FABIO Documentation

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Introduction

This documentation describes the scripts of the FABIO model v0.0.1 as provided at https://github.com/gru-wu/fabio. FABIO (Food and Agriculture Biomass Input-Output) is a set of multi-regional physical supply, use and input-output tables covering global agriculture and food industry. The work is based on data from FAOSTAT, IEA, EIA and COMTRADE/BACI. FABIO now covers 191 countries, 121 processes and 130 commodities (see Tables 1-3 in the Annex) for 1986-2013.

Download data

In order to run the scripts, please fork the GitHub repository. Then download the following data sets and store them in the folder *./fabio_input/raw data/* of your local copy of the FABIO repository.

Most of the data used for constructing the FABIO model are provided by FAOSTAT, the Statistical Services of the Food and Agriculture Organisation of the United Nations. The website of FAOSTAT is structured by data domains (such as *Production* or *Trade*) which each contain several data sets. For each of the required data sets, a bulk file can be downloaded from the following sources:

- Production, Crops: http://fenixservices.fao.org/faostat/static/bulkdownloads/Production_Crops_E_All_Data_(Normalized).zip
- Production, Crops processed: http://fenixservices.fao.org/faostat/static/bulkdownloads/Production_CropsProcessed_E_All_Data_(Normalized).zip
- Production, Live animals: http://fenixservices.fao.org/faostat/static/bulkdownloads/Production_Livestock_E_All_Data_(Normalized).zip
- Production, Livestock primary: http://fenixservices.fao.org/faostat/static/bulkdownloads/Production_LivestockPrimary_E_All_Data_(Normalized).zip
- Production, Livestock processed: http://fenixservices.fao.org/faostat/static/bulkdownloads/Production_LivestockProcessed_E_All_Data_(Normalized).zip
- Trade, Crops and livestock products: http://fenixservices.fao.org/faostat/static/bulkdownloads/Trade_Crops_Livestock_E_All_Data_(Normalized).zip
- Trade, Live animals: http://fenixservices.fao.org/faostat/static/bulkdownloads/Trade_LiveAnimals_E_All_Data_(Normalized).zip
- Trade, Detailed trade matrix: http://fenixservices.fao.org/faostat/static/bulkdownloads/Trade_DetailedTradeMatrix_E_All_Data_(Normalized).zip
- Commodity Balances, Crops Primary Equivalent: http://fenixservices.fao.org/faostat/static/bulkdownloads/CommodityBalances_Crops_E_All_Data_(Normalized).zip
- Commodity Balances, Livestock and Fish Primary Equivalent: http://fenixservices.fao.org/faostat/static/bulkdownloads/CommodityBalances_LivestockFish_E_All_Data_(Normalized).zip

Additionally, fodder crop production data (part of the aggregated item "Crops Primary > (List)" in the *Production* domain) was downloaded from http://www.fao.org/faostat/en/#data/QC, but is no longer

available from the FAOSTAT website. Therefore, in order to replicate the FABIO model, it is necessary to request these data from FAOSTAT.

Global fishery statistics can be retrieved from FAO's fishery division: http://www.fao.org/fishery/statistics/global-production/en.

COMTRADE, the global trade database of the United Nations Statistical Division, provides bilateral trade data, which are downloaded by the FABIO scripts directly via an API. Make sure that your computer is connected to the internet, when running the script. COMTRADE is free, but it requires to register online. You will receive a token which has to be copied into the file *./fabio_input/comtrade_token.txt*. We use the COMTRADE database for data on bilateral fish and ethanol trade for 1988 to 1994. Data for all other years are sourced from BACI, a reconciled and harmonised version of the COMTRADE database, which is available for 1995 to 2016 from http://www.cepii.fr/cepii/en/bdd_modele/download.asp?id=1. Download the BACI92 version. Please note that BACI is not free. Universities often provide access to the database. Alternatively, COMTRADE can be used for the whole time series with some minor adaptations of the code.

Production data for ethanol from agricultural sources are reported by FAOSTAT under the name *Alcohol, non-food*. However, large data gaps forced us to use alternative sources. We downloaded ethanol/biogasoline production data in xlsx-format from both EIA and IEA:

- EIA: https://www.eia.gov/beta/international/data/browser/#/?pa=000001g&c=ruvvvvvfvtvnvv1urvvvvfvvvvvvfvvvou20evvvvvvvvvvnvvuvo&ct=0&tl_id=79-A&vs=INTL.80-1-AFG-TBPD.A&vo=0&v=H&start=1980&end=2014
- IEA: http://dx.doi.org/10.1787/data-00550-en

After downloading all these data, you can start running the script step by step.

Tidy data

The first three functions of the package are used to read the raw data and harmonize and tidy their data structures, including country and commodity names. The final lists of countries, processes and commodities are given in the Annex.

The basis for the FABIO model are the Commodity Balance Sheets (CBS) from FAOSTAT. The CBS provide data on the supply and utilization of agricultural commodities which are balanced in terms of physical quantities by matching supply (domestic production and imports) with uses (exports, stock changes, and domestic use for food, feed, processing, seed, waste, and other uses). Other uses "refer to quantities of commodities used for non-food purposes, e.g. oil for soap. [...] In addition, this variable covers pet food." (FAO 1986)

While particularly the use accounts are an indispensable source of information for the development of physical supply and use tables (PSUT), an unavoidable limitation of these data is that for many cases crops and derived products are combined into a single CBS by converting products into primary equivalents. For example, the CBS for *wheat and products* comprises also trade and consumption of bread and pasta measured in wheat equivalents. Disaggregating primary from processed products, thus, represents an option for future refinements.

As other domains of FAOSTAT (e.g. *Trade* and *Production*) give the actual weight of products, units had to be converted into primary equivalents where applicable. This was done using country specific technical conversion factors (TCF) for 66 products and global average TCF for 404 products, which for example give the kg of wheat required to produce an average kg of bread (FAO 2003).

Trade data for crops and crop products, livestock and livestock products, timber, and fish are organized in different data domains of the FAO. We therefore harmonized their data structures and integrated them into one bilateral trade database (BTD). In any case, reported import data were given preference over reported export data, based on the expectations that the importer will rather know the correct origin of a traded commodity, than the exporter the correct final destination.

Estimate missing data

Data gaps are a common problem in any heavily data-dependent research work. We used several ways to estimate missing data.

Commodity balances

Some gaps occur in the time series of the CBS. A certain commodity might be reported by a country most of the time, but with a few years missing. The same is the case for the forestry statistics. In these cases we do linear inter- and extrapolation of the available data.

The CBS database does not cover some of the commodities included in the FABIO model, i.e. live animals, fodder crops (grasses, forages and silages), grazing (grasses and hay from grasslands), and timber. Therefore, commodity balances had to be built based on alternative sources. Production data for all missing commodities as well as trade data for live animals and timber are available from FAOSTAT. Fodder crops and grasses are assumed not to be traded internationally. Low prices and the consequent disproportionate transportation costs support this assumption. For simplicity, stock changes, seed use and waste were assumed to be zero. Domestic use of live animals is at large assigned to food processing (i.e. animal slaughtering), fodder crops and grazing to feed use, and timber to other uses.

The CBS and bilateral trade data for *Alcohol, non-food* were updated with production data from IEA and EIA (using the highest value respectively) and trade data from COMTRADE/BACI.

For some countries, not included in the CBS domain, all commodity balances were estimated based on available production, seed use[1] and trade data. Processing requirements, e.g. the rapeseed used for rapeseed oil production or the sugar cane used for sugar production, were estimated for each commodity based on production data for the derived products and the country specific TCF. If we then found data gaps for co-products, e.g. molasses from sugar production, we imputed these data using again the respective TCF.

In total, for the case of the year 2013, 15,234 commodity balances were reported for the 191 countries included in FABIO, and 4,271 were estimated (see Table 4 in the Annex). Countries that needed to be estimated entirely include Singapore, Qatar, Democratic Republic of the Congo, Bahrain, Syrian Arab Republic, Papua New Guinea, Burundi, Libya, Somalia, Eritrea, Timor-Leste, and Puerto Rico.

Bilateral trade

The BTD gives bilateral trade data b_c^{rs} in the format countries-by-countries ($r \times s$) for each commodity c. It reveals significant gaps and discrepancies with the total import and export quantities reported in the CBS. We followed a multi-step approach to estimate a comprehensive set of bilateral trade data, which is in accordance with the CBS:

- We first derive a BTD estimate by spreading exports for each commodity over all countries worldwide according to their import shares. The elements of for a specific crop c and a country pair r, s are derived by $b_c^{'rs} = imp_c^r / imp_c \cdot exp_c^s$
- We repeat this procedure, but spreading imports for each commodity over all countries worldwide according to their export shares: $b_c^{''rs} = exp_c^s / exp_c \cdot imp_c^r$
- We derive the average of the two estimates $\bar{b}_c^{rs}$ and proceed.
- We calculate the difference between the total exports of crop c from country r documented in the BTD and those reported in the CBS dataset.
- We populate the gaps in $\mathbf{B}$, i.e. those fields that are N/A, with the corresponding values from $\bar{\mathbf{B}}$ up-/down-scaling them to meet the target export sum for each commodity and each exporting country as reported in the CBS.

[1] FAO has stopped reporting the seed use in the production domain of FAOSTAT. Thus for future updates seed-production ratios reported in past years or for other countries will be taken.

- We balance the resulting trade matrices using the RAS technique.

The resulting bilateral trade matrix is in line with the import and export totals given by the CBS per country and commodity, while diverging from the reported BTD only as little as possible.

Populate supply table

We insert the compiled production data for each process-item combination into a supply table. Ten livestock commodities are supplied by multiple processes. Production values of those have to be divided between the respective processes:

- Milk and butter from 5 different animal groups are aggregated into one CBS item. At the same time, FAO reports detailed production data for fresh milk by animal type (e.g. cattle, goats, camels). These are used to split the aggregates over the supplying animal sectors in FABIO.
- The same is true for meat, hides and skins, where the CBS provide less detail than the FAO's production statistics. We use the latter to allocate meat supply to the detailed slaughtering processes.
- Slaughtering by-products such as edible offals, animal fats, and meat meal are split among the animal categories according to their respective share in overall meat production.

Populate use table

The FAO Commodity Balance Sheets distinguish the following uses: exports, stock changes, food, feed, processing, seed, waste, and other uses. Seed and waste are considered an own use of the process where the waste occurs and the seed is used. Exports, stock changes, food, and other uses are, in a first step, considered final demand categories, i.e. they are put into a final demand table. In the following, we describe the allocation of feed and processing use.

Allocation of processing use

Processing uses are allocated to the respective processes.

- **Single-process commodities:** Commodities that are only processed by one single process include oil crops (processed in the respective oil extraction processes), hops (use in beer production), seed cotton (separated into cotton lint and cotton seed in the cotton production process), and live animals (processed by the respective slaughtering sectors). Given processing quantities are directly allocated to the respective processes.
- **Multi-purpose crops:** Crops that are used by several processes are allocated by estimating the input requirements to each process based on technical conversion factors giving the conversion efficiencies for food processing. The use of product i in process p is determined by $u_i^p = \sum_j (s_j^p \cdot \phi_{ij}^p)$, where s_j^p is the supply of product j by process p and ϕ_{ij}^p is the conversion efficiency from product i to product j in process p. For example, $\phi_{ij}^p = 0.5$ indicates, that process p converts each ton of product i into 0.5 tons of product j. This approach is used to estimate the use of sugar crops in sugar production, rice in ricebran oil extraction, maize in maize germ oil extraction, and grapes in wine production.
- **Ethanol feedstock:** For Brazil and the US, responsible for over 85 % of the global ethanol production in 2014 (IEA 2019), the feedstock composition is known. Brazil uses sugar cane, while the ethanol industry of the US is mainly based on maize, with less than 2 % coming from sorghum, barley, cheese whey, sugar cane, wheat, and food and wood wastes (RFA 2010). For all other countries, i.e. less than 15 % of global ethanol production, feedstocks are estimated based on the availability of potential feedstock crops and their respective conversion rates.

- **Alcoholic beverages:** Crops are allocated to the processes which supply alcoholic beverages by solving an optimization problem. We have given the national production of beer and other alcoholic beverages s_j, the total available feedstock supply u_i which was not allocated already to other processes, and the conversion efficiencies ϕ_{ij}, e.g., from barley to beer. With these inputs, we solve the following constrained least-squares optimization problem:

$$min \sum \left(\left(\frac{\mathbf{s} - \tilde{\mathbf{s}}}{\bar{\phi}} \right)^2 + (\mathbf{u} - \tilde{\mathbf{u}})^2 \right),$$

where

$$\tilde{s}_j = \sum_{i=1}^{n} \left(\tilde{u}_{ij} \cdot \phi_{ij} \right),$$

subject to

$$\sum_{j=1}^{m} \tilde{u}_{ij} = u_i \pm 0.1.$$

Allocation of feed use

Feed is allocated to the 19 animal husbandry sectors, which are specified in FABIO (see Table 2 in the Annex). For this purpose we follow 4 steps:

1. **Feed supply:** Convert feed supply, reported by the FAO in fresh weight, into dry matter (DM).
2. **Feed demand:** Calculate feed demand of 19 livestock groups in tons of DM.
   a) **Cattle, pigs, poultry, sheep and goats:** Bouwman et al. (2011) published estimates on the feed demand in kg DM per kg product (e.g. milk, beef, fat) for 1970, 1995 and 2030, distinguishing 17 regions and 5 feed types, i.e. animal products, feed crops, grass, residues, and scavenging. We interpolate these feed conversion rates to get year-specific values and multiply them with the production quantities of animal products to get the total feed requirements per product. For this step, it was important to consider trade with live animals in order to correctly assign feed demand to the country, where the animals were raised.
   b) **Horses, asses, mules, camels, other camelids, rabbits, other rodents, other live animals:** Krausmann et al. (2008) provide rough feed demand coefficients for the above listed animal groups in kg DM per head, which are multiplied with the livestock numbers to calculate total feed requirements.
3. **Match supply and demand:** We then balance the generated feed requirement numbers per country to match the reported feed use by proportional up- or downscaling.
4. **Allocation to crops:** Finally, we proportionally distribute total feed crop requirements over the available feed crops according to their supply share and convert the numbers into fresh weight.

Trade-linking use tables

Once the supply and use tables for all countries are filled, they are linked into multi-regional supply and use tables. The multi-regional supply table $\mathbf{S}$ with the dimensions $\{r, i\} \times \{s, p\}$ contains zeros at the trade blocks (where $r \neq s$) and is filled with the domestic supply tables where $r = s$.

The national use tables are trade-linked by spreading the use of a product i in a process p in country s over the source countries r of that product: $u_{ip}^{rs} = u_{ip}^{s} \cdot h_i^{rs}$, where $h_i^{rs} = s_i^{rs}/s_i^{s}$ and s_i^{rs} is the total supply of product i in country s sourced from country r. Finally, we receive a matrix $\mathbf{U}$ with the dimensions $\{r, i\} \times \{s, p\}$.

Construct symmetric IO table

In order to construct a symmetric IO table from the multi-regional supply and use tables, we apply the industry technology assumption. We first derive the product mix matrix or transformation matrix $\mathbf{T} = \hat{\mathbf{g}}^{-1}\mathbf{S}$, where $\hat{\mathbf{g}}$ is a diagonalized vector with the row sums of $\mathbf{S}$. The input-output table is then calculated by multiplying the use and the transformation matrix $\mathbf{Z} = \mathbf{UT}$.

By converting $\mathbf{S}$ from tons to US Dollars, we can switch from mass to price allocation, i.e. allocating the inputs of each process to its outputs in relation to their value rather than their weight. This is particularly relevant for the allocation of inputs between vegetable oils and cakes, as well as between meat and other animal products.

Calculate footprints

The high similarity in the feed input composition among monogastric as well as among ruminant animals results in some degree of linear dependency between the columns of the input-output table $\mathbf{Z}$, thus impeding invertibility. We therefore approximate the Leontief inverse using the power series expansion up to level eight: $\mathbf{L} = \mathbf{I} + \mathbf{A} + \mathbf{A}^2 + \mathbf{A}^3 + \mathbf{A}^4 + \mathbf{A}^5 + \mathbf{A}^6 + \mathbf{A}^7 + \mathbf{A}^8$, where $\mathbf{I}$ is the identity matrix and $\mathbf{A}$ is the technology matrix, which is generated by the equation $\mathbf{A} = \mathbf{Z}\hat{\mathbf{x}}^{-1}$, where $\hat{\mathbf{x}}$ is the diagonalized vector of total production output.

The footprint of a certain country is then calculated by $\mathbf{f} = \mathbf{eLy}$, where $\mathbf{e}$ is a vector of environmental pressure per unit of output and $\mathbf{y}$ is a final demand vector.

References

Bouwman, Lex, Kees Klein Goldewijk, Van Der Hoek, Klaas W., Arthur H. W. Beusen, Detlef P. van Vuuren, Jaap Willems, Mariana C. Rufino, and Elke Stehfest. 2011. "Exploring Global Changes in Nitrogen and Phosphorus Cycles in Agriculture Induced by Livestock Production over the 1900–2050 Period." *Proceedings of the National Academy of Sciences*. doi:10.1073/pnas.1012878108.

FAO. 1986. "The Ics Users' Manual. Interlinked Computer Strorage and Processing System of Food and Agricultural Commodity Data." Rome: FAO.

———. 2003. "Technical Conversion Factors for Agricultural Commodities." Report. Food; Agriculture Organization of the United Nations.

IEA. 2019. *World - Renewable and Waste Energy Supply (Ktoe): IEA Renewables Information Statistics (Database)*. http://dx.doi.org/10.1787/data-00550-en.

Krausmann, F., K. Erb, S. Gingrich, C. Lauk, and H. Haberl. 2008. "Global Patterns of Socioeconomic Biomass Flows in the Year 2000: A Comprehensive Assessment of Supply, Consumption and Constraints." *Ecological Economics* 65 (3): 471–87. doi:10.1016/j.ecolecon.2007.07.012.

RFA. 2010. "2010 Ethanol Industry Outlook: Climate of Opportunity." Edited by Renewable Fuels Association. Washington, DC.

Appendix

Table 1: List of commodities

Com.Code	FAO.Code	FAO.Name	Com.Group
c001	2805	Rice (Milled Equivalent)	Cereals
c002	2511	Wheat and products	Cereals
c003	2513	Barley and products	Cereals
c004	2514	Maize and products	Cereals
c005	2515	Rye and products	Cereals
c006	2516	Oats	Cereals
c007	2517	Millet and products	Cereals
c008	2518	Sorghum and products	Cereals
c009	2520	Cereals, Other	Cereals
c010	2531	Potatoes and products	Roots and tubers
c011	2532	Cassava and products	Roots and tubers
c012	2533	Sweet potatoes	Roots and tubers
c013	2534	Roots, Other	Roots and tubers
c014	2535	Yams	Roots and tubers
c015	2536	Sugar cane	Sugar crops
c016	2537	Sugar beet	Sugar crops
c017	2546	Beans	Vegetables, fruit, nuts, pulses, spices
c018	2547	Peas	Vegetables, fruit, nuts, pulses, spices
c019	2549	Pulses, Other and products	Vegetables, fruit, nuts, pulses, spices
c020	2551	Nuts and products	Vegetables, fruit, nuts, pulses, spices
c021	2555	Soyabeans	Oil crops
c022	2556	Groundnuts (Shelled Eq)	Oil crops
c023	2557	Sunflower seed	Oil crops
c024	2558	Rape and Mustardseed	Oil crops
c025	328	Seed cotton	Oil crops
c026	2560	Coconuts - Incl Copra	Oil crops
c027	2561	Sesame seed	Oil crops
c028	254	Oil, palm fruit	Oil crops
c029	2563	Olives (including preserved)	Oil crops
c030	2570	Oilcrops, Other	Oil crops
c031	2601	Tomatoes and products	Vegetables, fruit, nuts, pulses, spices
c032	2602	Onions	Vegetables, fruit, nuts, pulses, spices
c033	2605	Vegetables, Other	Vegetables, fruit, nuts, pulses, spices
c034	2611	Oranges, Mandarines	Vegetables, fruit, nuts, pulses, spices
c035	2612	Lemons, Limes and products	Vegetables, fruit, nuts, pulses, spices
c036	2613	Grapefruit and products	Vegetables, fruit, nuts, pulses, spices
c037	2614	Citrus, Other	Vegetables, fruit, nuts, pulses, spices
c038	2615	Bananas	Vegetables, fruit, nuts, pulses, spices
c039	2616	Plantains	Vegetables, fruit, nuts, pulses, spices
c040	2617	Apples and products	Vegetables, fruit, nuts, pulses, spices
c041	2618	Pineapples and products	Vegetables, fruit, nuts, pulses, spices
c042	2619	Dates	Vegetables, fruit, nuts, pulses, spices
c043	2620	Grapes and products (excl wine)	Vegetables, fruit, nuts, pulses, spices
c044	2625	Fruits, Other	Vegetables, fruit, nuts, pulses, spices

Table 1: List of commodities *(continued)*

Com.Code	FAO.Code	FAO.Name	Com.Group
c045	2630	Coffee and products	Coffee, tea, cocoa
c046	2633	Cocoa Beans and products	Coffee, tea, cocoa
c047	2635	Tea (including mate)	Coffee, tea, cocoa
c048	677	Hops	Vegetables, fruit, nuts, pulses, spices
c049	2640	Pepper	Vegetables, fruit, nuts, pulses, spices
c050	2641	Pimento	Vegetables, fruit, nuts, pulses, spices
c051	2642	Cloves	Vegetables, fruit, nuts, pulses, spices
c052	2645	Spices, Other	Vegetables, fruit, nuts, pulses, spices
c053	2662	Jute	Fibre crops
c054	2663	Jute-Like Fibres	Fibre crops
c055	2664	Soft-Fibres, Other	Fibre crops
c056	2665	Sisal	Fibre crops
c057	2666	Abaca	Fibre crops
c058	2667	Hard Fibres, Other	Fibre crops
c059	2671	Tobacco	Tobacco, rubber
c060	2672	Rubber	Tobacco, rubber
c061	2000	Fodder crops	Fodder crops, grazing
c062	2001	Grazing	Fodder crops, grazing
c063	2559	Cottonseed	Fibre crops
c064	2562	Palm kernels	Oil crops
c065	2541	Sugar non-centrifugal	Sugar, sweeteners
c066	2544	Molasses	Sugar, sweeteners
c067	2818	Sugar, Refined Equiv	Sugar, sweeteners
c068	2543	Sweeteners, Other	Sugar, sweeteners
c069	2571	Soyabean Oil	Vegetable oils
c070	2572	Groundnut Oil	Vegetable oils
c071	2573	Sunflowerseed Oil	Vegetable oils
c072	2574	Rape and Mustard Oil	Vegetable oils
c073	2575	Cottonseed Oil	Vegetable oils
c074	2576	Palmkernel Oil	Vegetable oils
c075	2577	Palm Oil	Vegetable oils
c076	2578	Coconut Oil	Vegetable oils
c077	2579	Sesameseed Oil	Vegetable oils
c078	2580	Olive Oil	Vegetable oils
c079	2581	Ricebran Oil	Vegetable oils
c080	2582	Maize Germ Oil	Vegetable oils
c081	2586	Oilcrops Oil, Other	Vegetable oils
c082	2590	Soyabean Cake	Oil cakes
c083	2591	Groundnut Cake	Oil cakes
c084	2592	Sunflowerseed Cake	Oil cakes
c085	2593	Rape and Mustard Cake	Oil cakes
c086	2594	Cottonseed Cake	Oil cakes
c087	2595	Palmkernel Cake	Oil cakes
c088	2596	Copra Cake	Oil cakes
c089	2597	Sesameseed Cake	Oil cakes
c090	2598	Oilseed Cakes, Other	Oil cakes

Table 1: List of commodities *(continued)*

Com.Code	FAO.Code	FAO.Name	Com.Group
c091	2655	Wine	Alcohol
c092	2656	Beer	Alcohol
c093	2657	Beverages, Fermented	Alcohol
c094	2658	Beverages, Alcoholic	Alcohol
c095	2659	Alcohol, Non-Food	Ethanol
c096	2661	Cotton lint	Fibre crops
c097	866	Cattle	Live animals
c098	946	Buffaloes	Live animals
c099	976	Sheep	Live animals
c100	1016	Goats	Live animals
c101	1034	Pigs	Live animals
c102	2029	Poultry Birds	Live animals
c103	1096	Horses	Live animals
c104	1107	Asses	Live animals
c105	1110	Mules	Live animals
c106	1126	Camels	Live animals
c107	1157	Camelids, other	Live animals
c108	1140	Rabbits and hares	Live animals
c109	1150	Rodents, other	Live animals
c110	1171	Live animals, other	Live animals
c111	2848	Milk - Excluding Butter	Milk
c112	2740	Butter, Ghee	Milk
c113	2744	Eggs	Eggs
c114	2746	Wool (Clean Eq.)	Hides, skins, wool
c115	2731	Bovine Meat	Meat
c116	2732	Mutton & Goat Meat	Meat
c117	2733	Pigmeat	Meat
c118	2734	Poultry Meat	Meat
c119	2735	Meat, Other	Meat
c120	2736	Offals, Edible	Meat
c121	2737	Fats, Animals, Raw	Animal fats
c122	2748	Hides and skins	Hides, skins, wool
c123	2749	Meat Meal	Meat
c124	843	Pet food	Meat
c125	2745	Honey	Honey
c126	2747	Silk	Hides, skins, wool
c127	2960	Fish, Seafood	Fish
c128	1864	Wood fuel	Wood
c129	1866	Industrial roundwood, coniferous	Wood
c130	1867	Industrial roundwood, non-coniferous	Wood

Table 2: List of processes

Proc.Code	Process	Proc.Type
p001	Rice production	Primary production

Table 2: List of processes *(continued)*

Proc.Code	Process	Proc.Type
p002	Wheat production	Primary production
p003	Barley production	Primary production
p004	Maize production	Primary production
p005	Rye production	Primary production
p006	Oat production	Primary production
p007	Millet production	Primary production
p008	Sorghum production	Primary production
p009	Cereals production, Other	Primary production
p010	Potatoes production	Primary production
p011	Cassava production	Primary production
p012	Sweet potatoes production	Primary production
p013	Roots production, Other	Primary production
p014	Yams production	Primary production
p015	Suga cane production	Primary production
p016	Sugar beet production	Primary production
p017	Beans production	Primary production
p018	Peas production	Primary production
p019	Pulses production, Other	Primary production
p020	Nuts production	Primary production
p021	Soyabeans production	Primary production
p022	Groundnuts (Shelled Eq) production	Primary production
p023	Sunflower seed production	Primary production
p024	Rape and Mustardseed production	Primary production
p025	Seed cotton production	Primary production
p026	Coconuts production	Primary production
p027	Sesame seed production	Primary production
p028	Oil palm fruit production	Primary production
p029	Olives production	Primary production
p030	Oilcrops production, Other	Primary production
p031	Tomatoes production	Primary production
p032	Onions production	Primary production
p033	Vegetables production, Other	Primary production
p034	Oranges, Mandarines production	Primary production
p035	Lemons, Limes production	Primary production
p036	Grapefruit production	Primary production
p037	Citrus production, Other	Primary production
p038	Bananas production	Primary production
p039	Plantains production	Primary production
p040	Apples production	Primary production
p041	Pineapples production	Primary production
p042	Dates production	Primary production
p043	Grapes production	Primary production
p044	Fruits production, Other	Primary production
p045	Coffee production	Primary production
p046	Cocoa Beans production	Primary production
p047	Tea production	Primary production

Table 2: List of processes *(continued)*

Proc.Code	Process	Proc.Type
p048	Hops production	Primary production
p049	Pepper production	Primary production
p050	Pimento production	Primary production
p051	Cloves production	Primary production
p052	Spices production, Other	Primary production
p053	Jute production	Primary production
p054	Jute-Like Fibres production	Primary production
p055	Soft-Fibres production, Other	Primary production
p056	Sisal production	Primary production
p057	Abaca production	Primary production
p058	Hard Fibres production, Other	Primary production
p059	Tobacco production	Primary production
p060	Rubber production	Primary production
p061	Fodder crops production	Primary production
p062	Grazing production	Primary production
p063	Cotton production	Processing
p064	Sugar production, non-centrifugal	Processing
p065	Sugar production	Processing
p066	Sweeteners production, Other	Processing
p067	Soyabean Oil extraction	Processing
p068	Groundnut Oil extraction	Processing
p069	Sunflowerseed Oil extraction	Processing
p070	Rape and Mustard Oil extraction	Processing
p071	Cottonseed Oil extraction	Processing
p072	Palmkernel Oil extraction	Processing
p073	Palm Oil production	Processing
p074	Coconut Oil extraction	Processing
p075	Sesameseed Oil extraction	Processing
p076	Olive Oil extraction	Processing
p077	Ricebran Oil extraction	Processing
p078	Maize Germ Oil extraction	Processing
p079	Oilcrops Oil extraction, Other	Processing
p080	Wine production	Processing
p081	Beer production	Processing
p082	Beverages production, Fermented	Processing
p083	Beverages production, Alcoholic	Processing
p084	Alcohol production, Non-Food	Processing
p085	Cattle husbandry	Primary production
p086	Buffaloes husbandry	Primary production
p087	Sheep husbandry	Primary production
p088	Goats husbandry	Primary production
p089	Pigs farming	Primary production
p090	Poultry Birds farming	Primary production
p091	Horses husbandry	Primary production
p092	Asses husbandry	Primary production
p093	Mules husbandry	Primary production

Table 2: List of processes *(continued)*

Proc.Code	Process	Proc.Type
p094	Camels husbandry	Primary production
p095	Camelids husbandry, other	Primary production
p096	Rabbits husbandry	Primary production
p097	Rodents husbandry, other	Primary production
p098	Live animals husbandry, other	Primary production
p099	Dairy cattle husbandry	Primary production
p100	Dairy buffaloes husbandry	Primary production
p101	Dairy sheep husbandry	Primary production
p102	Dairy goats husbandry	Primary production
p103	Dairy camels husbandry	Primary production
p104	Cattle slaughtering	Processing
p105	Buffaloes slaughtering	Processing
p106	Sheep slaughtering	Processing
p107	Goat slaughtering	Processing
p108	Pigs slaughtering	Processing
p109	Poultry slaughtering	Processing
p110	Horses slaughtering	Processing
p111	Asses slaughtering	Processing
p112	Mules slaughtering	Processing
p113	Camels slaughtering	Processing
p114	Camelids slaughtering, other	Processing
p115	Rabbits slaughtering	Processing
p116	Rodents slaughtering, other	Processing
p117	Live animals slaughtering, other	Processing
p118	Beekeeping	Processing
p119	Silkworm breeding	Processing
p120	Fishing	Processing
p121	Forestry	Primary production

Table 3: List of countries

FAO.Code	Country	ISO	Continent
1	Armenia	ARM	ASI
2	Afghanistan	AFG	ASI
3	Albania	ALB	EUR
4	Algeria	DZA	AFR
7	Angola	AGO	AFR
8	Antigua and Barbuda	ATG	LAM
9	Argentina	ARG	LAM
10	Australia	AUS	OCE
11	Austria	AUT	EU
12	Bahamas	BHS	LAM
13	Bahrain	BHR	ASI
14	Barbados	BRB	LAM
15	Belgium-Luxembourg	BLX	EU
16	Bangladesh	BGD	ASI

Table 3: List of countries *(continued)*

FAO.Code	Country	ISO	Continent
19	Bolivia (Plurinational State of)	BOL	LAM
20	Botswana	BWA	AFR
21	Brazil	BRA	LAM
23	Belize	BLZ	LAM
25	Solomon Islands	SLB	OCE
26	Brunei Darussalam	BRN	ASI
27	Bulgaria	BGR	EU
28	Myanmar	MMR	ASI
29	Burundi	BDI	AFR
32	Cameroon	CMR	AFR
33	Canada	CAN	NAM
35	Cabo Verde	CPV	AFR
37	Central African Republic	CAF	AFR
38	Sri Lanka	LKA	ASI
39	Chad	TCD	AFR
40	Chile	CHL	LAM
41	China, mainland	CHN	ASI
44	Colombia	COL	LAM
46	Congo	COG	AFR
48	Costa Rica	CRI	LAM
49	Cuba	CUB	LAM
50	Cyprus	CYP	EU
51	Czechoslovakia	CSK	EU
52	Azerbaijan	AZE	ASI
53	Benin	BEN	AFR
54	Denmark	DNK	EU
55	Dominica	DMA	LAM
56	Dominican Republic	DOM	LAM
57	Belarus	BLR	EUR
58	Ecuador	ECU	LAM
59	Egypt	EGY	AFR
60	El Salvador	SLV	LAM
63	Estonia	EST	EU
66	Fiji	FJI	OCE
67	Finland	FIN	EU
68	France	FRA	EU
70	French Polynesia	PYF	OCE
72	Djibouti	DJI	AFR
73	Georgia	GEO	ASI
74	Gabon	GAB	AFR
75	Gambia	GMB	AFR
79	Germany	DEU	EU
80	Bosnia and Herzegovina	BIH	EUR
81	Ghana	GHA	AFR
83	Kiribati	KIR	OCE
84	Greece	GRC	EU

Table 3: List of countries *(continued)*

FAO.Code	Country	ISO	Continent
86	Grenada	GRD	LAM
89	Guatemala	GTM	LAM
90	Guinea	GIN	AFR
91	Guyana	GUY	LAM
93	Haiti	HTI	LAM
95	Honduras	HND	LAM
96	China, Hong Kong SAR	HKG	ASI
97	Hungary	HUN	EU
98	Croatia	HRV	EU
99	Iceland	ISL	EUR
100	India	IND	ASI
101	Indonesia	IDN	ASI
102	Iran (Islamic Republic of)	IRN	ASI
103	Iraq	IRQ	ASI
104	Ireland	IRL	EU
105	Israel	ISR	ASI
106	Italy	ITA	EU
107	Côte d'Ivoire	CIV	AFR
108	Kazakhstan	KAZ	ASI
109	Jamaica	JAM	LAM
110	Japan	JPN	ASI
112	Jordan	JOR	ASI
113	Kyrgyzstan	KGZ	ASI
114	Kenya	KEN	AFR
115	Cambodia	KHM	ASI
116	Democratic People's Republic of Korea	PRK	ASI
117	Republic of Korea	KOR	ASI
118	Kuwait	KWT	ASI
119	Latvia	LVA	EU
120	Lao People's Democratic Republic	LAO	ASI
121	Lebanon	LBN	ASI
122	Lesotho	LSO	AFR
123	Liberia	LBR	AFR
124	Libya	LBY	AFR
126	Lithuania	LTU	EU
128	China, Macao SAR	MAC	ASI
129	Madagascar	MDG	AFR
130	Malawi	MWI	AFR
131	Malaysia	MYS	ASI
132	Maldives	MDV	ASI
133	Mali	MLI	AFR
134	Malta	MLT	EU
136	Mauritania	MRT	AFR
137	Mauritius	MUS	AFR
138	Mexico	MEX	LAM
141	Mongolia	MNG	ASI

Table 3: List of countries *(continued)*

FAO.Code	Country	ISO	Continent
143	Morocco	MAR	AFR
144	Mozambique	MOZ	AFR
146	Republic of Moldova	MDA	EUR
147	Namibia	NAM	AFR
149	Nepal	NPL	ASI
150	Netherlands	NLD	EU
151	Netherlands Antilles	ANT	LAM
153	New Caledonia	NCL	OCE
154	The former Yugoslav Republic of Macedonia	MKD	EUR
155	Vanuatu	VUT	OCE
156	New Zealand	NZL	OCE
157	Nicaragua	NIC	LAM
158	Niger	NER	AFR
159	Nigeria	NGA	AFR
162	Norway	NOR	EUR
165	Pakistan	PAK	ASI
166	Panama	PAN	LAM
167	Czech Republic	CZE	EU
168	Papua New Guinea	PNG	OCE
169	Paraguay	PRY	LAM
170	Peru	PER	LAM
171	Philippines	PHL	ASI
173	Poland	POL	EU
174	Portugal	PRT	EU
175	Guinea-Bissau	GNB	AFR
176	Timor-Leste	TLS	ASI
177	Puerto Rico	PRI	LAM
178	Eritrea	ERI	AFR
179	Qatar	QAT	ASI
181	Zimbabwe	ZWE	AFR
183	Romania	ROU	EU
184	Rwanda	RWA	AFR
185	Russian Federation	RUS	ASI
186	Serbia and Montenegro	SCG	EUR
188	Saint Kitts and Nevis	KNA	LAM
189	Saint Lucia	LCA	LAM
191	Saint Vincent and the Grenadines	VCT	LAM
193	Sao Tome and Principe	STP	AFR
194	Saudi Arabia	SAU	ASI
195	Senegal	SEN	AFR
197	Sierra Leone	SLE	AFR
198	Slovenia	SVN	EU
199	Slovakia	SVK	EU
200	Singapore	SGP	ASI
201	Somalia	SOM	AFR
202	South Africa	ZAF	AFR

Table 3: List of countries *(continued)*

FAO.Code	Country	ISO	Continent
203	Spain	ESP	EU
207	Suriname	SUR	LAM
208	Tajikistan	TJK	ASI
209	Swaziland	SWZ	AFR
210	Sweden	SWE	EU
211	Switzerland	CHE	EUR
212	Syrian Arab Republic	SYR	ASI
213	Turkmenistan	TKM	ASI
214	China, Taiwan Province of	TWN	ASI
215	United Republic of Tanzania	TZA	AFR
216	Thailand	THA	ASI
217	Togo	TGO	AFR
220	Trinidad and Tobago	TTO	LAM
221	Oman	OMN	ASI
222	Tunisia	TUN	AFR
223	Turkey	TUR	EUR
225	United Arab Emirates	ARE	ASI
226	Uganda	UGA	AFR
228	USSR	SUN	ASI
229	United Kingdom	GBR	EU
230	Ukraine	UKR	EUR
231	United States of America	USA	NAM
233	Burkina Faso	BFA	AFR
234	Uruguay	URY	LAM
235	Uzbekistan	UZB	ASI
236	Venezuela (Bolivarian Republic of)	VEN	LAM
237	Viet Nam	VNM	ASI
238	Ethiopia	ETH	AFR
244	Samoa	WSM	OCE
248	Yugoslav SFR	YUG	EUR
249	Yemen	YEM	ASI
250	Democratic Republic of the Congo	COD	AFR
251	Zambia	ZMB	AFR
255	Belgium	BEL	EU
256	Luxembourg	LUX	EU
272	Serbia	SRB	EUR
273	Montenegro	MNE	EUR
276	Sudan	SDN	AFR
277	South Sudan	SSD	AFR
999	RoW	ROW	ROW

Table 4: Number of commodity balances reported and estimated for each country in 2013

Country	reported	estimated
Singapore	0	115
Qatar	0	112
Democratic Republic of the Congo	0	110
Bahrain	0	109
Syrian Arab Republic	0	103
Papua New Guinea	0	100
Burundi	0	94
Libya	0	91
Somalia	0	88
Eritrea	0	63
Lesotho	47	54
Democratic People's Republic of Korea	53	39
Turkmenistan	49	39
Lao People's Democratic Republic	65	37
Afghanistan	62	33
Viet Nam	83	31
Angola	81	31
Timor-Leste	47	31
South Sudan	0	29
Chad	63	28
Tajikistan	65	27
Sao Tome and Principe	62	27
Puerto Rico	0	27
Myanmar	88	25
United States of America	100	24
Kuwait	92	24
Mozambique	92	24
Liberia	67	24
Solomon Islands	63	23
China, mainland	104	22
Mexico	103	22
Thailand	103	22
Dominican Republic	87	22
Peru	98	21
Egypt	97	21
Iraq	86	21
Uzbekistan	78	21
Sierra Leone	74	21
Brazil	102	20
France	102	20
Canada	101	20
Germany	101	20
Netherlands	101	20
United Kingdom	101	20
Bulgaria	99	20

Table 4: Number of commodity balances reported and estimated for each country in 2013 *(continued)*

Country	reported	estimated
Spain	99	20
Colombia	98	20
Nepal	95	20
New Zealand	95	20
Côte d'Ivoire	94	20
Norway	94	20
Israel	91	20
Bolivia (Plurinational State of)	91	20
Bosnia and Herzegovina	89	20
Congo	85	20
Montenegro	78	20
South Africa	104	19
Philippines	103	19
Italy	102	19
Australia	101	19
Belgium	100	19
Czech Republic	100	19
Republic of Korea	100	19
Venezuela (Bolivarian Republic of)	100	19
Malaysia	99	19
China, Taiwan Province of	98	19
United Arab Emirates	98	19
Austria	98	19
Switzerland	97	19
Kenya	97	19
Ethiopia	95	19
Ecuador	95	19
Kazakhstan	95	19
Ghana	93	19
Ukraine	91	19
Serbia	89	19
Algeria	87	19
Brunei Darussalam	84	19
Cabo Verde	76	19
Mongolia	70	19
Samoa	64	19
Kiribati	53	19
Ireland	100	18
India	100	18
Indonesia	100	18
Poland	99	18
Greece	97	18
Guatemala	97	18
Romania	97	18
Russian Federation	96	18

Table 4: Number of commodity balances reported and estimated for each country in 2013 *(continued)*

Country	reported	estimated
Honduras	95	18
Nicaragua	95	18
Slovakia	95	18
Panama	93	18
Senegal	93	18
Uganda	92	18
Argentina	92	18
China, Hong Kong SAR	91	18
Iran (Islamic Republic of)	90	18
Albania	89	18
Burkina Faso	88	18
Rwanda	85	18
Niger	84	18
Bahamas	82	18
Gambia	80	18
Guinea-Bissau	65	18
Vanuatu	64	18
Japan	103	17
United Republic of Tanzania	103	17
Portugal	102	17
Pakistan	101	17
Nigeria	98	17
Hungary	97	17
Zambia	97	17
Madagascar	95	17
Morocco	95	17
Croatia	92	17
Uruguay	92	17
Botswana	92	17
Belarus	91	17
Swaziland	90	17
Jordan	90	17
Zimbabwe	90	17
Saudi Arabia	90	17
Tunisia	87	17
Guinea	86	17
Cuba	84	17
Kyrgyzstan	82	17
French Polynesia	79	17
Haiti	79	17
Denmark	98	16
Oman	98	16
Chile	97	16
Turkey	97	16
Costa Rica	96	16

Table 4: Number of commodity balances reported and estimated for each country in 2013 *(continued)*

Country	reported	estimated
Sweden	96	16
Mauritius	89	16
Malta	88	16
The former Yugoslav Republic of Macedonia	88	16
Trinidad and Tobago	87	16
New Caledonia	86	16
Azerbaijan	86	16
Malawi	86	16
Fiji	85	16
Republic of Moldova	84	16
Gabon	81	16
Antigua and Barbuda	80	16
Suriname	80	16
Maldives	78	16
Belize	75	16
Djibouti	67	16
Dominica	66	16
Saint Vincent and the Grenadines	66	16
Slovenia	96	15
Sri Lanka	96	15
Lebanon	95	15
Cameroon	93	15
Bangladesh	92	15
Namibia	92	15
Luxembourg	92	15
Finland	91	15
Latvia	91	15
Estonia	90	15
Jamaica	88	15
Cambodia	87	15
Benin	86	15
Georgia	86	15
Paraguay	86	15
Iceland	85	15
Mali	84	15
Barbados	81	15
Guyana	80	15
El Salvador	94	14
Lithuania	93	14
Cyprus	90	14
Togo	87	14
Central African Republic	66	14
Armenia	86	13
Mauritania	77	13
Saint Lucia	71	13

Table 4: Number of commodity balances reported and estimated for each country in 2013 *(continued)*

Country	reported	estimated
China, Macao SAR	68	13
Yemen	83	12
Saint Kitts and Nevis	69	12
Grenada	73	10
Netherlands Antilles	52	8
Sudan	92	4
Belgium-Luxembourg	0	0
Czechoslovakia	0	0
Serbia and Montenegro	0	0
USSR	0	0
Yugoslav SFR	0	0