Impact of climate change in the agri-food sector

Reducing emissions through improved farming practices

Contents:

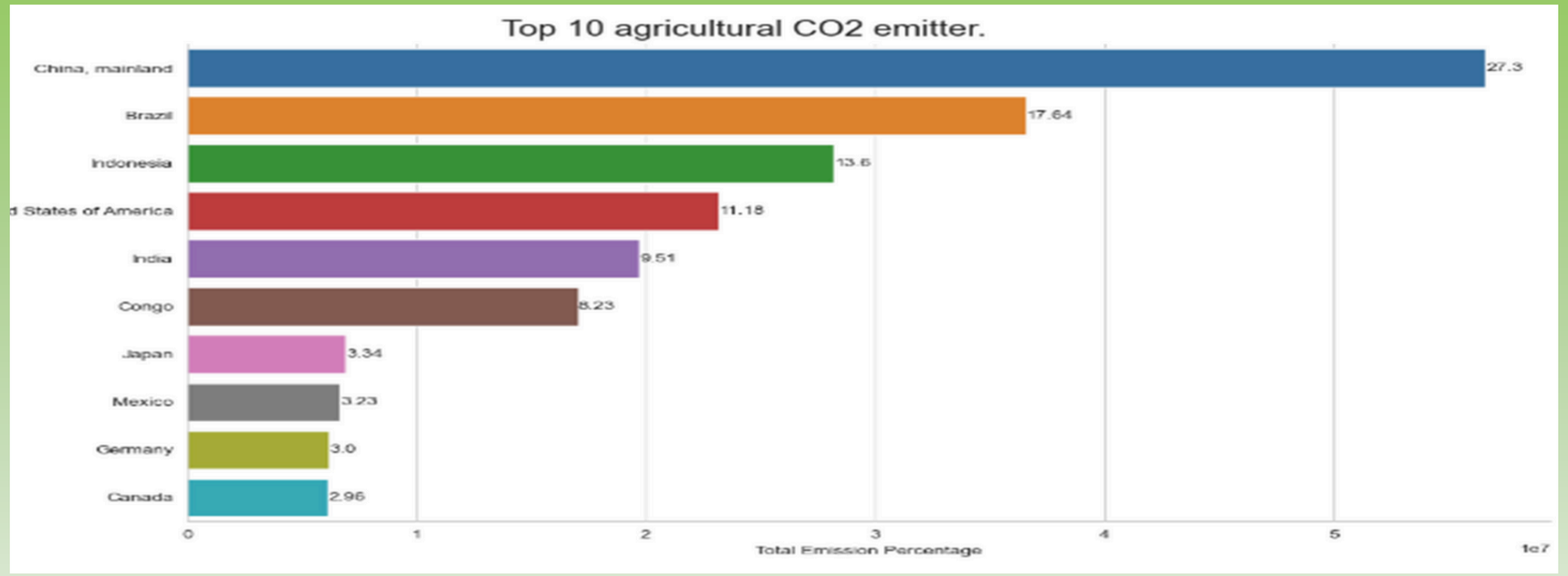
INTRODUCTION

The recent Intergovernmental Panel on Climate Change (IPCC) Report on the Impacts of Global Warming warned that the world is already seeing the consequences of global warming of 1°C, with more frequent and extreme weather, rising sea levels, diminishing Arctic sea ice, ocean acidification, land degradation and desertification, among other changes. It also warned that to limit global warming to 1.5°C requires “rapid and far-reaching transitions in land, energy, industry, buildings, transport and cities”. Change of this nature will impact every commercial, public and private endeavour. In coming years, the entire food and agribusiness value chain will likely be disrupted – not just because land is vulnerable to the physical effects of climate change and other stressors, but also because the industry is interdependent with the other sectors identified above. There will be significant changes and challenges to navigate. But there will also be significant opportunities

Climate change risks for food and agribusinesses

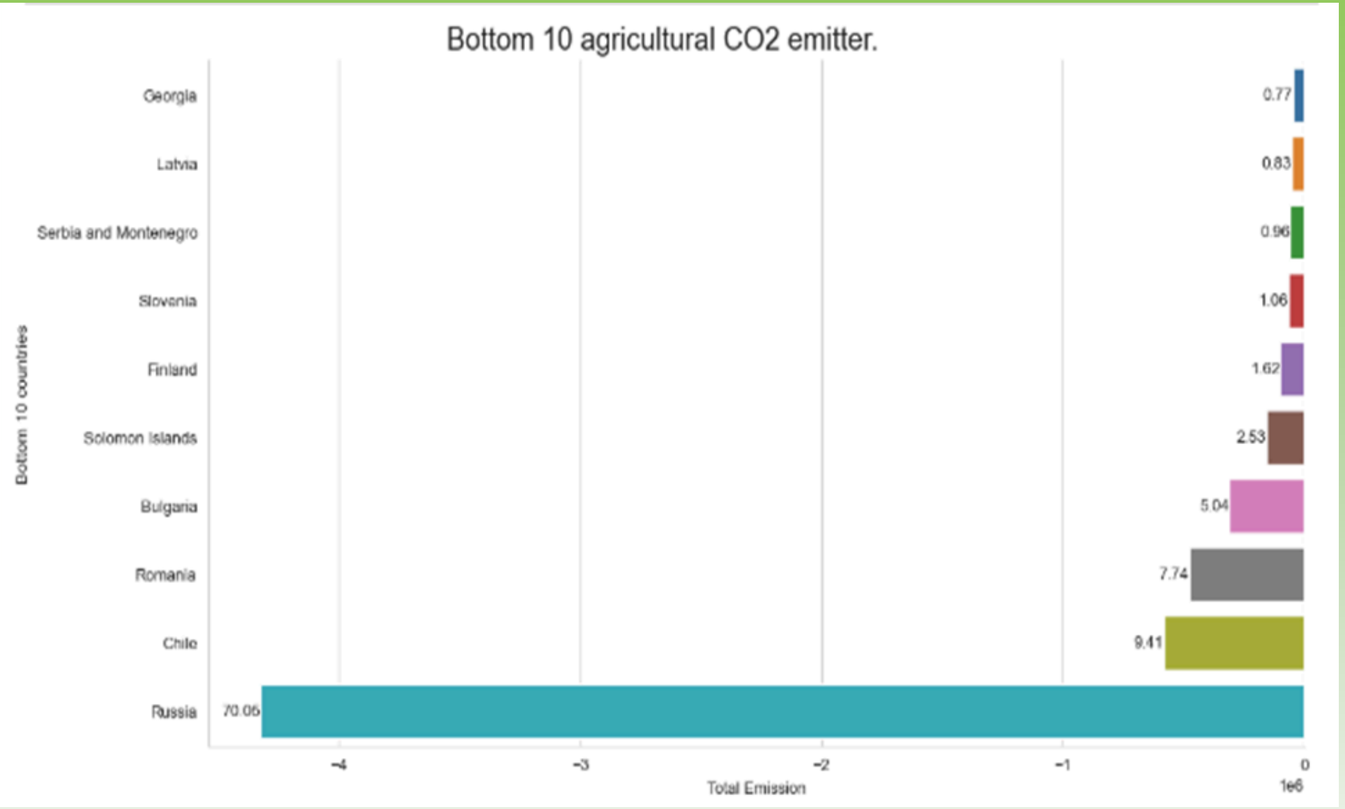
The climate change risk profile of the food and agribusiness industry is complex. The industry is highly vulnerable to the effects of climate change, and yet also well-placed to mitigate those risks and also benefit from opportunities that the transition to a more sustainable future presents.

The top 10 countries that contributed to most of the emissions. China is the leading emitter followed by Brazil where from China alone, about 10% more CO2 emission is coming than from the second most polluting country.



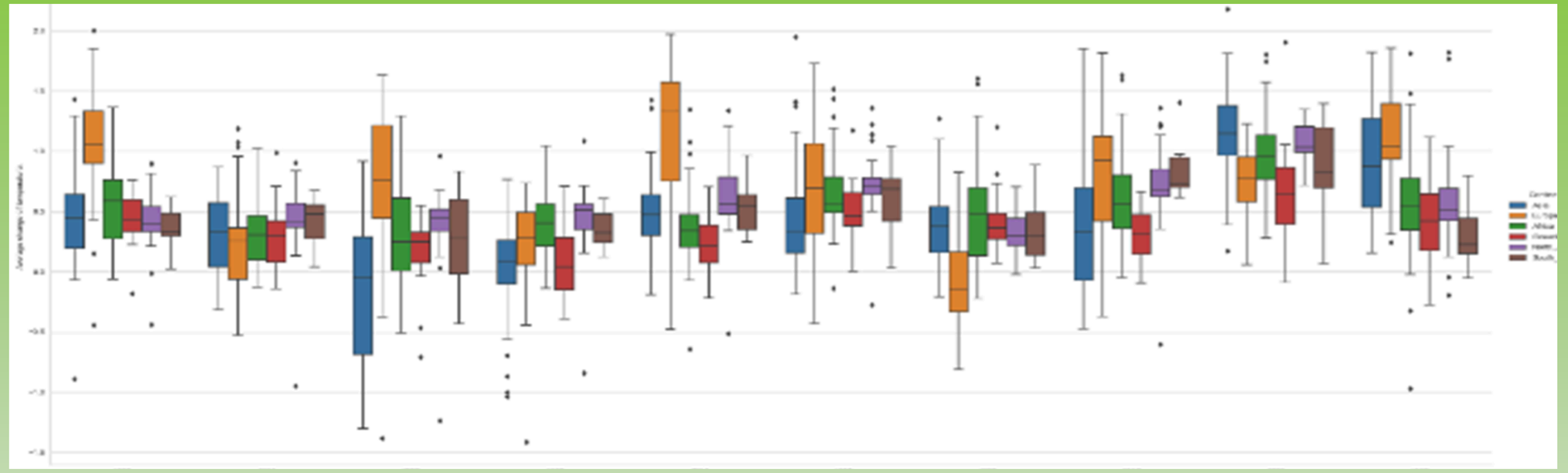
Agriculture emissions contribute a large portion of total global emissions. When we look at this over a 20-year time frame, agriculture accounts for approximately 20 percent of global GHG emissions, while forestry and land-use change account for around 7 percent (see sidebar “Global warming potential in 20 years versus 100 years”). This means that agriculture is almost as big as industry as a source of emissions.

The bottom 10 countries that contributed the least to the emissions. The least polluting from the agricultural sector is Russia due the forest/land area coverage followed by Chile and Romania



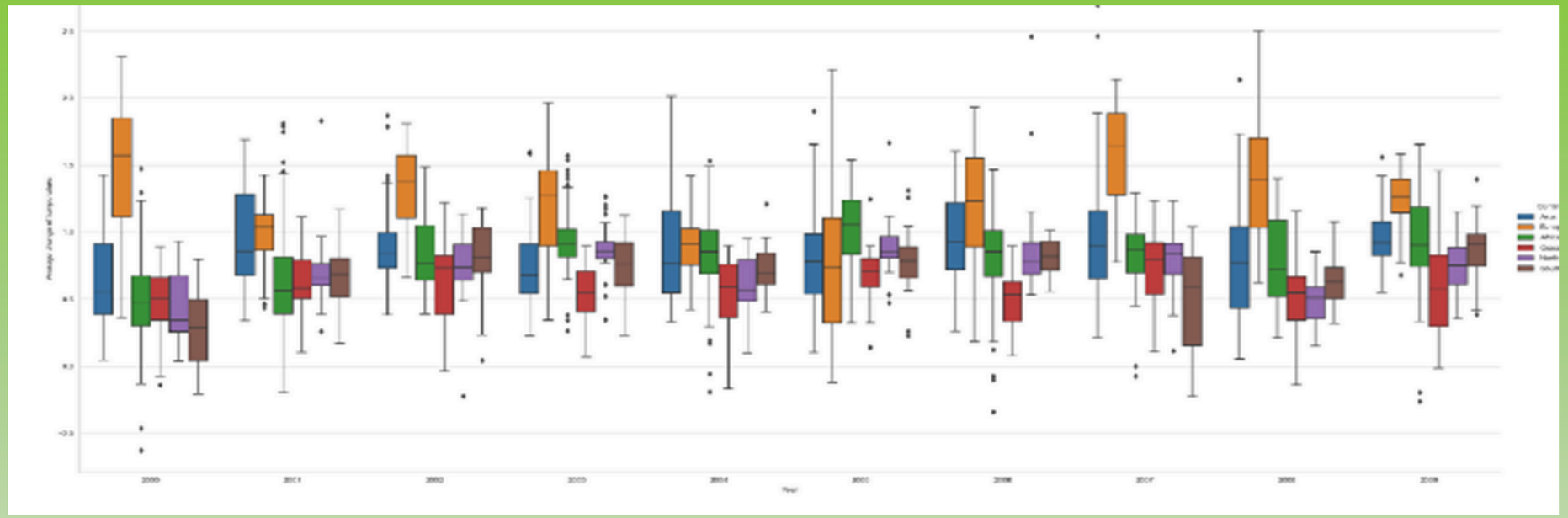
	Area	total_emission	Proportion_(%)
0	Georgia	-4.730578e+04	0.766362
1	Latvia	-5.110531e+04	0.827916
2	Serbia and Montenegro	-5.933866e+04	0.961297
3	Slovenia	-6.546388e+04	1.060527
4	Finland	-9.975058e+04	1.615978
5	Solomon Islands	-1.562589e+05	2.531424
6	Bulgaria	-3.108318e+05	5.035533
7	Romania	-4.778241e+05	7.740840
8	Chile	-5.811333e+05	9.414469
9	Russia	-4.323756e+06	70.045654

Average temperature change by year from 1990-1999



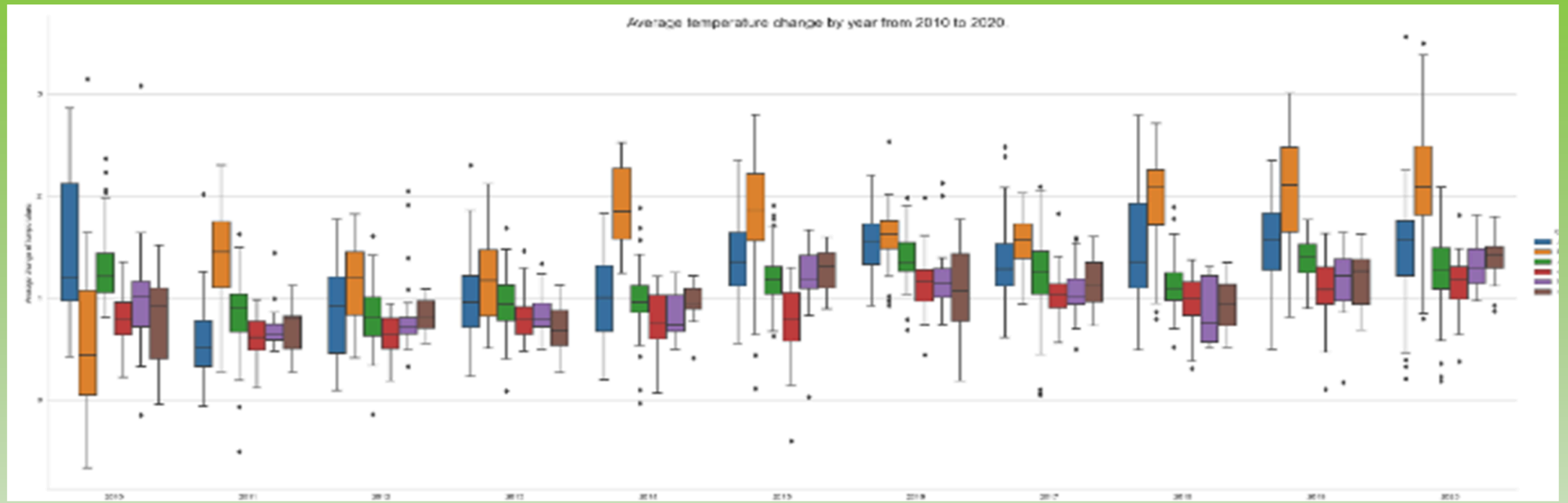
Looking at the average temperature change due to carnon emission year by year in the different regions of the world. From the next three plot we can conclude that the most effected by the CO2 emission is Europe and the second one is Asia.

Average temperature change by year from 2000-2009



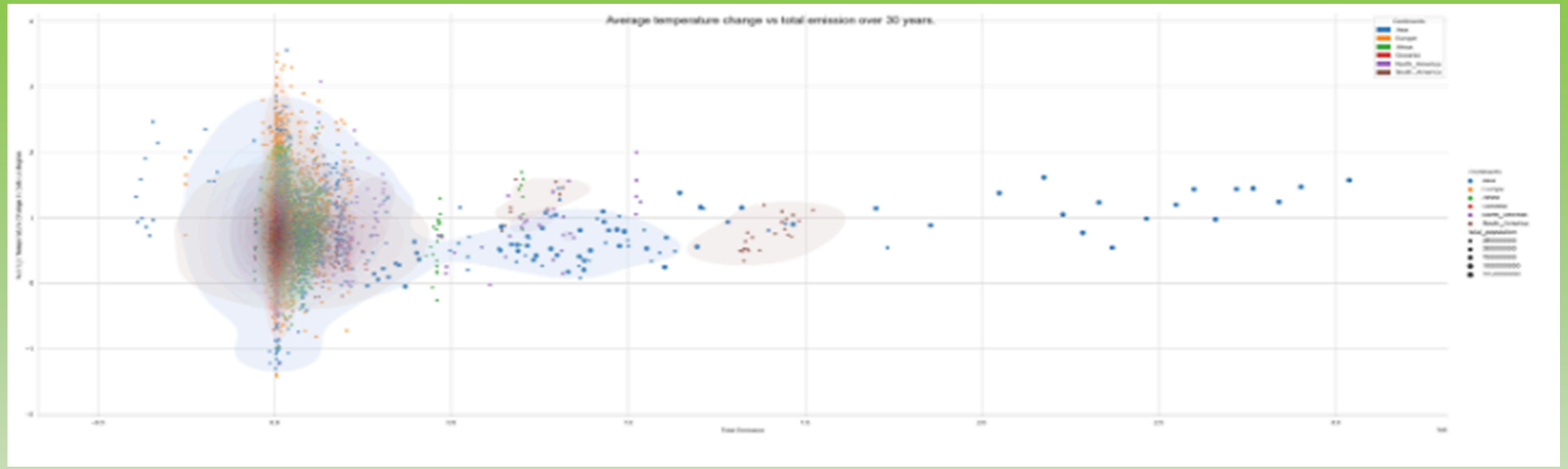
Looking at the average temperature change due to cannon emission year by year in the different regions of the world. From the next three plot we can conclude that the most effected by the CO2 emission is Europe and the second one is Asia.

Average temperature change by year from 2010-2020



Looking at the average temperature change due to carnon emission year by year in the different regions of the world. From the next three plot we can conclude that the most effected by the CO2 emission is Europe and the second one is Asia.

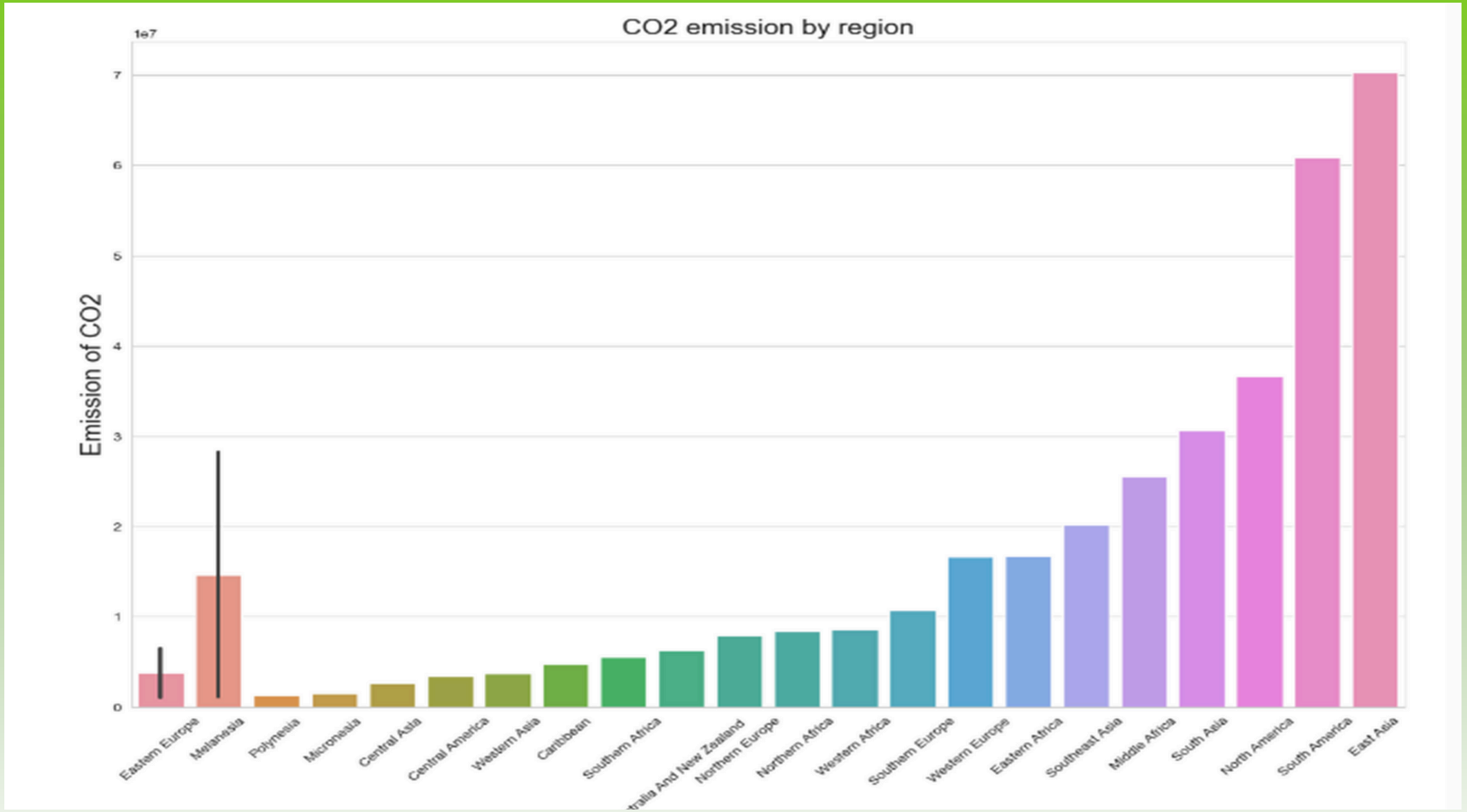
Average temp change vs total emission over 30 years



Looking at the same graph from a different perspective reveals that most of the agricultural CO2 emission is coming from Asia.
It can be seen from the plot that the population is also the largest in Asia but the average temperature change effects Europe the most followed by Asia.

Emission by regions

	World_regions	Continents	total_emission
0	Eastern Europe	Asia	1.044955e+06
1	Melanesia	Oceania	1.148229e+06
2	Polynesia	Oceania	1.302897e+06
3	Micronesia	Oceania	1.525515e+06
4	Central Asia	Asia	2.625027e+06
5	Central America	North_America	3.409985e+06
6	Western Asia	Asia	3.750231e+06
7	Caribbean	North_America	4.760109e+06
8	Southern Africa	Africa	5.542095e+06
9	Australia And New Zealand	Oceania	6.317674e+06
10	Eastern Europe	Europe	6.535580e+06
11	Northern Europe	Europe	7.884556e+06
12	Northern Africa	Africa	8.417827e+06
13	Western Africa	Africa	8.588273e+06
14	Southern Europe	Europe	1.069584e+07
15	Western Europe	Europe	1.666618e+07
16	Eastern Africa	Africa	1.669786e+07
17	Southeast Asia	Asia	2.023049e+07
18	Middle Africa	Africa	2.550740e+07
19	Melanesia	Asia	2.821637e+07
20	South Asia	Asia	3.066756e+07
21	North America	North_America	3.667396e+07
22	South America	South_America	6.092904e+07
23	East Asia	Asia	7.024067e+07


CO2 emission by region
1e7
Emission of CO2
0
1
2
3
4
5
6
7
Eastern Europe
Melanesia
Polynesia
Micronesia
Central Asia
Central America
Western Asia
Caribbean
Southern Africa
Northern Europe
Northern Africa
Western Africa
Southern Europe
Western Europe
Eastern Africa
Southeast Asia
Middle Africa
South Asia
North America
South America
East Asia

We can conclude that there is statistically significant difference between the groups in case of temperature and emission hence we reject H0.

The ANOVA doesn't tell us which groups are different, in order to find which groups are differ from each other we need to perform a post-hoc test.

As the groups are balanced, we can use the Tukey-HSD test

	A	B	mean(A)	mean(B)	diff	se	T	p-tukey	hedges
0	Africa	Asia	0.84607	0.84097	0.00511	0.07507	0.06803	1.00000	0.029116
1	Africa	Europe	0.84607	1.18630	-0.34023	0.08600	-3.95626	0.01012	-2.366263
2	Africa	North_America	0.84607	0.77157	0.07450	0.09362	0.79576	0.96464	0.523998
3	Africa	Oceania	0.84607	0.61412	0.23196	0.08600	2.69721	0.12443	1.74781
4	Africa	South_America	0.84607	0.72632	0.11975	0.14043	0.85274	0.95295	[0.7986834864554596]
5	Asia	Europe	0.84097	1.18630	-0.34534	0.08035	-4.29778	0.00492	-2.136108
6	Asia	North_America	0.84097	0.77157	0.06939	0.08847	0.78443	0.96670	0.425008
7	Asia	Oceania	0.84097	0.61412	0.22685	0.08035	2.82316	0.09883	1.467804
8	Asia	South_America	0.84097	0.72632	0.11465	0.13705	0.83654	0.95650	[0.6767165898372963]
9	Europe	North_America	1.18630	0.77157	0.41473	0.09791	4.23572	0.00561	4.824434
10	Europe	Oceania	1.18630	0.61412	0.57219	0.09065	6.31204	0.00008	6.823472
11	Europe	South_America	1.18630	0.72632	0.45998	0.14333	3.20927	0.04700	[5.0986739981609395]
12	North_America	Oceania	0.77157	0.61412	0.15745	0.09791	1.60809	0.60392	3.079275
13	North_America	South_America	0.77157	0.72632	0.04525	0.14803	0.30569	0.99957	[1.5144633270954668]
14	Oceania	South_America	0.61412	0.72632	-0.11220	0.14333	-0.78282	0.96699	[-2.246268887244142]

The post-hoc test confirms our earlier assumption from the data visualization, that Europe is the most effected region among all the continents.

The pairwise test tells us that Europe is different from all other continents in term of average temperature rise due to CO2 emissions.

From this post-hoc test we can conclude that there is no significant difference in terms of total emission however between Oceania and South-America it's close to the significant limit.

	A	B	mean(A)	mean(B)	diff	se	T	p-tukey	hedges
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1	Africa	Europe	0.84607	1.18630	-0.34023	0.08600	-3.95626	0.01012	-2.366263
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Adaptive measures and activities that mitigate climate change

Better land management can help tackle climate change. As an added benefit, many land-based responses that adapt to or mitigate climate change also combat land degradation and desertification, and enhance food security, sustainable development and other societal goals. These include sustainable food production, sustainable forest management, soil organic carbon management, ecosystem conservation and land restoration, and reduced deforestation and degradation.12 Non-land based options in food and agriculture value chain management, include reducing post-harvest losses and food and water loss and waste, or different dietary choices which can lower emissions or reduce pressure on land.

Land-based options can also deliver carbon sequestration in soil or vegetation, though with varying degrees and duration of efficiency and effectiveness, and sequestered carbon is at risk of loss if disturbed (for example by flood, fire or pests) or managed poorly.

For land-based solutions to be effective, an integrated response across multiple sectors (agriculture, forest, water) and across local, regional and national levels will generally be needed. Successful implementation also depends on local environmental, ecological and socio-economic conditions. Similarly, barriers to adaptation and mitigation efforts, and risks of side effects are tied to the regional and local environs – in particular the environmental and cultural contexts.

It is also important to consider if and to what extent land-based options compete for available land. Many do not (such as improved management of crop and grazing lands, or sustainable forestry). However, some do (such as afforestation, reforestation, or use of land for biochar or bioenergy feedstock). Increased land demand can lead to land degradation and desertification. There will accordingly be limits to land-based options. It cannot be the only solution. It is essential to reduce GHGs and implement adaption, mitigation and resilience measures across all sectors.

Having briefly touched on innovative ways to mitigate the effect on the environment caused by agribusiness the following, feature article, discusses in more depth the innovative solutions being used throughout the agricultural production process.

Conclusion

Winston Churchill once said ”There is nothing wrong with change, if it is in the right direction.” One hundred years ago, transitions in industry, energy and transport led to fundamental societal change. The automobile, for example, allowed for faster and safer travel over larger distances, which transformed industry and trade, and reshaped our cities as well as our private lives. The modern transitions to adapt to or mitigate global warming, including in the food and agribusiness sector, call for an equally significant reorganization of the way our societies, industries, businesses, and lives are ordered and run – even to the way we produce and consume food. Savvy food and agribusinesses will undertake early-stage assessments of the risks posed by climate change (physical and transition), and implement resilience plans and adaptive measures. In doing so, they will be well-placed not only to ride out the coming changes to the sector and to society as a whole, but also to identify and exploit the opportunities that change presents.

Meet Our Team

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Amukelani Khosa

Thank you

https://github.com/2401PTDS_Regression_Project.git

https://trello.com/invite/b/66fc3cc5ba5b9a15955e6974/ATTIc632f1785d4f3790efd4fc77ec25734b54C1E7A2/regression-project


Thank You