore balanced relationships in the food chain, and supports the extension of thevalue-sharing clause to cover all operators rather than just the first purchaser, in linewith the draft report adopted in April 2019 by Parliament’s Committee on Agricultureand Rural Development on the new common organisation of the markets in agriculturalproducts as part of the next reform of the common ***agricultural*** policy (CAP);67. Calls for an automatic express exemption from Article 101 of the TFEU to be providedunder Article 210 of the Single CMO Regulation, subject to the principles of necessityand proportionality, allowing ***agricultural*** interbranch organisations to accomplish thetasks assigned to them by the Single CMO Regulation, with a view to furthering theaims of Article 39 of the TFEU;68. Calls on the Commission to ensure that the provisions of Article 222 of the Single CMORegulation are activated swiftly in order to address serious market distortions;69. Welcomes the success of the supply management measures introduced for qualitycheese and ham at the request of POs, interbranch organisations and groups of14 OJ L 347, 20.12.2013, p. 671.15 OJ L 352, 24.12.2013, p.1 16 OJ C 213, 8.9.2009, p. 9.PE641.227v03-00 16/42 RR\1199837EN.docxENoperators; calls for the provisions of the Single CMO Regulation authorising theintroduction of supply control rules to be extended to cover all products benefiting froma protected designation of origin (PDO) or a protected geographical indication (PGI) inorder to achieve a better balance between supply and demand;70. Asks the Commission to engage in dialogue with all relevant stakeholders on thefunctioning of the ***agricultural*** and food supply chain, and to adapt EU competitionpolicy in line with the most recent developments in the trading environment;71. Welcomes the adoption of Directive (EU) 2019/633 17 April 2019 on unfair tradingpractices in business-to-business relationships in the ***agricultural*** and food supplychain17, which represents an important first step in ensuring fairness between operatorsand in addressing the imbalance of the bargaining power within the food supply chain;urges Member States to transpose the directive without delay and calls on theCommission to monitor the progress of transposition closely and to promote the sharingof best practices between Member States; encourages Member States to list furtherunfair practices as prohibited and set higher standards;72. Recalls that significant horizontal and vertical restructuring has taken place, which hasled to further consolidation in the already concentrated seed, agro-chemical, fertiliser,animal genetics and farm machinery sectors, as well as in processing and retailing; callson the Commission, when assessing mergers in these sectors, to consider impactsbeyond consumer prices; stresses that the interests of EU farmers, citizens and theenvironment must be protected, by comprehensively and holistically assessing theimpact, at farm level, of mergers and acquisitions among ***agricultural*** input suppliers,including producers of plant protection products;73. Considers it essential that the Commission continue its detailed monitoring of the EUmarket for pesticides, seeds and traits, and monitor the impact of digitalisation on theagricultural sector;74. Urges the Commission to set up a permanent EU-level information platform on riskmanagement tools to help farmers cope with the uncertainty of climate, market volatilityand other risks where stakeholders can exchange best practices, as set out in itscommunication on the future of food and farming from November 2017;75. Points out that large disparities in direct payments hamper sustainable farmers’initiatives for the climate and the environment and distort competition in the EU; recallsthe commitment made by the European Council on 7-8 February 2013 to harmonisepayments throughout the EU by 2013;76. Draws attention to the growing number of farmers’ protests and notes that thecumulative impact of free trade agreements (FTAs) on the EU’s agri-food sector is oneof their concerns; questions whether FTAs leave EU agri-food producers at acompetitive disadvantage, given differences in social, health, labour, environmental andanimal welfare standards in third countries; therefore calls on the Commission topresent, as soon as possible, its latest report on the cumulative impact of ongoing andfuture trade deals, and calls for the application of the principles of reciprocity andcompliance for ***agricultural*** products and for the protection of vulnerable sectors in17 OJ L 111, 25.4.2019, p. 59.RR\1199837EN.docx 17/42 PE641.227v03-00ENfuture and ongoing trade negotiations, ensuring that all necessary inspections are carriedout;77. Welcomes the proposal for a regulation on the single market programme, and, morespecifically, the food chain actions supported therein, such as veterinary andphytosanitary measures, to address animal and plant health crises; urges the Council andParliament to swiftly conclude the negotiations and adopt the regulation;78. Underlines the importance of timely conclusions to the Commission’s two proposals fortransition regulations, in order to avoid delays and complications that could lead tomarket instability;79. Considers it essential to keep within DG AGRI all competencies relating to theapplication of Articles 209 and 210 of the Single CMO Regulation and to State aid forthe development of ***agricultural*** and forestry sectors and of rural areas, thereby ensuringthe expertise needed to address and coordinate matters in this area, which is necessarygiven the specific nature of these sectors and is fully consistent with the objectives andsupport provided under the CAP;80. Calls on the Commission to continue to pay particular attention to the provision ofservices of general economic interest (SGEI) when applying State aid rules, especiallyin the context of isolated, remote or peripheral regions and islands in the Union; notescertain difficulties in applying the rules of the Almunia package for certain SGEIs, suchas the postal sector, whose public service missions may, in accordance with EU law, bedefined and organised at national level;81. Recalls the need for a roadmap for better-targeted State aid, especially for the deliveryof services of general economic interest including energy, transport ortelecommunications;82. Reiterates its call for coal regions to be identified as assisted areas in accordance withArticle 107(3) (a) and (c) of the TFEU and for EU aid rules for these special regions tobe adapted so as to enable measures to be taken to deal with structural change; insiststhat coal mining companies and coal power plant operators that have received and stillreceive public support for mining and burning coal must not be subject to a privilegedState-aid treatment, including for traditional corporate responsibility activities such asground water restoration, landscape refurbishment or other cleaning-up sites relatedactivities; calls on the Commission to provide clear guidance and conditionality in linewith EU climate commitments;83. Welcomes that the Commission has included in its targeted review of the General BlockExemption Regulation (GBER)18 the extension of this scheme to European TerritorialCooperation projects (also called Interreg);84. Is concerned about asymmetric treatment of EU-funded operations depending onwhether they are supported on EU side by cohesion policy resources or other EU fundsor programmes such as Horizon2020/Horizon Europe or EFSI2.0/ InvestEU as proposedby the Commission in its GBER review; believes that a level playing field should be18 OJ L 187 26.6.2014, p. 1.PE641.227v03-00 18/42 RR\1199837EN.docxENmaintained for projects that are similar in nature, but different in financing sources asthis would privilege certain funding schemes while crowding out others;A better focus on citizens through Parliament85. Calls, without Treaty change, for regular use of the ordinary legislative procedure incompetition policy, by analogy with the procedure for the Antitrust Damages Directive19and the ECN+ Directive;86. Calls on the Commission to report regularly to Parliament on the implementation andmonitoring of cooperation agreements with reference to competition, on the screeningof foreign direct investments; calls on the Commission to maintain high transparencystandards;87. Stresses its desire to play a greater role in determining and developing the generalframework for competition policy; notes that Parliament should be more involved in theactivity of working parties and expert groups, such as the International CompetitionNetwork (ICN), as an observer to get a better knowledge of the matter and keep itupdated on the developments in order to be more prepared for its role as co-legislator;calls on the Commission to particularly involve Parliament when devising soft-lawinstruments such as notices and guidelines;88. Calls on the Commission to organise multisectoral and interinstitutional forumsinvolving industry, national regulators including ***data*** protection authorities, consumergroups and other relevant stakeholders to decompartmentalise competition policy;89. Stresses that the current complaint form for State aid cases requests many specificdetails on when the State aid had been accorded, which ordinary citizens cannotpossibly know; calls. therefore, on the Commission to simplify the complaint form inorder to give ordinary citizens the possibility to send in complaints;90. Notes with regret the lack of information provided during the Commission’sinvestigation of submitted complaints; calls on the Commission to give the complainanta confirmation of receipt and a notification upon the launch of the investigation,including an expectation of the length of the investigation;91. Recalls the importance of coordination with national competition authorities and callson the Commission to present to Parliament an assessment of the implementation of theECN+ Directive; recalls that in the annex of the ECN+ Directive the Commissionidentified ‘interim measures’ as ‘a key tool for competition authorities to ensure thatcompetition is not harmed while an investigation is on-going’; recalls the need to assesswhether there are means to simplify the adoption of interim measures in the ECN withintwo years from the date of transposition of the Directive in order to enable competitionauthorities to deal more effectively with developments in fast-moving markets;92. Points out that the political independence of competition authorities is of utmostimportance to ensure the impartiality and credibility of competition policy; recognisesthat preventing distortion of competition requires public scrutiny of lobbying efforts in19 OJ L 349, 5.12.2014, p. 1.RR\1199837EN.docx 19/42 PE641.227v03-00ENall EU institutions; reiterates, therefore, its calls for an enhanced EU TransparencyRegister; insists that there be a more regular exchange with the Commission, in linewith the inter-institutional agreement with Parliament; calls on the Executive Vice-President for competition to stay in close contact with the ECON committee and with itsCompetition Working Group, which is an appropriate place for establishing a moreregular dialogue;93. Recalls the commitment made by the Executive Vice-President of the EuropeanCommission for Europe Fit for the Digital Age during her confirmation hearing on 8October 2019 to keep her digital policy and competition portfolios strictly separate;94. Instructs its President to forward this resolution to the Council, the Commission, thenational parliaments and national competition authorities.PE641.227v03-00 20/42 RR\1199837EN.docxEN22.1.2020OPINION OF THE COMMITTEE ON INTERNATIONAL TRADEfor the Committee on Economic and Monetary Affairson competition policy – annual report 2019(2019/2131(INI))Rapporteur for opinion: Enikő GyőriSUGGESTIONSThe Committee on International Trade calls on the Committee on Economic and MonetaryAffairs, as the committee responsible, to incorporate the following suggestions into its motionfor a resolution:1. Emphasises that an international level playing field in a rules-based multilateral tradingsystem safeguarding states’ policy-making scope is key for Europe, including Europeancompanies and in particular small and medium-sized enterprises (SMEs), as well as forworkers and consumers; considers that it contributes to boosting sustainable economicdevelopment, ensuring a stable and predictable environment, pursuing enhancedcompetitiveness and reciprocity, securing and creating decent jobs in the EU and thirdcountries, and ensuring high labour and environmental standards, since an increasingnumber of jobs are dependent on global value chains; stresses in this regard theimportance of increased transparency, sustainability and corporate accountability inglobal value chains, and calls on the EU to consider, among other measures,establishing a legal framework for mandatory due diligence in global value chains as anecessary step for achieving this;2. Invites the Commission, in the light of the growing debate, to reconcile the EUcompetition rules, industrial policy and international trade, which must go hand in handwith sustainability and respect for the environment; underlines the specific need forresearch funding as the basis of innovation and development for European businessesand as a key element for boosting trade and competitiveness;3. Underlines that SMEs play a vital role in international trade, accounting for anestimated 30 % of the EU’s goods exports to the rest of the world1; considers that theinternal market continues to be by far the most important market for SMEs; recalls that,in order to help SMEs cope with the greater challenges of entering new markets andenable them to compete on their own merits, EU trade and competition policy should1   [*https://ec.europa.eu/****eurostat****/****statistics****-explained/index.php/International\_trade\_in\_goods\_by\_enterprise\_sizeRR*](https://ec.europa.eu/eurostat/statistics-explained/index.php/International_trade_in_goods_by_enterprise_sizeRR)\1199837EN.docx 21/42 PE641.227v03-00ENcontribute to economic diversity and an SME-friendly trade environment, and that thisshould include considering modernising the EU’s definition of SMEs, in particular byadding qualitative criteria;4. Stresses that EU competition policy should promote fair competition and reciprocaltrading conditions in the internal market and at global level, with the further aim ofstrengthening industry’s efforts to also contribute to innovation and a just transitiontowards a climate-neutral EU economy; reiterates that EU competition rules apply to allactors active on the internal market; calls, therefore, for unfair trading practices to beaddressed effectively through a more coordinated, assertive and integrative approach bymaking full use of existing and reinforced instruments in such fields as competition,trade, defence and procurement, and by developing new and effective policies and toolsand tackling the effects on the internal market of distortions in international marketssuch as foreign state ownership and subsidies, in particular where EU funding isinvolved; calls for the strengthening of the anti-subsidy instrument by including asubsidy control mechanism;5 Calls on the Commission, in this context, also to consider whether it is appropriate tomodernise or update the interpretation of targeted competition rules while nothampering competition on relevant markets in the EU, also reforming the state aidguidelines and including state subsidies and government ownership as criteria in theEU’s public procurement directives in order to safeguard the long-term viability ofEurope’s industrial base and to the benefit of European consumers; welcomes, againstthis backdrop, the new Commission’s intention to strengthen the foreign directinvestment screening mechanism as soon as sufficient experience with the presentlegislation has been ***collected***;6 Points out the need to reduce persisting asymmetries in international public procurementmarkets, and calls on the Commission to show ambition in opening foreign markets toEU companies, especially SMEs; welcomes the renewed discussions on the EU’sinternational procurement instrument (IPI), and asks for it to be adopted by 2020 inorder to guarantee reciprocity where trade partners restrict their access to theirprocurement markets;7. Calls, moreover, on the Commission to further enhance global cooperation oncompetition matters, including pertinent dialogue with the US, Japan and other partners;calls on the Commission to ensure an international level playing field and to agree oncommon standards and procedures via bilateral trade agreements and in internationalfora such as the Organisation for Economic Cooperation and Development (OECD), theUnited Nations Conference on Trade and Development (UNCTAD), the World TradeOrganisation (WTO), the International Labour Organisation (ILO) and the World Bank;asks the Commission to be active in strengthening the International CompetitionNetwork (ICN), and highlights the importance of effective cooperation with thirdcountrynational competition authorities in order to increase the effectiveness of specificinvestigations;8 Fully supports the Commission’s efforts in the context of the ongoing reform of theWTO, including its Appellate Body, to update and make effectively enforceable themultilateral rules on subsidies or sectoral initiatives, in order to adequately address thePE641.227v03-00 22/42 RR\1199837EN.docxENissue of subsidies at international level, with particular reference to industrial subsidies,state-owned enterprises and forced technology transfers, and to act to counter nonmarket-oriented policies and practices of third countries; calls on the Commission tofully involve the European Parliament and the Member States in this area;9. Welcomes the presence of specific competition chapters in recently concluded bilateraltrade and investment agreements, and calls on the Commission to continue negotiatingmodern, ambitious and enforceable provisions on competition and state aid in all futuretrade agreements, as part of a holistic and ambitious EU trade policy;10 Stresses that effective enforcement of the sustainable development provisions of tradeagreements is important for ensuring fair competition and environmental and socialstandards; welcomes, in this perspective, the introduction of environmental and socialcriteria in the reform of anti-subsidy and anti-dumping measures; considers that thepossible inclusion of precise, justiciable ILO core standards under WTO law could alsobe explored in the context of the ongoing WTO reform and in order to contribute to aglobal level playing field;11. Calls on the Commission to ensure that competition rules are compatible with a fastchangingglobal economy and best serve European consumers, workers and businessesby fully taking into account the impact of the digitisation of the economy on how globalmarkets operate; calls on the Commission to address the impact of global e-commercein terms of increasing competition within retail markets, enhancement of consumerchoice and impact on product distribution and jobs; acknowledges that online platformsare key enablers of digital trade, but highlights in particular that the emergence of thedigital economy has led to excessive concentration of markets and power; stresses theneed to focus on key issues such as access to and portability of ***data***, role and presenceof platforms in the markets, and technological neutrality;12 Welcomes, in this context, the ongoing plurilateral WTO negotiations on e-commerce,and calls for a comprehensive and ambitious set of rules that will address digital tradebarriers, ensure that companies can compete worldwide in a level playing field, andenhance consumer trust in the online environment without detriment to European dataprotection standards; emphasises that the EU should take a leading role in theseinternational negotiations, with close consultations that involve the EuropeanParliament, Member States and stakeholders, including civil society;13. Calls on the Commission to properly analyse and study the public procurement marketsof the third countries with which it has or is negotiating a free trade agreement, in orderto negotiate the best access conditions for European companies;14. Calls on the Commission to coordinate the necessary action by the Directorates-Generalinvolved - DG Trade and DG Competence - to ensure that the competition rules andtheir implementation guarantee fair competition for European companies in thirdcountrymarkets, and vice versa;15. Calls on the Commission to pay particular attention to the role of international standardsettingfor fair competition; insists that the EU should strengthen its multilateralapproach to standard-setting, in particular in the context of ISO and IEC; warns againstthe nationalisation of standard-setting approaches, particularly in the context of China’sRR\1199837EN.docx 23/42 PE641.227v03-00ENBelt and Road Initiative and other connectivity-enhancing strategies; calls on theCommission to establish a high-level coordinator for standardisation policy in thiscontext;16. Highlights the importance of incorporating a gender-based perspective both atmultilateral and bilateral level, including gender chapters in trade agreements anddesigning gender-sensitive measures (e.g ensuring that both ex ante and ex post impactassessments include the gender impact of EU trade policy and agreements), in order toboost competition and promote inclusive economic growth.PE641.227v03-00 24/42 RR\1199837EN.docxENINFORMATION ON ADOPTION IN COMMITTEE ASKED FOR OPINIONDate adopted 21.1.2020Result of final vote +:–:0:3531Members present for the final vote Nikos Androulakis, Anna-Michelle Asimakopoulou, Tiziana Beghin,Geert Bourgeois, Jordi Cañas, Anna Cavazzini, Ellie Chowns, MiroslavČíž, Arnaud Danjean, Nicola Danti, Emmanouil Fragkos, Barbara AnnGibson, Markéta Gregorová, Enikő Győri, Roman Haider, ChristopheHansen, Heidi Hautala, Danuta Maria Hübner, Karin Karlsbro, JudeKirton-Darling, Maximilian Krah, Danilo Oscar Lancini, Bernd Lange,Emmanuel Maurel, Samira Rafaela, Luisa Regimenti, Inma Rodríguez-Piñero, Massimiliano Salini, Helmut Scholz, Liesje Schreinemacher,Sven Simon, Mihai Tudose, Kathleen Van Brempt, Marie-PierreVedrenne, Jörgen Warborn, James Wells, Iuliu Winkler, Jan ZahradilSubstitutes present for the final vote Angelika WinzigRR\1199837EN.docx 25/42 PE641.227v03-00ENFINAL VOTE BY ROLL CALL IN COMMITTEE ASKED FOR OPINION35 +ECR Geert Bourgeois, Emmanouil Fragkos, Jan ZahradilID Roman Haider, Danilo Oscar Lancini, Luisa RegimentiNI Tiziana BeghinPPE Anna-Michelle Asimakopoulou, Arnaud Danjean, Enikő Győri, Christophe Hansen, Danuta Maria Hübner,Massimiliano Salini, Sven Simon, Jörgen Warborn, Iuliu Winkler, Angelika WinzigRENEW Jordi Cañas, Barbara Ann Gibson, Karin Karlsbro, Samira Rafaela, Liesje Schreinemacher, Marie-PierreVedrenneS&D Nikos Androulakis, Miroslav Číž, Nicola Danti, Jude Kirton-Darling, Bernd Lange, Inma Rodríguez-Piñero,Mihai Tudose, Kathleen Van BremptVERTS/ALE Anna Cavazzini, Ellie Chowns, Markéta Gregorová, Heidi Hautala3 -GUE/NGL Emmanuel Maurel, Helmut ScholzNI James Wells1 0ID Maximilian KrahKey to symbols:+ : in favour- : against0 : abstentionPE641.227v03-00 26/42 RR\1199837EN.docxEN28.1.2020OPINION OF THE COMMITTEE ON ***AGRICULTURE*** AND RURALDEVELOPMENTfor the Committee on Economic and Monetary Affairson competition policy – annual report 2019(2019/2131(INI))Rapporteur for opinion: Isabel CarvalhaisSUGGESTIONSThe Committee on ***Agriculture*** and Rural Development calls on the Committee on Economicand Monetary Affairs, as the committee responsible, to incorporate the following suggestionsinto its motion for a resolution:A. whereas Article 42 of the Treaty on the Functioning of the European Union (TFEU)states that rules on competition shall apply to production of and trade in agriculturalproducts only to the extent determined by the European Parliament and the Council andtaking into account the objectives set out for the common ***agricultural*** policy (CAP) inArticle 39 of the TFEU;B. whereas one of the CAP objectives set out in Article 39 of the TFEU is to ensure a fairstandard of living for the ***agricultural*** community, in particular by increasing theindividual earnings of persons engaged in ***agriculture***;C. whereas the Court of Justice in its judgment of 14 November 20171 (‘the EndivesCase’) confirmed that the CAP takes precedence over competition rules; whereas theCourt ruled that practices related to a concertation on prices or quantities put on themarket or exchanges of strategic information may escape the prohibition of agreements,decisions and concerted practices laid down in Article 101(1) of the TFEU if they areagreed between the members of the same producer organisation (POs) or the sameassociation of producer organisations (APOs) recognised by a Member State and arestrictly necessary for the pursuit of one or more of the objectives assigned to theseorganisations, in compliance with EU legislation;D. whereas Regulation (EU) No 2017/23932 (the ‘Omnibus Regulation’) containsexemptions from the application of Article 101 of the TFEU, establishing, namely, that1 Judgment of the Court of Justice of 14 November 2017, President de l’Autorité de la concurrence vAssociation des producteurs vendeurs d’endives (APVE) and Others.2 OJ L 350, 29.12.2017, p. 15.RR\1199837EN.docx 27/42 PE641.227v03-00ENthe ***collective*** activities of POs and their APOs are necessary to attain the CAPobjectives as defined in Article 39 of the TFEU provided that the joint activities aregenuinely exercised and help to improve farmers’ competitiveness; whereas, as a result,activities such as production planning and contract negotiation are exempt from theprovisions established in Article 101 of the TFEU;E. whereas the specific nature and structural features of the EU ***agricultural*** sector, mainlycomposed of small farms in economic terms, results in fragmented production anddifficulties and challenges facing some farmers in responding and adapting to marketchanges and demands; whereas this contrasts with the high level of concentration of theother operators in the food supply chain, resulting in serious disadvantages in terms offarmers’ negotiating power and should be taken into account by the Commission andthe national authorities when enforcing competition rules;F. whereas the future CAP should focus on supporting small and family farms whileensuring that sustainable farming practices are being implemented; whereas such goalscan be achieved only by taking a uniform approach across all EU policies, includingcompetition policy;G. whereas unforeseeable natural disasters and unpredictable production circumstances,such as adverse weather conditions and disease outbreaks, are likely to make the marketfor ***agricultural*** products even more volatile, subject to crisis, and further weaken thebargaining position of farmers vis-à-vis buyers; whereas access to exceptional measuresthat aim to preserve market stability is important in this regard;H. whereas cooperation between farmers plays an essential role in strengthening theirposition in the food supply chain, contributes to the CAP objectives and helps farmersto respond to increasing societal demands; whereas many EU farmers are not yet able tobenefit from membership of producers’ organisations, thereby making their positionwithin the food supply chain highly vulnerable and weakening their bargaining power;whereas there is therefore a need to strengthen POs, including through consolidation,and APOs;I. whereas the competitiveness of EU farmers greatly depends on the proper and fairfunctioning of the internal market as well as on the clear interpretation and enforcementof State aid and competition policy rules governing all agri-food chain operators and, inparticular, POs, APOs, and on other forms of cooperation between producers in theagricultural sector;J. whereas abusive practices and the increasing consolidation trend in the input and retailsectors of the ***agricultural*** and food supply chain distort competition and innovation,thereby directly and indirectly affecting both producers and consumers;K. whereas digital technologies can help European farmers to provide safe, sustainable andquality food and help reduce the environmental impact of ***agriculture***, improve workingconditions for farmers and increase rural attractiveness, in particular for youngergenerations; whereas there is less of an incentive for the private sector to invest inbroadband provision in these areas;1. Calls on the Commission to take specific account of the fact that, as the Court of JusticePE641.227v03-00 28/42 RR\1199837EN.docxENhas ruled, CAP goals must be given priority over those relating to competition policy,by an application of competition rules to producers and POs which is clearer, moreflexible and more predictable POs;2. Stresses that, because of its specific nature and long production cycles, farming cannotbe compared to any other activity as far as elasticity of supply is concerned, and that thelogic of the market cannot therefore be applied to the farming sector in the same way asit is applied to other sectors;3. Welcomes the 2018 study undertaken on behalf of the Commission on POs and theiractivities in the olive oil, beef and veal, and arable crops sectors, which reaffirms theimportance of these organisations and their associations in strengthening the position ofprimary producers in the food chain and in contributing positively to the CAP objectivesset out in Article 39 of the TFEU; notes the study’s findings that there are five timesmore non-recognised POs/APOs than those formally recognised and that the lack ofsupport from governments poses a challenge for the establishment of POs and APOs;regrets the fact that POs are not developed to the same extent throughout the MemberStates and calls for the elimination of remaining hurdles in the recognition process andfor the guarantee of legal certainty; calls on the Commission, in this regard, to raiseawareness of the benefits of having POs recognised under Regulation (EU)No 1308/20133 establishing a common organisation of the markets in agriculturalproducts (Single CMO Regulation) and encourages the establishment of more POs as away for farmers to strengthen their position and effectively negotiate on price and tacklethe imbalances in power within the food supply chain, among their other roles;4. Considers it essential to clarify the provisions governing POs, APOs and interbranchorganisations in the Single CMO Regulation within the framework of the ongoing CAPreform, particularly as regards competition policy, building on the progress made by theOmnibus Regulation, and in line with the Court of Justice’s ruling in the Endives Case,thereby providing greater legal certainty and improving the position of farmers in thefood chain;5. Calls on the Commission to assess the implementation and clarify the scope ofArticle 209 of the Single CMO Regulation, specifically with regard to the exceptions tocompetition rules granted to certain agreements and practices of farmers in associations,in order to provide those concerned with greater clarity and legal certainty when thisarticle is implemented, and to give the Commission greater flexibility in implementingthis article;6. Welcomes the study compiled for the Commission on the best ways for POs to beformed, carry out their activities and be supported, which recognises the contributionthat POs and APOs make to the economic, technical and social development of theirmembers, with potential indirect beneficial effects for farmers who are not members ofPOs and positive externalities for other operators in the food supply chain; highlightsthe need to ensure legal certainty for POs, notably with regard to recognition criteriaand activities;7. Recognises the role of interbranch organisations in the chain, which serve as a platform3 OJ L 347, 20.12.2013, p. 671.RR\1199837EN.docx 29/42 PE641.227v03-00ENfor dialogue, research and development, best practices and market transparency;8. Calls for the role of interbranch organisations to be strengthened in order to promotemore balanced relationships in the food chain, and supports the extension of thevalue-sharing clause to cover all operators rather than just the first purchaser, in linewith the draft report adopted in April 2019 by Parliament’s Committee on Agricultureand Rural Development on the new common organisation of the markets in agriculturalproducts as part of the next CAP reform;9. Calls for an automatic express exemption from Article 101 of the TFEU to be providedunder Article 210 of the Single CMO Regulation, subject to the principles of necessityand proportionality, allowing ***agricultural*** interbranch organisations to accomplish thetasks assigned to them by the Single CMO Regulation, with a view to furthering theaims of Article 39 of the TFEU;10. Calls on the Commission to ensure that the provisions of Article 222 of the Single CMORegulation are activated swiftly in order to address serious market distortions;11. Welcomes the success of the supply management measures introduced for qualitycheese and ham at the request of POs, interbranch organisations and groups ofoperators; calls for the provisions of the Single CMO Regulation authorising theintroduction of supply control rules to be extended to cover all products benefiting froma protected designation of origin (PDO) or a protected geographical indication (PGI) inorder to achieve a better balance between supply and demand;12. Asks the Commission to engage in dialogue with all relevant stakeholders on thefunctioning of the ***agricultural*** and food supply chain, and to adapt EU competitionpolicy in line with the most recent developments in the trading environment;13. Welcomes the adoption of Directive (EU) 2019/633 17 April 2019 on unfair tradingpractices in business-to-business relationships in the ***agricultural*** and food supplychain4, which represents an important first step in ensuring fairness between operatorsand in addressing the imbalance of the bargaining power within the food supply chain;urges Member States to transpose the directive without delay and calls on theCommission to monitor the progress of transposition closely and to promote the sharingof best practices between Member States; encourages Member States to list furtherunfair practices as prohibited and set higher standards;14. Regrets the fact, however, that the scope of the directive on unfair practices in the foodsupply chain does not cover all suppliers, as it excludes those that are not SMEs, and thefact that selling at a loss is not on the list of practices that are prohibited at EU level;15. Expresses concern about unsustainable downward pressure on farm prices as a result ofexcessive processor or buyer power downstream in ***agricultural*** supply chains;encourages the Commission to revise its approach in assessing the abuse of dominantmarket positions, to include cases which place unsustainable downward pressure onfarm prices, regardless of whether they result in higher consumer prices; considers thatbroader consumer interest includes support for fair incomes for farmers by securing a4 OJ L 111, 25.4.2019, p. 59.PE641.227v03-00 30/42 RR\1199837EN.docxENfair share of the value generated along the food supply chain, in order to ensure aneconomically and environmentally sustainable ***agricultural*** sector;16. Reiterates that CAP support is designed, inter alia, to ensure the sustainability of farmsand encourage farmers to produce quality food at reasonable prices; expresses itsconcern about the ever-widening disparity between the production price and sale pricein the food sector; calls on the Commission to identify and implement effective marketmeasures that will narrow this gap and establish a balanced and sustainable correlationbetween the two;17. Acknowledges the possible role that buying alliances plays in creating economicefficiencies in the ***agricultural*** and food supply chain; stresses, however, that the currentlack of information does not allow for an evaluation of the economic effects of suchbuying alliances on the functioning of the supply chain, particularly on possiblestrategic alignments, which can result in reduced competition and smaller margins forinvestment and innovation; calls on the Commission to continue its in-depth analysis onthe extent and effect of buying alliances on the economic functioning of the agriculturaland food supply chain, in particular for farmers, small producers and suppliers andSMEs;18. Welcomes the publication of Regulation (EU) 2019/1150 of the European Parliamentand of the Council of 20 June 2019 on promoting fairness and transparency for businessusers of online intermediation services5; takes note of the opening by the Commissionof a formal antitrust investigation to assess Amazon’s use of sensitive ***data*** fromindependent retailers and possible abuses of its dual role as retailer and marketplace,and expresses concerns about possible parallels in European supermarket platforms;stresses that possible differentiated or discriminatory treatment between own brands andother retail goods might distort competition in the market and reduce innovation andproduct choice for consumers; stresses that the Commission and national competitionauthorities must play their roles in ensuring that such situations do not arise;19. Welcomes the publication of the Commission’s report on the application of competitionrules in the ***agricultural*** sector; notes that a significant part of competition lawinfringements in the ***agricultural*** sector are committed by processors of agriculturalproducts while most of the complaints originate from farmers; calls for the effectivesupervision by the Commission of the companies active in the market of foodprocessing;20. Recalls that significant horizontal and vertical restructuring has taken place, which hasled to further consolidation in the already concentrated seed, agro-chemical, fertiliser,animal genetics and farm machinery sectors, as well as in processing and retailing; callson the Commission, when assessing mergers in these sectors, to consider impactsbeyond consumer prices; stresses that the interests of EU farmers, citizens and theenvironment must be protected, by comprehensively and holistically assessing theimpact, at farm level, of mergers and acquisitions among ***agricultural*** input suppliers,including producers of plant protection products;21. Considers it essential that the Commission continue its detailed monitoring of the EU5 OJ L 186, 11.7.2019, p. 57.RR\1199837EN.docx 31/42 PE641.227v03-00ENmarket for pesticides, seeds and traits, and monitor the impact of digitalisation on theagricultural sector;22. Considers that the costs of production must be taken fully into account when agreeingprices in contracts between producers and retailers/processors, and that prices shouldalso provide a fair remuneration for farmers; stresses the need for greater markettransparency to contribute to fairer price transmission along the supply chain; calls onthe Commission to improve market observatory ***data*** on volumes, prices and margins,particularly in the organic sector; calls on the Commission to develop indicators forproduction costs and margins which can then serve as references in contracts that takebetter account of cost of production and remuneration; requests that the Commissionensure clear guidelines on value sharing along the supply chain to enable pricetransmission at levels that are fair for both the consumer and the producer;23. Urges the Commission to set up a permanent EU-level information platform on riskmanagement tools to help farmers cope with the uncertainty of climate, market volatilityand other risks where stakeholders can exchange best practices, as set out in itscommunication on the future of food and farming from November 2017;24. Points out that large disparities in direct payments hamper sustainable farmers’initiatives for the climate and the environment and distort competition in the EU; recallsthe commitment made by the European Council on 7-8 February 2013 to harmonisepayments throughout the EU by 2013;25. Draws attention to the growing number of farmers’ protests and notes that thecumulative impact of free trade agreements (FTAs) on the EU’s agri-food sector is oneof their concerns; questions whether FTAs leave EU agri-food producers at acompetitive disadvantage, given differences in social, health, labour, environmental andanimal welfare standards in third countries; therefore calls on the Commission topresent, as soon as possible, its latest report on the cumulative impact of ongoing andfuture trade deals, and calls for the application of the principles of reciprocity andcompliance for ***agricultural*** products and for the protection of vulnerable sectors infuture and ongoing trade negotiations, ensuring that all necessary inspections are carriedout;26. Considers that the public demand for more sustainable food systems needs to beaddressed in competition policy in order to better integrate the value of public goods infood pricing, taking into account social, environmental and animal welfare concerns;calls on the Commission to clarify for producers and national competition authoritiesthe conditions under which agreements between operators in the same sector aimed atimproving the sustainability of the food supply chain can be made without breachingcompetition law, thereby recognising the contribution of sustainability agreementstowards improving the production of ***agricultural*** products, while benefiting consumersand society as a whole, notably in the framework of the current review of the HorizontalBlock Exemption Regulations and related guidelines; considers that clear guidelines areparticularly relevant to the ***agricultural*** sector owing to the environmental challenges itmust face and the sustainability requirements it must meet;27. Notes that the European Green Deal must ensure policy coherence between ***agriculture***,PE641.227v03-00 32/42 RR\1199837EN.docxENclimate action, environment and trade policy;28. Highlights that the Farm to Fork (F2F) strategy and EU competition law must recognisethe important contribution made by primary producers in supplying high-quality foodand delivering public goods to society, for which they are currently insufficientlyrewarded, and must aim to achieve sustainability across the whole food supply chain;notes that the F2F strategy would require a uniform approach encompassing all EUpolicies, safeguarding fair competition and ensuring a level playing field for allbusinesses, and must take account of the impact of climate change on the functioningand sustainability of the food supply chain and on food security;29. Welcomes the ongoing fitness check of the 2012 State aid modernisation package and,more specifically, the ongoing revision of the ***Agricultural*** Block Exemption Regulation(ABER) and the European Union guidelines for State aid in the ***agricultural*** and forestrysectors and in rural areas, which will cease to apply on 31 December 2020;30. Considers that public funding is essential to ensure the deployment of broadbandnetworks in rural and remote areas; calls on the Commission to promote and supportpublic sector decision-makers in better exploring the possibilities of public support onthe basis of the EU Guidelines for the application of State aid rules in relation to therapid deployment of broadband networks, with a view to making broadbandinfrastructure deployment faster and easier and ensuring that rural areas are not leftbehind;31. Calls on the Commission to exempt from State aid rules the tax provisions applyingspecifically to the ***agricultural*** sector that the Member States introduced to encouragefarmers to set up voluntary precautionary savings with a view to coping better with theupsurge in climate-driven and health risks, as well as economic crises;32. Welcomes the completion of the ***Agricultural*** de minimis Regulation review; points outthat the increase in the maximum amount of aid per single undertaking and in thenational cap, combined with the application of a sector cap, will help farms to cope withclimate challenges while preventing any market distortions;33. Welcomes the proposal for a regulation on the single market programme, and, morespecifically, the food chain actions supported therein, such as veterinary andphytosanitary measures, to address animal and plant health crises; urges the Council andParliament to swiftly conclude the negotiations and adopt the regulation;34. Underlines the importance of timely conclusions to the Commission’s two proposals fortransition regulations, in order to avoid delays and complications that could lead tomarket instability;35. Considers it essential to keep within DG AGRI all competencies relating to theapplication of Articles 209 and 210 of the Single CMO Regulation and to State aid forthe development of ***agricultural*** and forestry sectors and of rural areas, thereby ensuringthe expertise needed to address and coordinate matters in this area, which is necessarygiven the specific nature of these sectors and is fully consistent with the objectives andsupport provided under the CAP.RR\1199837EN.docx 33/42 PE641.227v03-00ENINFORMATION ON ADOPTION IN COMMITTEE ASKED FOR OPINIONDate adopted 22.1.2020Result of final vote +:–:0:4500Members present for the final vote Mazaly Aguilar, Clara Aguilera, Álvaro Amaro, Eric Andrieu, AttilaAra-Kovács, Carmen Avram, Adrian-Dragoş Benea, Benoît Biteau,Mara Bizzotto, Daniel Buda, Isabel Carvalhais, Asger Christensen,Angelo Ciocca, Ivan David, Paolo De Castro, Jérémy Decerle, HerbertDorfmann, Luke Ming Flanagan, Dino Giarrusso, Martin Häusling,Martin Hlaváček, Krzysztof Jurgiel, Jarosław Kalinowski, GillesLebreton, Norbert Lins, Mairead McGuinness, Marlene Mortler, UlrikeMüller, Juozas Olekas, Pina Picierno, Maxette Pirbakas, Sheila Ritchie,Bronis Ropė, Bert-Jan Ruissen, Anne Sander, Simone Schmiedtbauer,Annie Schreijer-Pierik, Veronika Vrecionová, Sarah Wiener, JuanIgnacio Zoido ÁlvarezSubstitutes present for the final vote Atidzhe Alieva-Veli, Franc Bogovič, Balázs Hidvéghi, Pär Holmgren,Peter Jahr, Petros Kokkalis, Zbigniew Kuźmiuk, Ivan Vilibor Sinčić,Massimiliano SmeriglioPE641.227v03-00 34/42 RR\1199837EN.docxENFINAL VOTE BY ROLL CALL IN COMMITTEE ASKED FOR OPINION45 +ECR Mazaly Aguilar, Krzysztof Jurgiel, Bert-Jan Ruissen, Veronika VrecionováGUE/NGL Luke Ming Flanagan, Petros KokkalisID Mara Bizzotto, Angelo Ciocca, Ivan David, Gilles Lebreton, Maxette PirbakasNI Dino GiarrussoPPE Álvaro Amaro, Franc Bogovič, Daniel Buda, Herbert Dorfmann, Balázs Hidvéghi, Peter Jahr, Norbert Lins,Mairead McGuinness, Marlene Mortler, Anne Sander, Simone Schmiedtbauer, Juan Ignacio Zoido ÁlvarezRENEW Atidzhe Alieva-Veli, Asger Christensen, Jérémy Decerle, Martin Hlaváček, Elsi Katainen, Ulrike Müller,Sheila RitchieS&D Clara Aguilera, Eric Andrieu, Attila Ara-Kovács, Carmen Avram, Adrian-Dragoş Benea, Isabel Carvalhais,Paolo De Castro, Juozas Olekas, Massimiliano SmeriglioVERTS/ALE Benoît Biteau, Martin Häusling, Pär Holmgren, Bronis Ropė, Sarah Wiener0 -0 0Key to symbols:+ : in favour- : against0 : abstentionRR\1199837EN.docx 35/42 PE641.227v03-00ENLETTER OF THE COMMITTEE ON THE INTERNAL MARKET AND CONSUMERPROTECTIONMs Irene TinagliChairCommittee on Economic and Monetary AffairsASP 15G306BRUSSELSSubject: Opinion on Competition Policy – Annual Report 2019 (2019/2131(INI))Dear Madam Chair,Under the procedure referred to above, the Committee on the Internal Market and ConsumerProtection asked to submit an opinion to your committee in the form of a letter.The Committee on the Internal Market and Consumer Protection considered the matter at itsmeeting of 23 January 2020. At that meeting1, it decided to call on the Committee on Economicand Monetary Affairs, as the committee responsible, to annex the following suggestions to itsreport.The Committee would also like to express its strong concern as regards a point in the draftECON report, namely paragraph 14, which proposes the establishment of a European consumerprotection authority. AM 199, tabled in ECON, adds that this body should be 'encompassingthe Consumer Protection Cooperation network'.The IMCO Committee would like to point out that firstly, as a general point, the subject matterof consumer protection is an exclusive competence of the IMCO Committee, and should not,as such, figure in ECON’s report, which should deal with matters under its exclusivecompetence. In this regard, I would like to recall that the Consumer Protection CooperationRegulation (Regulation (EU) 2017/2394) was a file for which the IMCO Committee wascompetent, and in which the ECON Committee played no role. Secondly, the point is also outof scope in regards to the annual competition policy report, on which the current procedure is1 The following were present for the final vote: Petra De Sutter (Chair, Rapporteur for the Opinion), PierreKarleskind (Vice-Chair), Maria Grapini (Vice-Chair), Róża Thun und Hohenstein (Vice-Chair), Maria ManuelLeitão Marques (Vice-Chair), Adam Bielan, Carlo Fidanza, Eugen Jurzyca, Beata Mazurek, Marco Zullo, PabloArias Echeverría, Andrey Kovatchev, Antonius Manders, Dan-Ştefan Motreanu, Kris Peeters, Andreas Schwab,Tomislav Sokol, Ivan Štefanec, Edina Tóth, Marion Walsmann, Andrus Ansip, Vlad-Marius Botoş, DitaCharanzová, Dinesh Dhamija, Svenja Hahn, Morten Løkkegaard, Anne-Sophie Pelletier, Martin Schirdewan,Alessandra Basso, Lars Patrick Berg, Hynek Blaško, Virginie Joron, Alex Agius Saliba, Brando Benifei, BiljanaBorzan, Evelyne Gebhardt, Adriana Maldonado López, Leszek Miller, Christel Schaldemose, Rasmus Andresen,Anna Cavazzini, Alexandra Geese, Marcel Kolaja.PE641.227v03-00 36/42 RR\1199837EN.docxENbased. As a consequence, I call on you to declare paragraph 14 of the draft report and allamendments to it, including AM 199, inadmissible.Yours sincerely,Petra De Sutter MD, PhDChairwomanCC: - Antonio TAJANI, Chair of the Conference of Committee ChairsRR\1199837EN.docx 37/42 PE641.227v03-00ENSUGGESTIONSI. Internal market1. Recalls that competition policy plays a key role in the internal market and that thefundamental objectives of competition law remain inherently linked to achieving thecompletion of the internal market, namely preventing the distortion of competition,building a fair and level playing field for all market participants to compete based onmerit, promoting growth of innovative enterprises, achieving a high level of consumerwelfare, and allowing consumers to choose between a variety of suppliers in order toget the best deals in terms of quality and value for money; considers that SMEs couldstand to benefit from rigorous application of competition rules, particularly in thedigital sphere;2. Welcomes the Commission’s ongoing fitness checks and future wholesale review ofCommission guidelines relating to competition law and policy as announced by thenew Commissioner during her confirmation hearing; in this context, looks forward tothe outcome of the ongoing revision of the Vertical Block Exemption Regulation andthe Vertical Guidelines due by 2022; calls on the Commission to strengthen andaccelerate competition enforcement practices in the context of increasingly fastmovingmarkets; underlines the need for competition policy and Commission andMember States’ decisions in relation to it to be completely independent from otherpolicies and decision-making; stresses that it is this independence that givescompetition decisions their weight and value and which ensures that they arerespected by companies and governments alike; welcomes the Commission’s use ofArt. 114 TFEU and Art. 103 TFEU in competition policy legislative files in the pastand calls for a systemic use of the ordinary legislative procedure for future legislativeproposals relating to competition;3. Notes that in an increasingly globalised economy, it is important to acknowledge thepotential distortion of competition in the internal market emanating from thirdcountrycompanies benefitting from State financing, whether in the form of State aidor subsidies; in this regard, calls on the Commission to take appropriate measures toensure fair market access;4. Stresses, however, that competition policy decisions should not be used as a form ofprotectionist measure or non-tariff barrier to trade and should rather, among otherthings, ensure proportionality and due process and analyse competition on a case-bycasebasis within the single market, while seeking remedies to market failures;5. Underlines that the service sector accounts for the greatest part of the EU economy,but that further development of services in the internal market is hampered by newand existing national legislation limiting competition between companies andconsumer choice; regrets that some local regulatory standards still focus on protectingtheir respective markets from fair competition;6. Recalls that, in order to fight effectively against anti-competitive practices, all aspectsof unfair competition must be taken into consideration;PE641.227v03-00 38/42 RR\1199837EN.docxENII. Digital Single Market7. Stresses the importance for the Commission and Member States’ competitionauthorities to keep pace with the new challenges of the digital age in terms of theirenforcement priorities, enforcement capacities and assessment of harm to consumers;8. Welcomes the Commission’s investigations into certain anti-competitive practices bycompanies operating in digital markets; encourages the Commission to close ongoingprocedures as soon as possible and to pursue a policy of pro-active and effectiveenforcement of the competition rules, in order to combat the abuse of dominantpositions and thereby foster innovation and innovative business models, as well asenabling consumers to seize all the opportunities of a fully-functioning Digital SingleMarket;9. Notes that, as regards the Digital Single Market and the manner in which digitisationaffects competition, there is an intrinsic complementarity between market regulationand competition policy, as highlighted in the Commission’s Special Advisers’ Reportentitled “Competition policy for the digital era”, namely that primary Union law asset out in Articles 101 - 109 TFEU can function as an effective ‘background regime’to enacting targeted legislation to combat competition-distorting practices in digitalmarkets, based on a thorough case-by-case analysis of relevant markets and marketfailures;10. Recalls that, during the eighth legislature, regulation of digital markets constituted thecore work of the IMCO Committee; in this context, highlights the importance ofcareful review of the e-Commerce Directive, particularly in the light of theCommission’s commitment to propose a Digital Services Act;Data11. Recalls the core role of ***data*** in the global digital economy; draws attention to theemergence of digital market players who control ever larger volumes of ***data***;emphasises the comparability of ***data*** to an essential facility in the real economy, as asource of considerable economic power and leverage; urges the Commission tocombat unjustified market practices and national regulatory barriers resulting inmonopolisation of ***data*** ***collection*** and restrictions on ***data*** flow and access; calls onthe Commission to support open ***data*** and fair access to ***data*** for all companies, inparticular SMEs and start-ups, so as to foster a competitive digital environment givingrise to more innovation, higher quality products and better services for consumers;Platforms12. Notes that online platforms permit millions of undertakings, including manyEuropean SMEs, to exploit the advantages of e-commerce; considers that, in order tocreate fair conditions of competition, it is necessary to pursue a regulatory policywhich includes proposals for targeted, sector-specific legislation in order to removethe imbalances that allow market players to abuse their position, while safeguardingEuropean values; in this regard, highlights that any new regulatory obligations onRR\1199837EN.docx 39/42 PE641.227v03-00ENplatforms must be subject to the principle of proportionality and not give rise tounjustified regulatory burdens for companies capable of stifling innovation andcompetition;13. Stresses the importance of continuing the regulatory debate as to the appropriatemechanisms for upholding the integrity of the European market in response to theattainment of dominant positions by a small number of online platforms due tonetwork effects and winner-take-all dynamics; expresses its concern as to the growingtrend of involuntarily bestowing rule-setting powers on such platforms in view ofcurrent regulatory gaps; calls on the Commission to use all the tools at its disposal tocombat emerging types of anti-competitive practices adopted by dominant platforms,such as abusive self-preferencing, and to ensure that the Regulation on promotingfairness and transparency for business users of online intermediations services(2019/1150) is respected by all market players; objects to the negative lock-in effectssuch anti-competitive practices have on consumer choice as well as market access;Remedies14. Welcomes the recent use of interim measures by the Commission in themicroelectronics sector; regrets, however, the Commission’s reluctance to applyinterim measures in the digital sector and asks the Commission to evaluate its use ofinterim measures as well as other structural and behavioural remedies, in addition tofines, when assessing whether operators can block market entry, restrict consumerchoice and information flows and manipulate users’ behaviour, so as to preventdistortions of competition capable of harming European companies, in particularSMEs, and resulting in consumer detriment;Geo-blocking15. Following the adoption of the Geoblocking Regulation (EU) 2018/302, calls on theCommission to continue actively monitoring all potential competition issues relatedto unjustified geo-blocking and other restrictions on online sales; encourages theCommission to pursue an ambitious vision for tackling online discrimination againstconsumers based on harmonised consumer protection rules; calls on the Commissionto adopt a forward-looking and pro-consumer approach when conducting the reviewprocess of the Geoblocking Regulation, which is foreseen for March 2020;III. Consumer welfare16. Highlights with satisfaction the Commission’s pursuit of an effects-based approachin its enforcement practices centred on consumer welfare and the prevention ofconsumer harm as an essential aspect of competition policy; welcomes an expandedinterpretation of the concepts of consumer benefit and consumer detriment, especiallyin digital markets, including the novel approach of considering ***data*** protection as aquality criterion when assessing the impacts of mergers on consumer welfare; notesthat mergers are not inherently negative for consumers and can lead to innovation andbetter products, but that consumer welfare should be crucial;PE641.227v03-00 40/42 RR\1199837EN.docxEN17. Stresses that, in this regard, consumer protection must remain a central policy goal ofboth current enforcement practices and any future sectoral legislation, especially inthe digital sector; welcomes the assertion in the Special Advisers’ Report that theconsumer welfare standard must be adapted to the digital age, in terms of the requisitestandards of proof when assessing aggressive strategies employed by dominantplatforms aimed at reducing competitive pressures, without any demonstrablycommensurate consumer welfare gains; recalls that fair competition must ultimatelysecure a high level of consumer protection and choice.RR\1199837EN.docx 41/42 PE641.227v03-00ENINFORMATION ON ADOPTION IN COMMITTEE RESPONSIBLEDate adopted 18.2.2020Result of final vote +:–:0:28518Members present for the final vote Carmen Avram, Gunnar Beck, Isabel Benjumea Benjumea, StefanBerger, Gilles Boyer, Francesca Donato, Derk Jan Eppink, EnginEroglu, Markus Ferber, Jonás Fernández, Giuseppe Ferrandino, FrancesFitzgerald, Luis Garicano, Sven Giegold, Claude Gruffat, Enikő Győri,Eero Heinäluoma, Danuta Maria Hübner, Stasys Jakeliūnas, HerveJuvin, Othmar Karas, Billy Kelleher, Ondřej Kovařík, Aurore Lalucq,Philippe Lamberts, Aušra Maldeikienė, Pedro Marques, CostasMavrides, Siegfried Mureşan, Piernicola Pedicini, Lídia Pereira, SirpaPietikäinen, Antonio Maria Rinaldi, Alfred Sant, Martin Schirdewan,Joachim Schuster, Ralf Seekatz, Pedro Silva Pereira, Paul Tang,Stéphanie Yon-CourtinSubstitutes present for the final vote Manon Aubry, Karima Delli, Niels Fuglsang, Maximilian Krah,Andreas Schwab, Stéphane Séjourné, Jessica Stegrud, Antonio TajaniSubstitutes under Rule 209(7) presentfor the final voteMichael Bloss, Łukasz Kohut, Lefteris Nikolaou-AlavanosPE641.227v03-00 42/42 RR\1199837EN.docxENFINAL VOTE BY ROLL CALL IN COMMITTEE RESPONSIBLE28 +ID Francesca Donato, Herve Juvin, Antonio Maria RinaldiRENEW Gilles Boyer, Engin Eroglu, Luis Garicano, Ondřej Kovařík, Stéphane Séjourné, Stéphanie Yon-CourtinS&D Carmen Avram, Jonás Fernández, Giuseppe Ferrandino, Niels Fuglsang, Eero Heinäluoma, Łukasz Kohut,Aurore Lalucq, Pedro Marques, Costas Mavrides, Alfred Sant, Joachim Schuster, Pedro Silva Pereira, PaulTangVERTS/ALE Michael Bloss, Karima Delli, Sven Giegold, Claude Gruffat, Stasys Jakeliūnas, Philippe Lamberts5 -ECR Derk Jan Eppink, Jessica StegrudID Gunnar Beck, Maximilian KrahNI Lefteris Nikolaou-Alavanos18 0GUE/NGL Manon Aubry, Martin SchirdewanNI Piernicola PediciniPPE Isabel Benjumea Benjumea, Stefan Berger, Markus Ferber, Frances Fitzgerald, Enikő Győri, Danuta MariaHübner, Othmar Karas, Aušra Maldeikienė, Siegfried Mureşan, Lídia Pereira, Sirpa Pietikäinen, AndreasSchwab, Ralf Seekatz, Antonio TajaniRENEW Billy KelleherKey to symbols:+ : in favour- : against0 : abstention

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Impact News Service

April 17, 2020 Friday

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**Length:** 31412 words

**Body**

Brussels: Council of the European Union has issued the following document:

7363/20 ADD 1 TS/csECOMP.2 ENCouncil of theEuropean UnionBrussels, 16 April 2020(OR. en)7363/20ADD 1FSTR 31FC 28REGIO 55SOC 212PECHE 98TRANS 157ENER 101ENV 201TOUR 10COWEB 42COVER NOTEFrom: Secretary-General of the European Commission,signed by Mr Jordi AYET PUIGARNAU, Directordate of receipt: 2 April 2020To: Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council ofthe European UnionNo. Cion doc.: SWD(2020) 57 finalSubject: COMMISSION STAFF WORKING DOCUMENTAction Plan Accompanying the document COMMUNICATION FROM THECOMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THEEUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THECOMMITTEE OF THE REGIONS concerning the European Union Strategyfor the Adriatic and Ionian RegionDelegations will find attached document SWD(2020) 57 final.Encl.: SWD(2020) 57 finalEN ENEUROPEAN COMMISSION Brussels, 2.4.2020 SWD(2020) 57 final This document replaces document SWD(2014) 190 final COMMISSION STAFF WORKING DOCUMENT Action Plan Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS concerning the European Union Strategy for the Adriatic and Ionian Region {COM(2020) 132 final}1Table of ContentsINTRODUCTION ............................................................................................................... 31. 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ENVIRONMENTAL QUALITY .............................................................................. 373.1 The marine environment.................................................................................. 403.2 Transnational terrestrial habitats and biodiversity .......................................... 484. SUSTAINABLE TOURISM ..................................................................................... 514.1 Diversified tourism offer (products and services) ........................................... 534.2 Sustainable and responsible tourism management (innovation and quality) ............................................................................................................. 595. FUNDING ................................................................................................................. 646. MONITORING, REPORTING AND EVALUATION ............................................ 66ANNEX I ROLE OF THE EUROPEAN INVESTMENT BANK (EIB) IN THE EU STRATEGY FOR THE ADRIATIC AND IONIAN REGION ................................. 682INTRODUCTIONThe ‘EU Strategy for the Adriatic-Ionian Region’ is described in two documents: (1) a Communication from the European Commission to the other EU Institutions and its addendum, and (2) an accompanying Action Plan which complements the Communication.The Action Plan is one of the outputs of the Strategy approach. Its aim is to go from ‘words to actions’ by identifying the concrete priorities for the macro-region. Once an action or project is selected, it should be implemented by the countries and stakeholders concerned.The Action Plan is informed by an extensive, bottom-up consultation process that involved a wide range of stakeholders from the Adriatic-Ionian Region representing national, regional and local authorities, but also the private sector, academia and civil society. This approach allowed stakeholders at all levels to comment on and to endorse the selected four pillars as well as to point to actions/projects under each pillar that appeared promising for responding to challenges and opportunities shared by participating countries. The Action Plan is conceived to be rolling. This means that new actions may be added as needs change over time while existing actions are adapted as they move closer to completion.While implementation of the Action Plan is the responsibility of all, at country, regional, and local/municipal level, within each participating country, the Strategy's coordination mechanism will be in charge of coordinating and monitoring this implementation. For each pillar, this mechanism should be made up by two or three coordinators from relevant line ministries and representing EU and non-EU countries, working closely with counterparts in the Region, in consultation with the Commission, relevant EU agencies and regional bodies. This involves securing agreement on a plan associated to a timetable, and ensuring close contacts between project promoters, programmes and funding sources. It also involves providing technical assistance and advice as required. This work must be transnational, inter-sector and inter-institutional. It will be eligible for institutional and administrative support from the transnational cooperation programme covering the same geography of the EUSAIR.It is crucial to ensure that sufficient information and outreach be issued about the Action Plan so as to make it widely known among all types of stakeholders.Organisation of the Action PlanThe Action Plan is structured so as to reflect the four pillars as well as the topics selected under each pillar. Accordingly, the Action Plan incorporates the following features:- Pillars: These address the core challenges and opportunities identified as being of central importance for the Adriatic-Ionian Region. They are at the core of the Strategy and are essential to the success of its work, and how it is communicated.3- Topics under each pillar: These represent the main areas where the macro-regional strategy can contribute to improvements (either through tackling the main challenges or through seizing the main opportunities). For each topic, the Action Plan will present the issue and indicate what particular contribution it will bring. Examples: To support competitiveness of enterprises, etc. Each topic has to be considered with other policy fields. The Strategy encourages a horizontal approach highlighting interdependence between its four pillars. For example, climate change mitigation and adaptation as well as transition to a low-carbon economy have an impact on transport, energy, tourism, and other policies whilst the latter also have an impact on climate change. Accordingly, for each topic, involvement of bodies and institutions representing other policy fields is required.- Actions: An action is the intervention which countries and stakeholders carry out in order to address the different topics. It can be a new approach, an increased coordination in policy making, policy review, support to a process already engaged, a networking initiative, etc. An action may not necessarily require financing. All actions should be understood without prejudice to existing EU competences and requirements of the EU acquis. Examples: New approach: “To legislate at the appropriate level to tackle the problem of by-catch in fisheries”; - Increased coordination in policy making: “To develop a joint position of the Region regarding changes which could be introduced in the framework of the TEN-E'; Support to a process already engaged: “To implement fully commitments under the Adriatic-Ionian Initiative”.- Projects: The Action Plan is not meant to list specific projects. It is meant to outline the scope of the Strategy (the pillars) as well as the topics (per pillar) on which cooperation should focus. Projects are presented by way of examples to stimulate further initiatives, as the Strategy progresses and as new ideas emerge, and to illustrate what is needed. These examples are drawn from reports pertaining to each pillar as well as from inputs made during the stakeholder consultation and its closing conference which took place in Athens 6th and 7th of February 2014. As far as Blue Growth is concerned, the examples offered are also drawn from a study commissioned by the Commission to support the elaboration of the Adriatic and Ionian Maritime Action Plan. Examples: “To establish a macro-regional platform for the monitoring and observation of fishing activities“; “To improve connectivity between ports and their hinterlands: linking freight railways to important ports', etc. Concrete projects to be implemented have to be identified by the coordination mechanism of the Strategy. As a general rule, each project would have a lead organisation/country and a deadline.When identifying actions and projects to be included in the Action Plan, the following criteria shall be taken into account:• They should address identified priorities, meeting well-substantiated needs and be widely supported. The need for the action or project concerned should have been clearly expressed by countries, regions and stakeholders or Commission’s services. The proposals should have been thoroughly discussed with these partners since their support is crucial during the implementation phase. Generally speaking, actions and4projects should reinforce existing EU policies such as: Europe 2020, Territorial Cohesion, Trans-European Networks (transport and energy), the Energy and the future Transport Communities1, disaster risk management policy; or implementation of EU strategies such as the strategies on Biodiversity2 and on Adaptation to Climate Change3, both of which encourage the development of (macro) regional strategies, as well as relevant EU Directives4. Finally they should also associate, as appropriate, transnational initiatives of relevance for the macro-region, such as the Adriatic-Ionian Initiative, the Regional Cooperation Council, or the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean.• Their scope or impact should be transnational, if not macro-regional. Most actions and projects having an impact at the macro-regional scale will involve several countries who wish to cooperate and coordinate their efforts. If, however, a national/regional project has a direct impact on (i.e is for the benefit of) the macro-region (e.g the construction of a waste water treatment plant that improves the water quality of rivers or extension of a port to buttress a macro-regional transport networks), it could also be included. The impact should ideally be articulated in terms of an impact indicator which could be evaluated over time. Consideration should be given to the ***data*** which will need to be gathered in order to evaluate the impact (including definition of the baseline situation). To contribute to this end, an inventory of ***data*** already available, including their quality, should be established. Actions and projects spanning national boundaries with a view to implementing the Strategy should furthermore complement each other.• They should be realistic and credible. Projects should be feasible (technically and financially) and there should be overall agreement between countries, stakeholders and the Commission of their worth. In particular, the feasibility and cost-effectiveness of a project should be established and a realistic source of funding should be identified. Confirming the consistency of a project with the Action Plan does not per se guarantee funding,• They should build on existing initiatives and have reached a fair degree of maturity.• They should pay attention to the cross-cutting aspects identified in the Communication, further developed in this Action Plan.• They should be coherent and mutually supportive. While mainly relating to one particular pillar, each action or project must take fully into account possible impacts on actions and projects carried out under other pillars. Actions and projects undertaken under the different pillars must thus be compatible with each other and create win-win solutions. For example, transport projects or energy efficiency initiatives should not jeopardise achievement of environmental targets, such as air quality, and should preferably contribute to achieving such targets.1 While the Transport Community Treaty is not signed, actions and projects in the transport sector should build upon the South-East Europe Observatory (SEETO).2 COM(2011) 244 final.3 COM(2013) 216 final.4 Such as the Habitats and Birds, Water Framework, Maritime Spatial Planning and Marine Strategy framework Directives.5Reference to EU policies is systematically made for each pillar and efforts were made to link actions and projects to existing EU programmes. The targets included in the Action Plan are set by way of examples. They will serve as a source of inspiration for the bodies in charge of turning the Action Plan as it now stands into a concrete tool for implementing the Strategy. This work will include development of result indicators and precise targets, systematically matching the actions or projects that will eventually be selected.In an initial phase, the Action Plan will concentrate on 'low hanging fruits', that is to say projects emanating from existing initiatives and having reached a fair degree of maturity.61. BLUE GROWTHCOORDINATORS: GREECE AND MONTENEGROThe overall objective of Pillar 1 “Blue Growth” is about driving innovative maritime and marine growth in the Adriatic-Ionian Region by promoting sustainable economic growth and jobs as well as business opportunities in the blue economy sectors.This requires building on the regional diversity in the Adriatic-Ionian Region, and taking into account that there are various pathways to innovative maritime and marine growth. At the same time a number of challenges and development opportunities need to be approached through cooperation among the countries, regions and cities.The specific objectives for this pillar are:1. To promote research, innovation and business opportunities in blue economy sectors, by facilitating the brain circulation between research and business communities and increasing their networking and clustering capacity.2. To adapt to sustainable seafood production and consumption, by developing common standards and approaches for strengthening these two sectors and providing a level playing field in the macro-region.3. To improve sea basin governance, by enhancing administrative and institutional capacities in the area of maritime governance and services.To achieve the abovementioned objectives Pillar 1 will focus on three topics:Topic 1 - Blue technologiesTopic 2 - Fisheries and aquacultureTopic 3 - Maritime and marine governance and servicesThis pillar strongly supports the Europe 2020 Strategy:• Smart growth. Strengthened blue technologies, as well as improvements in the sectors of fisheries and aquaculture contribute to smart growth in the Region. Actions in this area will have to build on the smart specialisation strategies being developed at regional and national levels. The work under this pillar aims also at contributing to the smart growth dimension outlined in the South East Europe 2020 Strategy. Particular focus is on developing human capital (skills, and administrative and institutional capacity), promoting entrepreneurship, networks of excellence, cooperation between research and public and private sectors, as well as users, to develop innovative products and services and technology transfer.7• Sustainable growth. Improved maritime governance and services, notably through Maritime Spatial Planning and enhanced management in the fields of fisheries and aquaculture, can contribute a more sustainable use of existing natural resources and thus to sustainable growth. Furthermore, innovations in the sectors of fisheries, aquaculture and blue technologies have potential for supporting sustainable growth by mitigating environmental risk and by cutting emissions from vessels at sea and in ports. The work under this pillar may also contribute to the sustainable growth dimensions outlined in the South East Europe 2020 Strategy, mainly with regard competitiveness. Particular focus is on making sustainable use of natural resources, reducing environmental risk, and on enhancing GDP growth through enhancing regional value chains and coordinating policies.• Inclusive growth. Developments in the field of Blue Growth can create new jobs. Paying more attention to job opportunities in the maritime and marine sector and improving skills and capacities in these fields can be an asset for inclusive growth. The work under this pillar may also contribute to the inclusive growth dimensions outlined in the South East Europe 2020 Strategy, mainly with regard to employment and labour mobility.Inclusive growth is also about integrated growth in South East Europe. The work under Pillar 1 will contribute to the objective of integrated growth by removing barriers to trade and investment, and by promoting policies which are non-discriminatory, transparent and predictable and which can therefore enhance the flow of goods, investment, services and people within the Region. A clear territorial perspective in relation to this growth will increase territorial cohesion.• Blue Growth. In addition to the standard objectives of Europe 2020, the actions carried out under this pillar will contribute to growth, mainly in the field of blue technology but also with regard to strengthening the aquaculture sector. Blue Growth is the overarching objective of an EU initiative published in 2012. It is the maritime dimension of Europe 2020. The concept is connected to the Europe 2020 objectives of smart, sustainable and inclusive growth and aims at unlocking the untapped potential of Europe’s seas and coastal areas. The Blue Growth Strategy seeks to foster growth and job creation by capitalising upon the so-called blue economy. Its main focus is on blue energy, aquaculture, maritime, coastal and cruise tourism, marine mineral resources and blue biotechnology.• Governance for growth. The South East Europe 2020 Strategy follows the objective of governance for growth, including compliance with EU regulations underlining that institutions contribute significantly to development and growth. Actions in the topic of “maritime and marine governance and services” can contribute to strengthening effective public services and EU compliance throughout the Region, including the work towards common standards in the fields of fisheries, aquaculture, maritime spatial planning and integrated coastal management.Links with other pillars8In line with the integrated approach recommended by the Strategy, the three topics under Blue Growth must be brought together with objectives pursued under the other pillars. For example, while strengthening innovative marine and maritime growth has a positive impact on business development, it also improves environmental conditions (Pillar 3 – Environmental quality) through better coordinated and more sustainable use of marine and maritime resources. In this regard, marine biodiversity will be preserved by improving fisheries and aquaculture management and sustainability. Furthermore, this improves the tourist attractiveness of an area and stimulates cooperation between fisheries and tourism activities (Pillar 4 – Sustainable tourism). At the same time, increasing business activities will be closely linked to available transport connections for delivery of goods (Pillar 2 – Connecting the Region).Cross-cutting issuesRegarding ”capacity building”, the actions under the third topic of this pillar, “maritime and marine governance and services”, will increase the capacity of the public sector in the countries involved - in particular with regard to enhancing administrative and institutional capacities and to promoting EU integration. Enhanced cooperation and sharing of best practices between countries in the Region (as well as outside the Region) will be promoted. Focus is on coordination of planning activities needed for better marine and maritime governance and services. Furthermore, actions under the second topic “fisheries and aquaculture” require strengthening capacity in the Region with regard to management, surveillance, monitoring and skills. This will improve strategic decision-making related to Blue Growth.A communication dimension is also central for actions involving stakeholder participation, marketing and awareness raising actions. Such actions contribute to the global objective of EU integration as well as interaction with citizens and businesses.Regarding “research, innovation and SMEs development”, actions under the first topic “blue technology” and the second topic “fisheries and aquaculture” both have a strong focus on research and innovation. This involves using the latest research for developing commercial products and internationalising clusters. Actions may thus help transfer the latest R&D results to seafood processing and new products, helping SMEs develop in the sectors concerned. There is a strong focus on “brain circulation” (mobility of researchers, also between academia and private sector) and on establishment of joint research and innovation platforms in the Region.91.1 Blue technologiesPresentation of the issueThe Adriatic and Ionian Region is short on clustering and fails to fully exploit the advantages that could be gained from better cooperation between research centres and the public and private sectors. There is an insufficient “business resource efficient culture” in the Region resulting from weak involvement of stakeholders and interrelation of business, research and the public sector. Some key sectors, such as shipbuilding, the boating industry and logistics, risk losing competitive leverage while others, such as marine technologies or blue bio-technologies, have not yet developed to their full potential.To maximise sustainable economic growth and employment as well as business creation based on blue technologies, brain circulation between research and business communities must be enhanced, their capacity to network and cooperate increased, and access to seed and venture capital improved.Adriatic-Ionian Region specificsIn geographical terms, the topic affects all the countries in the sea-basin. However, non-EU countries have great potential in terms of blue R&D&I, often limited by outdated technologies, lack of support schemes and of planning and financial resources. Projects in this respect are mainly carried out under the umbrella of the 7th Framework Programme and the European Territorial Cooperation programmes. Research networks on which actions can build already exist, e.g under the framework of UNIADRION5. The actions suggested below reflect environmental and economic challenges specific to the Adriatic-Ionian sea basin.Indicative actions⮚ Action - R&D&I platforms on green sea mobility, deep sea resources, biosecurity and bio-technologies: to boost blue technologies in the Region, there is a need to develop macro-regional research & development & innovation platforms on selected themes of relevance. The most promising themes are green sea mobility, deep sea resources (including the development of unmanned marine vehicles), bio-security and blue bio-technologies.5 UNIADRION is a universities network across the Adriatic Ionian area, which focuses on the creation of a permanent connection among universities and research centres in the area. Members of UNIADRION are Albania, Bosnia Herzegovina, Croatia, Greece, Italy, Montenegro, Serbia and Slovenia. This university network deals with five working groups, which work on protections, cataloguing and promotion of cultural heritage, environment and sustainable environment, cultural tourism and development, economy, communication, ports and economic relations, as well as the technical aspects of its network.10⮚ Action - Macro-regional cluster development: to support the establishment of trans-boundary clusters on promising sectors such as green shipbuilding and new materials in order to enhance exploitation of emerging technologies and internationalisation of Small and Medium Enterprises.⮚ Action - Researchers mobility: to promote “brain circulation” amongst research institutes/academies and companies as a condition for developing macro-regional cooperation in the field of blue technologies.⮚ Action - Improving access to finance and promoting start-ups: boosting blue technologies requires financial resources. Improving access to funding and promoting start-ups for development and testing prototypes or ideas is crucial, as well as supporting business spin-offs from scientific research.The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors, and examples of possible projects. Actions Indicative actors Examples of possible projectsR&D&I platforms on green sea mobility, deep sea resources, biosecurity and bio-technologiesResearch institutes, businesses, national/ regional authorities• “Deep sea observation network”6: to map and monitor the seabed and analyse potential deep sea resources which can contribute to strengthening economic activities in the blue sector.• “Research platform marine robotics” e.g to strengthen unmanned marine vehicles for underwater and seabed operations based on existing cooperation between Italian and Croatian research institutes, and the capacities of Greek companies and other stakeholders in the Region. This could also involve develop into platforms for macro-regional quadruple helix networks linking research, business, public sector stakeholders and the civil society.• “Research platform for green shipping” to develop new materials, sensor technologies shore-based supply of electricity for vessels in ports and to innovative propulsion modes and fuels (switch from diesel to Liquid Natural Gas and electric vessels).• “Research platform on the exploitation of micro-organisms” growing in the Adriatic and Ionian seas for the production of pharmaceuticals and cosmetic products.Macro-regional cluster developmentAdvanced training institutes, public admin., research institutes and businesses• “Green shipbuilding clusters in the Adriatic and Ionian Seas” to support the establishment of trans-boundary clusters on green shipbuilding and new materials. This strengthening of the internationalisation of clusters could e.g build on cooperation taking place between stakeholders in Italy and Montenegro, and also involve stakeholders in Slovenia (where technological capacity is available) and Croatia (where technological capacity is under development).6 In line with the Communication on Blue Innovation.11Researchers mobilityAdvanced training institutes, public admin., research institutes and businesses• “Blue technology ‘brain circulation’ in the Adriatic and Ionian Region” to support researcher mobility in the areas of blue technology and build on the experience of UNIADRION. This may also involve the development of a “cloud environment”, for facilitating the matching between researchers and institutes and companies, and for setting up a scheme for supporting researcher mobility.Improving access to finance and promoting start-upsFinancial institutions, research institutes (nat. and internat.),private operators, national/ regional authorities• “Adriatic-Ionian Blue Financing” could be a macro-regional project exploring innovative financial and incentives instruments to facilitate the access to seed and venture capital, such as blending mechanisms, Adriatic-Ionian Blue prize, crowd-funding, etc. This could also be linked to instruments of the EIB and EIF or other international funding bodies.Examples of targets by 2020Concrete outputs and results are mainly to be found in the field of increased networking between researchers and clusters linked to the fields of blue technology within the macro-region. Accordingly, the number of newly-established research networks, or clusters involving more than two participant countries, but also joint research papers, or the number of researchers exchanged could be a starting point for the definition of result indicators. These results can be expected to pave the way for increased cooperation on a long-term basis and for internationalisation of research activities and clusters. Possible points of departure for related result indicators may be the number of R&D&I platforms established, as well as the number of clusters with enlarged international cooperation.As an example, the following target could be mentioned:• 20 % increase - as compared to the base line situation - in R&D&I investment in the blue technology domain by 2020121.2 Fisheries and aquaculturePresentation of the issueFisheries and aquaculture are important sectors for Blue Growth in the Adriatic-Ionian Region. In particular, the social, cultural and economic contribution of fisheries is crucial at local and regional level, especially on islands and in remote regions.FisheriesThe Strategy aims at long-term sustainable and responsible fisheries so that fishing activities can continue to provide income for coastal communities. For this, the following points are of particular importance:• Effective implementation of the principles of the Common Fisheries Policy (CFP): The CFP advocates the promotion of a bottom -up approach to fisheries management with a view to achieving fishing levels at or below the ‘Maximum Sustainable Yield’. Common principles and tools for Marine Protected Areas of fishery interest, including the adoption of measures for the protection of sensitive habitats and certain threatened species (e.g sea turtles, dolphins), would also be beneficial.• Market intelligence and services: Such services ensure better traceability and marketing of products. These services should build on existing cooperation among administrative bodies and producer organisations in Croatia, Italy and Slovenia and extended to the other Adriatic-Ionian countries.• Sustainable fishery management: Multiannual fishery management plans are important tools for strengthening sustainable management of fisheries, to be implemented in close cooperation at national or international level. ***Data*** ***collection*** is essential to designing management actions and proper control is critical to their implementation.• Control, monitoring and surveillance: The culture of compliance, transfer and share of ***data*** and information need to improve, based on the exchange of expertise and best practices and further development of common operational initiatives. Upgrading of all operational tools (systems, equipment and other resources) should also be promoted.AquacultureThe development of a strong, high-quality aquaculture sector that is economically sustainable and environmentally-friendly, contributes to job creation and to supply of healthy food products, respecting the EU and international rules. However, a number of barriers prevent aquaculture in the Adriatic-Ionian sea basin from developing its full potential: lack of a clear and harmonised policy with respect to access to space and licensing; industry fragmentation; limited access to seed capital or loans for innovation; time-consuming administrative procedures and red tape.13Respecting subsidiarity, the Common Fisheries Policy reform proposes to promote aquaculture through a coordinated approach, based on non-binding strategic guidelines and common priorities and exchange of best practices through the open method of coordination.Adriatic-Ionian Region specificsFisheriesThis topic is specific to both the Adriatic and Ionian Seas albeit with a differentiated degree of overexploitation7. Fishery activities are predominantly small-scale. About 80% of commercial fishing vessels are below 15 meters long8. The fishery sector faces various challenges linked to global competitiveness and market forces, as well as to environmental objectives concerning the conservation of fish stocks. Many stocks are shared and overexploited. The culture of compliance, and the monitoring, control and surveillance capacity are still weak in many Adriatic-Ionian countries. Risk of depletion of marine resources is a recognised issue. Out of approx. 450 fish species in the sea basin, 120 are threatened by overexploitation9.Sustainable use of resources and integrated control of fisheries are critical for the entire Adriatic-Ionian Region, and deployment of the necessary capacities is essential. Building capacity to comply with the EU acquis on fisheries is essential for long-term sustainability.This notwithstanding, all countries in the area (barring Bosnia and Herzegovina and the landlocked Serbia) have implemented or have been involved in specific cooperation projects aiming at increasing the profitability of fishery activities. Better cooperation across the Adriatic-Ionian sea basin should trigger a virtuous process of increasing the competitiveness of the coastal communities depending on fisheries and of widening stakeholders’ involvement. The benefits of combining fisheries with tourism activity (Pillar 4) should be exploited.Cooperation on scientific issues and fisheries management already takes place within the multilateral framework of the General Fisheries Commission for the Mediterranean and FAO regional projects (ADRIAMED and EASTMED). Building on this experience, further scientific cooperation between the Region's countries could be promoted to link scientific research to the needs of fisheries and aquaculture.AquacultureAquaculture is a key sector in the blue economy of countries like Italy, Croatia and Greece. There is significant potential for increasing capacity, and thereby reducing EU7 According to Scientific Technical and Economic Committee for Fisheries (STECF), the largest part of stocks assessed in the Adriatic is overexploited. Available information on assessed stocks shows that the Ionian Sea fares slightly better but remains however alarming (Sources: Set of STECF reports, [*http://stecf.jrc.ec.europa.eu/reports/medbs).8*](http://stecf.jrc.ec.europa.eu/reports/medbs).8) Sources:   [*https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/Exec%20sum%20Adr-Ion\_31-3-2013.pdf*](https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/Exec%20sum%20Adr-Ion_31-3-2013.pdf)   [*https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/Report%202\_21\_03\_2014.pdf*](https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/Report%202_21_03_2014.pdf)   [*https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/Annex\_21-03-2014-2.pdf9*](https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/Annex_21-03-2014-2.pdf9) Cf. footnote 8.14dependency on imports, and for decreasing the pressure on wild stocks, provided this is done in a sustainable manner. This activity is one of the most promising in the seven coastal countries of the macro-region and can play a pivotal role in the entire area.Sustainable and profitable aquaculture requires strengthened stakeholder involvement in the overall management, simplified procedures, as well as improved skills and product diversification. Development of new sites needs proper space and planning, in coordination with other activities (including co-location). Balancing of the costs/benefits of fisheries/aquaculture is required, notably in relation to tourism, as there tends to be a trade-off between the use of marine space for aquaculture and tourism and vessel traffic. This already happens in Slovenia and in some Italian regions (especially on the North-Adriatic shore), where aquaculture is linked to conservation of habitats and ecosystem services, as well as to tourism. However, this also implies developing tools for proper site management, environmental monitoring and improving quality schemes.Indicative actions⮚ Action - Scientific cooperation on fisheries and fish stocks: Supporting regular assessment of shared fish stocks in the Adriatic and Ionian Seas and evaluating main elements for sustainable management of fisheries are important for strategic decisions in the sector. These assessments require increasing scientific cooperation and capacities. Existing frameworks of cooperation10 should be more extensively used.⮚ Action - Sustainable management of fisheries: Multiannual fishery management plans are crucial for sustainable fisheries. In order to become useful and powerful instruments, these plans should be combined with economic impact assessment and established in close cooperation between the different areas at national or international level.⮚ Action - EU compliance and common standards and practices: In the fields of both fisheries and aquaculture, efforts are needed to develop and apply common standards and practices. Compliance with the EU acquis in these sectors and alignment to common standards are needed for sustainable fishery management and sustainable aquaculture, as well as for implementation of the Common Fisheries Policy. Establishment of thematic EU compliance networks may help to increase awareness among fishermen and public authorities, as well as sharing of ***data***, exchange of experiences and best practice, and capacity building.⮚ Action - Diversification and profitability of fisheries and aquaculture: Sustainable and profitable fisheries and aquaculture require strengthened stakeholder involvement in the overall management, as well as improved and diversified activities. With regard to aquaculture, this may also imply developing tools for proper site management, environmental monitoring and improving quality schemes.⮚ Action - R&D platform for seafood: Seafood-related R&D and internationalisation of existing seafood clusters are critical to increasing the added value of fisheries and10 Such as initiatives promoted by FAO (Food and ***Agriculture*** Organization of the United Nations) and GFCM (General Fisheries Commission for the Mediterranean) as well as the MEDAC (Mediterranean Advisory Council).15aquaculture products. Actions include research aiming at improving productivity, quality and environmental sustainability of aquaculture (including offshore aquaculture), as well as at increase the industry's ability to respond to market needs and to diversify its offer (new species).⮚ Action - Developing skills: Professional skills and competencies are needed as well as higher capacity to develop them. This action focuses on promoting and strengthening networks of academies and training institutes aiming to develop specific educational and (joint) training programs for fishermen and aquaculture farmers on innovative fishing and aquaculture techniques and safety at work.⮚ Action - Marketing of seafood products: Communication and customer awareness on quality and origin of seafood products are critical to creating added value throughout the fisheries and aquaculture value chains in the Region. This involves development of market intelligence to ensure that marketing and processing of fisheries and aquaculture products in the Region are clear (labelling, traceability and certification), efficient and in full compliance with applicable rules, as well as organisation of and participation in relevant fairs.The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors and examples of possible projects. Actions Indicative actors Examples of possible projectsScientific cooperation on fisheries and fish stocksResearch institutes, fisheries organisations, national/ regional authorities• “Increasing ***data*** ***collection*** and scientific capacity”, in the fields of scientific thematic areas of investigation to be jointly explored by (national) research institutions, e.g : (i) the ecology of larval and juvenile stages and stock recruitment relationship of small pelagic and demersal fish relevant for fisheries; (ii) stock connectivity at sea basin level of the most important fishery resources; (iii) the biology and ecology of important coastal resources (e.g Sparidae) targeted by the small scale fishery.• “New knowledge for minimising maritime damage caused by fishing”, e.g focusing on developing improved multi-species modelling, fishing gear and related techniques and technologies so as to minimise carbon footprint, seabed damage, discards and by-catch.• “***Data*** sharing on fishery impacts to support evidenced based decision making”, sharing socio-economic and environmental ***data*** to enhance managers' understanding of the socio-economic and ecosystem impacts of fisheries management measures and establish synergies between the fishing sector and other maritime activities (e.g aquaculture, shipping, tourism, amateur fishing, small-scale fisheries, etc.).• “Fish stock monitoring platforms”, monitoring the state of fish stocks in the Adriatic and Ionian Seas and evaluating the main elements for sustainable fisheries management, such as fishing pressure levels, catch/discards composition, habitat16mapping, genetics, tagging, etc. Using to the greatest extent existing cooperation frameworks, e.g the GFCM,11Sustainable management of fisheriesInternational organisations, local fisheries stakeholders, research institutes, national and local authorities• 'Multiannual fishery management plans”: establishing management plans for shared fish stocks12 at national or international level by building also on the experience of the Adriatic-Ionian Plan for Small Pelagics. Ex-ante studies should be carried out in order to simulate consequences of different management systems. This also involves strengthening stakeholders’ involvement in fisheries management.• Cooperation to support responsible fisheries in the Adriatic and Ionian Seas”, building on existing initiatives. This cooperation should be strengthened by focusing on the code of conduct for responsible fisheries established by UN-FAO).EU compliance and common standards and practicesNational/ regional authorities, research institutes, private operators and organisations• “EU compliance in the field of fishery”, focusing on establishment of thematic EU compliance networks to increase awareness among fishermen and public authorities, sharing of ***data*** and exchange of experiences and best practices and building capacity notably in candidate and potential candidate countries.• “Development of common standards in the field of aquaculture”, setting up a macro-regional working group for standardising licensing procedures and permission for new farming plants and reducing administrative burdens and constraints.Diversification and profitability of fisheries and aquacultureNational/ regional authorities, research institutes, private operators (fishermen, POs, processors, etc.)Fisheries Local Action Groups (FLAGs)• “Anti-crisis network for sea food industries”, setting up a network capable of responding quickly to crisis situations in the food industry. The set-up of market monitoring tools at sea basin-level could support the prevention of such crises, aimed at developing ***data*** and information dissemination.• “Improvement and diversification of fishing activities” addresses renewal of fishing fleet equipment enhancing fishermen's safety at work and improving storage facilities. Others job opportunities can be created by diversifying fisheries activities by promoting e.g fishing tourism. Fisheries Local Action Groups could represent the natural tool for diversifying fisheries.• “Sustainable aquaculture site location and management”, focusing on development of tools (including indicators) for proper location of aquaculture, including tools for identifying potential co-location with other economic activities. This could address issues such as improving quality schemes, increasing the cage number at sea, expanding farming of existing species and introducing new species of high commercial value, while minimising the impact of such measures on the surrounding marine environment.11 General Fisheries Commission for the Mediterranean.12 As defined by the Regulation (EC) No 1967/2006 for the Mediterranean Sea, Articles 18 and 19.17R&D platform for seafoodResearch and training institutes, private operators (fishermen, aquaculture farmers, processors, producer organisations)• “Macro-regional seafood clusters and processing capacity”, to carry out research to improve the growth, productivity, quality and environmental sustainability of aquaculture (including offshore aquaculture) and the industry's ability to respond to market needs and diversify offer (new species).Developing skillsTraining institutes, private operators, Fisheries Local Action Groups (FLAGs)• “Boosting skill development”, promoting networks of academies and training institutes to develop specific educational and (joint) training programs for fishermen and aquaculture farmers on innovative fishing and aquaculture techniques and safety at work.• “Strengthening of Centres for Aquaculture production and Safety surveillance” based on the experience of CAPS213. Such a project could aim at strengthening diagnostic capacities of laboratories, for contamination of fish and shellfish and to develop concrete improvements of diagnostic competences in terms of equipment and knowledge, skills and capacities.Marketing of seafood productsPrivate operators, public authorities, Fisheries Local Action Groups (FLAGs)• “The taste of Adriatic-Ionian seafood”, developing market intelligence to ensure that marketing and processing of fisheries and aquaculture products bear clear labelling, traceability and certification, are efficient and fully comply with applicable rules. Such a project might also work on a joint quality label for high-quality seafood products from the Region.• “Adriatic-Ionian Seafood on Fairs”, supporting organisation of regional fairs, integration in tourist routes/products to promote common marketing of seafood products. At the same time such a project may also support participation in fairs as a means of marketing seafood products from the Adriatic-Ionian Region.Examples of targets by 2020The number of newly established networks relating to research & monitoring, compliance with respect to EU regulations regarding fisheries and aquaculture, common standards in fisheries and aquaculture as well as diversification of aquaculture products, marketing of seafood products from the Region could serve as starting point for the establishment of result indicators.Examples of targets could include:• Multiannual fisheries management plans for the stocks adopted and implemented at Sea basin level13 CAPS2- Centres for Aquaculture production and Safety surveillance in Adriatic Cross-border Countries is a cooperation project funded in the framework of the Adriatic IPA Cross Border Cooperation 2007-2013 Programme of the European Union.18• Number of joint marketing initiatives aiming at establishing an Adriatic-Ionian brand for seafood products191.3 Maritime and marine governance and servicesPresentation of the issueThe countries in the Adriatic-Ionian Region are characterised by different administrative and political structures as well as government and governance systems.A wide range of topics relevant for strengthening Blue Growth are not tied to specific sectors such as blue technologies, fisheries or aquaculture. These overarching topics address mainly the wider administrative capacity to deliver marine and maritime services of public interest.Cooperation on various services – notably those linked to the capacity building in the public sector and better coordination of planning activities – is needed for preparing the ground for better marine and maritime governance and services. In a wide range of fields, coordination of activities would improve use of existing resources. Focus should be on bringing together national or regional activities under one roof, e.g via joint planning efforts.Adriatic-Ionian Region specificsThe Adriatic-Ionian Region displays considerable imbalances and currently undergoes significant political transformation. This makes bridging political divides particularly important, as well as improving institutional capacity and management mechanisms transcending national boundaries. Mutual trust among neighbouring countries is crucial. Although accession and prospective accession to the EU has improved the situation, new systems take time to be put in place. They require change in mind sets, raised awareness, confidence-building among public and private stakeholders and improvement of skills.There are also considerable imbalances both as regards the access to funding as well as administrative capacities and cooperation experience. These imbalances affect the capacity to respond jointly.Thus, existing networks and organisations active at the level of the Adriatic and Ionian Seas ought to be strongly involved in the future work. Cooperation experience has already been gained in the macro-region, notably thanks to networks involving major ports (like the North Adriatic Ports Association) or regional authorities (e.g under the umbrella of the Bologna Charter) and/or research institutes (e.g involved in SHAPe and ADRIPLAN), fora such as those encompassing Adriatic-Ionian Universities and Cities, and organisations such as the Adriatic-Ionian Initiative or the General Fisheries Commission for the Mediterranean.Indicative Actions⮚ Action - Governance of maritime space: Proper joint governance of the maritime space provides an important framework for a sustainable and transparent use of maritime and marine resources. This will include supporting the implementation of20the new Directive on Maritime Spatial Planning (through coordinated planning) and may imply adopting clearer legal frameworks for exploiting deep-sea water and marine mineral resources.⮚ Action - Institutional capacity to harmonise standards and regulations: This action aims at improving the quality of public services and improving governance mechanisms for international cooperation. In a wide range of sectors (e.g fishery policy, maritime spatial planning, integrated coastal management), the development of common understandings and harmonised standards and regulations as well as sharing of best practices are needed. This requires institutional capacity of the involved public bodies and stakeholders.⮚ Action - ***Data*** and knowledge sharing: This action aims at improving the evidence base for policy and decision-making in the Region. Sharing ***data*** and knowledge among public bodies in the Region can increase the efficiency of the public administration (e.g by avoiding duplication of monitoring or ***data*** ***collection*** efforts) and increase their capacity to seize opportunities or react to challenges which can be detected earlier if ***data*** and information is shared and analysed across countries.⮚ Action - Maritime skills: Working in the maritime sectors requires skills and increasingly specialised professional profiles and expertise. This actions aims at improving the levels of skills in the Region, e.g by strengthening networks of academics, training organisations and professional organisations in the maritime sector.⮚ Action - Citizen and business awareness and involvement: This action aims at promoting citizen and business awareness regarding blue economy, new technologies, fisheries and aquaculture.The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors, and examples of possible projects. Actions Indicative actors Examples of possible projectsGovernance of maritime spaceNational and local authorities, research institutes• “Maritime governance and services task force”, ensuring the legal framework for exploiting deep-sea water and marine mineral resources in a sustainable manner, through governance mechanisms such as establishment of maritime zones.• “Implementing coordinated Maritime Spatial Planning (MSP) and Integrated Coastal Management (ICM)”, based on the experience of e.g ADRIPLAN14, with the aim of improving the on-going process to develop Maritime Spatial Planning (MSP) in the sea basin, of overcoming barriers to full participation of all neighbouring countries in the process and of promoting sound technically/scientifically based political decisions. This will promote a coherent transnational approach to the spatial planning of the two seas and support14 See also   [*http://adriplan.eu21implementation*](http://adriplan.eu21implementation) of the MSP Directive. The ultimate aim would be good governance of economic activities in this sea region and implementation of common plans.Institutional capacity to harmonise standards and regulationsNational and local authorities, business associations• “Twin Fish”, focusing on training and networking activities with the aim of boosting capacity-building and of twinning projects between EU and non-EU stakeholders on Common Fisheries Policy (***data*** ***collection***, controls, etc.).• “MSP and ICM training and mutual support”, focusing on the development of training activities and networks needed to support capacity building on Maritime Spatial Planning and Integrated Coastal Management.***Data*** and knowledge sharingNational and local authorities, research institutes• “Adriatic-Ionian ***data*** cloud supporting maritime governance and services”, establishing knowledge innovative communities and IT platforms for sharing ***data*** and exchanging knowledge. Information from heterogeneous ***data*** sources (e.g sensor ***data***, operational or regulatory ***data***, open source ***data***, voluntary reporting, platforms of opportunity ***data*** etc.) would be made available for modelling, risk analysis and wider maritime domain awareness through ***data*** broker and 'big ***data*** analytics' capabilities. Such a project could benefit from a quadruple helix approach involving potential users and providers of relevant information in the academic, private and public sectors and civil society.Maritime skillsTraining institutes, academies, private operators• “Maritime skills circulation”, developing networks of academies and training institutes on maritime profiles/professions (including shared module trainings) with the aim of developing new high-standard training curricula for experts in the maritime sectors. This could also include development of joint curricula taught at different places in the Region. Such a project could benefit from experience of the UNIADRION network.Citizen and business awareness and involvementFLAGs, media, private operators, civil society, local authorities• “Citizens exploiting the Region's blue potential”, promoting awareness about the macro-region's potential in terms of blue economy, new technologies, aquaculture and fisheries . The target group would mainly be citizens and businesses in the Region. The aim of such a project would be draw attention to and to discuss potential in this field of activity and to encourage citizens and businesses to exploit it.Examples of targets by 2020Concrete results are mainly to be found in the field of increased networking on improving EU compliance, ***data*** and information sharing and development of common standards. Other results will pertain to training to improve skills and capacities and to awareness-raising. Accordingly, the number of newly established networks on monitoring and maritime spatial planning or integrated coastal management, as well as the number of trainings provided could serve as starting point for establishing result indicators. These results would prepare the ground for improved cooperation structures,22joint databases or monitoring systems and implementation of joint plans. Possible points of departure for quantifiable result indicators may thus be a common MSP and ICM plans along the Adriatic-Ionian Sea basin and coastlines, the number of joint databases or monitoring systems put in place.Examples of targets could include:• Creation of a shared system of major macro-regional ***data*** bases (i.e Adriatic-Ionian Cloud)• 100% of the water under national jurisdiction and 100% of coast lines covered by Maritime Spatial Planning and Integrated Coastal Management and their implementing mechanisms fully in place232. CONNECTING THE REGIONCOORDINATORS: ITALY, SERBIA AND NORTH MACEDONIAThe overall objective of Pillar 2 'Connecting the Region' is to improve connectivity within the Region and with the rest of Europe in terms of transport and energy networks. This requires thorough coordination of infrastructure works and improved operation of transport and energy systems between the countries in the Region.The macro-region is facing huge infrastructure disparities, notably between 'old' EU Member States and the other countries, following years of isolation and conflict. Better transport and energy connections are compelling needs for the macro-region and a pre-condition for its economic and social development. Environmental impacts have to be duly considered (e.g air emission). Infrastructure projects should be embedded in a wider sustainable transport plan linked to local and regional air quality plans.Efficient and sustainable transport connections, capable of coping effectively with increased traffic flows, will create attractiveness, both for foreign direct investments and for tourism, hence jobs and prosperity. Better use of intermodal transport will reduce the costs of delivering goods in Central and Eastern Europe, improve the eco-balance and restore the competitive position of the North Adriatic ports as natural gateways to Central and Eastern Europe. Better interconnected energy networks will benefit the whole South-East Europe region, and beyond. A better working and interconnected energy market will reduce wholesale prices and attract investors.The specific objectives for this pillar are:1. To strengthen maritime safety and security and develop a competitive regional intermodal port system;2. To develop reliable transport networks and intermodal connections with the hinterland, both for freight and passengers;3. To achieve a well-interconnected and well-functioning internal energy market supporting the three energy policy objectives of the EU – competitiveness, security of supply and sustainability.To achieve these objectives, the pillar will focus on three topics:Topic 1 - Maritime transport;Topic 2 - Intermodal connections to the hinterland;Topic 3 - Energy networks.The challenges posed by improving the connectivity within the Region and between the Region and the rest of the EU can only be tackled through cooperative and coordinated approach.24As the Region is made up of many relatively small countries, national actions are not enough, and even bi-lateral cooperation does not provide the necessary solutions. Wider regional cooperation is needed to overcome bottlenecks and to promote connectivity (i.e cooperation aimed at developing projects of common interest (PCIs) which will provide services to several countries involved in the Strategy). Many of the planned major infrastructure projects only make sense if looked at from a macro-regional perspective.The core transport and energy axes are macro-regional per definition or even European in the perspective of the Trans-European Networks for transport (TEN-T) and energy (TEN-E). A coordinated approach is therefore vital.An additional factor to take into consideration for the railway and electricity markets is their fragmentation. Most of the national markets are too small to attract investors and competition. Freight transport, in particular combined, requires distances above 300km, often exceeding the distance between two borders in the Western Balkans. Electricity interconnections are a condition sine qua non to have a well-functioning market, not to mention the safety of supply. Macro-region-wide railway and energy packages would also make more sense. This, however, requires advanced regulatory and trading skills, not easily found in small markets. Scale is bringing added value. On the sea side, maritime traffic congestion requires better coordination on maritime surveillance, so as to improve maritime safety.This also holds true for border crossings. Simplifying border crossings, between EU Member States, between them and non-EU countries, Schengen and non-Schengen, for passengers and for freight, is better conceived and implemented at macro-region level.This pillar strongly supports the Europe 2020 Strategy:• Smart growth. Better transport and energy connections require innovative solutions which reduce costs, improve efficiency and contribute to smart growth.• Sustainable growth. It supports modernisation of the transport sector to make it more efficient hence more environmentally-friendly (e.g by promoting inter-modality). Through interconnection of energy networks, it provides the condition for better functioning energy market and thus development of energy production from renewable sources.• Inclusive growth. Territorial cohesion is supported through better connections and secure and affordable energy, including in remote areas. New business opportunities are created, hence new jobs.Inspired by the Europe 2020 Strategy, the countries of South East Europe endorsed their own 2020 Strategy (South East Europe 2020 Strategy - SEE 2020) as a regional response to Europe 2020 in the context of the Regional Cooperation Council (RCC)15.15 The Regional Cooperation Council (RCC), launched in 2008 in the context of the South-East European Cooperation Process, focuses on promotion and enhancement of regional cooperation in South East Europe (SEE). The work of the RCC focuses on the priority areas of economic and social development, energy and infrastructure, justice and home affairs, security cooperation, building human capital, and parliamentary cooperation as an overarching theme.25SEE 2020 focuses on five main pillars: integrated, smart, sustainable, and inclusive growth, underpinned by good governance.With regards to transport, SEE 2020 sets ambitious targets, including decrease of the cost of transport, improvement of transport infrastructure utilisation rates and increase in railway/waterborne share. The South-East Europe Transport Observatory (SEETO) is playing a central role in the Region, in close coordination with the Commission. The aim of the SEETO is to promote regional cooperation in the Western Balkans in developing the multimodal SEETO Comprehensive Network and to connect it to the EU's TEN-T. The SEETO Comprehensive Network has been defined in close co-operation between the European Commission and the regional partners. It constitutes the indicative extension of the TEN-T into the Western Balkans. It has been included in the TEN-T guidelines.Concerning energy, the countries in South–East Europe, as signatories of the Energy Community Treaty16, have embarked on a path of energy market reforms and regional integration. SEE 2020 aims at increasing energy efficiency, promoting renewable energy production and consumption, stimulating energy infrastructure development and creating a well-functioning SEE energy market.Implementing the energy and railway packages remains a challenge in the macro-region, Italy excepted. Unbundling of energy production, transport and distribution and of the railway market in infrastructure and train operations may be done on paper, but the access to these markets remains limited and competition almost inexistent.Actions in each sector should combine investments in the network, soft measures to ensure correct application of the regulatory framework and market functioning, plus specific measures for smoothing border crossings. Effective improvements need coordinated planning, funding and implementation. Market failures, due to externalities, are strikingly evident in lack of investments across borders. Large projects need to be identified and implemented sustainably and efficiently, with shared costs and benefits. The more users, the more efficient investments become, with significant economies of scale. This would for example apply to LNG infrastructure to facilitate fuel switching and to infrastructure providing shore-based power supply.Links with other pillarsThe topics identified under this pillar must be considered with the other policy fields, in line with the integrated approach encouraged by the Strategy. Pillar 2 is an obvious prerequisite for the three other pillars. For example: harmonisation of maritime traffic monitoring and information system will help development of fisheries and aquaculture; intermodal transports will reduce environmental impact; better transport connections are a must for tourism development, particularly in insular and remote areas.Cross-cutting issues16 The Energy Community was established in 2005 by the European Union and the countries from the South-East Europe and the Black Sea region. On top of the EU, it includes 8 contracting parties (the Western Balkans plus Ukraine and Moldova) and a number of observers which includes Turkey, Georgia and Armenia. The Energy Community extends the EU energy policy to the Region on the ground of legally binding framework. Its overall objective is to create a stable regulatory and market framework.26The three topics included in this pillar, and the related specific objectives, would strongly benefit from the cross-cutting issues identified for the Strategy, in particular:• Institutional and administrative capacity of the national and regional bodies responsible for transport (maritime, land, air) is essential for effective coordination at macro-regional level, for coordination in the TEN-T and TEN-E context and, eventually, for achieving the objectives set. Capacity building should aim, inter alia, to help joint planning, financing and implementation of actions. It should aim, first and foremost, to bolster macro-regional thinking.• Communication and awareness-raising is essential for participation of stakeholders in the decision-making process and for building a feeling of ownership in the population. This will also be of benefit for the implementation phase, where actions need wide-ranging public support.• Investments in transports and in energy networks can benefit from innovative approaches which would come from research. The business community, and in particular the small and medium size enterprises, would benefit directly from investments in the sectors, though work, services and supplies contracts, and indirectly from more efficient transport and energy networks which would favour investments, thus growth and jobs.272.1 Maritime transportPresentation of the issueThe Adriatic and Ionian Seas represent the backbone of the Region, and its major asset. Maritime transport is an economic sector that could play a significant role in Adriatic and Ionian countries.During the 1960s, 1970s and 1980s, the ports of the macro-region were unable to develop their container traffic to a significant extent, because of the Region being located on the fringe of Western Europe. Current trends of trade have increased the competitive position of the North Adriatic ports as natural gateways to Central and Eastern Europe. There is evidence that the North Adriatic ports could secure 6.0m TEU containers/year of traffic by 2030 (or 11.3% of the EU market); this would represent traffic growth of almost 350% over 20 years, provided good railway access is provided for the hinterland.In this context, development of maritime transport, in particular motorways of the sea as navigation corridors, is of paramount importance and must go hand-in-hand with the creation of modern and efficient intermodal ports integrating maritime transport with rail and road. Such an extension of infrastructure and transport activities must be accompanied by a coherent sustainable transport plan linked, inter alia, to an air quality plan under Directive 2008/50/EC. Investments in innovation and modernisation of infrastructure, reduction of procedural constraints and bureaucratic burden (especially in port operations) and promotion of safe maritime traffic should be given priority in the entire sea basin.Adriatic-Ionian Region specificsTraffic monitoring and management are still an issue in the Region. The current ADRIREP17, a mandatory Ship Reporting System in the Adriatic Sea, is outdated and not fully serving its objectives. Significant improvements are still needed on harmonising the procedures, the ***data*** exchange and the national VTMIS18 and on establishing mechanisms to enable maritime traffic information exchange between national VTMIS systems, also in view of including pre-accession countries in SafeSeaNet19.The North Adriatic Ports Association (NAPA) constitutes a positive step of cooperation between the Adriatic ports in their global competition with those of Northern Europe. The partners agreed, in particular: (a) to establish a network of port community systems capable of integrating all members of the transport community through internet; (b) to exchange ***data*** on the shipping lines and vessels operating between sea ports and harbours in order to achieve coordination and integration; and (c) to promote the concept of17 Adriatic Traffic Reporting system18 Vessel Traffic Management Information System19 A European vessel traffic monitoring and information system established in order to enhance maritime safety, port and maritime security, marine environment protection and efficiency of maritime traffic and maritime transport in EU waters.28“Single Window” with the aim of reducing transaction costs and operation turnaround time.Ports also play a key role in local traffic, with ferries and Ro-Ro short-sea shipping. More routes would decrease the distances between the two coasts of both seas. Tourism is heavily dependent on ports, for cruise ships, big and small, and for yachting. Trends in the fast growing cruise industry and in logistics and distribution systems, have led to an increased need for value-added services within the area of the port. Ports require new facilities such as cranes, new passenger terminals, new operational procedures, and good sequential or parallel coordination of the different services provided by the port actors inside and outside the port, in the context of door-to-door logistics. Port services could also address air quality measures such as power supply from shore and cleaner non road mobile machinery (e.g cranes). For the same reason clean short sea shipping in the very touristic Adriatic Sea basin should also be promoted, by using clean shipping and retrofitting technologies.The multiple islands in the Region present a unique point of attractiveness, but, without improving connections within the macro-region and beyond, they will not be able to develop this competitive economic advantage.On the problematic side, ports are a possible gate for unlawful trades concerning drugs, weapons, counterfeited goods. Ports are also gateways for introduction of invasive alien species which can make a negative impact on other activities, like aquaculture or tourism. Security concerns will have to be continuously addressed in an appropriate manner.Overall, ports will need to invest substantially in order to meet all these technological, industrial, safety, security, environmental and climate change challenges.Indicative Actions⮚ Action - Clustering port activities/services throughout the region: Following the example of the existing NAPA cooperation agreement, harmonising the ports processes through a common ITS (Intelligent Transport System) would attract traffic that is now avoiding the Region.⮚ Action - Improving and harmonising traffic monitoring and management: Strengthening and securing frequent exchange of information between coastal countries through the development of a Common Adriatic-Ionian Vessel Traffic Monitoring and Information System (by building on existing regional exchange of Automated Identification of Ships ***data*** and Ship Mandatory Reporting system, i.e ADRIREP), will improve safety and security of maritime traffic in the region.⮚ Action - Developing ports, optimising port interfaces, infrastructures and procedures/operations: Developing the ports and port terminals in order to boost maritime transport, short-sea shipping capacity and cross-border ferry connectivity. Ports should favour development of combined infrastructure (trade, procedures, movement of goods information systems, structures, vehicles and operations), improving links to the mainland and emphasising the supply chain of goods.29The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors and examples of possible projects. Actions Indicative actors Examples of possible projectsClustering port activities /servicesPort authorities, port users, shipping companies, freight transporters• Sharing strategic functions and harmonising ports processes through a common Intelligent Transport System (ITS), building e.g on the NAPA initiative (Trieste, Koper, Venice and Rijeka) and on the APC -Adriatic Port Community (APC) project (Venice, Ploce and Igoumenitsa).• Common certification of the ports on safety, sustainability and computerisation.Improving and harmonising traffic monitoring and management.Masters, owners, agents, operators, shippers and relevant authorities• Establish a working group to amend the current Adriatic Traffic Reporting system (ADRIREP) in order to reduce excessive administrative burden and unnecessary duplication of ***data*** ***collected*** by Vessel Traffic Monitoring & Information System (VTMIS) infrastructure.• Implement a new ADRIREP ensuring that ***data*** providers, including masters, owners, agents, operators, shippers and relevant authorities, need to submit information only once, and that the information submitted is available for use in all relevant reporting, notification and VTMIS systems• Link all Adriatic and Ionian countries to a Sub-Regional MARE server to take advantage of AIS sharing ***data***, including as an example, ***data*** on ships, emission factors, results of fuel quality inspections, clean shipping index, that could help monitoring emission and improve air quality in port cities.• Capacity -building activities (training, education programmes, standardization and interoperability) improving the application of international legal requirements.• Traffic Separation Schemes (TSS) could be envisaged in the congested areas.Developing ports, optimising port interfaces, infrastructures and procedures / operationsPort authorities, port users, shipping companies, transport companies• Implementation of Information and Communication Technology (ICT) and intelligent infrastructure services (e.g tracking and monitoring) to improve the efficiency, reliability and safety/security of the port operations and of the delivery system• Harmonisation of the port processes through a common ITS• Creation of an accessible maritime transport database allowing for the design of new itineraries• Support port multimodal connectivity through the development of Short- Sea Shipping and the improvement of raid and railway connections.• Given the increased traffic in ports and the requirement to finalise international routes in time by the companies organising30cruises, development of a system of berth allocation in Adriatic Ionian ports.• Green upgrading of ships, of port machinery and port activities (e.g cranes, power supply from shore, fuel switching to LNG, retrofitting, etc.).Examples of targets by 2020• Double the current Adriatic-Ionian market share in container traffic reaching EU• Establish a single system for maritime traffic surveillance through a unique window and common ***data*** exchange• Increase the traffic of clean Ro-Ro, ferries, short-sea shipping and cruise ships and yachts by 20%312.2 Intermodal connections to the hinterlandPresentation of the issueIntermodality goes beyond technical aspects and infrastructure. It includes organisational issues, meeting overall transport demand and seasonal/daily traffic peaks, spatial planning, life-styles, innovations, etc. Together with inland waterways, road and rail provide important international connections within the Region. Ports of the Adriatic and Ionian Seas, as well as railway lines and airports, are immediate entry points to the Region from abroad. An appropriate transport policy must take into account all these considerations, promoting multimodality, while also taking into account environmental aspects (e.g air emission, etc.), economic growth and social development.Adriatic-Ionian Region specificsHigh investments in the road network in the Western Balkans delivered 36% increase in highways from 2006 to 2011 in relation to the SEETO Comprehensive Road Network. In the period 2007-2011, investments in this network amounted to EUR 10.8 billion, with more than 80% going to the roads network. In addition, the SEETO multi annual plan 2014 defines 20 mature priority projects, and 20 more that require preparatory activities. In relation to the Western Balkans road network, approx. 500 km need urgent rehabilitation and approx. 700 km urgent upgrading of capacity. More attention should, however, be paid to sustainable transport, i.e multimodal combining maritime, rail and inland waterways. More of less the whole SEETO railway network needs urgent rehabilitation and removal of bottlenecks.Cumbersome procedures are still leading to excessive delays for freight transport at border-crossing points. The completion of the Adriatic and Ionian Motorway, from Trieste to Patras, is a priority for the development of the Region, in particular for tourism, provided its environmental impacts are carefully considered.Railway services must become better and more competitive through the on-going reform process separating infrastructure and operations and introducing licensing and regulation. Their complete operational establishment is still lagging behind. After a long period of under-investing in infrastructure and rolling stock, current on-going and planned projects indicate that the rehabilitation of the main rail lines has begun. The SEETO comprehensive network has been improved by rehabilitation and overhaul work mainly on the corridor X, the main artery in the region, and on corridor Vc. However, further efforts and investments are needed in order to bring the railway network of the region close to TEN-T standards. Nevertheless, both freight and passenger traffic volumes continue to decline. Despite border crossing agreements, excessive waiting times and cumbersome procedures and the large number of border crossing points in small areas, present one of the most serious obstacles.A major issue regarding air transport is the need to develop the route network. Lack of intraregional connectivity reduces the attractiveness of the Region. Given undeveloped32road and railway traffic infrastructure, the fastest and cheapest way to increase intraregional links between the countries of the Region may by air. Synergies may be sought, as appropriate, with the air policy initiative in the Western Balkans (Joint Service Provision Area) which aims at creating proactive relationship between regional civil aviation administrations and service providers. Coherence with the ISIS programme (Implementation of the Single European Sky in South-East Europe) should also be sought.Development of the South East Mediterranean Motorway of the Sea Master plan is intended to concentrate flows of freight on sea-based logistical routes. This should improve existing maritime links or establish new viable, regular and frequent maritime links for transporting goods between participating countries so as to reduce road congestion and/or to improve access to peripheral regions or islands. For example, the Adriamos project aims at enhancing a viable, regular and reliable sea-based transport service integrated in the logistic chain along the Adriatic-Ionian transport corridor between the port of Venice and the Ionian Sea/West Greece port cluster (Igoumenitsa and Patras). This would contribute to reducing economic, social and environmental costs related to port and logistics activities. This project involves infrastructure and facility investments (both works and studies) necessary for removing bottlenecks and for improving the efficiency of the logistic chain.Indicative Actions⮚ Action - Developing the Western Balkans comprehensive network: Western Balkans need to prioritise investments on the defined SEETO comprehensive network (railway, inland waterways, nodes and hubs, notably with the motorways of the sea), aimed at promoting sustainable transport in the Region, and to prepare their integration in the Trans-European Network – Transport (TEN-T) network. This implies elaborating integrated planning for infrastructure developments and defining joint roadmaps for investments.⮚ Action - Improving the accessibility of the coastal areas and islands: Coastal area and island accessibility are mostly affected by tourism seasonality and commercial and passenger maritime transport are not sufficiently developed . This needs to be addressed by exploring new coordinated and market-based options, optimising use of freight and passenger routes and involving private and public stakeholders.⮚ Action - Developing motorways of the sea: Intermodal transport requires integrated management of the whole logistic chain. Essential elements are, inter alia, improved road and rail infrastructure linking ports with the hinterland and improved infrastructure within a port and ITS solutions.⮚ Action - Railway reform: Taking measures to expedite progress in railway reform, e.g transparent non-discriminatory access to rail terminals, in particular in sea and inland ports, introducing a concession approach for infrastructure, with direct cost-oriented track access charges, performance schemes and management contracts for authorised applicants33⮚ Action - Development of air transport: Establishing a dialogue amongst stakeholders on regional flight connections aiming to develop better links within the Region and to optimise year-round regional flights connections with outside destinations.⮚ Action – Cross-border facilitation: This requires physical and non-physical investments on specific transport axes.The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors, and examples of possible projects. Actions Indicative actors Examples of possible projectsDeveloping the Western Balkans comprehensive networkNational ministries of transport and infrastructure, railway undertakings, port authorities, multi-modal operators• Develop integrated planning for infrastructure developments and define joint roadmaps for investment.• Upgrade multimodal corridors linked to TEN-T core corridors (Baltic-Adriatic, Mediterranean) starting with cross-border bottle necks. Ste-by-step renovation of the railway between Bar and Belgrade.• Build capacity and develop communication activities (training, education programmes, seminars) aimed at improving the application of international legal requirements in the field of environmental impact assessment of transport and energy infrastructures.Improving the accessibility of the coastal areas and islandsShip-owners, port authorities, public authorities, tourist operators and associations• Support feasibility studies and market analyses on maritime connections between neighbouring countries, islands and mainland in order to (i) limit seasonality and (ii) draw new routes.• Promote cooperation between relevant actors to set/improve maritime connections between neighbouring countries, between islands and with mainland.Developing motorways of the seaShipping operators, shippers, maritime transport industry, ports, customs• Analyse the comparative socio-economic and environmental costs and benefits of different modes of transport (motorway of the sea, railway, motorway, including city bypass-roads) along the eastern coast of the Adriatic and Ionian Seas from Trieste to Patras.• Foster development of a Motorway of the Sea in the Adriatic-Ionian region by building on existing experiences, such as the Adriamos project between the ports of Venice and Igoumenitsa.• Improving the railway connections at the port terminals instead of RO-RO.• Support the logistic chain with shared IT solutions.Railway reformRailway undertakings,• Coordinate and align access and access charges.34multi-modal operatorsDevelopment of air transportRegional airports, carriers, public authorities, tourist operators and associations• Establish a cooperation platform between relevant actors to set/improve flight connections between countries in the Region and optimise year-round flights connections with outside destinations.Cross-border facilitationNational ministries of transport and infrastructure• Re-launch cross-border bus or train connections for passengers.• Agree on simplified border-crossing procedures.Examples of targets by 2020• Agree on a master plan for coastal road traffic• Double cross-region regular container train connections• Reduce the time spent at regional border crossings by 50%352.3 Energy networksPresentation of the issueThe energy systems are made up of energy networks and energy markets. The two are interrelated as networks are essential for the effective operation of the markets. The opening of the EU electricity markets, pursued by the third internal market package, contributes to both competition and security of supply and will be facilitated by creation of the European Network of Transmission System Operators and the Agency for Cooperation of Energy Regulators.In particular in the gas sector, the interconnections between national markets have be improved and countries in the Region need to gain access to new external sources. Reinforcing gas transmission infrastructure will be pivotal for preventing potential supply disruption in the future. Well-functioning networks, interconnections and interoperability are needed for energy security, diversification and effective energy operation.Adriatic-Ionian Region specificsThe three energy policy objectives of the EU – competitiveness, security of supply and sustainability – can only be achieved through a well-interconnected and well-functioning internal energy market. For the Western Balkans, a treaty establishing the Energy Community was signed in 2005 and an energy strategy developed in 2012.The energy markets remain fragmented. Integration of the electricity market is a goal which should be achieved by 2020. In the electricity market, the ultimate goals remain the removal of regulated electricity prices, the substantial easing of network congestion, and unhampered cross-border exchanges of energy. In gas, substantial investments are required in transmission and storage infrastructure, in order to improve market liquidity. Investment in infrastructure is crucial for achieving market competition for both electricity and gas. Development of freely accessible energy trading/ auctioning platforms is necessary to enhance market competition.Unavailability of grid capacity to dispatch fluctuating energy from renewable sources is limiting the development of renewable energy. Hydropower is the most commonly used type of renewable energy in the Region. Only between 2012 and 2020, the installed generation capacity in the Western Balkans is forecast to grow by some 13 GW, which represents an increase of about 64% from 2009 capacity at a cost of some EUR 28 billion. The Energy Community interconnection plans include connecting new renewable energy to the grid, integrating energy markets, enhancing the security of supply, and improving the reliability and quality of energy services provided. Interconnection of electricity grids and adequate grids capacity are pre-conditions for large-scale investments in renewable energy.36Developing natural gas infrastructure will also help currently isolated regions to have access to natural gas supplies, to ensure continuous and secure supplies by having network renovated and modernised, and to bring natural gas from a new range of export markets via new routes (Trans Adriatic Pipeline – TAP, and the Ionian- Adriatic Pipeline - IAP). The TAP project is under development, while the IAP project still lacks a defined business model. In addition to this, LNG infrastructure in ports enabling fuel switching to LNG would also be welcomed, both for the benefit of ship operators and for the sake of air quality.Wherever possible, energy efficiency improvements should be considered with a view to enhancing security of supply and to achieving a better degree of energy autonomy. Moreover, the participation of the demand side is particularly valuable for matching varying supply patterns and accommodating renewable energy sources in the system. However, owing to economies of scale, each country pursuing full energy independence and striving to achieve security of supply on its own would be far less efficient than cooperating and planning infrastructure developments with its neighbours, while at the same time increasing the reliance on the regional energy trade. In case of a coordinated approach, investment requirements in electricity generation would be significantly reduced – by around 10% of the energy expenses between 2005 and 2020, in South East Europe, according to the Power Generation Investment Study conducted for the World Bank.Regulated and/or non-cost-reflective prices and tariffs constitute a major barrier to investment. In the majority of cases, regulated end-user prices do not reflect the real costs of electricity supply. The regulatory framework is not yet fully in line with the EU acquis, especially regarding wholesale market opening, transparency of capacity allocation and third party-access to energy networks. Slow progress in unbundling supply and distribution still constitutes an important barrier to market opening, creating an unequal playing field between the incumbent supplier and a new entrant. Differences in allocation of cross-border capacity (in particular non-market based allocation) and in pricing methodologies constitute obstacles to trading. When planning and developing cross-border connecting networks, potential impacts on the environment - e.g on the marine environment from pipelines - need to be duly considered.Indicative Actions• Action - Cross-border electricity interconnections: Improving cross-border electricity interconnections is a fundamental prerequisite for supporting the investments required in energy generation.• Action - Gas pipelines: For gas, the objective is to enhance security of supply and to promote market integration through diversification of sources and routes to connect gas supply sources, as well as through necessary internal market actions. The creation of a gas ring in the Region will contribute to more secure gas supply.• Action - Support the establishment of a well-functioning electricity market: Energy needs an integrated and well-functioning market. One of the major requirements for harmonising South-East Europe a far as electricity supply is concerned is to establish a Coordinated Auction Office (CAO). A well-functioning Day Ahead Market for the37whole SEE region thus requires, among other things, that all transmission capacity should be made available for the implicit auctions. In this respect, the main function of the CAO is to provide correct transmission capacities to the market, irrespective of the market concept applied.• Action - Remove barriers for cross-border investments: In order to facilitate development and implementation of Projects of Energy Community Interest, the Energy Community will adopt a holistic approach, in which regulatory measures will be enforced in order to remove some of the barriers to cross-border investment; these may involve permitting procedures, information for decision makers, cost benefit analysis, incentives for projects with a cross-border impact and others.The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors, and examples of possible projects. Actions Indicative actors Examples of possible projectsCross border electricity interconnectionsTransmission system operators, project promotersExample of possible projects amongst the 2013 PECI (Project of Energy Community Interest) list:• 400 kV OHL Banja Luka (BiH) - Lika (HR)• 400 kV OHL Brinje - Lika - Velebit – Konjsko including 400 kV sub-station Brinje• 400 kV HVDC SS Vlora - Bari WestGas ringTransmission system operators, project promoters• Realising the TAP and its IAP connection• LNG infrastructure in ports to allow fuel switching in shippingSupport the establishment of a well-functioning electricity marketNational and regional competent authorities, energy companies• Establishment of a Coordinated Auction Office (CAO)Remove barriers for cross-border investmentsNational, regional competent authorities• Coordinate and align permits and regulations.• Joined capacity building and innovative solutions for implementing a common market.Examples of targets by 2020• Complete the agreed PECI projects• Security of gas supply at the same level as elsewhere in the EU• 'x' ports with LNG infrastructure383. ENVIRONMENTAL QUALITYCOORDINATORS: SLOVENIA AND BOSNIA HERZEGOVINAThis overall objective of the pillar is to address the issue of environmental quality, with respect to marine, coastal and terrestrial ecosystems in the Region. Environmental quality is essential for underpinning human activities in the Region and for ensuring economic and social well-being for its peoples. The pillar will deal with the environmental issues that can only be adequately tackled through cooperation at the level and scale of the macro-region.The specific objectives for this pillar are:1. To ensure a good environmental and ecological status of the marine and coastal environment by 2020 in line with the relevant EU acquis and the ecosystem approach of the Barcelona Convention.2. To contribute to the goal of the EU Biodiversity Strategy to halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restore them in so far as feasible, by addressing threats to marine and terrestrial biodiversity.3. To improve waste management by reducing waste flows to the sea and, to reduce ***nutrient*** flows and other pollutants to the rivers and the sea.Two topics are identified as pivotal in relation to environmental quality in the Adriatic-Ionian Region:Topic 1 - The marine environment;Topic 2 - Transnational terrestrial habitats and biodiversity.Actions under both topics are expected to contribute to attaining a good ecological and environmental status for marine, coastal and terrestrial ecosystems by 2020.This pillar strongly supports the Europe 2020 Strategy:• It contributes to smart growth by strengthening of technical and scientific capacities, and establishment of common platforms and innovative solutions for research, observation and monitoring;• It contributes to sustainable growth, in particular to the objectives of ‘A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy’. The actions under the pillar will support efficient and sustainable use of natural resources including fish stocks, materials and water, preservation of biodiversity, habitats and ecosystems, and will contribute to minimising the impact of climate change on marine and terrestrial ecosystems;• It contributes to inclusive growth by promoting stakeholder involvement in exploring sustainable options, including the involvement notably of fishermen and farmers, thereby ensuring the economic and social sustainability of actions.39Taking appropriate actions to address environmental issues faced by the macro-region will contribute to implementing the EU Environmental acquis, particularly the Marine Strategy Framework, Maritime Spatial Planning, Water Framework, Urban Waste Water, Nitrates, Waste, Birds, Habitats Directives as well the Green Infrastructure Strategy. It will also contribute to achieving the goals set out in the Common Fisheries Policy, the EU Adaptation Strategy and the EU Biodiversity Strategy.The Adriatic and Ionian Region is vulnerable to disasters and to the impact of climate change and comprehensive actions to adapt to those circumstances are needed. Enhancing cooperation in this area, through different actions such as conducting adequate comprehensive risk assessment, implementing a disaster risk management policy, as well as developing a regional strategy on adaptation to climate change, will make the Region more resilient to such changes.The pillar also contributes to the South East Europe 2020 Strategy of the Regional Cooperation Council, in particular to the Environment Dimension of its Sustainable Growth Pillar, by addressing issues related to water quality, disaster risk reduction and climate change mitigation and adaptation.Involvement of a wide range of stakeholders in the implementation of all actions proposed under this pillar and, more specifically, the social partners and private sector actors from fisheries and producers of packaging, as well as the scientific community and civil society, will further contribute to an integrated approach.Links with other pillarsWhile being addressed as a separate pillar, this issue runs across the other three pillars of the Strategy. In line with the Strategy's emphasis on an integrated approach tying together different policy areas and sectors, this pillar is to be linked to the other three pillars on which the Strategy is built. In addition to supporting low-carbon developments and helping limit the ecological footprint of, for example, transport and energy programmes and projects, it directs attention to how environmental quality can ultimately enhance prospects for smart and inclusive growth under the three other pillars. It thus reinforces Blue Growth, through actions related to ensuring the sustainability of fisheries and aquaculture. It also contributes to sustainable tourism by ensuring preservation of natural resources and cultural heritage on which tourism depends, and by addressing issues resulting in part from tourism, such as inappropriate coastal development and marine litter, and issues affecting tourism such as air emissions (e.g from shipping and road transport). It also contributes to bolstering the resilience of the macro-region's economies and societies in the face of existing and/or potential impacts of climate change.Cross-cutting issuesIn respect of cross-cutting issues:• Capacity building and communication is of paramount importance for both topics under Pillar 3. Macro-regional cooperation in the field of environment can only be successful if there are adequate legislative and institutional conditions at the national level. Moreover, after the necessary legislation has been put in place, environmental protection requires monitoring and enforcement. Capacity building40and communication can contribute to raising awareness of the issues and ownership of efforts to address them as well as to aligning national environmental legislation to existing EU legislation, thereby also improving implementation where relevant;• Research and Innovation, and SMEs - Many of the actions listed under both topics depend on research and innovation for reliable and up-to-date ***data*** for identifying baseline situations and hence for monitoring progress. There is a clear need for sharing existing knowledge and development of scientific cooperation, notably through innovative integrated observatory infrastructure and ***data*** exchange platforms across the Region and across sectors.413.1 The marine environmentTwo issues can be identified as particularly relevant for the Adriatic-Ionian marine environment, namely threats to coastal and marine biodiversity and pollution of the sea.a) Threat to coastal and marine biodiversityPresentation of the issueThe Adriatic-Ionian Region is rich in biodiversity. However, our understanding of marine biodiversity is still not complete. While the marine sub-region has rare or unique habitats, there is a lack of habitat maps covering the Adriatic and Ionian Seas. The high biodiversity of the two seas is the basis for tourism, recreational and fishing activities and contributes to the cultural heritage of the macro-region.Overfishing, habitat degradation and incidental catches pose serious threats to marine biodiversity, including fish, sea turtle, cetacean, seabird and other species. In addition, uncontrolled and illegal coastal development often leads to destruction of habitats. Invasive alien species from aquaculture and ballast water discharge also threaten ecosystem functions, and illegal ***collection*** of sponges, corals and bivalves are further cause for concern.Increased human use of the marine and coastal space, in particular for fishing, maritime transport, tourism, and construction, has intensified pressures on coastal and marine ecosystems. Ecosystem-based approach to coordination of activities is needed within the framework of Integrated Coastal Management (ICM) and Marine Spatial Planning (MSP) in order to ensure sustainable use of resources. Both frameworks are important stimulants for trans-boundary collaboration and stakeholder cooperation across different coastal and maritime sector activities, and have potential for bringing together ecosystem services and Blue Growth opportunities in a sustainable way. They are key tools for achieving decision-making balancing sector-based interests competing for marine and coastal space.Adriatic-Ionian Region specificsThe Adriatic and Ionian Seas are home to almost half of all the recorded marine species found in the Mediterranean Sea. High variation in hydro-geographic and other conditions gives rise to a large number of diverse ecosystems and habitats, in turn generating rich biodiversity. A complete inventory of this rich biodiversity and marine habitat maps is however still missing. The highly indented eastern coast of the Adriatic also acts as a breeding ground and nursery to a large number of species. At the same time, the Adriatic and Ionian Seas are subjected to intense fishing activity, aquaculture and coastal development that pose serious threat to this natural capital. There is a general lack of information on small-scale fisheries, illegal fishing gear is not uncommon, and monitoring and enforcement are insufficient. Aquaculture is a rapidly growing industry which is not regulated in all countries so as to ensure sustainability. Raising the42awareness of fishermen regarding marine species and fishing nets minimising by-catch, is needed for improving compliance and for strengthening their involvement in identifying the best measures for meeting sustainable fishing targets.Illegal and uncontrolled construction is a widespread phenomenon across much of the macro-region, with the demand for additional construction stemming from tourism further exacerbating the problem. Coverage in terms of offshore Marine Protected Areas (MPAs) beyond 12 nautical miles is the lowest of all EU marine regions20, while existing MPAs are often not adequately managed. Invasive marine alien species with possible detrimental effects to aquaculture and fisheries are introduced by shipping vectors.Indicative Actions⮚ Action - Increasing marine knowledge: To ensure a sound basis for actions related to Maritime Spatial Planning (MSP), Integrated Coastal Management (ICM) and implementation of the Marine Framework Strategy Directive, it is important for the Region to:- Make an inventory of marine biodiversity and detailed habitat mapping in coastal and offshore areas- Agree on a common approach to be applied across the Adriatic and Ionian sea basin for monitoring diversity descriptors on the status of the marine environment the two seas, and for determining Good Environmental Status indicators and targets- Establish a common infrastructure platform in terms of ***data*** ***collection***, marine research, lab analysis through common survey programs, research vessels and laboratories- Develop a Web-GIS Observatory Network to gather and process geographical and statistical ***data*** related to sustainable development and the marine environment.⮚ Action - Enhancing the network of Marine Protected Areas: By possible designation of new areas in coordination with the process of designation of Specially Protected Areas of Mediterranean Importance under United Nations Environment Programme – Mediterranean Action Plan (UNEP MAP); by establishment of Fisheries Restricted Areas under the General Fisheries Commission for the Mediterranean (GFCM), by completing marine NATURA 2000 network under Birds and Habitats Directives; by designating further protected areas to form a coherent and representative network of MPAs according to the Marine Strategy Framework Directive; and by ensuring their joint or coordinated management, also in relation to maritime spatial planning and integrated coastal management;⮚ Action - Exchanging best practices among managing authorities of Marine Protected Areas: Aiming to achieve and/or to maintain the Good Ecological Status of marine waters and to preserve biodiversity also by integrating a fishing component in each MPA (e.g Fishing Protected Areas);20 Forthcoming EEA report on Spatial analysis of Marine Protected Area networks in the Regional Seas surrounding Europe.43⮚ Action - Implementing Maritime Spatial Planning and Integrated Coastal Management: By ensuring coordination of different projects/initiatives with the frameworks provided by the Maritime Spatial Planning Directive and the Priority Action Plan of UNEP/MAP. The latter plays an important role in supporting ICM by Mediterranean countries and in implementing the ICZM (Integrated Coastal Zone Management) Protocol of the Barcelona Convention.Several actions related to the environmental impact of fisheries and aquaculture have been included under the Blue Growth pillar of the Strategy, These actions make a strong contribution to preserving marine biodiversity, by supporting enhanced cooperation on ***data*** ***collection***, scientific study, policy planning, monitoring, control and enforcement. In addition to the actions listed under this pillar, a number of other actions can favour preservation of marine biodiversity.The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors, and examples of possible projects. Actions Indicative actors Examples of possible projectsIncreasing marine knowledgeResearch institutes, national/regional authorities, NGOs• Building on the CREAM21 2011-2014 FP7 project which coordinates research in fisheries management with a view to establishing guidelines on ecosystem based fisheries management• Building on the PERSEUS (Policy-oriented marine Environmental Research for the Southern European Seas) project, which assesses the dual impact of human activity and natural pressures on the Mediterranean and Black Seas by merging natural and socio-economic science approaches to predict the long-term effects of pressures on marine ecosystems• Building on national marine biodiversity inventories and habitat mapping projectsEnhancing the network of Marine Protected AreasNational/regional authorities, NGOs• Building on the ECOSEA project22 for the protection, improvement and integrated management of the sea environment and of cross-border natural resources• Building on the MediSeH project, an FP7 project focused on identifying Mediterranean Sensitive Habitats and gathering and disseminating GIS ***data***• Building on the CoCoNET project23, an FP 7 project aimed at producing the guidelines to design, manage and monitor network21 This acronym stands for: Coordinating Research in support to application of Ecosystem Approach to Fisheries and Management advice in the Mediterranean and Black Seas.22 Starting at the end of year 2012 and funded by the IPA Adriatic Programme, this project aims to promote, improve and protect the marine and coastal environment from the upper Adriatic District to the Ionian Sea through sustainable management of fishing activities.23 The Project's full title is: 'Towards COast to COast NETworks of Marine Protected Areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential'.44of MPAs, and an enriched wind atlas for both the Mediterranean and the Black Seas, creating a permanent network of excellent researchers (e.g with summer schools) that will work together also in the future, making their expertise available to their countries and to the European UnionExchanging best practices among managing authorities of Marine Protected AreasMPAs’ managing authorities, national/regional authorities, civil society, NGOs• Using the experience of MEDPAN24 and building on the work of the Adriatic Protected Areas Network (AdriaPAN), a network of all managing authorities of Marine Protected Areas of the Adriatic and Ionian Seas, to exchange best practice and work on measures to improve ecological status of the seas, including through fishing measures• Exchanging best practices among Marine Protected Areas regarding actions, also outside PAs, and in coordination with relevant actors, preventing introduction of Invasive Alien Species (IAS), quickly eradicating newly emerging IAS, and controlling established ones• Exchanging best practices for managing NATURA 2000 areas, including designating fishery measures under the new Common Fishery PolicyImplementing Maritime Spatial Planning (MSP) and Integrated Coastal Management (ICM)National /regional authorities, research institutes, representatives of private sector, NGOs• Implementing common spatial information systems on ecosystem components and human uses and activities• Implementing pilot projects for the Ecosystem Approach (ECAP) developed under the Barcelona Convention• Building on the ADRIPLAN25 project aiming to promote a coherent transnational approach to the spatial planning of the Adriatic and Ionian seas and implement common Maritime Spatial Plans• Building on the SHAPE (Shaping an Holistic Approach to Protect the Adriatic Environment) project, which aims at the development of a multilevel and cross-sector governance system, based on an holistic approach and on an integrated management of the natural resources, risk prevention and conflict resolution among uses and users of the Adriatic coast and sea• Building on the PEGASO (People for Ecosystem-Based Governance in Assessing Sustainable Development of Ocean and Coast project, which establishes a shared 'Integrated Coastal Management (ICM) Governance Platform' to bridge the gap between scientists and decision-makers to support the implementation of ICM in the Mediterranean and Black Sea.Examples of targets:• Establishment of a common infrastructure platform with participation of all countries for ***data*** ***collection***, research, and laboratory analysis by end of 201524 MedPAN is a network of managers of Marine Protected Areas in the Mediterranean (   [*www.medpan.org*](http://www.medpan.org)).25 See also   [*http://adriplan.eu45*](http://adriplan.eu45)• 10% surface coverage of Adriatic and Ionian Seas by Marine Protected areas26• Adoption of maritime spatial planning and integrated coastal management strategies by EU Member State by 2017 and for coastal candidate and potential candidate Countries by 2018• Achieving Good Ecological Status of the Adriatic and Ionian Seas by 2020• Enhancement of a marine NATURA 2000 network and a coherent and representative network of MPAs under the Marine Strategy Framework Directive by 2020b) Pollution of the seaPresentation of the issuePollution of the sea originates from a number of different sources. Intense maritime transport activities and hydrocarbon exploration and exploitation result in oil spills, including large scale pollution events, and noise pollution. Insufficient waste water treatment in several participant countries leads to pollution from rivers, exacerbated by use of nitrates on ***agricultural*** lands. Pollution is also caused by ecologically-unsound aquaculture practices, entailing discharge of ***nutrient*** and chemicals into the sea.Marine litter stemming both from land-based sources and lost and discarded fishing gear poses a serious problem. In addition to entailing significant costs to shipping, marine litter affects human safety and health, as well as marine wildlife, and it also has an aesthetic impact. Coastal and recreational activities account for more than half of the litter found on beaches. Poor management of solid waste and a large number of illegal landfills including hazardous waste result from a combination of scarce funding for solid waste treatment infrastructure, lack of awareness on the part of the general public, weak enforcement and increasing urbanisation of the coastlines. Facilities for treating waste water are equally poor in many places.Adriatic-Ionian Region specificsOwing to its semi-enclosed and relatively shallow nature, the Adriatic is highly vulnerable to anthropogenic pressures. Its waters are exchanged with those of the open seas of the Mediterranean only once every 3 or 4 years and the North Adriatic is the shallowest part of the entire Mediterranean Sea, with an average depth of around 50 metres. The high degree of eutrophication, observed especially in this part of the Adriatic, is caused mainly by fertiliser run-off from ***agricultural*** lands. Industrial accidents on land and maritime accidents can potentially cause large damage to the marine ecosystems. The Ionian Sea is less vulnerable to such impacts as it is part of the open Mediterranean waters. However, pollution from the Adriatic is exchanged with the Mediterranean through the Ionian Sea, and the latter is therefore also affected by human activities in the Adriatic. The high vulnerability of the Adriatic is further compounded by high levels of human activity. With the increase of maritime traffic and interest for26 In line with the Aichi Target 11 of the Convention on Biodiversity and related commitments of the EU and the Barcelona Convention.46exploring seabed mineral resources, raising levels of marine noise will seriously threaten endangered marine wildlife like cetaceans and sea turtles.Indicative Actions⮚ Action - Implementing a life cycle approach to marine litter.- Establishing a coordinated monitoring system and database on marine litter and marine pollution, including sources and types of litter and pollution and a GIS database on the location and sources of marine litter27.- Strengthening collaboration between sectors for the development of new possibilities for marine litter recycling including production of packaging waste and fishing gears to enable recycling;- Preparation of a joint strategy for the assessment, prevention and reduction of marine litter, building on the work of MED POL programme28 and in line with the Regional Plan of the Barcelona Convention on Marine Litter Management in the Mediterranean, including an economic assessment of the costs and benefits of different options for reducing marine litter, as well as actions intervening at different stages of production, sources, transmission and loss.- Supporting the preventative measures to address Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG), implementing gear marking and gear registration, marine spatial management, codes of practice for fishermen.⮚ Action - Supporting clean-up programmes for both floating and sunken litter, integrating these activities with recycling programmes, and investing in necessary infrastructure.⮚ Action - Drafting and implementation of a joint contingency plan for oil spills and other large-scale pollution events, building on the work on the sub-regional contingency plan developed by the Joint Commission for the protection of the Adriatic Sea and coastal areas, and on the forthcoming Action Plan for the Offshore Protocol of the Barcelona Convention. Implementation of measures to enable joint contingency planning and coordinated emergency response.⮚ Action - Identifying hotspots and investing in reducing emissions of pollutants by realising a Hot Spot Inventory and aiming to depollute the sea.⮚ Action - Ensure prioritisation of investments to reflect the contribution to reducing pollution of the sea in the catchment area of the Adriatic and Ionian Seas. Aligning existing funding instruments, including funding from the European Regional Development Fund, the Cohesion Fund and the European ***Agricultural*** Fund for Rural Development, to support investment in waste management, waste water treatment and environmentally-friendly ***agricultural*** practices.27 This action should help countries to align to the Marine Strategy Framework Directive.28 This programme is the marine pollution assessment and control component of the Mediterranean Action Plan under the Barcelona Convention.47⮚ Action - Address diffuse sources (e.g nitrates from ***agriculture***) by decreasing fertiliser use and by enhancing the recycling of ***nutrients*** through e.g awareness-raising among farmers on the impacts of excessive use of fertilisers, education and training activities on the implementation and financial aspects of environmentally-friendly farming practices.The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors, and examples of possible projects. Actions Indicative actors Examples of possible projectsImplementing a life cycle approach to marine litterNational authorities, Marine Protected Area managing authorities, producers of packaging and fishing gear, fisheries representatives, local population, NGOs• Building on the CleanSea project, which provides analysis of marine litter, proposes monitoring tools and standard protocols to facilitate monitoring marine litter in a harmonised way and presents cost-effective management measures and policy options for addressing the issue• Building on the MARLISCO (MARine LItter in Europe’s Seas, Social awareness and CO-responsibility) FP7 project, which raises awareness of the issue of marine litter, triggers co-responsibility and facilitates stakeholder dialogue.Supporting Clean-up programmes for both floating and sunken litterFisheries representatives, local authorities, NGOs.• Developing further the ‘Fishing for litter’ project, started by local municipalities to enlist local fishermen. It is designed to recover marine litter whilst raising awareness in the Region• Building on the Guardians of the sea project, which focused on reorienting fishermen and reassigning fishing vessels to carry out other activities, including cleaning of the seas from marine litter• Building on the DEFISHGEAR (Derelict Fishing Gear Management System in the Adriatic Region) project, which quantifies and monitors marine litter, constructs a marine litter Geographic Information System (GIS), and also establishes a permanent cooperation network to involve stakeholders in generating new, more sustainable optionsDrafting and implementation of a joint contingency plan for oil spill and other large-scale pollution eventsNational and local public authorities• Building on the HAZADR (Strengthening common reaction capacity to fight sea pollution of oil, toxic and hazardous substances in Adriatic Sea) project, which includes activities aimed at harmonising national, regional and country contingency plans in Adriatic• Contributing to preparation and implementation of the Action Plan for the Offshore Protocol of the Barcelona Convention by building on the experience of REMPEC29 and the Union Civil Protection Mechanism29 REMPEC is the Regional Marine Pollution Emergency Response Centre in charge of the marine pollution assessment and control component of the Mediterranean Action Plan under the Barcelona Convention. for the Mediterranean Sea, a Regional Activity Centre of the Barcelona Convention.48Identifying hotspotsNational and local authorities, local population, NGOs, industry• Building on the Horizon 2020 initiative for the depollution of the Mediterranean programme, which includes a working group on pollution reduction investments, with a Hot Spot Inventory being prepared for the Western Balkans, to complement the hot spot inventory for the Southern Mediterranean prepared by the Mediterranean Hot Spots Investment Programme aiming to de-pollute the Mediterranean by 2020Ensure prioritisation of investments to reflect the contribution to pollution of the seaNational and regional authorities,• Horizon 2020 initiative for the depollution of the Mediterranean• Building on the SURF nature project30 aiming to improve funding opportunities for nature conservation and biodiversity through the European Regional Development Fund (ERDF).Address diffuse sourcesRural communities, ***agricultural*** representatives, advisory services, rural development networks, LAGs31, NGOs.• Promoting networking in good practices and guidance for sustainable use of fertilisers in agricultureExamples of targets:• Reduction of marine litter in line with Marine Strategy Framework Directive and 7th Environment Action Programme targets by 2020• Reduction of anthropogenic ***nutrient*** flows to the Adriatic and Ionian seas to ensure that by 2021 eutrophication is minimised• A joint contingency plan for oil spills and other large scale pollution events adopted by 2016 and measures to enable joint and coordinated emergency response implemented by 202030 Funded through the ERDF INTERREG IVC programme, the SURF-nature is a project of 14 partners in 10 different EU member states who have come together to enhance regional policies for the promotion and preservation of biodiversity and nature.31 Local Action Groups (rural development).493.2 Transnational terrestrial habitats and biodiversityPresentation of the issueMacro-regional cooperation also needs to focus on the protection and preservation of terrestrial ecosystems, in particular transnational habitats and landscape elements of central importance for large carnivores and migratory bird species.Climate change is expected to affect much of the Adriatic- Ionian Region more severely than elsewhere in the EU, especially natural habitats and biodiversity. The risks of climate change to biodiversity can be reduced by bolstering the general resilience of ecosystems, thereby increasing their ability to adapt to its effects. Joint action in shared eco-regions (mainly forest areas) to better withstand and contain catastrophes (e.g forest fires) can also be the focus of such cooperation.Adriatic-Ionian Region specificsSeveral countries of the macro-region are home to shared eco-regions32 stretching across borders. These eco-regions include the Illyrian deciduous forests, and the Dinaric Mountains and the Pannonian mixed forests. The Region also contains a number of unique ecosystems, including karstic regions and tectonic lakes. The preservation of these is essential to Europe's natural heritage and requires joint action from the countries concerned.The macro-region has rich biodiversity in comparison to the average European region, with many species33. All countries of the macro-region provide habitats for Europe’s large carnivores, including the wolf, the Eurasian lynx and the brown bear. These species require large habitats to sustain viable populations, and cooperation is therefore needed on joint management and on ensuring that infrastructure investments will not result in significant fragmentation of important landscape features.The Adriatic Flyway is one of the main routes for millions of migratory birds crossing the Mediterranean, with birds making a resting stop along the eastern Adriatic. A number of bird species also spend winter in the area. The low number of undisturbed wetlands on the eastern coast of the Adriatic, lack of hunting ban areas and hunting rules which are not in line with EU legislation, (as well as low enforcement of the rules in place) result in vulnerable, threatened or endangered migratory bird species being killed. This has impacts for the entire EU, as efforts to protect species breeding risk are being undone if protection is not ensured during migration.Indicative Actions32 According to the definition of eco-regions used by WWF, these are land or water areas that contain a geographically distinct assemblage of natural communities which (1) share a large majority of their species and ecological dynamics, (2) have similar environmental conditions, and (3) interact ecologically in ways that are critical for their long-term persistence.33   [*http://195.97.36.231/publications/SoMMCER*](http://195.97.36.231/publications/SoMMCER) Eng.pdf, p. 64.50⮚ Action – Development of joint management plans for cross-border habitats and ecosystems, which should include a transnational plan to deal with landscape fragmentation through Green Infrastructure investment and to enhance the NATURA 2000 network. It should also enhance the Emerald network of protected areas, launched by the Council of Europe in compliance with Resolution 4 and 6 of the Bern Convention, and strengthen ecosystem resilience in preparation for potential impacts of climate change;⮚ Action - Joint population level management plans for large carnivores and awareness-raising activities, e.g developing GIS database of large carnivore habitats to underpin transnational planning, monitoring and management of large carnivore populations and their habitats and identifying needs for developing green infrastructure. Alleviating habitat fragmentation, and supporting awareness-raising activities, targeting the rural population, so as to increase awareness of benefits to be reaped from healthy carnivore populations, notably for species preservation and for marketing areas for eco-tourism.⮚ Action - Harmonisation and enforcement of national laws with EU legislation, with respect to length and timing of hunting season, list of species which can be hunted, designation of 'no hunting' areas. Protecting migratory birds and other species through awareness-raising and capacity building, including assessing the impact of laws on species and communities. Improving the ability of nature protection authorities and customs officials to enhance enforcement of hunting laws. Awareness raising activities among local populations on the benefits of species preservation, and activities enabling the capitalisation of species preservation, including marketing of areas for eco-tourism;⮚ Action - Protection and restoration of coastal wetland areas and karst fields relevant for the Adriatic Flyway: Activities to restore wetland areas including restoration of water flows and vegetation, investments in green infrastructure and removal of grey infrastructure; clean-up of sites and investment in waste water treatment.⮚ Action – Awareness-raising activities on implementation and financial aspects of environmentally-friendly farming practices (e.g organic farming, agri-environmental measures) complementing restoration and preservation of biodiversity. Coordination should be ensured between actions foreseen at national level through use of the existing networking, coordination and cooperation instruments, such as those under the National Rural Networks and the European Network for Rural Development.51The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors, and examples of possible projects. Actions Indicative actors Examples of possible projectDevelopment of joint management plans for cross-border habitats and ecosystemsNature protection authorities, research institutes, NGOs• Trans-boundary management of shared natural resources in South Eastern Europe, building on projects of the Environment and Security Initiative (ENVSEC), which includes publication of the feasibility studies on establishing Trans-boundary Protected Areas and the Network of Mountain Protected Areas in the Balkans and the Dinaric Arc, and encourages regional cooperation for management of trans-boundary natural resources, in particular water and mountain areas.• Building on the BE-NATUR (BEtter management and implementation of NATURA 2000 sites) project, which improves the management of rivers, lakes and coastal areas, in order to implement the EU legislative framework and to develop common tools for a better management and implementation of NATURA 2000 sites.• Building on the European Green Belt initiative that aims to preserve habitats along the former ‘Iron curtain’ through joint cross-border activities in nature conservation and sustainable development.Joint population level management plans for large carnivoresNature protection authorities, research institutes, NGOs, local communities• Development of national and transnational management plans for large carnivoresHarmonisation and enforcement of national lawsNational public administration, nature protection authorities, customs officials, local communities, NGOs• Cooperation of all countries in joint implementation of CITES regulations and fighting illegal wildlife traffickingProtection and restoration of coastal wetland areas and karst fieldsNature protection authorities, local authorities, local population, NGOs• Building on good practices developed under a successful LIFE NATURE project targeting an important karstic landscape in Slovenia , including Lake Cerknica• Building on good practices developed under the LIFE Nature project aimed at improving water circulation and reducing eutrophication in the PO delta.Awareness-raising activities on the implementationLocal authorities, Universities, schools, Chambers of• Building on good practices developed under the AGRI-KNOWS project, co-financed in 2007-2013 under cross-border cooperation between Italy and Slovenia under the European ***Agricultural*** Fund for Rural Development (EAFRD), focusing on52and financial aspects of environmentally friendly farming practicesAgricultureraising awareness of young people working in ***agriculture*** about practical application of scientific knowledge relative to environmentally-friendly practices• Building on the WWF “One Europe, More Nature (OEMN)” innovative pilot project in the trans boundary “Prespa Park” region of Greece, Albania and North Macedonia, aimed at introducing environmentally-friendly ***agricultural*** practises connected with the special environmental needs of the areaExamples of targets by 2020:• Establishment of transnational management plans for all terrestrial eco-regions, shared by two or more participating countries• Enhancement of NATURA 2000 and Emerald networks in the Region534. SUSTAINABLE TOURISMCO-ORDINATORS: CROATIA AND ALBANIAThis pillar focuses on developing the sustainable and responsible tourism potential of the Adriatic-Ionian Region, through innovative and quality tourism products and services. It also aims at promoting responsible tourism behaviour on the part of all stakeholders (wider public, local, regional and national private and public actors, tourists/visitors) across the Region. Facilitating the socio-economic perspectives, removing bureaucratic obstacles, creating business opportunities and enhancing the competitiveness of SMEs are essential for the development of tourism.The specific objectives for this pillar are:1. Diversification of the macro-region’s tourism products and services along with tackling seasonality of inland, coastal and maritime tourism demand.2. Improving the quality and innovation of tourism offer and enhancing the sustainable and responsible tourism capacities of the tourism actors across the macro-region.To achieve the above mentioned objectives the pillar will focus on two topics:Topic 1 - Diversified tourism offer (products and services);Topic 2 - Sustainable and responsible tourism management (innovation and quality).This pillar strongly supports the Europe 2020 Strategy. It aims to contribute to smart growth through stimulation of competitiveness in the tourism sector of the Adriatic Ionian Region, as well as optimisation of the potential of EU policies and available financial instruments. It also aims to contribute to sustainable and inclusive growth through the promotion of resource-efficient, responsible and high-quality tourism with new, better and more long-term jobs and to consolidation of the Adriatic-Ionian Region's profile as a sustainable and high-quality destination.As far as the EU Tourism Policy is concerned, the pillar reflects the Communication (COM(2010)352) “Europe, the world’s No 1 tourist destination – a new political framework for tourism in Europe”, in which the Commission focuses on two key concepts mutually influencing each other: the need for a sustainable approach and the need to boost the competitiveness of the European tourism sector. In addition it takes good note of the Communication COM(2014)86) “A European Strategy for more Growth and Jobs in Coastal and Maritime Tourism” that sets the framework for current challenges and proposes a strategy dedicated to enhancing the sector's sustainability and competitiveness so as to unlock the full potential of this growing and promising sector34.Furthermore the pillar's objectives are in line with the South-East Europe Strategy 2020.34 The pillar takes also into account the 'Agenda for a sustainable and competitive European tourism' - COM (2007) 621 - which outlined the objectives and principles for the sustainability of tourism and the challenges to be tackled at EU level.54Its smart growth objective in particular reinforces implementation of the Ljubljana Process which calls for integrated rehabilitation of cultural heritage in the Region.Sustainability in tourism should be strongly linked to commercial and business perspectives. In this regard, the Forum of the Adriatic and Ionian Chambers of Commerce (AIC Forum)35 is linking the chambers of commerce of most of countries participating in this Strategy. Administrative barriers and red-tape must be removed and commercial opportunities facilitated and exploited. With a special thematic Round Table on Tourism, a Round Table on EU Project Management and the International Court of the Adriatic and Ionian Area, it aims at influencing policies targeting SMEs so as to increase the macro-region attractiveness in terms of tourism.For several actions, the Action Plan could further build on the work already carried out in a bottom-up manner by established macro-regional actors. Such is the case of the Adriatic-Ionian Initiative (with a special group for Tourism and Culture), the network of the Adriatic and Ionian Universities (UNIADRION), the Adriatic-Ionian Euro-region (through its Thematic Committee on Tourism and Culture), the Forum of Adriatic and Ionian Cities and the mentioned AIC Forum.Links to other pillarsIn line with the integrated approach encouraged by the Strategy, the ‘Sustainable Tourism’ pillar is strongly linked to the other three pillars. Successful implementation of the Action Plan for Pillar 4 could thus be reinforced thanks to increased and better intermodal connectivity, which is the focus of Pillar 2 (‘Connecting the Region’). Pillar 3 (‘Environmental Quality’) and Pillar 1 (‘Blue growth’) play an evident role in ensuring the integrated sustainability sought through the ‘Sustainable Tourism’ pillar.Cross-Cutting IssuesThe highlighted cross-cutting issues are of high relevance to both proposed topics: Research and Innovation, with particular attention to SMEs development, and Capacity Building, both for private actors and public bodies who need to engage in a much closer cooperation. Communication – especially publicity - to wider and specific audiences, as well as higher quality of education, life-long learning, vocational training, and development of skills, are incorporated in the proposed Action Plan as part of the 'Capacity building' process.35   [*http://www.forumaic.org/554.1*](http://www.forumaic.org/554.1) Diversified tourism offer (products and services)Presentation of the issueJoint cooperation at macro-regional level will result in sustainable diversification of the Region’s tourism offer (compared to other competitors), profiting from business opportunities, reducing the sector's dependence on the seasonal model, limiting the environmental footprint and taking into consideration the impacts of a changing climate. It will provide high value-added products and services. This diversification of products and services can be a vehicle for attracting more and/or different types of tourists, as well as prolonging tourist seasons, strengthening ‘all year round tourism’ and creating more and better jobs for the Region’s economy. The overall Strategy should also combine every available support for an entrepreneurial approach36, in order to improve the quality of the Region’s products, and encourage tourism in a way that would lead to diversification of the rural and coastal economy, linking it further to the tourism sector. It should, above all, have a strong commercial and business-oriented dynamic based on best practices (mainly at transnational and/or interregional level) and be implemented through regional integrated territorial development action plans linked to coherent sustainable transport plans and air quality plans.Adriatic-Ionian Region specificsAlthough tourism is already one of the fastest growing economic activities in the Adriatic- Ionian Region, and one of the main contributors to the area’s GDP, the full potential of the Region’s rich natural, cultural, historic and archaeological heritage is not yet exploited in a sustainable and responsible way. This should build on climatic as well as on existing market advantages. However, the concept of sustainable tourism37, as well as developing innovative, quality tourism products and services and making the Adriatic-Ionian destination even more attractive, has not yet been taken fully on board by the tourism actors across the Region. As a result, many alternative and potentially sustainable forms of tourism38 have not been sufficiently developed, diversified and/or integrated in wider regional development strategies (e.g sustainable tourism supported by creative and /or cultural industries, as well as cultural entrepreneurship) so as to reinforce the strong socio-economic tourist advantage the Region has already built. Improving quality is central for developing sustainable tourism products and services. In addition, this is needed for developing responsible tourism; including all stakeholders, the local population as well as tourists/visitors, is part of the sustainable tourism concept. 36 Including possible involvement of the Enterprise Europe Network- EEN (   [*http://een.ec.europa.eu*](http://een.ec.europa.eu))/37 Sustainability principles refer to the environmental, economic and socio-cultural aspects of tourism development, and a suitable balance must be established between these three dimensions to guarantee long-term sustainability. 38 Including cultural tourism, sports tourism, eco-tourism, thermal, health and wellbeing tourism, nature tourism, historical, scholastic, pilgrim tourism, agro-tourism, rural tourism, business, or tourism capitalising on the maritime and sub-aquatic cultural heritage, industrial heritage or the economic fabric of a region, etc.56Indicative actions⮚ Action - “Brand-building of the Adriatic Ionian tourist products/services’’. Gradual establishment of an Adriatic-Ionian brand which would posit the Region as one destination in the eyes of visitors, residents and stakeholders. This strategic approach will only be effective through a brand-building process based on a common identity and strongly collaborative efforts, pooling of joint resources, networking, partnerships in association with an appropriate communication strategy. Overall, the branding exercise should formulate a vision emphasising the clear benefits that improved tourism products/services will bring to both residents and visitors in the Region. In this regard, actors should also explore how to take stock of existing synergies39.⮚ Action – 'Initiative to improve quality for sustainable tourism offer'. Although improving quality in tourism offer is a horizontal issue that should touch upon all topics and actions, it is to be treated also as a distinct action. Improving the quality of the existing offer and delivering new services and products of enhanced quality should be at the basis of sustainable tourism offer In this context, a tourism offer addressing specific target of tourists, such as: seniors, youth or people with disabilities, would be of interest. The tourism offer in the Adriatic-Ionian Region could also derive its strength from individual excellences in each country, in particular with regard to quality and visibility. Thanks to a critical mass of interconnected niches of excellence, the overall offer of the Region will be significantly optimised.⮚ Action - “Diversification of the cruise and nautical sectors and enhancement of the yachting sector’’. While the cruise and nautical sectors are already operating at a macro-regional level with a strong potential for further growth, local coastal and hinterland economies have not tapped into their full potential. Subsequently, local economies have not developed appropriate ways of managing profitably effects of intensive influx of tourists within a relative short period. By exploring alternative routes and/or business model, linking better the cruise offer to local people and products, unsustainable congestion can be better tackled and the full potential could be better exploited, with more lasting economic benefits for local economies. To secure the support of the local population, such developments should be linked to sustainable transport plans.⮚ Action - “Sustainable tourism R&D platform on new products and services”. This action focuses on joining forces in the Region among university departments, research centres, innovation and technology transfer networks, together with the business community for development and marketing of new products and services, development of clusters and smart specialisation strategies.⮚ Action - “Sustainable and thematic tourist routes’’. This action focuses on development and branding of macro-regional tourism routes, through mapping and39 Being patented brand and owned by the AIC Forum, ADRION aims to help tourist operators in the Region to present themselves to international tourist markets, to stimulate the growth of weak tourist areas by connecting them with the more established tourist destinations, and to assist consumers/tourists with immediate identification of services and tourist products of the Region.57further promoting existing routes, (i.e cruise, motor bike, walking/hiking, cycling, sailing). In addition, one should also explore creation of new routes building on the assets and diversity of the Adriatic-Ionian Region. This will include developing strategies for attracting new niche markets, especially for cultural, luxury and business tourism. The action should build on knowledge, skills and heritage assets, which would connect and promote lesser-known destinations of the Region.⮚ Action - “Fostering Adriatic-Ionian cultural heritage”. In order to diversify the Region's profile in the eyes of its visitors and to extend the tourism inflows beyond the summer season, the rich cultural background and assets should be further exploited. This could be achieved by strengthening cultural cooperation. In this way the implementation of the Ljubljana process40 will be reinforced and there will be increased demand for use of the creative, cultural and natural industries sector. With a critical mass of cultural hotspots at macro-regional level certain areas could be rejuvenated and enjoy increased tourism attention.⮚ Action - “Improving accessibility for Adriatic-Ionian tourism products and services’’. This action is expected to adjust tourism products and services in the Region to the needs of both residents and visitors with special access needs (i.e senior groups, young people and schools, disabled people, families with low income). By successfully creating a 'critical mass' across the Region of 'year-round' accessible destinations, attractions, sights and tourism-related quality services, more tourists can be expected to be attracted while tourism flows could be maintained also in the low season.⮚ Action - “Upgrade of Adriatic-Ionian tourism products’’. The Region has a unique variety of products - especially in ***agriculture*** and food processing sector - generated through processes that are unique in the world. Investment opportunities may arise from exploration of new ways of entering the global markets. In addition, labelling and upgrading local products at macro-regional level is likely to result in stronger affiliation with the Region. At the same time development of local products could be an effective economic development tool.The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors, and examples of possible projects. Actions Indicative actors Examples of possible projectsBrand-building of the Adriatic- Ionian tourist products/ servicesNational Tourism Organisations, Destination management organisations, international experts, research and, cultural institutes, museums, non-• Adriatic-Ionian brand strategy. Preparatory steps require targeting global travel, on the basis of important topics, such as the target customer groups, the portfolio of value-added products and services, administrative adaptations needed, as well as key messages (based on the Region’s values) that will effectively communicate the brand.• Identification and development of an Adriatic–Ionian ‘basket of products’ that can be associated in a unique manner with the Region.40   [*http://www.coe.int/t/dg4/cultureheritage/cooperation/see/irppsaah/ljubljanaprocessii\_EN.asp58profit*](http://www.coe.int/t/dg4/cultureheritage/cooperation/see/irppsaah/ljubljanaprocessii_EN.asp58profit) organizations, and private operators,• Communication of the branding strategy, both within the Region, with targeted common niches, and internationally with continuous campaigns promoting the Region so as to attract visitors from other continents and from both established and emerging markets.Initiative to improve quality for sustainable tourism offerChambers of commerce, shipping and environment, SMEs, tourism organisations, destination management associations, ministries of tourism, tourism local actors, LAGs41 and FLAGs, municipalities and regions• Digitalisation of communication and of available tourism offer ***data*** storage. The public and private sectors should use a common Adriatic-Ionian tourism portal to upload all available tourism offer and rating in order to facilitate dissemination of tourism information.• Public/private cooperation to enhance the quality of tourism offer. Defining common quality criteria for the specific Adriatic- Ionian tourism offer. Based on those predefined criteria, launching of a needs analysis of the tourism offer in terms of quality. Defining niches of excellence in the broader Region and interconnecting them so as to enhance the tourism offer.• Setting up modes for facilitating circulation of tourists throughout the macro-region. Creating common road signals and cross-border/transnational information for tourism attractions, using appropriate languages for the designation of products, using common standards and classification systems.• Developing projects enhancing the economic potential of tourism by combining innovative facilities with ancient routes (e.g Odyssea project42)Diversification of the cruise and nautical sectors and enhancement of the yachting sectorPort Authorities, cruise lines, nautical industry, tourist operators, local municipalities, university departments in relative fields, leisure sports organizations/associations• Consultation with the cruise sector and the local authorities for designing possible alternative sea routes43 (including alternative use of smaller-scale cruise) that could promote joint coastal and rural tourism packages to attract tourists to the hinterland as well as to reduce the environmental impacts Joint promotion campaign in all the macro-region's cruise ports.• Identifying new and innovative business and logistics models for supplying Adriatic-Ionian food and non-food products in the cruise sector. Development of guidelines and study of the carrying capacity of the call ports for the application of sustainability criteria for the decongestion of cruise ports and better development of these ports. This would include linking such approaches with coherent sustainable mobility plans and air quality plans.Sustainable tourism R&D platform on new products and servicesUniversities and research centres and networks, , Regional development• Network of Adriatic – Ionian regional tourism innovation centres. Mapping and networking of the various innovation structures for tourism-related sectors such as sustainable construction, energy efficiency, waste management, ICT for tourism to facilitate transfer of knowledge, best practices in41 Local Action Groups (rural development) and Fisheries Local Action Groups.42   [*www.odyssea.eu43*](http://www.odyssea.eu43) Promotion of transnational thematic itineraries like cultural, pilgrim or ancient trade routes.59agencies, Ministries of Competitiveness, of Research and Educationtechnology transfer and business cooperation.• New business opportunities in environmental technology. Joint calls for proposals, at macro-regional level, with a view to helping the environmental technology sector facing particular challenges to exploit research results in the Region.• Develop transnational new clusters in the field of tourism, encouraging trans-sectorial and cross-border cooperation.Sustainable and thematic tourist routesPrivate operators, national tourism ministries, regional and local authorities, destinations management associations, chambers of commerce• Mapping and joint promotion of existing macro-regional routes.• Further development of thematic tourism such as cultural tourism, sports tourism, eco-tourism, thermal, health and wellbeing tourism, nature tourism, historical, scholastic, pilgrim tourism, agro-tourism, rural tourism, business, or tourism capitalising on the maritime and sub-aquatic cultural heritage, industrial heritage or the economic fabric of a region, etc.• Establishing synergies between macro-regional routes and local communities.Fostering Adriatic-Ionian cultural heritageMinistries of Culture and Tourism, regional authorities and municipalities, NGOs, Universities, museums• Adriatic-Ionian Museum Network for the establishment of a regional network that will direct visitors to the various museums, cultural events and premises across the Region.• More emphasis on archaeological sites for the promotion of the Region as a global destination for archaeological tourism.• Creative Adriatic-Ionian Region. Globally, creative industries are among emerging drivers of the economy. Networking of creative industries actors for exchanging ideas, know-how and experience will help distribute the creative potential across the entire region. This project would identify issues of common interest and concentrate on knowledge, experience, information and sharing of excellence in support of artistic entrepreneurship, creative start-ups and contemporary art festivals.Improving accessibility for Adriatic -Ionian tourism products and servicesRelevant tourism authorities and agencies, tourism operators, SMEs, training providers across the Region and disability stakeholders• Improving specific skills and training relative to accessibility in the tourism supply chain.• Disseminating good practices among tourism stakeholders in accessible tourism44.• Promoting the Adriatic-Ionian Region as an accessible Region to key markets; promoting the Region through means based on, but not limited to, use of new technologies and social networks oriented towards different target users. An example could be creation of accessible and safe marinas, mainly for people with reduced mobility, in particular in the field of leisure boating.44 E.g: Calypso project, and Holiday4All project, managed by Serbia and Montenegro. They aim at developing sustainable social-off season tourism for disadvantaged people, and at making tourism leisure activities accessible to all.60Upgrade of the Adriatic Ionian tourism productsFarmers, producer groups, processing industry, short supply chains, LAGs, and FLAGs45, universities, Venture capitals, regional authorities, • Connecting local ***agricultural***, fisheries, tourism and food supply sectors, partnerships between businesses participating in local food projects in order to develop new strategies for placing their products and attracting new types of customers. • Exchange of good practices46 and know-how transfer from the European Network for Rural Development. • Linking with technology transfer and business cooperation networks such as Enterprise Europe Network for facilitation of technology transfer and identification of business cooperation opportunities, new production, labelling and marketing methods.Examples of targets by 2020:• 5 new macro-regional routes created• Conformity with EU standards and best practice by hotels and museums in the Adriatic-Ionian, to be fully accessible by special needs groups45 Local Action Groups (rural development) and Fisheries Local Action Groups46   [*http://enrd.ec.europa.eu/app\_templates/filedownload.cfm?id=18EC541F-CB32-ED81-55DF-AFB25B27E01E614.2*](http://enrd.ec.europa.eu/app_templates/filedownload.cfm?id=18EC541F-CB32-ED81-55DF-AFB25B27E01E614.2) Sustainable and responsible tourism management (innovation and quality)Presentation of the issueThe current state of Adriatic and Ionian cooperation in the management of the sustainable tourism is rather limited. This in turn results in limited options addressing common organisational, human resources and financial problems. A series of actions aiming at better understanding the concept of “sustainable development” among tourism stakeholders are therefore needed, including: horizontal interventions promoting establishment of generally accepted standards and rules, and improved cooperation between public bodies and private tourism associations. The net gains of a joint approach will include increased tourist flows and access to new tourism markets, more business opportunities, diffusion of new technologies and know-how, increased employment and enterprise development, better resource efficiency and preservation of natural capital and cultural heritage.Adriatic-Ionian Region specificsCurrently intensive tourism activities are very important and profitable. However, they are not always managed soundly, and can even have negative effects (production of waste, pressure on water supply, impact on land and biodiversity, etc.) on the coastal, marine, and hinterland environment. By integrating sustainability approaches47 into their activities, tourism stakeholders will increase business by protecting the competitive advantages (its intrinsic diversity, its variety of landscapes and cultures) that make the Adriatic Ionian an attractive tourist destination.The tourism industry also needs to build innovation transfer networks, in order to develop better its products and services and to increase its quality and value. Sustainability needs, however, to be linked strongly to commercial perspectives. A commercial approach needs to be developed together with the sustainable and smart approach of tourism. The objectives of this particular topic are: enhancing, strengthening cooperation between key public and private stakeholders; fostering competitive and innovative tourist SMEs; tackling the seasonality issue, and promoting the sustainability of the tourism sector.Indicative actions ⮚ Action - Network of Sustainable Tourism businesses and clusters: Stimulating innovation through interaction between different tourism actors and creation of strong synergies with complementary sectors along the value chain. Useful lessons could be also learnt from applying the Smart Specialisation approach and, in particular, through adapting the Entrepreneurial discovery process, actively involving47 Such as, the responsible use of natural resources, taking into account the environmental impact of activities, the use of 'clean' energy, protection of the heritage and preservation of the natural and cultural integrity of destinations.62the private sector in identifying sustainable tourism activities with the most promising potential for growth and for absorbing research outputs.⮚ Action - Facilitating access to finance for new innovative tourism start-ups: This action would facilitate access to information on funding possibilities for innovative sustainable tourism start-ups, and for SMEs and university spin-offs capitalising on new research results and bringing new products and services into the sector. Establishment of joint ventures and innovation incubators can also boost the Adriatic- Ionian SMEs at an international level. This could be done through European Structural and Investment Funds, COSME48 programme for the competitiveness of Enterprises and small-medium-sized enterprises, and other relevant funding programmes.⮚ Action – Promoting the Region in world markets: Improving the promotion of destinations in international key markets is needed for increased tourist flows. More tourists want to discover the rich artistic and monumental heritage of a destination and to discover new places beyond the mainstream attractions of Europe. The attractiveness of the Region could, therefore, be enhanced from common promotion campaigns in key markets49. Creating B2B and B2C European platforms would link the Region's business actors among themselves and with customers. This can give the Region a comparative advantage.⮚ Action - Expanding the tourist season to all year-round: The Action will seek to alleviate seasonality in the Adriatic Ionian, and expand the tourist season. It will promote off-season tourism (such as culture activities, comfortable transport and accommodation), target markets (such as senior and accessible tourism, business and conference tourism, winter tourism, rural tourism) and design a strategy for setting Adriatic-Ionian as an excellent off-season destination.⮚ Action – Training in vocational and entrepreneurial skills in tourism: Tourism in the Region is experiencing a gap in skills; a lack of qualified and skilled labour represents (together with increased competition from other destinations) a main threat for the sector. Tourism entrepreneurship is also in need of strategic information, new learning concepts taking into account new global tourism trends and new management concepts. The action will focus on the need for training for SMEs (including e-training), the creation of an Adriatic-Ionian Observatory on Sustainable Tourism skills, and training for tourism entrepreneurship.⮚ Action - Adriatic Ionian cooperation for facilitating tourist circulation: Given the current fragmented cooperation at macro-regional level, framework conditions for better overall cooperation in tourism are needed. Common procedures on visas, and nautical licenses valid for visitors wishing to visit a range of Adriatic and Ionian attractions, revising the legislative regime for skippers and recreational boating and establishing stable and simplified legislative and fiscal framework are some of the actions needed for considerably increasing the tourism inflows.48 Regulation (EU) No 1287/2013 of the European Parliament and of the Council.49 AIC Forum studies.63⮚ Action - Adriatic-Ionian action for more sustainable and responsible tourism: This action would include the establishment of an Adriatic-Ionian Charter to encourage sustainable and responsible tourism practices in the Region. It would be based on tested ideas and practices to be easily taken up by the sector actors, and especially the SMEs that form the majority of tourism enterprises. It would promote the use of indicators to measure sustainable development at destination level50The table below provides an overview of the mentioned actions, a non-exhaustive list of indicative actors, and examples of possible projects. Actions Indicative actors Examples of possible projectsNetwork of Sustainable Tourism businesses and clustersSMEs, tourism clusters, technology transfer and innovation support networks, research centres• Tourism smart specialisation platforms to develop an extended macro-regional Entrepreneurial Discovery Process, building on experience gained by the Smart Specialisation Strategies, with a particular emphasis on commercial tourism opportunities.• Enhancing the use of ICT tools and information packages for setting-up, managing and promoting tourism business and tourism business opportunities, and the digital connection between SMEs in source and destination markets.• Strengthening links with industries with real growth potential, including environment-based industries and the cultural and creative sector, and with a strong overall commercial perspective.• Exchange of business cooperation opportunities and best practices in sustainable tourism innovation. The existing Enterprise Europe Network, in particular with the Tourism and Cultural Heritage Sector Group, can help.Facilitating access to finance for new innovative tourism start-ups.Financial institutions, private operators, relative university departments and research institutes• The ‘Adriatic-Ionian Sustainable Tourism Financing’ can develop innovative financial and incentives instruments facilitating access to seed and venture capital European Investment bank (EIB) and European Investment Fund (EIF) or other international financial bodies for new start-ups.Promoting the Region in world markets.Destination Management Organisations, Tourism Business Associations, Ministries of Tourism• Joint promotion strategy and campaigns in the world market.• Supporting internationalisation of tourism SMEs in the macro-region through establishment of 'one-stop shops', 'BtoB' or 'BtoC' shops, in order to provide assistance and guidance to businesses and customers, to promote partnerships, and to define new entry strategies to foreign markets. An example can be the TOURISMlink51 project which aims at bringing together European business on a common IT platform.50 e.g European Tourism Indicator System (ETIS).51   [*http://www.tourismlink.eu64Expanding*](http://www.tourismlink.eu64Expanding) the tourist season to all year-round.Regional Authorities, Destination Management Organisations, Tourism Business Associations, Ministries of Tourism• Adopt and implement a strategy for all year- tourism, by- Building on the EU initiatives SENIOR52 and Accessible tourism53- Promoting rural tourism- Promoting the Region for year round conference and business tourism , and especially during the off-season- Promoting winter tourism and cooperation, with exchange of best practice, in winter sports infrastructure and management of sport events.Training in vocational and entrepreneurial skills in tourism.Chambers of Commerce and Industry, Adriatic Ionian Initiative Forums, National vocational training foundations, CEDEFOP, European Training Foundation• Adriatic-Ionian Observatory on Sustainably Tourism skills for monitoring and getting feedback from the sector stakeholders on key issues and latest trends. This project aims at matching supply and demand in specific labour skills and to stimulate reforms in vocational training. An integrated information management system (for business, clients and Public Authorities) should also be connected to this Tourism Observatory.• Training for tourism entrepreneurship, for developing key skills in managing tourism businesses; this training will include an update on new market trends and transfer of know-how regarding destination management.• E-learning platform for SME training.• Link with the EURES portal, which provides information for jobseekers and employers in a special 'blue jobs' section.54Adriatic Ionian cooperation for facilitating tourist circulationMinistries of interior affairs – ministries of foreign affairs, national tourism organisations, ministries of tourism, national ***statistics*** organisations, Universities, Chambers of Shipping, Tourism SMEs, Ship-owners, Marinas, yacht skippers, and Yacht brokers associations• Developing harmonised visa procedures for tourists visiting the Adriatic-Ionian region.• Developing common system for delivering and recognising nautical licenses within the Region; Assessing the need for EU action on qualification requirements for skippers and recreational boating; Addressing the 'insularity' and the public service character as key issues for coastal shipping55.• Joint Set of Quality Standards for the Adriatic-Ionian Tourism, for a high level of tourist satisfaction while protecting environment and culture. This should address tourism professions, tourism jobs qualifications, and common classification systems as an important benchmarking instrument.• Harmonisation of national ***statistics*** on tourism for more detailed, more comparable and more comprehensive ***data*** to measure the impact of the sector on the economy and to better design policy options and macro-regional tools (including building on the existing European Tourism Indicator System -52   [*http://ec.europa.eu/enterprise/sectors/tourism/tourism-seniors/index\_en.htm53*](http://ec.europa.eu/enterprise/sectors/tourism/tourism-seniors/index_en.htm53)   [*http://ec.europa.eu/enterprise/sectors/tourism/eden/index\_en.htm54*](http://ec.europa.eu/enterprise/sectors/tourism/eden/index_en.htm54)   [*http://ec.europa*](http://ec.europa) /eures55 University of Aegean, stakeholders' report of the department of Shipping, Trade and Transport on the Strategy for coastal and maritime tourism.65ETIS).• Guidelines for Green Public procurement across the Adriatic- Ionian Region and dissemination of best practices among national and regional authorities to help them procure low-carbon, environmentally-friendly goods, works and services in the tourism sector.• Annual Adriatic Ionian Sustainable Tourism ForumAdriatic-Ionian Charter for sustainable and responsible tourismMinistries of Tourism, Business Associations, Chambers, Environmental state agencies, regional and international experts, regional administrations, University departments• Development of an Adriatic-Ionian Charter to encourage sustainable and responsible tourism with a set of principles and guidelines, It could promote implementation of the European Tourism Indicator System (ETIS)56 for Sustainable Management of Tourist Destination, allowing measuring of destinations' performance, to enable their sustainable development and improvement.• The Charter could be supported by actions such as the application of the EU Eco-Management and Audit Scheme (EMAS), and training of tourism companies to evaluate, report, and improve their environmental performance.Examples of targets by 2020:• 50% increase in tourist arrivals from countries outside the Region• 50% increase in tourism arrivals during the off-season period56   [*http://ec.europa.eu/enterprise/sectors/tourism/sustainable-tourism/indicators/index\_en.htm665*](http://ec.europa.eu/enterprise/sectors/tourism/sustainable-tourism/indicators/index_en.htm665). FUNDINGThe Action Plan accompanying the Strategy shall be implemented by mobilising and aligning all available EU, international, national and private funding of relevance for the four pillars and the specific topics identified under each pillar.The regulatory framework for European Structural and Investment Funds (ESI Funds) for 2014-2020 and the Instrument for Pre-accession Assistance (IPA) for non-EU countries provide significant financial resources and a wide range of tools and technical options.The macro-regional approach was included in the Regulations for the programming period 2014-2020 and should be included in the new generation of Regulations for the programming period 2021-202757. In addition, due to the coordinated approach of the Directorate General for Regional and Urban Policy and the Directorate General for Enlargement, Strategy Papers for non-EU countries (Montenegro, Serbia, Bosnia and Herzegovina, Albania) did explicitly refer to the Strategy and so should do the IPA Strategic Framework 2021-2027. Moreover, considering that the macro-regional strategy will contribute directly to national objectives, thereby becoming an integral component of national, regional and local strategies, all kinds of existing funding sources beside EU level can be harnessed, dramatically increasing funding possibilities in support of cooperation activities throughout the macro-region.Other means are also available. In addition to interventions of international financial institutions, the Western Balkan Investment Framework (WBIF) provides finance and technical assistance for strategic investments, particularly in infrastructure, energy efficiency and private sector development. Capitalising on the work done in the framework of the two other macro-regional strategies on innovative financing58, implementation of projects - also in the non-EU countries - can benefit from innovative options involving, among others, the WBIF. The European Investment Bank (EIB), for its part, stands ready to mobilise its financing tools and expertise in support of suitable projects under the topics included in the Action Plan. The EIB can extend support to both public and private sector activities in the form of lending, blending and technical advice. It offers a variety of financing instruments, ranging from investment loans for both direct and indirect financing to equity funds via the European Investment Fund. An overview of how the EIB can contribute to implementation of the Strategy for the Adriatic-Ionian Region is enclosed in this document.Funds of relevance for the specific pillars are also available. The European Maritime and Fisheries Fund as well as Horizon 2020 (Horizon Europe for post-2020), which targets57 Proposal for a Regulation of the European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, and the European Maritime and Fisheries Fund and financial rules for those and for the Asylum and Migration Fund, the Internal Security Fund and the Border Management and Visa Instrument – COM(2018) 375 final, Article 17.58 E.g the Danube Financing Dialogue This Dialogue brings together projects, available sources of funding and international financial institutions.67Blue Growth as one of its focus areas for RTD, can lend key support to implementation of actions and projects under Pillar 1.Of high relevance for Pillar 2, the Connecting Europe Facility (CEF) 2014-2020 supports the development of high-performing, sustainable and efficiently interconnected trans-European networks in the field of transport, energy and digital services. The Facility focuses on projects with high EU added value, such as building missing cross-border links and removing bottlenecks along main trans-European transport corridors. The CEF creates significant leverage and attracts additional public and private funding through the use of innovative financial instruments, notably EU project bonds. CEF financing for actions in pre-accession countries can be granted if these actions are necessary for implementing projects of common interest59. CEF coordination with the Horizon 2020 research and innovation programme as well as with the Cohesion and Structural Funds will be central. Parts of the budget of the ESI Funds for 2021-2027 could be dedicated to projects related to energy, transport and ICT infrastructure via embedding cooperation in mainstream programmes as proposed by the European Commission60. Opportunities of CEF 2021-2027 for the implementation of the EUSAIR in the near future should be thouroghly explored.As for Pillar 3, funds under the LIFE programme are open also to non-Member States. This programme explicitly mentions cross-border actions and includes mitigation as well as an adaptation pillar. Pillar 4 may, among others, benefit from the COSME programme for SMEs.59 A 'project of common interest' means a project identified in Regulation (EU) No 1315/2013 or Regulation (EU) No 347/2013 or in Regulation on guidelines for trans-European networks in the area of telecommunication infrastructure.60 Staff Working Document accompanying the Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of EU macro-regional strategies - SWD(2019) 6 final.686. MONITORING, REPORTING AND EVALUATIONThe experience reaped from the two existing macro-regional strategies notwithstanding, the macro-regional approach remains new and hence somewhat experimental. Moreover, despite substantial overlaps between the Danube and the Adriatic-Ionian macro-regional strategies in terms of countries involved (five out of eight countries are engaged in both strategies), certain challenges specific to the Adriatic-Ionian macro-region call for sui generis responses, not only in terms of action/project implementation, but also in terms of action/project monitoring and evaluation.While there should be a description of the status quo in the participating countries with regard to the topics identified under each pillar as well as prioritisation of actions under each topic, ***data*** and analyses currently available do not make this possible. ***Collecting*** and analysing reliable and comparable ***data*** throughout the Region, on which sound description of baseline situations can be delivered and well-founded prioritisation of actions can be done, will form an integral part of further development of the macro-regional approach.Setting, already at this early stage, tentative result indicators aimed at capturing the change hoped for, with respect to specific aspects of the problems identified, can nonetheless facilitate understanding of these problems as well as of the kinds of response(s) required. It will furthermore facilitate ex-post evaluation of the extent to which actions or projects carried out contributed to alleviating the problems identified in the baseline situation. Evidence, in particular regarding economic geography for fisheries and aquaculture, and marine environmental assessment and modelling to be provided by the Joint Research Centre will be used to this end.A ***data*** base including existing projects and providing ***data*** on the basis of which the necessity of possible projects can be justified should furthermore be established. For the sake of comparability, monitoring of the Action Plan will preferably make use of available statistical indicators from the European Statistical System (ESS). If appropriate, statistical ***data*** ***collections*** and territorial analyses will furthermore make use of harmonised spatial definitions (e.g NUTS) and existing typologies for coastal regions (based on NUTS 3 regions) and coastal areas (based on Local Administrative Units).Far from relating to beneficiaries of the actions or projects alone, result indicators should relate to entire segments of the macro-regional territory. Result indicators often relate to concrete achievements with a macro-regional or transnational impact. They may however also relate to results that are less easily quantifiable, such as: increased coordination of policies across national boundaries; creation of cooperative networks; joint ventures initiated by SMEs; growing sense of ownership and raised awareness of interdependencies across national boundaries; raised level of engagement among municipalities and other public authorities, SMEs as well as civil society; greater acknowledgement among decision makers of mutual effects of national decisions with a territorial impact and hence better compliance with the requirements of the Strategic Environmental Assessment (SEA), etc. Consequently, result indicators will not69exclusively be variables to be measured in quantitative terms. Depending on the context they can also be assessed in qualitative terms.In order to convey a sense of direction to the actions/project, it is useful to associate targets for result indicators. These targets can however at best be approximate estimates subject to regular revision and adaptation in pace with implementation of the Action Plan. Like result indicators, they may be set in quantitative terms (e.g attaching a quantified value or a range of quantified values to the change expected)61 or indicate in qualitative terms the expected direction and pace of change as compared to a baseline situation.While the Action Plan should ideally remain relatively stable for a certain period of time, new issues may emerge along the way and priorities may evolve, requiring actions and projects and their associated targets to be updated, transformed or replaced. In other words, the Action Plan will be “rolling”, and will retain a certain flexibility.To further reflect this situation, reasonable buffer time must be built into implementation plans for each project and caveats foreseen acknowledging that impacts might only be measurable in the medium and longer term. While the Strategy itself is open-ended and therefore has no deadlines attached to it, the time-horizon for the first phase of the Action Plan will coincides with that of the multi-annual financial framework. Within this overall time-horizon the specific time-frame for actions and projects can vary. Some can be implemented in a short time (1-2 years) and some will need longer.61 For the fisheries sector, it is suggested to refer to Maximum Sustainable Yields and to have assessment/evaluation carried out by experts groups (such as the Sceintific , Technical and Economic Committee for Fisheries –TECF- and Working Groups on Stock Assessment of Demersal and Small Pelagic species under the General fisheries Commission for the Mediterranean - SAC/GFCM) in sessions dedicated to the Region.70ANNEX IRole of the European Investment Bank (EIB) in the EU Strategy for the Adriatic and Ionian RegionThe role of the EIB in the Strategy can be crucial, especially in mobilising and blending sources of finance for bankable projects. The EIB has much experience of cooperation with most of the countries in the Adriatic and Ionian Region across a range of different sectors. EIB’s key role in ensuring the availability of long-term financing to key infrastructure and industrial projects is underlined by the already substantial support provided by the Bank in the Region over the course of the last 10 years. Additionally, the JASPERS (Joint Assistance to Support Projects in European Regions) initiative62, is also supporting projects in the Region.EIB presence in the Adriatic and Ionian Region is marked by increased lending volumes: in the last 4 years (2010-2013), the EIB lent EUR 46.6bn in the countries covered by the Strategy. The main sectors supported have been: (i) intermediated loans to SMEs, mid-caps and small infrastructure, with EUR 16bn. of loans signed; (ii) transportation and storage, with EUR 9.4bn of loans; (iii) electricity and gas with EUR 8.4bn ; (iv) manufacturing, with EUR 4.3bn; (v) water supply, sewerage and waste management, with EUR 2.2bn; and (vi) information technologies with EUR 2.1bn The sectors financed contribute directly or indirectly to the four pillars of the Adriatic and Ionian Strategy. For instance, in Italy, one can mention as relevant to the 'Blue Growth' and 'Connecting the Region' pillars, the support given by the Bank to the ports included under the TEN-T network, for which a loan of EUR 120m was approved at the end of last year for the modernisation and expansion of the port of Ravenna.Furthermore, the EIB is assisting Member States in the Region, such as Greece and Slovenia, to finance the national contribution to EU funded projects under the respective National Strategic Reference Frameworks (NSRFs). Many of these projects have a trans-regional impact. For example, the PATHEP (Patras-Athens-Thessaloniki-Idomeni/Promahonas) Railway Corridor, TEN-T priority project, is expected to have a broad impact on transport and logistics in the Balkans, which suffered till now of poor rail connections.Other examples of EIB projects contributing to the 'Connecting the Region' pillar are the Port of Koper in Slovenia; and the support of the TEN-T networks in Western Balkans. The Bank supported investment in the Port of Koper as well as the construction of the energy and gas transmission networks, which have clear regional relevance for all the Western Balkans. With regards to TEN-T project in Western Balkans, one can mention in particular the sizeable projects financed by loans on Corridor Vc in Croatia and Bosnia and Herzegovina, as well as on Corridor X in Serbia and North Macedonia. In Croatia in 2013 the Bank also signed the first 80m loan for a PPP project for Zagreb airport. In Greece, the Bank signed in 2013 a first tranche of EUR 350m (out of EUR 650m approved by the EIB) for the re-launch of the 4 stalled Motorway concessions, which are also TEN-T networks.62 Shared by the EU Commission, the EIB, KfW and EBRD.71The Bank also plays an important role in supporting investments aiming to preserve, protect and improve the environmental quality. For example, in Serbia the Bank supports investments in rehabilitation and upgrading of water supply and wastewater ***collection*** and treatment networks in the city of Novi Sad, while in Montenegro EIB supports the rehabilitation and construction of water and waste water infrastructure of different municipalities.EIB’s intermediated loans in the Italian Adriatic regions and the other seven countries covered by the Strategy supported EUR 749m of investment in sectors related to the touristic activity in the last 4 years.Furthermore, the EIB, in line with its mandate for Western Balkan, supports investments that spur growth and increase employment in the Region, therefore these investments are considered to create added value to the Strategy. The Bank´s EUR 500m loan to the investment in the FIAT factory in Kragujevac, is deemed to create considerable indirect employment effects in addition to the employment at the plant itself, as well as creating export income for Serbia, having a positive effect on the trade balance.Given EIB’s experience from the Baltic Sea and Danube strategies and its priority lending objectives, the Bank is well positioned to support developments in all sectors specified in the Adriatic and Ionian Region strategy.In addition to the EIB’s lending activity in the Region, EIB provides technical and financial advisory assistance to support countries of the Region and their intergovernmental organisations. The Bank’s 5-year (2011-2015) pilot project to provide technical assistance (TA) to Greece in support of the EUR 2bn co-financing of the national component of the 2007-2013 NSRF, has led to extensive capacity building and identification of best practices and lessons learned that are being incorporated in the upcoming Partnership Agreement for 2014-2020. Similar projects might be extended in the Region to other EU Member States and candidate/potential candidate countries.Technical Assistance is also provided in the Region under the JASPERS initiative in Slovenia, Croatia, Greece, Serbia and Montenegro. In the beginning of 2014, there are approximately 100 JASPERS assignments in the Region, with Croatia as the main recipient, while Slovenia and Greece benefit also from the JASPERS TAs, albeit in a lesser extent.JESSICA (Joint European Support for Sustainable Investment in City Areas) is an initiative launched in 2006 and uses 2007-2013 Structural Fund allocations to establish revolving investment instruments rather than grant subsidies, in favour of urban development projects. The JEREMIE initiative63 (Joint European Resources for Small and Medium-sized Enterprises), also launched in 2006, offers EU Member States, through their national or regional Managing Authorities, the opportunity to use part of their EU Structural Funds allocations to finance small and medium-sized enterprises (SMEs) by means of equity, loans or guarantees, through a revolving Holding Fund acting as an umbrella fund. EPEC (the European PPP Expertise Centre)64 was launched63 Developed by the European Commission and the European Investment Fund (EIF), which is part of the European Investment Bank Group.64 Launched by the EIB and the European Commission.72in September 2008 and aims to strengthen the organisational capacity of the public sector to engage in Public Private Partnership (PPP) transactions.The EIB also cooperates with other International Financial Institutions active in the Region (European Bank for Reconstruction and Development (EBRD), World Bank, etc.) and EC project preparation facilities to build a pipeline of potential projects.For example, since 2009, the EIB, the European Commission, the Council of Europe Development Bank and the European Bank for Reconstruction and Development have been cooperating under the Western Balkans Investment Framework (WBIF). The WBIF was launched in 2009 as an initiative aimed at facilitating the preparation and financing of priority projects in the framework of the EU’s Pre-Accession process for the Western Balkans countries. It is implemented jointly by the EIB with the European Commission, the EBRD and the CEB as well as EU Member States and other multilateral and bilateral institutions. It blends available grants and loans for the priority projects in the Western Balkans. During the period 2008-2013, it approved grants for a total amount of EUR 302m in support of 178 operations. In connection with the grants approved by the WBIF, a total of EUR 7.4bn of loans have been identified, of which EUR 3.1bn are signed. Amongst the initiatives supported by the WBIF, there is also the Western Balkan Enterprise Development and Innovation Facility (WB EDIF), which was launched in December 2012 at the initiative of the EIB Group and EBRD as a new complementary measure for improving access to finance for SMEs and supporting economic development in the Region. The WB EDIF will help to develop the local economy and regional venture capital markets, while promoting policy reforms to support access to finance through financial instruments.It should also be noted that EIB is significantly contributing to the Strategy’s objectives through its recent initiatives following the capital increase of 10bn. The Bank’s focus on growth and job creation through financing public infrastructure, SMEs development and support to Foreign Direct Investment has numerous spill over effects that have a cross-cutting effect throughout the Region.In considering the opportunities offered by EIB loans to leverage EU grants for the Strategy, there are thus several concrete examples that can be followed and EIB is available to support its Italian, Slovenian, Croatian, Western Balkans and Greek counterparts in preparing projects that could fit into the regional dimensions of the Strategy through its lending, blending and advisory services.73Examples of selected EIB and JASPERS projects in the Adriatic and Ionian Region and their contribution to the EUSAIREIB ProjectsPillars of the StrategyCross cutting issuesBlue GrowthConnecting the regionEnvironmental qualitySustainable tourismR&I and SME developmentCapacity buildingGreece: EU Funds Co-financing (EUR 2bn)√√√√√Serbia: Rehabilitation and upgrading of water supply (EUR 25 million)√Serbia: Corridor X (E-75) Motorway (EUR 384 million)√Slovenia: Port of Koper (EUR 36 million)√√Montenegro: Urgent Flood Relief and Prevention (EUR 20 million in two loans respectively for transport and WSS)√√Croatia: Zagreb airport (80 million)√Bosnia-Herzegovina: Banja Luka-Doboj Motorway (EUR 160 million)√Italy: Modernisation and expansion of the port of Ravenna (EUR 120 million)√√Albania: Fier Motorway Bypass (EUR 35 million)√Montenegro: Rehabilitation and construction of water and waste water infrastructure of municipalities (EUR 57 million)√North Macedonia: Construction of motorway section between Demir Kapija and Smokvica in Corridor X (TEN)√JASPERS ProjectsPPP waste-to-energy projects in different regions in Greece√√Save river crossing-Gradiska in Croatia√√Sava navigability in Croatia√√√74Dubrovnik airport development in Croatia√√Remediation and closure landfill Sovjak in Promorje-Gorski Kotar county in Croatia√√

**Load-Date:** April 18, 2020

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[***POLITICAS DE CIENCIA, TECNOLOGIA E INNOVACION HACIA ATRAS, HACIA ADELANTE Y MAS ALLA: RETOS Y OPORTUNIDADES DE DESARROLLO PARA IBEROAMERICA EN LA ERA DE COVID-19.***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6360-HF41-DYTM-91TW-00000-00&context=1516831)

Revista de Economía Mundial (Magazine of World Economy (ies)

September 1, 2020

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**Section:** Pg. 115; No. 56"; ISSN: 1576-0162

**Length:** 8573 words

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SCIENCE, TECHNOLOGY AND INNOVATION POLICIES LOOKING BACKWARDS, FORWARDS AND BEYOND: DEVELOPMENTAL CHALLENGES AND OPPORTUNITIES FOR IBERO-AMERICA IN THE ERA OF COVID-19.

INTRODUCTION (1)

The COVID-19 pandemic has explicitly shown the relevance of incorporating science, technology and innovation (STI) as a suitable tool for achieving higher living standards and advancing toward a path of sustainable development. This implies reflecting on the nature of STI policies, evolution, and current opportunities to collaborate with social resilience for facing local and global challenges. The issue is that although biomedical scientific research occupies a central place in the short-term solutions for producing vaccines and treatments, and research and development (R&D) assets have been mobilized in the international context, and also in the Ibero-American countries, the pandemic has shown how a multifaceted health crisis requires a multi-faceted systemic response and involves addressing multiple socio-economic impacts.

The original contribution of this article is to explore STI policy challenges and opportunities for Ibero-America as a result of the COVID-19 pandemic considering a multidirectional approach that combines: (i) transversality, for national innovation systems (NIS) integration with the rest of the national subsystems; and (ii) coordination of STI across national and international spaces, following the 2030 Agenda for Sustainable Development Goals (SDG). We claim that a new approach to STI policy is required that would be based on specific aspects of building capabilities processes that would combine a short-term view related to fighting the pandemic and a more long-term view based on the systems' resilience. This approach must also be based on a democratic construction of the STI agenda which demands to attend several present obstacles such as the rigid borders across disciplines, the still scarce bottom-up approach in the definition of STI policies, and the lack of dialogue among the implied communities. Our proposal here is a multi-actor and multidisciplinary approach in order to define the developmental problems and the strategies needed to tackle them. It must also incorporate the specificities of the region in terms of the NIS and the heterogeneous levels of development.

More than two decades after Freeman (1995) pointed out the importance of scientific and technological institutions, education and health systems, government policies and cultural traditions, we will discuss how NIS remains crucial to facing short term shocks and long-term challenges. The response of the different NIS from Ibero-America has proved their ability to offer ready-to-use solutions for the disease, supporting economic recovery, and to generate and strengthen capabilities in a sustainable way, so we can count on mature systems to better face new crises. The challenge is to look beyond the current one and move forward into a new STI policy that is more articulated with a development agenda that combines national and international solutions.

After this introduction, section two reflects on the situation of Ibero-American countries prior to the COVID-19 crisis in order to understand how it shocked them in terms of the healthcare and economic crisis, the evolution of NIS and the STI policy rationale in Ibero-American countries. Section three proposes some guidelines for a new STI policy agenda that reflects on the developmental challenges ahead in relation to STI policy and the need to coordinate mechanisms at different levels of policy action including a specific reference to the SDGs and Agenda 2030. Finally, in section four, some conclusions are presented.

2. THE PAST DEPENDENCE LEADING TO THE 2020 COVID-19 CRISIS

2.1. ÏHE CONTEXT: EVOLUTION OF COVID-19 AND ECONOMIC CONTRACTION

Within Ibero-American countries, the first confirmed case of COVID-19 appeared in Brazil at the end of February 2020, and as of October (2), 2020 there were nearly 5.38 million confirmed cases (approximately 157,000 deaths). Brazil is followed by Spain, with more than 1.1 million infections, Argentina and Perú (1 million) and Mexico (0.8 million) follow. Nonetheless, these figures may be inaccurate because of the general lack of massive tests. The number of cases has grown exponentially and very quickly since the WHO's declaration of a pandemic on March 11, 2020. The situation is aggravated by respiratory problems, which are the 3rd cause of death in the regional context, together with the added risk of "synergy of epidemics" -outbreaks of measles and dengue fever, diseases that are not completely controlled and affect the most vulnerable population. Furthermore, chronic non-communicable degenerative diseases (hypertension and other cardiovascular diseases, cancer and diabetes) that increase the COVID-19 mortality rate are highly correlated with social determinants, an unfavorable scenario for the region (IDB, 2020).

Another dimension of the crisis is the economic impact of COVID-19. The International Monetary Fund (IMF, 2020) estimates a 3% contraction in the world economy while the World Bank's prediction is -5.2% for 2020 (WB, 2020a), with different magnitudes across regions. Projections for Ibero-American countries underline severe slowdowns or outright contractions in economic activity, where the fall is expected to be 7%, with higher rates for Peru -12%, Brazil -8 %, and Mexico -7.5 %. The Inter-American Development Bank (IDB) forecasts a drop in GDP in Latin America and the Caribbean (LAC) of between 1.8% and 5.5% in 2020 (IDB, 2020). On the other side, Spain and Portugal are among the most affected economies in the European Union (EU): the IMF forecasts more than a -8% rate in 2020, above the -7.1% in the EU (IMF, 2020). Elevation in unemployment rates and inequality are at stake, further deepening the negative social consequences that the 2008 crisis generated. Although economic crises will be a global phenomenon, we can expect greater impact in the region: internal and external shocks accentuated by the contraction of global demand; the reduced margins of maneuverability for fiscal and monetary policy to lessen the impact of the crisis and self-reinforcing inequality being among the worst negative consequences (Lustig and Tommasi, 2020).

This situation forces the adoption and implementation of substantial social and economic measures to help affected households and businesses. Some social emergency responses have already been adopted in many countries (i.e. Spain and Argentina). However, this pandemic calls for coordinated international responses and actions -such as the program approved by the EU (European Parliament, 2020), but its success will be directly dependent on national or sub-continental areas.

Our proposal is that going beyond existing approaches, we need coordinated actions in order to cope with the multifaceted effects of this crisis while the underlying role of STI in the alleviation of these effects is twofold. On one hand, we need to use the STI capabilities to provide effective solutions for people's health: from the provision of medical devices (such as mechanical ventilators and safety equipment) to the production of pharmaceuticals (such as antiretroviral drugs and vaccines) that would protect human life. On the other, NIS should provide resilient conditions that would help to ensure economic and social recovery, implementing short term strategies that must be aligned with long term plans for development.

2.2. THE EVOLUTÍON OF NATIONAL SYSTEMS OF INNOVATION ÍN IBERO-AMERÍCA

NIS is a concept that refers to the set of organizations, institutions and their interactions, that take part of the process of the creation and exploitation of knowledge, at the national level (Arocena and Sutz, 2020; Chaminade et al., 2018). It is a powerful conceptual and methodological tool for broaching the study of innovation, as long as it recognizes the complexity and evolving nature of technological and organizational change. Since the approach first appeared in the 1990s, academic literature and policy instruments have multiplied, especially in Ibero-America and Europe (Rakas and Rain, 2019). In the case of NIS from Ibero-America, literature agrees on some stylized facts about countries within the region.

Firstly, they are characterized by historically low levels of investments in knowledge creation and application, which results in a limited science and technology (S&T) infrastructure (Suarez et al, 2020). On average, total investment in Research and development (R&D) is around 0.75%, with an annual growth rate of 0.71% for the last decade. These figures contrast with the 2% observed for the European Union (EU), with an average annual growth rate of 2%. In absolute values, this means the average for Ibero-America is 16% of the average investment registered in the EU (***Eurostat***, 2020; RICYT, 2020).

Secondly, the largest share of R&D expenditure is funded and executed by the public sector, which accounts for poor innovative dynamics among firms, with innovations concentrated on modernization by means of imported capital goods (Álvarez et al., 2013; Erbes and Suárez, 2016). Moreover, 60% of R&D investments in the region come from the public sector and institutions of higher education, while the average for the EU is 30%. Similarly, patent applications in the EU is around 106 per million inhabitants, while this ratio falls to 21 for the Ibero-American case (***Eurostat***, 2020; RICYT, 2020).

Thirdly, unlike other developing countries, the region has a long tradition of investment in higher education and S&T capabilities (Dutrenit & Sutz, 2014). This was evidenced in the rapid response of both education and S&T to the COVID-19 crisis in terms of virtual training and development of solutions (Pedró et al. 2020). This can also be observed in the number of papers published on the subject. Since March 2020, nearly 2,250 papers have been published in specialized journals in relation to COVID-19 (June, 11, 2020); however, general figures are still far from the values registered in the EU, China or USA, since only 7% corresponds to Ibero-American countries. Moreover, in Ibero-America there are 1,250 researchers per million inhabitants versus 12,670 for the case of the EU, that is, 10 times more personnel (***Eurostat***, 2020; RICYT, 2020).

Fourthly, productive systems work as an archipelago of modernity islands within an ocean of firms with low levels of productivity (Dutrenit & Katz, 2005). There are some firms competing on the international frontier, with technological and commercial problems very similar to those of firms from developed countries, but scarcely connected to the rest of the productive structure. This structure is far below the level for developed countries, and the gap expands every year. For instance, EU trade ***data*** shows that both imports from and exports to Latin America are highly concentrated in less than 10 countries and represent nearly 5% of total EU merchandise trade (***Eurostat***, 2020). In this context, strategic planning of STI from the public sector is not strong enough to connect knowledge supply and demand, whether in terms of searching for technological upgrade among firms or providing solutions for development challenges.

Fifthly, there is inter- and intra-national heterogeneity. Ibero-America refers to a group of countries with different levels of development, with dissimilar levels of accumulated productive and STI capabilities. There are OECD country members such as Chile, Mexico, Portugal, and Spain; Costa Rica now being in the process of accession; some emerging economies such as Brazil and high- and medium-high income countries such as Uruguay, Argentina and Colombia. But also, medium-low- and low-income countries such as Bolivia, Haiti, Guatemala and Nicaragua. In addition, there is intra-national heterogeneity (Erbes et al., 2016). Resources, capabilities and population are concentrated around a small number of cities, mainly the capital districts and some ***agricultural*** and productive nodes. The GINI index shows that Latin America is the most unequal region; it has oscillated between 45 and 55 over the last twenty years, while for the EU it is close to 28 (WB, 2020b). Moreover, around 188 million people live under the poverty line, that is 30% of the population of the region, and the income gap is increasing, while the level of informality is also very high (ECLAC, 2020). This means not only that elementary capabilities, such as access to higher education, are very limited in some regions, but also that different problems of development demand STI solutions connected to heterogeneous levels of technological complexity that ranges from the lack of healthcare systems to environmental degradation due to the use of genetically modified seeds.

In short, NIS of Ibero-American countries are historically characterized by low investments in the creation and application of knowledge, aggravated by weak linkages between the different components of the system. However, and even in the presence of high heterogeneous situations, there are accumulated capabilities in STI which account for the potential of the NIS to contribute to development. In addition, the region shares a long history of cooperation and geographical, cultural and institutional similarities. All of this accounts for the possibility of an articulated strategy, and strengthening the linkages between the NIS and the rest of the national systems will be a key challenge for STI policy.

2.3. STI POLICY RATIONALE IN ?BERO-AMERICA

The rationality behind STI policies in Ibero-American countries evolved hand-in-hand with changes in the general frameworks for public intervention. In a very summarized racconto of the history of STI policy, four moments can be identified. The origins of STI policy as a state policy go back to the model of import substitution during the 1950s. This period was led by the promotion of knowledge supply in the form of traditional S&T institutions. During the 1990s, the cycle of structural adjustment and policy reforms linked to the Washington Consensus led to market oriented STI policy, characterized by competing matching grants and the promotion of firms, defined as the knowledge demand (Katz, 2007). The diffusion of the NIS approach and the cycle of post-structural reforms initiated at the beginning of this Century led to the implementation of "systemic" policies, based on vertical and integrated schemes to promote innovation by means of generating linkages within sectorial, regional and national innovation systems (Crespi and Dutrenit, 2013). Since the 2008 financial crisis - and partially explained by the limited impact of systemic policies- a new rationale behind STI policy emerged and challenged the traditional NIS-based view of public intervention. This new approach is based on the idea that STI must be directed towards strategic goals, defined outside the NIS but connected to it.

It would be unfair to state that STI contribution to development has been denied in past policy rationales. Many STI policy instruments have been fundamental to the development of knowledge-intensive solutions that collaborate with social welfare, particularly for health issues (Natera et al., 2019). STI policy has always been thought of as a means to development, and changes in policy rationale were in fact changes in both: the conceptualization of how to reach it and the role played by STI. During the fifties, development was defined in terms of industrialization and S&T was expected to push innovation. Despite the early recognition of the importance of articulation within the NIS (Sabato and Botana, 1968), STI policy was focused on S&T institutions and protecting national industry. During the nineties, development was assimilated into competitiveness, this reached by means of market competition. Under this scheme, innovation and technologies were assumed to promote S&T activities based on pseudo-market interactions. The systemic view of the NIS approach showed the importance of articulating both sides of the system, with a more complex definition of development that includes equality, but to some extent assuming a linear relationship between innovation and development. What we have been evidencing in recent times is an explicit emphasis on the design of STI policies targeted at collaborating with development challenges.

Hence, the fourth moment of STI policy, which began during the last decade, is still under debate without a clear conceptual framework. Three approximations are gaining consensus. Mainly based on contributions from LAC, the interest in innovation processes focused on inclusion issues and related national problems (Dutrenit and Sutz, 2014), to strengthen NIS and their capabilities and interactions in innovations meeting the needs of marginalized populations, but more widely, to close the income gap. The development of new products and services can be oriented towards solving national problems, by applying two strategies: the generation of ready-to-use solutions for marginalized populations and the co-production of solutions. In both cases, the integration of multiple agents and S&T disciplines are intended to better define the development challenge based on solutions that integrate communities in the process (Cozzens and Sutz, 2014).

Another approach is the organization of development challenges in "Mission oriented projects" (Mazzucatto and Penna, 2016). S&T capabilities must be combined with other types of capabilities -namely the State, technical-administrative, political, productive and market capabilities- to provide solutions to development challenges. They are concrete goals, set with measurable levels of achievement, which must be executed within certain deadlines. Missions are articulated in a portfolio of specific projects, usually inter-sectoral, which are geared towards meeting their goals in a timely manner; they require validation in the public agenda and by State entities.

A more recent approach is the promotion of Transformative Innovation Policies (TIP), that considers the reconfiguration of social and economic relations, in achieving new arrangements of socio-technical systems for the solution of problems (Schot & Steinmueller, 2018). These include new structures in terms of market relations, political processes, generation of local or transnational interactions or promotion of certain lines of R&D. Furthermore, it states that innovation processes generate positive and negative externalities: innovation has effectively served as an engine for economic development in some regions but, at the same time, it is part of the structural processes that sustain problems in other parts of the world.

Unlike other dimensions of public policy, every new cycle of STI policy led to new instruments and programs but maintained previous interventions. As a result, today's STI policies are composed of layers of instruments and programs from the four historical moments of STI policy with different objectives (not always designed in a coherent way), aimed at generating, applying and exploiting knowledge to contribute to overcoming development challenges. The current scenario of COVID-19 will require the combination of all three competing approaches to STI policy. Beyond the current crisis, policy concerned with the generation of specific solutions could be part of the strategic projects defined in a long-term framework, using the immediate needs as means for achieving scientific, technological and institutional capability development. The COVID-19 crisis constitutes an opportunity to look beyond the pandemic and to think of a more long-term and integrated development strategy. In this scenario, STI policy has a role to play and some lessons to learn.

3. STI POLICY PERSPECTIVES: SYSTEMIC INTEGRATION AND MULTILEVEL COORDINATION

3.1. STI POLICIES FOR DEVELOPMENT CHALLENGES

The duality between the efforts required and the potential benefits justify the emergence of a new STI policy framework. The potential of STI capabilities reaches its maximum when they are framed in a systemic vision, where social, cultural, political and economic dimensions are combined (Borras and Edquist, 2019). The integration of different disciplines requires an effort in the construction of a common language, interdisciplinary analytical frameworks and harmonized methodologies. This implies a problem of coordination for the multi-level (national, sub-national and international) layout for agreements and actions.

STI policy for the challenges ahead must consider the complexity of their object: it implies dealing with non-linear processes and requires the conjunction of heterogeneous agents. This implies recognizing the relationship between the knowledge generation processes and their possible use (S + T+I). Different research teams' configurations can achieve these results, however some of them make the generation of these virtuous products more likely to occur: they are multi-, inter-or transdisciplinary teams that seek capabilities integration mechanisms by being oriented at problem-solving research. These teams work under "type 2 mode of knowledge production," made up of heterogeneous agents, with a research process that combines academic rigor with social reflexivity (Gibbons, 2000; Nowotny et al. 2003). The COVID-19 crisis is also a call for rethinking how STI processes could collaborate in the generation of new solutions, specifically through the generation of interdisciplinary frameworks, paying special attention to the creation of analytical bridges between health studies and innovation studies. A recent proposal points out four analytical dimensions in this direction (Natera et al., 2020):

\* Heterogeneous agents, including knowledge generators from the public sector, the productive sector, the scientific community and health services providers. And, as the COVID-19 crisis shows, two more types of agents are knowledge users, the medical personnel who are trained to apply possible new treatments; and knowledge beneficiaries, patients and general population that should know how to act in the face of possible infections.

\* Asymmetrical interactions that could foster or inhibit knowledge flows, conditioning the relationship between different agents. The COVID-19 pandemic has boosted telemedicine services, giving a more active role to patients in self-managed healthcare treatments; this reconfigures the hierarchical nature of the doctor-patient relationship as per the implementation of an STI solution.

\* Learning processes, based on specific models for healthcare activities, that include the productive activities and feedback loops in a non-linear configuration: knowledge sources are distributed in the model. New insights come on a daily basis from the observation of the COVID-19 measures, such as the massive use of masks in public spaces or the use of certain drugs to alleviate symptoms.

\* Institutional framework: considering formal institutions (laws and regulations) and informal institutions (socio-cultural background). The rights to use a SARS-CoV-2 vaccine will need a legal discussion on the scope of Intellectual Property Rights. On the other hand, the effectiveness of social distancing measures is greatly determined by the possibility of changing our social interactions -and living conditions- in a sustainable way.

There is no one discipline capable of dealing with all the aspects of these four dimensions for the COVID-19 pandemic. STI Policy needs a multidisciplinary approach, in which different agents can interact. It is crucial to establish a common agenda in which STI processes are oriented towards the solution of the crisis and its effects. STI policies have to consider participation mechanisms to articulate agents' needs, interests, visions and capabilities. Dialogues for STI policy design are a fundamental tool for this objective (Dutrénit and Natera, 2017) and its relevance can be observed at two moments. The first is the design phase because processes of dialogue must be oriented at reaching consensus on the definition of agendas, objectives and strategies of the STI policy. The second is the implementation, monitoring and evaluation of the policy. When it comes to troubleshooting, maintaining links with relevant agents (stakeholders) throughout the process is highly recommended. Participation benefits due to the usefulness of the instruments of STI policy and the appropriation of the agenda and solutions are clear, making it a mechanism for guaranteeing the efficiency and effectiveness of the STI process. Also, it may be basic to enhancing NIS linkages and generating coordination mechanisms between national and international levels.

3.2. STI POLICY AND THE RECONFIGURATION OF THE NIS

The COVID-19 crisis made the scientific community aware of the imperative nature of social needs, even when it meant skipping steps of scientific methods -which explains part of the scientific uncertainty when reacting to the multiple impacts of COVID-19. The pandemic showed society the timing of scientific activity and the importance of basic knowledge ready to be applied in response to an emergency. This was a clear reminder of the false dilemma between basic and applied research or between curiosity driven versus mission- oriented research (Stokes, 1997).

The shift of STI policy towards development challenges demands a new discussion regarding the autonomy of science and how, and to what extent, basic knowledge driven by the search for general rules should be supported. S&T institutionality in the import substitution model was built under the idea of self-regulation, as if only science were capable of regulating science. This institutionality has predominated ever since. STI policies to development challenges are at odds with that structure of coordination by forcing scientific activity to channel efforts to specific objectives, defined outside the scientific community. The pandemic showed that these two ways of producing knowledge are two sides of the same NIS. Among Ibero-American countries, the accumulation of scientific and technological capabilities and infrastructure to create and apply knowledge, and the development of industries to transform them into innovations were a precondition for rapidly responding to a change in the environmental conditions such as the COVID19 crisis. However, curiosity-driven S&T, based on the traditional mode of research had been developed before, so capabilities and solutions were ready to use (once again S + T + I).

Another element that emerged from this crisis and that affects the new framework for STI policy is the impact of the systematic reduction in public budgets allocated to S&T. During the last decades, S&T infrastructure had suffered from the impacts of the economic crises, but especially from the back and forth of State policies more or less aimed at supporting STI as a means of development. In some countries -Argentina, Brazil, and recently Uruguay, the return to neoliberal policies aggravated the situation, as the policy' responses to 2008 financial crisis on the European side. The pandemic showed that the accumulation of knowledge depends on a path dependence processes linked to the generation of capabilities and infrastructures in basic and applied science, which demands sustained investments. When the COVID-19 crises arrived, there was no time to train biologists, virologist and epidemiologists to search for solutions. There was no time to train sanitarians, sociologists, economists, or engineers to deal with the side-effects of COVID-19 either. All fields of S&T had to search for practical solutions in a very short time.

A third element linked to a new framework for STI policy has to do with the need for a new way of articulating the NIS. Countries better responding to the crisis are those that had accumulated capabilities - including S&T infrastructures- decades before, not just in terms of S&T resources but also in terms of the different dimensions, interactions and coherence that determine the NIS and its articulation with other national systems (Freeman, 2002). In this regard, although an increase in the articulation of the system was observed, most of the reactions were based on traditional S&T disciplines. This is a partial explanation of why the healthcare crisis is moving differently than other problems--the increase in domestic violence linked to the lockdown, or the access to basic needs within the most vulnerable sectors of societies. The impact of this crisis on small and medium-sized firms cannot be estimated yet and deserves a complete article. This lack of multidisciplinary and multi-actor approach to national problems is probably the biggest challenge to STI policy.

Finally, the permeability of digital techniques -the changes entailed in terms of production, consumption, distribution, and also in the provision of social and particularly healthcare services - puts the access to digital technology and communications at the forefront of the STI agenda (Cano-Kollman et al., 2013; Medina et al. 2020). The lockdown measures have increased the virtualization of many economic and social relationships. STI policy actions must take into account the disruptive capacity of these technologies in order to guarantee the basics (such as e-education or e-health services), the essentials (supply of food, energy, housing), and those more advanced functions that are equally relevant in the changing routines during the pandemic and the challenges defined by our societies (finance, computing, big ***data***). STI policies oriented at fostering basic scientific research in experimental disciplines (i.e., contributing to vaccines or drugs) have to be accompanied by the construction of a more inclusive, transformative and resilient societies.

Hence, the constitutionality of STI activities must be rethought, in order to allow other voices to be part of the construction of the STI agenda, without losing the role of autonomy and self-coordination in the process of knowledge creation. The role of STI policy includes the promotion of a more integrated definition of research agendas, working on a more articulated NIS not only in terms of their agents and linkages but specially in terms of the NIS and development problems. The key is to look beyond the COVID19 crisis and to understand development challenges in the context of Ibero-American countries and their relationships with the rest of the world.

3.3. THE INTERNATIONAL ARENA FOR STI POLICY

The long-term objective of sustainability -social, environmental and economic- is moving hand-in-hand with the digital transformation of economies and societies, empowered by artificial intelligence, big ***data***, blockchain and quantum computing (Rubmann et al, 2015). This more advanced phase of information and communication technologies (ICT), has significant implications for worldwide production and consumption - increasingly dominated by networks and extremely dependent on ***data*** and international platforms (UNCTAD, 2019). In the horizon ahead, green and digital challenges are the main focuses targeted by the transformative capacity of the different layers in STI policy (EC, 2020) while talent becomes a key factor in policy action for development (OECD, 2019).

The pandemic also comes with effects on the potential reconfiguration of global value chains -GVC (Baldwin & Freeman, 2020). The high level of interdependence and the pivotal place of China in the evolution of globalization invites us to rethink and discuss the adequacy of greater productive diversification. The COVID-19 crisis revealed the great international interaction of agents and countries, the notable concentration in some production poles, and the rise of several protectionist measures in a few months. Among direct consequences we find the reinforcement of national industry to compensate the negative impacts generated by the high degree of dependence on GVCs, clearly in the case of strategic goods (i.e. personal protective equipment, PPE) and medical devices. This evokes a reflexive diversification strategy, reshoring phase or the idea of reintegrating supply chains inside the EU (European Parliament, 2020).

The question is what possibilities, if any, exist for regional institutions in Ibero-America, particularly for the governance of STI policy that would combine, for instance low carbon and sustainability, with the promotion of digital skills in both individuals (education shift) and businesses (industrial and innovation policies). Although in the first case governance is placed at the international level, education is an issue of national State competence. Nevertheless, international collaboration and cooperation in Europe and LAC may enhance and multiply the positive effects of the European Research Area and the Ibero-American Higher Education Space. Regarding the domain of industrial and innovation policies, a convergence of several levels of government -local, regional, subnational, national and even international- can be considered. In this regard, governance of GVC brings large multinational enterprises (Gereffi et al, 2005) and digital Giant-tech companies onto the scene. It is worth saying that they are not from Europe nor from ALC but owned by the USA and China. This deficit has been revealed as a crucial issue for future scenarios of prosperity. Realistically, it is very difficult for countries to succeed alone. A concept based on public-private partnerships can be seen as a plausible answer for success. The challenge is how to move ahead in a coordinated international way.

3.4. ACENDA 2030: CLOBAL CHALLENCES TO NATIONAL SYSTEMS

The COVID-19 pandemic arrived at a time when STI had been specifically incorporated into the international development agenda. Specifically, SDG 9, addresses the process of building resilient infrastructure, promoting inclusion and sustainable industrialization and fostering innovation (United Nations, 2015). In this regard, the challenge for STI policies is to work on the broad meaning of NIS while looking simultaneously at the coordination of actions in different SDG, and dealing with the regional and national specificities at different levels of government, including the international arena.

As COVID19 has shown, a multidisciplinary and multi-actor approach is imperative because we are facing a comprehensive crisis that cannot be reduced to the purely epidemiological field, as it concerns the economy, social cohesion, and also is related to environmental implications. The biomedical angle therefore needs to be supplemented by scientific and social criteria while challenges ahead require a coordinated common action, the same for the pandemic as for combating climate change; it means to deal with global problems and international solutions.

The COVID-19 crisis also shows that going forward towards the universal digitalization of the region has to be part of any inclusiveness strategy (SDGs 1 and 10). At this point, the issue of coherence of policies á la Freeman (2002) is more important than ever, taking objectives such as infrastructure, education and training into account, and considering the international, national and local dimension of STI policies.

Following an Agenda 2030 perspective, several aspects enter the scene and coordination will only be possible if three conditions are met. Firstly, there is the availability of resources in the region, being clear that the problem is not partially reduced to the matter of sufficient investments but enters into the process of building coordinated capabilities. This means concentrating efforts on the development of institutional complementarities which, so far, are very fragile (Alvarez et al., 2019). The objective is to mobilize ***collective*** resources and skills while the target is the resilience of Ibero-American NIS. In this sense, the transversality dimension of the STI policy agenda suggested here for the post-Covid-1 9 era, implies reinforcing complementarities to directly address multiple SDGs such as Goal 3: Good Health and Well-being; Goal 9: Industry, Innovation and Infrastructure; and Goal 17: Partnerships to achieve the Goals.

A potential coordination strategy can be built from the generalization of a bottom up process of dialogue (Alvarez et al., 2016). This can be defined at the national level of policy as a mechanism of cohesion being applied and supervised at the subnational level of policy (subnational regions, local) following an approach of democratization STI. The dialogue methodology mentioned in section 3.1. can be expanded to the international arena to reconcile national and local conditions with international synergies. Moreover, a coordinating body for assessment and evaluation can also be created at the international level in the heart of the international cooperation on STI within the framework of SEGIB-CYTED as it was in its origin.

Secondly, multilateralism seems to be a valid coordination mechanism across different levels of policy (international, continental, subcontinental, national) and for the provision of the basics and the essentials. In such a case, STI policies oriented at resolving undersupplied structural problems must be complementary and then coordinated to facilitate initiatives of international organizations such as the IDB on regional public goods to enhance R&D for their provision, or the efforts at the core of UNESCO to enhance universal education levels.

Third, related aspects in the present world-context such as the situation of GVC is not purely of national concern but rather it is mediated by international regulations and multinational agents. The international fragmentation of production, the lack of autonomy in national industries and also healthcare in the region and STI have been then at the expense of policies looking backwards, forward and beyond in the region. However, the green and digital challenges of the postcovid-19 era require a common and coordinated commitment to mobilize resources and actions in order to enhance a knowledge co-creation process also at the international level. In this regard, it seems to be plausible to think of the reinforcement of both collaboration with the EU and bilateral R&D cooperation in Ibero-America.

4. CONCLUSIONS

The pandemic has underlined some challenges and opportunities for the world economy and also in the specific arena of STI. Shocks non-rooted in economic problems like the COVID-19, affecting public health at the global level, undoubtedly imply radical shifts moving us towards a new development path. Globalization has meant notably high levels of international flows of goods, services, capital, but also people, knowledge and ideas. International interactions and spillovers must be taken into account more than ever because we have seen that they can be more serious than we could have guessed. The COVID-19 has suddenly brought us an uncertain scenario and has shaken what many understood to be stylized and rather permanent facts. It has imbued us with some overnight certainties that in the field of STI lead to the reaffirmation of its multi and interdisciplinary nature. It has also revealed that a multi-stakeholder and multi-level policy approach are two dimensions that are needed in STI policy more than ever.

The first dimension implies the coordination of public bodies with the productive sector and with some other relevant agents such as hospitals, universities and non-governmental organizations (NGO), as we have seen during the COVID-19 outbreak. Research activities (science-based) in much of these cases must also be combined with logistic capabilities for problem solving (innovation-oriented), that turned out to be critical in facing emergencies. This dimension implies the institutionalization of STI processes, and STI dialogues can be seen as a matching instrument that guarantee a higher level of democratization. Democratization of knowledge means empowering society to understand the nature and consequences of the way of producing and distributing income, and the strategies for approaching them are not neutral in terms of social and environmental sustainability (Arocena, 2019). The dialogue approach is just one dimension of that democratization process in which different communities must be involved throughout the process of searching for and implementing solutions, monitoring and adjusting instruments and the redefinition of the problems (Dutrénit & Natera, 2017).

The second dimension calls for proximity of government bodies to people and problems. The complex development challenges together with the decentralization trends in the region need STI policy in national governments with legitimacy for intervention when needed (especially in cases of emergency), and robustly built on some durable pillars (not subject to political cycles) that provide stability (instead of fragility) to the systems. We can learn from the three approaches to STI policy under debate such as its transformative capacity and the necessary coordination of national objectives at the level of state policies to contribute to solving real national problems, the lesson is that these can only be defined by means of the integration of the different agents and institutions involved. In addition to being persistent, the STI policy requires being suitable and matching the principle of coherence in terms of development challenges.

Finally, global challenges such as SDGs require global responses too and imply targets of great coordination in the STI field at the regional level. It is not easy to deal with the complexity of development problems nor even with the SDGs agenda. A coordinated regional definition of actions makes achieving a better place in the new geopolitical map more likely. In other words, a solid bid in favor of a sustained STI policy including (at least) mid- level scientific programs in the Ibero-American countries that looks at the development challenges through the lens of inclusion. This implies the democratization of strategies to define instruments and institutional arrangements to cope with issues such as climate change and digitalization. Low carbon-consuming and diversified industries are some elements to be born in mind on the side of technological innovation, while national strategies in favor of a sustainable development path which must be supervised and subject to regulation under more solid and democratic multilateral commitments are called for.

In a situation where all predictions have failed to foresee a global crisis and all textbooks lack lessons on courses of action, we need to look beyond the crisis and start doing things differently. Some conceptual and empirical elements that would support this shift are, on the one hand, the integration nd articulation of systems and, on the other, the transversal coordination of them in the national and international contexts. Solutions for the reappraisal of issues talked in this article imply that STI must be part of a more integrated agenda to contribute to the basics, the essentials and the advanced aspects of development challenges. More integrated and articulated national innovation systems can be used as tools for those challenges but only if we manage to make them more transversally coordinated with other equally relevant systems at the local, national, regional and international levels. STI policy has a key role to play in this agenda.

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DOI: [*http://dx.doi.org/10.33776/rem.v0i56.4862*](http://dx.doi.org/10.33776/rem.v0i56.4862)

Recibido: junio de 2020; aceptado: octubre de 2020

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(1) Authors acknowledge the reviewer and the Editor for useful comments and suggestions. This article has been partially funded by Agencia I + D + i/MINCYT, project PICT-2018/01283 (UNGS) and Proyecto Santander-Complutense PR75/18-21662.

(2) The original version of this paper was submitted in June 2020 and available ***data*** corresponded to April. Authors acknowledge the Editor for the possibility of updating ***data*** to October 2020 before resubmission.

**Load-Date:** July 20, 2021

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[***Food production in China requires intensified measures to be consistent with national and provincial environmental boundaries***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H841-F129-P4DY-00000-00&context=1516831)

Nature Food

September 2020

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**Section:** Pg. 572-582; Vol. 1; No. 9; ISSN: 2662-1355

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**Body**

Main

Food demand has been increasing as a result of urbanization, population growth and increasing incomes—and meeting it sustainably remains a major global challenge. Planetary boundaries demarcate safe operating spaces and represent environmental limits for ensuring the stability of earth systems. Food systems, especially at the food production stage, pose a major threat to planetary boundaries because of their effects on climate change, freshwater use, nitrogen and phosphorus pollution, land-use changes and biodiversity loss. The boundary for biogeochemical flow has already been exceeded, and those for climate change, freshwater use, land-system change and ocean acidification could be reached shortly,. ***Agriculture***’s global annual greenhouse gas (GHG) emissions (6.2 GtCO2e) from 2007 to 2016 have already exceeded the sector’s estimated boundary for that period by approximately 32%,.

There is a critical need for effective environmental mitigation solutions for food producers and consumers. This need has been addressed at both the global and national scales–. Key strategies for sustainably meeting increasing food requirements include avoiding excessive ***agricultural*** inputs, improving productivity, reducing food loss and waste (FLW) and changing dietary patterns,,. Previous studies have examined different environmental impacts,,–, tested the effectiveness of individual mitigation strategies on the food system and proposed methods for downscaling planetary boundaries to national levels,. However, little attention has been paid to analysing the environmental impacts of, and mitigation strategies for, food systems at subnational and provincial scales,. ***Data*** scarcity, limited parameters and limited model capability to represent and/or simulate the subnational and provincial levels have hindered the exploration of effective mitigation strategies and pathways for the maintenance of safe regional operating spaces.

To address this knowledge gap, the present study explores integrated strategies that can keep the environmental impact of national and subnational food systems within local environmental boundaries (or limits) by combining local and inter-regional interventions along the food supply chain. National and subnational analyses of food systems can help identify region-specific strategies and reduce nationwide inequalities in environmental stress and may also inform global sustainability. These practical benefits are especially applicable to developing countries with large territories and heterogeneous environmental and socio-economic conditions. The present study focuses on mainland China (referred to hereafter as China) and its provinces, given their major impacts on global sustainability. The provincial scale was selected to facilitate the integration of different environmental boundaries, simplify decision-making and secure higher quality ***data*** unavailable at finer scales.

We set up a food systems model that quantifies five domains of environmental impact for food production stages related to planetary boundaries. The model was applied to 31 Chinese provinces and 139 countries or regions worldwide for 2011 and 2030 and assumes a peak in China’s population of 1,450 million as projected by the State Council of China (Supplementary Table ). The boundary control variables and boundary processes considered in the model were phosphorus and nitrogen emissions (biogeochemical flows), GHG (climate change), bluewater footprint (freshwater use) and cropland use (land-system change). The current and future environmental impacts and mitigation strategies were quantified by analysing the food production, supply and consumption processes. The national and provincial boundaries for phosphorus, nitrogen and freshwater were downscaled according to regional freshwater availability in proportion to global totals. The national and provincial GHG and cropland boundaries were downscaled according to regional populations and farmland areas, respectively (). The ranges between the upper and lower boundaries of national and provincial boundaries were based on scientific principles and the various properties (local or global effects) of different planetary boundaries,,.

Our investigation of an integrated mitigation pathway comprised three steps. First, we examined basic mitigation strategies,, at the national scale and compared the reduced environmental impacts with the national boundaries. The basic strategies included optimizing fertilizer application, improving supply-side efficiency of food, applying demand-side strategies for reducing FLW and shifting dietary patterns (). Second, we asserted that if the reduced environmental impacts still exceeded their respective national boundaries, then augmentation (that is, intensification) of the basic strategies to address these impacts would be required. Third, we investigated pathways for keeping food systems within provincial boundaries through the redistribution of food production.

Results

Environmental impacts and boundaries

The total environmental impact of China’s food system is projected to have increased by 20–45% by 2030 compared with 2011 in the absence of dedicated mitigation strategies. With the exception of GHG emissions, these impacts need to be reduced by 54–95% to remain below the national boundary means (Fig. and Supplementary Table ). The GHG emissions in 2011 are below the lower boundary, while the emissions in 2030 are below the upper GHG boundary. The GHG boundaries were downscaled according to population levels and have relatively larger values than the other boundaries.

Required environmental mitigation rates at national and provincial scales.

a, Environmental impacts in 2011 and 2030 as a percentage of national environmental boundaries. The error bars indicate the coefficient of variation of environmental impacts. b, Average environmental impact reduction (%) required to keep all five types of environmental impacts below the provincial upper boundaries.

The environmental impacts of provincial food production are projected to increase in some regions and decrease in others between 2011 and 2030: for example, they are projected to increase by up to 126% for cropland use in Guizhou but to decrease by 2–65% in Beijing, Shanghai and Zhejiang. To remain within the provincial boundaries requires a reduction of environmental impacts by up to 99%. Specifically, the impacts of phosphorus and nitrogen in all of the provinces require substantial reductions (approximately 47–99%), whereas GHG emissions, bluewater footprint and cropland use in many provinces (for example, in Guangdong and Tibet) are below the upper bounds of the provincial boundaries (Fig. and Supplementary Table ).

We conducted Monte Carlo simulations to verify the robustness of the model results through the uncertainty range of the five environmental impacts studied. Uncertainties could have been caused by parameter estimation, ***data*** unavailability and ***data*** inconsistency. The model was run 5,000 times using randomly selected values from the continuously (normally) distributed model input, with consideration of ***data*** quality. The environmental impacts had mostly the same sign in all trials for the seven food categories tested (namely cereals; soy, oil and potato (S&O&P); sugar; vegetables and fruit (Vege&Fru); livestock; poultry and freshwater aquaculture). The coefficient of variation of the five environmental impacts ranged from 1.8 to 6.2% at the national level and from 0.8 to 22.4% at the provincial level (Supplementary Table ). Regions with smaller environmental impacts, such as Tibet, exhibited much larger uncertainties. The sensitivity of the environmental impacts to the changes in the parameters and activity ***data*** is shown in Supplementary Table . We found that a 1% change in any single parameter caused less than a 0.3% change in environmental impacts.

National mitigation strategies

We used three scenarios to explore the mitigation effects of environmental impacts, namely basic strategies, intensified basic strategies and reallocation of food production. Our evaluation of high-ambition scenarios, which assume the implementation of 75% of the maximum potential of change across the food system (), indicated that basic strategies can contribute substantially to mitigating the environmental impacts of food production. There was considerable potential for optimizing fertilizer application by reducing the application of chemical fertilizers and by substituting straw and manure. Our evaluation also revealed that advanced fertilizer optimization could reduce phosphorus emissions by 25%, nitrogen emissions by 23% and GHG emissions by 2%. Fertilizer optimization would not, however, lead to direct reductions of bluewater consumption and cropland use (Fig. ). Strategies related to livestock, out of the seven food categories, contributed to more than half of the total phosphorus mitigation (that is, 13% out of 25%) and more than one-third of the total nitrogen mitigation (8% out of 23%) through reductions in manure discharge. Cereals had a greater potential for reducing nitrogen fertilizer use than phosphorus fertilizer use and reduced nitrogen emissions (6% out of 23%) more than phosphorus emissions (3% out of 25%).

Accumulated national environmental mitigation effects in 2030.

a, Effects of basic mitigation strategies (abbreviated as ‘Fertilizer’, ‘Efficiency’, ‘FLW’ and ‘Diet’). ‘Baseline’ depicts baseline environmental impacts in 2030, while ‘Scenario’ depicts final mitigation effects. These final effects can be compared with national boundaries, which are represented by horizontal bars, to check whether the effects have been kept within the boundaries (the light-red bars show the upper bounds, the light-yellow bars show the means and the light-blue bars show the lower bounds). Dietary shifts both increase environmental impacts (‘Diet+’) and have mitigating effects (‘Diet−’). The increased impacts are attributed to greater consumption of vegetables and fruit and aquaculture products (freshwater only), while mitigated impacts result from the reduced consumption of other foods. The error bars indicate the coefficient of variation of environmental impacts. b, Reduced nitrogen impacts of augmented strategies. These mitigation effects were the result of an additional 10% improvement in efficiency and an additional 10% reduction from FLW and diet deviation (in kt N).

Improved efficiency could be achieved primarily through the adoption of more productive soil–crop and feed management technologies based on institutional knowledge (). The environmental impacts of food production could be reduced by 46–53% through improved efficiency. The contributions of different food categories varied substantially across the five environmental impacts. Specifically, livestock accounted for the largest share of phosphorus (19% out of 49%) and GHG (27% out of 53%) mitigation. Vegetables and fruit contributed most to mitigating nitrogen emissions (16% out of 51%) and the water footprint (22% out of 52%). Soy, oil and potato production accounted for about half of total reduced cropland use (22% out of 46%). Improved efficiency in cereal production contributed substantially to the mitigation of GHG emissions, bluewater consumption and cropland use. These results revealed the specific contributions of different food categories to the overall reductions in all five environmental impacts.

The impact mitigation effects of demand-side strategies were evaluated taking into account the reduced environmental intensities resulting from supply-side mitigations to ensure that the cumulative effects of all of the strategies were valid. The mitigation of environmental impacts from changes in food consumption was linked back to food production through supply-chain modelling in an input–output analysis (). Our results showed that a reduction of 75% in FLW across all of China’s provinces would lead to an overall reduction of 9–11% in the five environmental impacts of food production. The reductions in nitrogen and GHG emissions, bluewater footprint and cropland use were largely achieved by the reduced demand for cereals, while the greatest reduction in phosphorus emissions stemmed from reduced demands for livestock products.

A shift towards a more balanced diet could contribute to a reduction of 7–12% in the five environmental impacts. The dietary shifts were determined by eliminating differences (or deviations) between current dietary patterns and the nationally recommended diet,. These shifts would prompt increases in the national demand for freshwater aquatic products, vegetables and fruit, while demand for other foods would decrease. The increased demands (for freshwater aquatic products and so on) would have negative mitigation effects (increases of 1–2%). Reduced demands for other foods could lead to a reduction in environmental impacts by 8–13%, mostly as a result of reductions in livestock and cereal consumption. The mitigation effects associated with demand-side strategies point to the possibility of a promising inter-regional collaboration scheme: reducing local-level impacts in one region by changing consumption patterns in the region it exports to. This possibility arises because approximately 31–86% of food produced in one region is transported to other regions. If these two demand-side strategies (that is, reducing FLW and shifting diets) were applied in China, they could reduce food production and the associated environmental impacts from international imports by approximately 29–34%.

Combined, the four basic mitigation strategies reduced the national-level environmental impacts in 2030 by 63–90% relative to the 2030 baseline (Fig. ). Of all strategies, improving production efficiency was the most effective. At the national scale, GHG emission and cropland use were well below the lower bounds and remained within the safe zone. Phosphorus emissions were kept below the mean value, while the bluewater footprint was well below the upper boundary and stayed in the uncertain zone. The environmental impacts within the uncertain zone would not immediately cause undesirable outcomes, but uncertainty and the risk of destabilizing system processes and resilience would increase, rendering the monitoring of these factors needed. Nitrogen emissions, by contrast, remained around 102% (or 770 kt N) greater than the upper bound and thus remained within the danger zone.

Augmentation of the aforementioned strategies would be needed to specifically reduce nitrogen emissions from China’s food system. We identified provincial food systems with nitrogen emissions exceeding the 90th percentile and applied additional efficiency improvements by assuming a further 10% decrease in emission intensities compared with the 2030 baseline (Fig. and Supplementary Tables and ). Advanced food production practices in other countries suggest that further improvements in production efficiency in China are possible. For example, the average nitrogen emission intensity in China is 12.1 g N per kg food, but it is 8.6 g N per kg food in the rest of the world (Supplementary Table ). We prioritized improving food production efficiency over other strategies because its superiority had been demonstrated (Fig. ). When applied to all of the identified food systems collectively, improved food production efficiency resulted in a reduction of excess nitrogen emissions by 93% (or 717 kt N). Livestock production had the greatest potential for further mitigation of nitrogen emissions (a reduction of 306 kt N), followed by vegetable and fruit production (a reduction of 138 kt N) and aquaculture (a reduction of 127 kt N). Inner Mongolia had the largest potential for achieving a further reduction of nitrogen emissions (138 kt N), while reductions of 69 and 58 kt N could be achieved in Shandong and Qinghai, respectively. However, even with mitigation from additional improvements in production efficiency, nitrogen emissions were still 7% (or 53 kt N) greater than the upper bounds of the national boundary.

We further reduced FLW and dietary deviations by 10% in five provinces (namely Hebei, Shanxi, Jiangsu, Shandong and Henan). These provinces had the highest rates of provincial boundary transgression for nitrogen (Fig. and Supplementary Table ). The total reduction in nitrogen emissions amounted to 12% (or 91 kt N) of the excess emissions. This was primarily achieved by reduced demands for livestock and cereals. Compared to the basic strategies, the augmentation with demand-side strategies in these five regions would have a broad effect, resulting in a 2–8% reduction in the other four environmental impacts. A combination of augmented strategies involving efficiency, FLW and dietary changes would lead to national nitrogen emissions being reduced to 710 kt N, which is 5% lower than the upper bound of the national boundary for nitrogen (749 kt N).

The combined mitigation effects of the basic and augmented strategies were reductions of 63–93% for the five types of environmental impacts. Consequently, the impacts were 5–73% lower than the national upper bounds. Henan, Shandong and Heilongjiang were crucial provinces, each contributing more than 5% to the total impact mitigation at the national level, primarily through strategies for livestock, vegetables, fruit and cereals (Supplementary Tables and ). Addressing food production systems in just six to nine provinces (each contributing >5% of total mitigation) accounted for about 42–62% of the total mitigation effects and should be prioritized for the five aspects of environmental mitigation analysed here.

Safeguarding provincial boundaries

Our analyses revealed that a combination of basic and augmented strategies reduced all five environmental impacts to levels below the upper bounds of national environmental boundaries. However, the impacts of phosphorus, nitrogen and bluewater in provinces of northern China (for example, Hebei, Shandong and Henan), eastern China (for example, Anhui and Jiangsu) and north-western China (for example, Gansu and Ningxia) still greatly exceeded the provincial boundaries (represented in Fig. by the bars larger than 100%). Notably, these impacts in Hebei, Shanxi, Henan and Ningxia were more than five times greater than their corresponding boundaries and could cause water eutrophication and excessive groundwater withdrawals. Of the five environmental types of environmental impacts, the bluewater footprint was the most problematic, transgressing the boundaries in 18 out of 31 provinces. Cropland use exceeded provincial boundaries in 13 provinces (particularly in northern China). GHG emissions from the food system caused very little stress across China, with emissions well below the upper bound in all provinces.

Total mitigation effects of basic and augmented strategies for five environmental impacts.

a, GHG emission. b, Cropland use. c, Nitrogen emission. d, Phosphorus emission. e, Bluewater footprint. In all panels, the values of the blue bars are shown on the left axis and indicate the ratio of environmental impacts after mitigation to provincial environmental boundaries (horizontal red lines indicate 100% on the left axis). The values of the orange dots are shown on the right axis and indicate the reduction of environmental impacts in 2030 compared to the 2030 baselines. The error bars indicate the coefficient of variation of environmental impacts.

Our analyses also illuminated the absolute gap between environmental impacts and environmental boundaries at the provincial level. In summary, ten provinces should reduce phosphorus emission by a total of 107 kt P; 12 provinces should reduce nitrogen emission by a total of 283 kt N; 18 provinces should reduce bluewater consumption by a total of 43 km3 and 15 provinces should reduce cropland use by 0.17 million km2 to remain within provincial environmental boundaries (Supplementary Table ). Seven provinces accounted for 68–80% of the total required reduction of environmental impacts (Fig. ). Of these provinces, Shandong, Henan, Inner Mongolia and Hebei were the most stressed regions, each accounting for 6–23% of the total required reductions. The remaining 13–21 provinces (varying across different types of environmental impacts) were well within the upper boundaries and had ample space to endure additional environmental impacts (Fig. ), and all provinces could accommodate additional GHG emissions.

Redistribution of environmental impacts and food production for safeguarding provincial environmental boundaries.

a, Regional shares of the required decreases (negative values) and space available for increase (positive values) of environmental impacts; no decrease is required for GHG emissions. b, Regional shares of food production decreased (negative values) and increased (positive values) with redistribution. c, Average percentages of the required decrease in environmental impact (negative values) and the increase that would reach the boundary (positive values), that is, the available space for increasing environmental impacts (compared with the levels in Fig. ). d, Average percentages of decreased (negative values) and increased (positive values) food production resulting from redistribution (compared to the levels in Fig. ).

Previous studies have shown that redistributing food production between regions is a potentially effective strategy for bringing about positive environmental benefits,. This strategy entails moving parts of the food production (mainly livestock and vegetables) from northern provinces (with bars above 100% in Fig. ) to specific southern provinces (with bars below 100% in Fig. ) that can accommodate more environmental impacts within their boundaries. For the provinces that had exceeded the environmental boundaries, we first applied linear programming () to remove the smallest amount of food production necessary to keep the environmental impacts for each province within the environmental boundaries (Fig. ). We prioritized the removal of animal-based food over plant-based food and the removal of vegetables and maize over other plant-based food types. Vegetables and maize are less restricted by climatic conditions and landforms. Many vegetables are cultivated in greenhouses and are therefore well adapted for redistribution across different agroclimatic zones. Maize is widely cultivated across China and is more suited to redistribution than other cereals such as rice. In 2030, food production in 16 provinces had to be reduced by 11% of the national total food production (values for the seven food categories ranged from 1–14%) to keep the environmental impacts within their upper bound of provincial boundaries (Supplementary Table ). The percentages of food removed were the highest in Ningxia, Shanxi and Henan (each account for more than 30% of their provincial food production) (Fig. ). Henan and Shandong contributed more than 20% of the total national reduction in vegetable, fruit, livestock and poultry production, while more than 55% of the reduction in cereal production was realized in Henan, Jiangsu and Hebei (Fig. ). The reduced food production could substantially alleviate environmental pressures such as groundwater depletion and water pollution in the provinces of northern China.

Next, we redistributed the total amount of reduced food production to the remaining provinces proportionately to their available environmental space (that is, the surplus to the boundary). Food production was mainly reallocated to Guangxi, Sichuan, Guangdong and Jiangxi, with each receiving more than 12% of the total removed quantities of each food type (Fig. and Supplementary Table ). Compared to the 2030 baseline values, food production in Zhejiang, Fujian and Jiangxi increased by more than 60% (Fig. ), mostly due to increases in livestock, poultry, vegetable, fruit and cereal production. As a result of food redistribution, the five environmental impacts in all provinces were kept within the upper bounds of their boundaries (Supplementary Table ). Nationally, phosphorus, nitrogen and water impacts were reduced by 16, 15 and 18%, respectively, and GHG emissions and cropland use increased by 12 and 1%, respectively, compared to the levels obtained from the combination of basic and augmented strategies. To minimize the potential undesirable impacts of increasing plant-based food production in Guangxi and other southern provinces, innovative technologies such as soilless cultures could be introduced.

Limitations of the study

Unlike previous studies (for example, that by Springmann et al.), we used different control variables for the boundaries of biogeochemical flows and freshwater use () to relate these boundaries more directly to regional environmental pressures (Supplementary Table ). Our approach might generate uncertainty when adjusting boundary values from one control variable to another, although using different variables (for example, nitrogen application versus nitrogen surplus) had little impact on the evaluation. Moreover, we focused on strategies that ensured staying within the upper bound of provincial boundaries, as our aim was to minimize the need for change along the supply chain. Staying within the uncertainty zone has occasionally been an objective in previous research, but future research could adopt a strict precautionary approach while maintaining an acceptable level of food self-sufficiency.

Our scenarios also entail some limitations. Our estimation of the 2030 baseline did not consider the influences of future climate change and international trade on food productivity and food supply. In addition, the strategy for improving the efficiency of cereal production in field experiments also includes the effects of fertilizer application rates. Therefore, we had to estimate the efficiency gains solely due to management techniques by excluding the effects of changed fertilizer application rates. Furthermore, we did not consider innovations such as soilless cultivation or ‘cultured’ meat by in vitro cultivation as mitigation strategies in this study.

More detailed analyses of food system transitions are needed. Specifically, future assessments of the reallocation of food production between provinces should include potential trade-offs with economic costs, labour migration and the influence of climate change and increasing natural disasters. Assessments of the environmental impacts of the entire supply chain could inform broader mitigation strategies. Mid-stage strategies, such as process optimization and trade pattern changes, are also important, especially for highly processed foods. In-depth examination of factors such as human health, biodiversity and infectious diseases are also important for a more systematic understanding of the sustainability of regional food systems.

Discussion

Our findings point to the need for radical changes if food production is to be consistent with both national and provincial environmental boundaries in China in 2030. These changes involve the integration and augmentation of basic strategies (that is, optimizing fertilizer application, improving production efficiency, reducing FLW and dietary shifts) as well as the partial reallocation of food production from northern to southern China. The resultant environmental mitigation would largely alleviate the intense competition between cropland and land for urban expansion in China without sacrificing future food production and food diversity. These strategies could also contribute to the mitigation of, and adaptation to, global climate change, and are complementary to the results of previous studies,.

Inter-regional collaboration can operate in two ways. First, changes in the food requirements of one province can prompt transboundary changes in national and international food production and supplies. Second, food production in all provinces can largely be kept within environmental boundaries by moving parts of the food production from the northern provinces to the southern provinces. If all these strategies are integrated, cropland use, phosphorus and GHG emissions from food systems will be lower than the mean of the national boundary, while nitrogen emissions and bluewater footprint will be slightly higher than the mean value (Supplementary Table ).

Future food security and climate change risks are affected by the choice of ‘shared socio-economic pathways’. It is essential that radical societal changes be promoted, and that initiatives that have proven successful at maintaining safe operating spaces be efficiently disseminated—which would also benefit future Chinese food production. At the global level, international commitment needs to be fostered to guide concerted actions towards a more sustainable global food system. At the national and provincial levels, the implementation of integrated mitigation strategies requires collaborative and streamlined actions in the spheres of scientific research and decision-making, as well as broad engagement of stakeholders (including researchers, extension agents, policymakers, farmers, consumers, industries and markets). For example, researchers, policymakers and farmers can work together on planning ***agricultural*** production, while taking into consideration multilevel environmental boundaries. Major levers to facilitate the implementation of a given sustainability strategy are incentives for improvements, technology extension and continuous research. Major barriers to strategy implementation include non-mainstreamed technology, lack of political will and communication gaps between researchers and policymakers. Better connection between farmers and markets could be built if farmers were provided with more training to develop their entrepreneurial skills and if market mechanisms such as contract farming with high-margin products were improved. Stronger connections have the potential to reduce FLW and alleviate poverty in rural regions. Moreover, the rapid development of smart farming practices using big ***data*** and the Internet of Things has considerable potential for improving resource efficiency and enabling the adoption of advanced ***agricultural*** technologies by farmers and industries.

More coordination and in-depth analysis of the redistribution of food production from northern to southern China is required. Redistribution should focus on the suitability of ***agricultural*** production, the practicality of specific measures, economic costs and benefits, possibility for regional re-employment, industrial transitions and capital investments. The provincial environmental impacts and boundaries quantified in the present research could contribute to guidelines for ***agricultural*** regionalization in China and be used to optimize ***agricultural*** distribution and land use. In the last two decades, there has been a substantial loss of high-quality arable land in south-eastern China. Coordinated development of the ***agricultural***, manufacturing and service sectors in rural regions can abate or reverse this trend. This can be facilitated by incentive and regulation schemes that facilitate the establishment of new ***agricultural*** enterprises and increased financial rewards.

This research bridges the gap between strategic analysis and the application of mitigation targets using new datasets and a food systems model that considers multiple food-related environmental impacts on subnational regions. Our ***data*** and model can be easily applied in analyses of sustainable food systems in other nations or regions, especially in those facing increasing food demand, severe deforestation and ***agriculture*** expansion. The analysis of food systems at subnational level or at watershed or sector scale is an important research avenue that can aid the identification of new and more effective levers of food system transitions.

Methods

Configuration of the food systems model

We constructed a food systems model with four major modules (Supplementary Figure ) depicting food supplies and environmental impacts for 170 countries, aggregated regions and Chinese provinces. This model was used to evaluate the environmental impacts of, and mitigation strategies for, food production and consumption processes. The environmental impacts of food production were modelled using a process-based life cycle assessment (Module 1). The impacts of food consumption were assessed using a global multiregional input–output analysis. Specifically, we tracked production, processing, transportation, distribution, consumption and numerous minor direct and indirect processes along the entire global supply chain (Module 2). We modelled the mitigation effects of both supply- and demand-side strategies in Chinese provinces by applying ***data*** from the literature obtained from on-farm experiments, field surveys and reviews. To determine whether the impacts of food production were adequately mitigated at sustainable levels, we compared the mitigated impacts with downscaled planetary boundaries that defined regional environmental limits (Module 3). This model also contained parameters representing optional strategies for further mitigation, including the introduction of better practices in food production from abroad and the reallocation of food production between provinces to alleviate environmental pressure in severely stressed regions (Module 4).

Environmental impacts of food production

We evaluated five aspects of the environmental impacts of ***agricultural*** processes relating to food production for 32 food categories in a total of 170 regions (31 Chinese provinces and 139 world regions) using a process-based life cycle assessment (Supplementary Figure ). These impacts were GHG emissions, bluewater footprint, reactive nitrogen and phosphorus emissions, and cropland use. We included all of the sources of environmental impacts in ***agricultural*** production: in crop production, these are seeds, energy, chemical fertilizers, reused manure and straw, rice paddies and atmospheric deposition; in pasture management and animal husbandry, they are feed, energy, enteric fermentation and manure and for fisheries and cultivation they consist of energy and feed. The impact F for food type f of environmental domain i in region r was calculated by multiplying activity ***data*** D by emission factors R in all the production processes p:***Data*** on reactive nitrogen and phosphorus run-off to surface water and leaching into groundwater were evaluated from ***collected*** ***data*** and a substance flow analysis depicting the food production processes for each food type. The China Statistical Yearbook provided activity ***data*** for, inter alia, regional crop production, livestock breeding and grazing, aquaculture and fisheries, fertilizer application, irrigation and energy inputs, while the National Cost-Benefit Compilation of ***Agricultural*** Products provided ***agricultural*** inputs (for example, fertilizer and feed) for each food category per province. Emissions in 139 regions worldwide were quantified using ***data*** sourced from the Food and ***Agriculture*** Organization ([*http://www.fao.org/faostat/en/*](http://www.fao.org/faostat/en/)) and the International Fertilizer Industry Association ([*https://www.fertilizer.org/*](https://www.fertilizer.org/)). The parameter settings are listed in previous studies,, and the equations used for quantification are listed in Supplementary Table .

***Data*** on GHG emissions for 31 Chinese provinces were assessed by referring to the guidelines of the Intergovernmental Panel on Climate Change and findings from previous studies (Supplementary Table ). GHG emissions from other industrial and service sectors were quantified using ***data*** sourced from the China Energy Statistical Yearbook. We quantified GHG emissions from all food and non-food sectors across 139 regions worldwide. ***Data*** on CO2 emissions were sourced from the Global Trade Analysis Project (GTAP v9, [*https://www.gtap.agecon.purdue.edu/*](https://www.gtap.agecon.purdue.edu/)) database, and non-CO2 emissions were quantified by applying the same method used for phosphorus and nitrogen emissions. The CO2 sources and sinks caused by land-use changes, especially human-induced deforestation and carbon sequestration, should be included in future research that evaluates food system impacts on climate change.

The consumptive surface and groundwater use (bluewater footprint) associated with plant- and livestock-based food products in all 170 regions were calculated by multiplying the food production amount by the relevant parameters (bluewater footprint per ton of food) derived from Hoekstra and Mekonnen. Consumptive water use of aquatic products includes reductions in streamflow caused by increased evaporation and seepage from aquaculture facilities (for example, aeration facilities), freshwater from wells and water removed through biomass harvesting. The bluewater footprint of aquatic products was calculated from evaporation rates obtained in field experiments. We calculated the bluewater footprints of China’s industrial sectors as their water withdrawals minus discharged wastewater. The total quantities of water withdrawal by industrial sectors in China’s provinces were calculated using ***data*** from the China Economic Census Yearbook 2008 (Energy), while ***data*** on quantities of wastewater discharged by industrial sectors were sourced from the China Environmental ***Statistics*** Yearbook. We assumed that the service sectors consume approximately 10% of the withdrawn water. The bluewater footprints of the industrial and service sectors in the regions analysed outside of China were sourced from the World Input–Output Dababase ([*http://www.wiod.org/home*](http://www.wiod.org/home)).

***Data*** on the areas of crop sowing, grazing land and aquaculture were extracted from the China Statistical Yearbook, the China ***Agriculture*** Yearbook and Food and ***Agriculture*** Organization. Actual land use through crop sowing is less than the sum of crop sowing areas because of widespread interplanting and rotation in ***agricultural*** practices globally. We estimated regional cropland use by rescaling cultivated crop areas to match regional cropland areas.

Regional boundaries of environmental impacts

The appropriate selection of control variables (for example, nitrogen application or reactive nitrogen run-off) and methods of downscaling (for example, by population or value added) are subject to debate,,. A top-down approach (‘equal per capita principle’) was used to allocate climate change risks, while the other four spatially heterogeneous boundaries were allocated using a multiscale approach (incorporating regional resource endowments). Specifically, the national or provincial boundary (Br) was calculated from the proxies aswhere PB is the value of the planetary boundary, R is the global proxy and r is the regional proxy. The proxy for the GHG boundary was population; for the nitrogen, phosphorus and bluewater boundary, it was water resource availability; and for the cropland boundary, it was farmland area. The detailed downscaling method is shown below.

The boundary for regional GHG emissions was downscaled according to the proportion of the regional population to the total global population, because humanity everywhere faces similar threats and because the impacts of humanity on the Earth are direct and equal. The GHG emissions budget was based on the goal of there being a 66% probability of limiting warming to a 2 °C rise above pre-industrial levels by 2100 (Representative Concentration Pathway 2.6). We obtained a global budget value of 4.7 GtCO2e yr−1 (range of 4.3–5.3 GtCO2e yr−1) for non-CO2 emissions by comparing three integrated assessment models and following further normalization and interpretation. CO2 emissions from direct energy use, however, comprised 11–15% of the total emissions. Therefore, the total global budget for ***agricultural*** GHG emissions (non-CO2 and CO2) was 5.4 GtCO2e yr−1 (range of 4.9–6.1 GtCO2e yr−1) after adding up these two components. Based on the proportion of the Chinese population to the global population, China’s national budget was 0.97 GtCO2e yr−1 (range of 0.88–1.1 GtCO2e yr−1). Future studies should include the carbon sources and sinks associated with ***agricultural*** land and should consider their impacts in the accounting of planetary boundaries and environmental impacts.

In our simulations, we allocate global consumptive freshwater use according to regional water resources. This approach accounts for regional water scarcity and possible excessive water withdrawals that could affect environmental flow requirements. Some studies have not addressed the issue of heterogeneous water resources, while many others have applied a similar downscaling method to the one we used,. We adopted a rigorous value for bluewater planetary boundaries derived from a detailed stand-alone analysis (2,800 km3 yr−1, range of 1,100–4,500 km3 yr−1) and also included other proposed values and an uncertainty range. We scaled the total consumptive bluewater use to ***agriculture*** use from values proposed in previous studies, resulting in a planetary boundary of 1,980 km3 yr−1 (range of 780–3,190 km3 yr−1). The water resource impacts of different food categories can be more easily quantified using the concept of ‘bluewater footprint’, which differs from indicators used in planetary boundary estimations. We scaled the consumptive bluewater value to a bluewater footprint by applying the current ratio of these two variables (the current global consumptive bluewater use is 2,550 km3 yr−1 and the current global total bluewater footprint, including ***agricultural***, industrial and domestic use, is 1,025 km3 yr−1). The resulting planetary boundary was 792 km3 yr−1 (range of 312–1,276 km3 yr−1) when using the bluewater footprint as the control variable. From the availability of regional freshwater resources, China’s national bluewater footprint limit is 53 km3 yr−1 (range of 21–86 km3 yr−1).

The assessment of planetary boundaries for biogeochemical flows encompasses human food security associated with nitrogen and phosphorus applications, as well as risk indicators for environmental impacts. To determine regional environmental stress, we adopted nitrogen and phosphorus discharge to regional water bodies as control variables associated with local water quality (rather than nitrogen and phosphorus fertilizer application or other control variables adopted in previous studies). The current global nitrogen loss to surface water is 5.4 Tg N yr−1 based on a nitrogen fixation value of 62 Tg N yr−1 (ref. ). This figure is comparable to the nitrogen application rate identified in a previous study. The global nitrogen loss to groundwater was estimated from the ratio of leach to run-off, amounting to a leach volume of 3.2 Tg N yr−1. The total planetary boundary for nitrogen discharge to water bodies is 8.6 Tg N yr−1 (range of 7.2–11.1 Tg N yr−1).

We determined planetary phosphorus discharge limits based on a scenario analysis of global phosphorus flows, and we adopted a riverine water quality criterion of 160 mg m−3 and a phosphorus flow rate to the ocean of 22 Tg P yr−1, which were the most plausible estimates. The resulting planetary boundary for phosphorus loss to surface freshwater from terrestrial ecosystems was 8.58 Tg P yr−1. We estimated the planetary boundary of ***agricultural*** systems to be 4.1 Tg P yr−1 after subtracting the flow caused by natural and human-induced weathering. Phosphorus flows (0.6 Tg P yr−1) also leach to groundwater; thus, the total planetary boundary for phosphorus loss to water bodies was 4.7 Tg P yr−1 (range of 2.4–5.0 Tg P yr−1). We allocated the global nitrogen and phosphorus discharge limits to national and subnational regions according to regional proportions of available water resources. The resulting national boundaries were 580 kt N yr−1 (range of 486–749 kt N yr−1) for nitrogen and 317 kt P yr−1 (range of 162–337 kt P yr−1) for phosphorus.

Several control variables have been proposed for measuring the planetary boundary of land-system change. These variables include forest biomes, cropland conversion and biocapacity. Biocapacity is a more complete and aggregated indicator than forest biomes and cropland conversion, measures critical thresholds of biologically productive land use and represents national land boundaries required to attain self-sufficiency. However, current biocapacity accounting cannot readily reveal forest and cropland resources at subnational scales and is only available at national or per capita scales. Because our model tracks ***agricultural*** land use and incorporates details on regions and food types, we adopted a cropland use value of 12.6 million km2 (range of 10.6–14.6 million km2) adapted from the forest biomes target obtained from the results of other studies. Based on this, the total cropland limit in China was 0.80 million km2 (range of 0.68–0.93 million km2). Supplementary Table shows the ***data*** sources and primary estimations.

Scenario analysis

Food production in 2030

The quantity of national food production in the business-as-usual scenario in 2030 was estimated by multiplying the amount of required food by the projected food self-sufficiency (the rate of the total quantity of required food met through local production). The national food requirement is closely correlated with the national mean per capita gross domestic product (GDP) and could therefore be estimated using projections of the national population and GDP. We used a hybrid copula theory and Markov chain Monte Carlo simulation method to analyse the relationship between food requirements and economic benefits, and projected per capita food requirements for the seven food categories. Copulas are mathematical functions used for ‘coupling’ a set of variables that change with time or region and are used for revealing the underlying dependence structure. The Markov chain Monte Carlo simulation was applied in a further analysis of the associated parameters of the copula function. The general approach when using this function is to determine the joint density function (fX,Y (x,y)) of two or more random variable (for example, two variables x and y, or in this study, food requirement and per capita GDP):where FX(x) and FY(y) are cumulative distribution functions of X and Y and fX(x) and fY(y) are the probability density functions of x and y. is the unique copula function of joint probability for the two variables.

To evaluate the territorial environmental impacts, national food production was then estimated by multiplying the copula-based national food requirement by the self-sufficiency rate. Provincial food production in 2030 was estimated by extending the historical (logarithmic) trend of provincial food production, and then the provincial food production was adjusted according to the estimated national total and the sum of the provincial totals. The ***data*** sources used for this projection are listed in Supplementary Table . We assumed a 5% reduction in the environmental intensity of food production in 2030 in the absence of dedicated technological improvements and mitigation strategies.

Supply-side strategies

Optimizing fertilizer application is a supply-side strategy designed to enhance straw and manure reuse and to reduce avoidable chemical fertilizer application. The nitrogen and phosphorus included in this reuse substitutes for chemical fertilizers and reduces the direct manure discharge from livestock and poultry cultivation. We adopted a medium-high (that is, three-quarters of the largest potential) increase in the reuse of straw and manure as a replacement for chemical fertilizers and assumed a medium-high reduction in excessive fertilizer application (that is, application that has little benefit to yield). Around 15–60% of crop straw is currently used as fertilizer. We assumed that an additional 10% of straw would be reused in cropland, apart from the other diverse uses of straw, such as producing feed, paper and biogas. We adopted a 20–30% increase in manure reuse based on the current rate. The ***nutrients*** contained in this reused straw and manure replaced about 10% of chemical fertilizer use. Studies have shown that reductions of 20–70% of nitrogen, and 10–30% of phosphorus, fertilizer use do not decrease cereal yields, and thus that the amounts currently in use are unnecessarily high. Every 1% reduction in fertilizer use results in a 0.8% reduction, on average, in ***nutrient*** loss.

Improving food production efficiency through crop–soil and feed management is another supply-side strategy for linking changes in bottom-up techniques to subsequent reductions in environmental and resource intensities. The production efficiency of cereals (rice, wheat and maize) can be improved through the delivery and acquisition of institutional knowledge and through insights and feedback gained from farming practices. On-site farming experiments have been conducted across China to determine the factors influencing cereal yield gaps and resource use efficiency. The results indicate that many factors, including crop seed varieties, planting density and sowing time, have substantial impacts on crop yields and resource use efficiency. A set of recommended practices led to improvements in nitrogen use efficiency (the amount of food produced per unit of resource input) of 62–86% in winter wheat and summer maize and to a subsequent reduction in nitrogen emission intensities of 38–46% (ref. ). The findings of this experiment also revealed a potential improvement of 52–60% in water use efficiency, resulting in a 34–38% reduction in water use intensity. Given the lack of evidence for other plant-based food categories, we defined improved efficiency in terms of best practices and the lowest intensities of food production within China. We anticipated a 40% improvement in the efficiencies of livestock and poultry meat production through grazing and precision feeding management. Moreover, the ***nutrient*** loss from livestock production can be reduced by around 50% by incorporating manure management practices such as prohibiting manure discharge.

Demand-side strategies

Reducing FLW is a demand-side strategy designed to reduce food requirements and thus food production. Reducing FLW is inspired by the United Nations’ Sustainable Development Goals (SDGs 12.3) and is assumed to reach close to the maximum theoretical potentials. According to previous survey findings and estimates,, current rates of post-harvest loss for grain, meat and vegetables are 23.2, 17.2 and 32.3%, respectively. Based on the maximum theoretical values proposed in previous studies,, we assumed a medium-high reduction in FLW for the consumption (post-harvest) stage. We also assumed that changes in the environmental impacts of food production across all regions in the supply chain would be commensurate with changes in food requirements in a given region. We did not consider potential FLW reductions for international trade partners that import food from China.

Dietary shift is another demand-side strategy and was based on the national dietary guidelines that advocate a more balanced and healthy diet compared with current dietary patterns. To evaluate current dietary patterns in each of China’s provinces, we compiled food consumption ***data*** extracted from the China Statistical Yearbook and from the China Health and Nutrition Survey (CHNS, [*https://www.cpc.unc.edu/projects/china*](https://www.cpc.unc.edu/projects/china)), which contains over 30,000 samples in 15 provinces. We estimated food consumption in all Chinese provinces using supplementary ***data*** obtained from provincial statistical yearbooks, which also report on food consumption (but in much less detail). We proposed a balanced and healthy dietary pattern that bridges 75% of the gap between the current and recommended diets. The detailed parameter settings for the four basic strategies described above are listed in Supplementary Table .

To evaluate changes in the environmental impacts of food production resulting from strategies that influence food requirements, we developed global multiregional input–output (MRIO) ***data*** for the year 2011. This was done by linking a disaggregated Chinese MRIO table, which we compiled based on an algorithm from the Chinese Industrial Ecology Laboratory (IELab), with a global MRIO table extracted from the GTAP database. The Chinese MRIO table contains 12 food production sectors and 41 other sectors (Supplementary Tables –) and applies a hierarchically nested system from Chinese IELab. The same method was applied in a previous study and was used to extract the global MRIO table from the GTAP v9 database (Supplementary Tables and ). This global MRIO model covers a total of 9,566 sectors in 170 regions, including 12 food sectors in each region. Supplementary Table shows the sectoral coordination between the Chinese and global MRIO table when nesting these two tables. The changes in environmental impact due to consumption activities in one region r can be linked back to the production side based on the supply chain from production Pr to consumption Cr (ref. ):The changes in production-based impacts in region r (ΔPr) are caused by the changes in the final consumption in all the regions importing products from region r (ΔCr1, ΔCr2 and ΔCrn). These changes are known as the ‘spillover effect’. In the above equations, the F vector denotes the environmental intensity of production and X denotes total output, the L matrix denotes the Leontief inverse, and Δyr denotes changes of final consumption. A detailed explanation of the feedback from consumption to production is shown in Supplementary Table , and the global food supply is shown in Supplementary Table .

In the nested MRIO model, we paid particular attention to two feedback effects that ensure a more reasonable estimation of the strategies. First, changing requirements for animal-based food in one region will correspond to changes in grain feed requirements in all regions. We quantified changes in grain feed requirements with reference to cereal supply chains and feed conversion factors for different animal-based food products. Second, the evaluation of demand-side strategies entails the reductions in environmental impacts per unit food products (for example, 1 kgCO2e per kg rice) from the two supply-side strategies.

Redistributing food production

To remove environmental impacts in regions where boundaries had been exceeded and to accommodate these impacts in other more ‘affluent’ areas, linear programming was applied to redistribute food production among the Chinese provinces. The objective was to minimize the redistributed food production within the constraints of keeping provincial environmental impacts within their boundaries (Supplementary Table ). We first minimized the removal of provincial food productions from the ‘exceeded’ provinces to mitigate their environmental impacts to a level below their boundaries, and then allocated these removed productions to the remaining provinces in proportion to the amount of ‘affluent’ space. Smaller changes are more likely to be practical and economically feasible than large changes. Therefore, we prioritized the redistribution of food categories associated with higher environmental intensities (for example, livestock) over those with lower intensities (for example, cereals). Removal of cereal production in the breadbasket areas was restricted to below 20%, while removal of other food types was restricted to below 60%. This approach facilitates the implementation of redistribution, because animal production is easier to relocate and less dependent on climatic conditions and landforms than cereals. We restricted the increase of food production in Tibet and Qinghai given their limited food productivity and their critical importance to the conservation of biodiversity and ecosystem services.

Uncertainty and sensitivity analysis

The Monte Carlo approach was applied to evaluate the uncertainty of environmental impacts associated with Chinese food production resulting from model structure, activity ***data*** and parameter values. The input variables for nitrogen, phosphorus and GHG emissions are listed in Supplementary Tables and . Based on different ***data*** quality, activity ***data*** obtained from the ***statistics*** were assumed to have a coefficient of variation (CV) of 5% and at-scale and estimated parameters were assumed to have CVs of 10% and 20%, respectively. Bluewater footprints per unit of food production ***data*** were obtained from Hoekstra and Mekonnen, and vary within ±9.5% of the mean. ***Data*** for cropland use were taken solely from our ***statistics*** and varied by ±5%. The model was run 100 times using randomly selected values from the input mean, CV and distributions to quantify the range of the model results. The CV for the environmental impacts of provincial food production is shown in Supplementary Table .

We used the one-at-a-time method (sensitivity curve) to investigate the sensitivity of environmental impacts to changes in the input variables. The one-at-a-time method is intuitive and is widely used in investigating the response of output results to variations in input values. The sensitivity of the output variables was evaluated by introducing marginal changes in the target input variable and keeping the other inputs constant. The output variables in the present research are the five environmental impacts of Chinese food production, while the input variables are listed in Supplementary Tables and and described above. We obtained the corresponding output results when input variables varied from −20% to +20% from the mean. The results are summarized in Supplementary Table .

Reporting Summary

Further information on research design is available in the linked to this article.

**Acknowledgements**

This research was supported by the National Science Foundation for Innovative Research Group (no. 51721093), the Chinese Postdoctoral Science Foundation (2019M663739), the Natural Science Foundation for Distinguished Young Scholars of Guangdong Province (no. 2017A030306032), GDUPS (2017), the Major Program of National Philosophy and Social Science Foundation of China (no. 16ZDA051) and National Natural Science Foundation of China (no. 71874014). We thank Y. Zhou of Guangdong University of Technology and S. Liang of Beijing Normal University for their valuable comments.

**Notes**

Supplementary informationis available for this paper at [*https://doi.org/10.1038/s43016-020-00143-2.Publisher’s*](https://doi.org/10.1038/s43016-020-00143-2.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

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