

Dataset Information:

Title	Cropland Nutrient Balance
Abstract	The Cropland Nutrient Balance domain contains information on the soil nutrient flows of nitrogen, phosphorus, and potassium from mineral fertilizer, manure applied, atmospheric deposition, biological N fixation, crop harvest removal, and crop residue removal over all cropland and per unit area of cropland by countries or regions. The flows are aggregated to total inputs and total outputs, from which the cropland nutrient balance and nutrient use efficiency are calculated. Statistics are disseminated in units of tonnes of mineral elements (N, P or K) and in kg/ha, as appropriate. Data are available by country, with global coverage for the period 1961-2023, with annual updates.
Supplemental	The FAOSTAT domain “Cropland Nutrient Balance” disseminates nutrient flows in a given country and year. The cropland nutrient balance can give an indication of nutrient use and nutrient use efficiency, i.e., it can help quantify excess nutrients leading to environmental risks, for instance, GHG emissions or pollution from volatilization and leaching/runoff. Or it can signal soil nutrient deficits that limit crop production.
Creation Date	2020
Last Update	2025
Data Type	Agri-Environmental
Category	Agriculture; Environment
Time Period	1961—2023
Periodicity	Annual
Geographical Coverage	World
Spatial Unit	The database covers 196 countries and territories
Language	Multilingual (EN, FR, ES)

Methodology and Quality Information:

Methods and processing The cropland nutrient balance (CNB) is calculated as the sum of nutrient inputs that include (1) mineral fertilizers (applied to cropland) (MF) (2) manure applied (to cropland) (MA), (3) atmospheric nitrogen deposition (ND), (4) biological nitrogen fixation (BF), and (5) seed (SD) minus nutrient outputs as crop harvest removal (CR; i.e. nutrient removal with harvested products only, not including crop residue). The MF is calculated as total fertilizer use multiplied by the fraction of fertilizer applied to cropland (CF). The MA is calculated as Manure applied to Soil multiplied by CF.

The **cropland nutrient balance** for country *i* for nutrient *j* for year *y* is calculated as:

$$CNB_{i,j,y} = \text{sum}(MF_{i,j,y}, MA_{i,j,y}, ND_{i,j,y}, BF_{i,j,y}, SD_{i,j,y}) - CR_{i,j,y}$$

Using the same input and output variables, **cropland nutrient use efficiency** is calculated as the ratio of outputs/inputs and reported as percentage (%).

The 2025 update of the cropland nutrient balance database introduces an important component of the nutrient balance: the crop nutrient output through crop residues, i.e. crop residue is removed from the cropland for other uses (e.g. off-field livestock feed or bedding, cooking, growing mushrooms, industrial uses, etc.). The nutrient output (N, P, K) with crop residues is now included as a new standalone item “crop residue removal”. The new item was estimated based on newly collected expert estimates and available data on crop residue direct removal for each crop-country combination, and crop-specific nutrient concentrations in crop residue. To ensure consistency with previous releases, crop residue removal is however not included in the

calculation of nutrient balances or nutrient use efficiencies. Data users are encouraged to do their own analysis, comparing results and trends over time with and without including crop residue nutrient removal.

The definition of cropland corresponds to that of FAOSTAT:

Cropland is Land used for cultivation of crops. The total of areas under "Arable land" and "Permanent crops", where:

Arable land is the total of areas under temporary crops, temporary meadows and pastures, and land with temporary fallow. Arable land does not include land that is potentially cultivable but is not normally cultivated.

Land under temporary crops is land used for crops with a less-than-one-year growing cycle, which must be newly sown or planted for further production after the harvest. Some crops that remain in the field for more than one year may also be considered as temporary crops e.g., asparagus, strawberries, pineapples, bananas and sugar cane. Multiple-cropped areas are counted only once. Land under temporary meadows and pastures is land temporarily cultivated with herbaceous forage crops for mowing or pasture. A period of less than five years is used to differentiate between temporary and permanent meadows and pastures.

Land with temporary fallow is land that is not seeded for one or more growing seasons. The maximum idle period is usually less than five years. This land may be in the form sown for the exclusive production of green manure. Land remaining fallow for too long may acquire characteristics requiring it to be reclassified, as for instance "Permanent meadows and pastures" if used for grazing or haying.

Land under permanent crops is land cultivated with long-term crops which do not have to be replanted for several years (such as cocoa and coffee), land under trees and shrubs producing flowers (such as roses and jasmine), and nurseries (except those for forest trees, which should be classified under "Forestry"). Permanent meadows and pastures are excluded from land under permanent crops.

Input 1 – Mineral fertilizers

Data for mineral fertilizers for the Food and Agriculture Organization of the United Nations (FAO) are sourced from the "Fertilizers by Nutrient" domain under "Inputs" in FAOSTAT for the element "Agricultural Use" and the items "Nutrient nitrogen N (total)", "Nutrient phosphate P₂O₅ (total)", and "Nutrient potash K₂O (total)".

<https://www.fao.org/faostat/en/#data/RFN>. Data for mineral fertilizers for the International Fertilizer Association (IFA) are sourced from the IFA consumption database:

<https://www.ifastat.org/databases/plant-nutrition>

For records with data for both FAO and IFA, the average of the two data sources was used.

Data for chemical compounds are converted to the elements Nitrogen (N), Phosphorus (P), and Potassium (K) using the mass percent composition conversions of 0.436 for P and 0.830 for K.

For detailed descriptions of the methods used to derive cropland fraction (CF) estimates please refer to Ludemann et al. (2024). In addition that, starting with the 2024 data release, three additional datasets on N, P, and K fertilizer were used to derive additional cropland fraction estimates. These datasets were provided by Maggi et al. (2023), Ray et al. (2025), and Fertilizer Europe. Additionally, we also now include P and K estimates from Ludemann et al. (2022) which were not considered in releases prior to 2024.

With additional data sources available for CF estimates, we updated our screening and selection process of fraction estimates. Results from this updated process were compared to our 2022 list

of fraction estimates; country-specific differences between our 2022 and 2023 lists were flagged and used to justify changes. The inclusion of additional data and our updated selection process has resulted in 0, 2, and 7 countries for which N, P, and K estimates were updated from the 2022 data release (Table 1). For those countries not shown in Table 1, the fraction of N, P, and K fertilizers applied to cropland is assumed to be 100%.

The updated approach considered each country’s respective nutrient datasets and was tested to see if there was broad agreement between all available data sources for their five most years of available data. For a given country and nutrient dataset, we considered the totality of available data sources and first calculated a fraction estimate for an identified priority source (based on an internal hierarchical list of sources); we then tested if averages for all other available data sources were within 10% of this prioritized value. If all available sources were within this range, we considered them to be in general agreement and took the average of their averages, rounded to the nearest 10th percent. If this value differed from the estimate used in the 2022 release it was identified as a recommended update. The final list of countries with N, P, and K cropland fractions was then applied across the CNB database’s entire time series. It should be noted that this approach only considered recommended updates if there were at least two available data sources for a given country’s nutrient database. This approach enabled us to incorporate additional data sources in our cropland fraction selection process while also addressing any privacy concerns from those contributing data to this selection process. In other words, an updated fraction estimate is only present if there exist multiple available data sources that are all in agreement; and the updated fraction estimate reflects an average of all available data.

Table 1: N, P, & K cropland fraction estimates used in the 2024 and 2025 CNB database. For countries not expressed in the table, the fraction of N; P; and K applied to cropland is assumed to be 100%.

Country	N	P	K
Australia	90%	70%	80%
Austria	90%	90%	90%
Brazil	90%	100%	100%
Canada	90%	100%	100%
Chile	80%	70%	70%
Finland	70%	100%	80%
France	90%	90%	90%
Germany	80%	90%	90%
Ireland	23%	22%	37%
Japan	80%	100%	90%
Morocco	90%	100%	100%
Netherlands	50%	90%	70%
New Zealand	8%	5%	12%
Poland	80%	90%	90%
Slovenia	60%	70%	80%
South Africa	90%	90%	90%
Switzerland	70%	70%	70%
United Kingdom of Great Britain and Northern Ireland	80%	70%	80%
United States of America	80%	100%	90%
Uruguay	90%	90%	90%
Luxembourg	40%	70%	60%

Sources:

Ludemann, C. I., Gruere, A., Heffer, P., and Dobermann, A. (2022). Global data on fertilizer use by crop and by country, Dryad data set, updated 2025, <https://datadryad.org/dataset/doi:10.5061/dryad.2rbnzs7qh>

Ludemann, C.I., Wanner, N., Chivenge, P., Dobermann, A., Einarsson, R., Grassini, P., Gruere, A., Jackson, K., Lassaletta, L., Maggi, F. and Obli-Laryea, G. (2024). A global reference database in FAOSTAT of cropland nutrient b and nutrient use efficiency: nitrogen, phosphorus and potassium, 1961–2020. Earth System Science Data 16, 525-541, <https://essd.copernicus.org/articles/16/525/2024/>

Maggi, F.; Tang, H.M.F.; Nguyen, T.H.; Conchedda, G.; Casse, L.; Tubiello, F. N. (2023). NPKGRIDS. figshare. Dataset. <https://doi.org/10.6084/m9.figshare.24616050.v1>

Ray, D.; Sapkota, T.B.; Dobermann, A. (2025). N-P-K fertilizer application rates by crop and country for circa 2020. Dryad data set, <https://datadryad.org/dataset/doi:10.5061/dryad.59zw3r2mq>

Input 2 – Manure applied

Data for the N content of treated manure are extracted from the “Manure Management” domain under “Climate Change - Emissions – Farm gate” in FAOSTAT for the element “Manure treated (N content)” by livestock item. The N content is converted to P and K content using the unitless ratios shown in Table 2 below:

Table 2: Manure nutrient ratios for P and K by livestock category

Item Code	Item	P	K
960	Cattle, dairy	0.14	1.11
961	Cattle, non-dairy	0.19	0.95
976	Sheep	0.16	0.96
1016	Goats	0.17	0.88
1049	Swine, market	0.25	0.55
1051	Swine, breeding	0.28	0.45
1052	Chickens, layers	0.27	0.37
1053	Chickens, broilers	0.22	0.34
1068	Ducks	0.18	0.32
1079	Turkeys	0.23	0.33
1096	Horses	0.18	0.80
1759	Mules and Asses	0.18	0.80
1760	Camels and Llamas	0.18	0.80
946	Buffaloes	0.16	1.17

The unitless ratios were derived from nutrient excretion data reflecting OECD countries (OECD Secretariat 1997), USA (Midwest Plan Service 1985) and Europe (Levington Agriculture 1997) and came from Sheldrick et al (2003). To fill in the gaps for some missing classes of livestock data from Statistics Netherlands (2012) were used. As losses from manure management are more extensive for the nutrient nitrogen, these conversion factors were applied to the manure treated.

These cropland fractions shown in Table 1 were also used to apportion nutrients from manure from livestock in agriculture (‘Manure applied to Soil’) to cropland.

Input 3 – Atmospheric nitrogen deposition

Nitrogen (N) deposition describes the input from the atmosphere of nitrogen to the soil as dry and wet deposition. Data were taken from the following public repository:

Vishwakarma, S., Zhang, X., Dobermann, A., Heffer, P., Zhou, F. (2022), Quantifying nitrogen deposition inputs to cropland: A national scale dataset from 1961 to 2020, Dryad dataset, updated in 2025, <https://doi.org/10.5061/dryad.msbcc2g1x>

Input 4 – Biological nitrogen fixation

Data for nitrogen-fixing crops was taken from the domain “Crops and livestock products” in FAOSTAT, and biological nitrogen fixation was calculated according to the two following sources:

Peoples, M.B., Giller, K.E., Jensen, E.S. et al. Quantifying country-to-global scale nitrogen fixation for grain legumes: I. Reliance on nitrogen fixation of soybean, groundnut and pulses. *Plant Soil* 469, 1–14 (2021). <https://doi.org/10.1007/s11104-021-05167-6>

Herridge, D.F., Giller, K.E., Jensen, E.S. et al. Quantifying country-to-global scale nitrogen fixation for grain legumes II. Coefficients, templates and estimates for soybean, groundnut and pulses. *Plant Soil* 474, 1–15 (2022). <https://doi.org/10.1007/s11104-021-05166-7>

Input 5 – Seed

Data for the amounts of seed was taken from Food Balance Sheets in the domain “Food Balances” in FAOSTAT, <https://www.fao.org/faostat/en/#data/FBS>. Average nutrient coefficients of seed were obtained from Ludemann et al. (2022), as shown in Table 3.

Ludemann, C., Hijbeek, R., van Loon, M., Murrell, S.T., Dobermann, A., van Ittersum, M. 2023. Global data on crop nutrient concentration and harvest indices. Dryad, dataset, <https://datadryad.org/dataset/doi:10.5061/dryad.n2z34tn0x>

Table 3: Nutrient concentrations of seed with mapping of the item codes from the agricultural production domain to the Food Balance Sheets domain.

Item Code (FAO)	Seed	Item FBS	Item Agricultural Production	Item_Code_Removal	N_kg_per_t_fresh_wt	P_kg_per_t_fresh_wt	K_kg_per_t_fresh_wt
2511	Wheat and products	Wheat	15	20.69	3.84	4.62	
2807	Rice and products	Rice, paddy	27	12.44	2.87	2.98	
2513	Barley and products	Barley	44	17.73	3.46	5.66	
2514	Maize and products	Maize	56	12.34	2.94	3.85	
2517	Millet and products	Millet	79	22.90	3.91	5.91	
2531	Potatoes and products	Potatoes	116	2.74	0.80	5.70	
2549	Pulses, Other and products	Pulses nes	211	26.07	4.23	13.19	
2557	Sunflower seed	Sunflower seed	267	25.57	4.09	7.09	
2559	Cottonseed	Seed cotton	328	58.50	11.62	31.51	
2561	Sesame seed	Sesame seed	289	25.74	5.12	9.67	
2570	Oilcrops, Other	Oilseeds nes	339	17.69	4.79	24.98	
2515	Rye and products	Rye	71	22.12	3.42	4.38	
2516	Oats	Oats	75	21.68	3.73	4.71	
2518	Sorghum and products	Sorghum	83	14.03	3.83	4.35	
2546	Beans	Beans, dry	176	42.17	5.71	17.19	
2555	Soybeans	Soybeans	236	55.90	6.33	17.11	
2547	Peas	Peas, dry	187	39.00	8.73	9.80	
2552	Groundnuts	Groundnuts, with shell	242	34.28	3.61	7.44	
2558	Rape and Mustardseed	Rapeseed	270	31.81	7.04	6.64	
2536	Sugar cane	Sugar cane	156	3.67	0.31	1.40	
2520	Cereals, other	Cereals nes	108	14.33	3.30	4.48	
2605	Vegetables, other	Vegetables, fresh nes	463	5.62	0.90	2.60	
2533	Sweet potatoes	Sweet potatoes	122	3.76	0.83	7.22	
2535	Yams	Yams	137	3.64	1.14	3.49	
2532	Cassava and products	Cassava	125	2.47	0.30	2.64	
2534	Roots, Other	Roots and tubers nes	149	4.37	0.30	2.90	
2560	Coconuts - Incl Copra	Coconuts	249	15.37	2.62	5.94	
2640	Pepper	Pepper (piper spp.)	687	12.20	1.31	15.77	
2537	Sugar beet	Sugar beet	157	2.30	0.58	3.81	
2562	Palm kernels	Oilseeds nes	339	17.69	4.79	24.98	
2543	Sweeteners, Other	Sugar crops nes	161	0.00	NA	NA	
2563	Olives (including preserved)	Olives	260	6.70	7.67	7.00	
2645	Spices, Other	Spices nes	723	13.75	1.09	11.15	
2620	Grapes and products (excl wine)	Grapes	560	3.18	0.57	3.88	
2619	Dates	Dates	577	3.30	0.92	2.82	
2551	Nuts and products	Nuts nes	234	11.20	NA	NA	
2805	Rice (Milled Equivalent)	Rice, paddy	27	12.44	2.87	2.98	
2556	Groundnuts (Shelled Eq)	Groundnuts, with shell	242	34.28	3.61	7.44	
2602	Onions	Onions, dry	403	2.44	0.58	1.99	

For countries without seed data from the FBS, data for nutrient input from seed is derived from the most recent published version of the Eurostat/OECD Nutrient Budgets Methodology and Handbook by estimating the nutrient input as a percentage of nutrient production as well as expert judgment for soybean. Values estimates for N and P are:

Crop	N	P
Wheat	4.6%	4.1%
Barley	4.4%	4.3%
Rye	5.0%	4.6%
Oats	5.5%	5.5%
Grain maize	0.6%	0.9%
Triticale	3.8%	4.9%
Potatoes	9.4%	8.3%
Pulses	7.8%	9.5%
Soya beans	2.0%	2.0%
Oilseeds	0.5%	0.4%

For K, nutrient percentages as seed were calculated as the average of N and P.

Output – Crop harvest removal

Crop harvest removal was calculated from data for Primary Crops under the domain “Crops and livestock products” in FAOSTAT (<https://www.fao.org/faostat/en/#data/QCL>). Average concentrations of nutrients in harvested products were obtained from Ludemann et al. (2022):

Ludemann, C., Hijbeek, R., van Loon, M., Murrell, S.T., Dobermann, A., van Ittersum, M. 2023. Global data on crop nutrient concentration and harvest indices. Dryad, dataset, <https://datadryad.org/dataset/doi:10.5061/dryad.n2z34tn0x>

Table 4 lists the nutrient removal coefficients used.

Table 4: Nitrogen, phosphorous and potassium removal coefficients (kg nutrient removed per tonne crop produced).

Item	Item Code	N	P	K	Item	Item Code	N	P	K
Agave fibres nes	800	5	1	3	Lupins	210	47	5	15
Almonds, with shell	221	44	10	54	Maize	56	12	3	4
Anise, badian, fennel, coriander	711	13	2	15	Maize, green	446	8	1	6
Apples	515	2	1	5	Mangoes, mangosteens, guavas	571	4	1	5
Apricots	526	4	1	2	Manila fibre (abaca)	809	3	1	3
Areca nuts	226	8			Melons, other (inc.cantaloupes)	568	2	0	1
Artichokes	366	4	1	3	Melonseed	299	39	11	32
Asparagus	367	5	1	4	Millet	79	23	4	6
Avocados	572	3	1	2	Mushrooms and truffles	449	9		
Bambara beans	203	26	5	15	Mustard seed	292	41	9	28
Bananas	486	2	0	8	Nutmeg, mace and cardamoms	702	14	1	16
Barley	44	18	3	6	Nuts nes	234	11		
Bastfibres, other	782	4	1	3	Oats	75	22	4	5
Beans, dry	176	42	6	17	Oil palm fruit	254	4	1	5
Beans, green	414	4	1	2	Oilseeds nes	339	18	5	25
Berries nes	558	2			Okra	430	3	1	3
Blueberries	552	1	0	1	Olives	260	7	8	7
Brazil nuts, with shell	216	17	5	15	Onions, dry	403	2	1	2
Broad beans, horse beans, dry	181	30	5	15	Onions, shallots, green	402	2	1	2
Buckwheat	89	17	2	4	Oranges	490	3	0	4
Cabbages and other brassicas	358	4	0	3	Papayas	600	80	18	144
Canary seed	101	19	3	11	Peaches and nectarines	534	3	1	3
Carobs	461	5	2	5	Pears	521	2	0	2
Carrots and turnips	426	2	1	2	Peas, dry	187	39	9	10
Cashew nuts, with shell	217	21	7	20	Peas, green	417	17	3	10
Cashewapple	591	1			Pepper (piper spp.)	687	12	1	16
Cassava	125	2	0	3	Peppermint	748	11	1	12
Castor oil seed	265	14			Persimmons	587	1		
Cauliflowers and broccoli	393	4	1	3	Pigeon peas	197			
Cereals nes	108	14	3	4	Pineapples	574	1	0	1
Cherries	531	2			Pistachios	223	16		
Cherries, sour	530	1			Plantains and others	489	4	0	4
Chestnut	220	3			Plums and sloes	536	2		
Chick peas	191	27	5	15	Poppy seed	296	29	6	19
Chicory roots	459	2			Potatoes	116	3	1	6
Chillies and peppers, dry	689	13	1	12	Pulses nes	211	26	4	13
Chillies and peppers, green	401	2	1	2	Pumpkins, squash and gourds	394	3	0	4
Cinnamon (cannella)	693	12	1	12	Pyrethrum, dried	754	15	1	16
Cloves	698	18	3	17	Quinces	523	0		
Cocoa, beans	661	24	5	40	Quinoa	92	17	2	4
Coconuts	249	15	3	6	Ramie	788	4	1	3
Coffee, green	656	22	3	17	Rapeseed	270	32	7	7
Cow peas, dry	195	31	5	15	Raspberries	547	1		
Cranberries	554	1			Rice, paddy	27	12	3	3
Cucumbers and gherkins	397	1	0	2	Roots and tubers nes	149	4	0	3
Currants	550	2			Rubber, natural	836	7	1	4
Dates	577	3	1	3	Rye	71	22	3	4
Eggplants (aubergines)	399	3	1	3	Safflower seed	280	35	5	23
Fibre crops nes	821	4	1	3	Seed cotton	328	59	12	32
Figs	569	3			Sesame seed	289	26	5	10
Flax fibre and tow	773	19	4	7	Sisal	789	5	1	3
Fonio	94	13	2	4	Sorghum	83	14	4	4
Fruit, citrus nes	512	2	0	2	Soybeans	236	56	6	17
Fruit, fresh nes	619	2	0	2	Spices nes	723	14	1	11
Fruit, pome nes	542	3	1	2	Spinach	373	4	1	4
Fruit, stone nes	541	2	1	2	Strawberries	544	7	2	8
Fruit, tropical fresh nes	603	3	1	2	String beans	423	3	1	2
Garlic	406	6	1	3	Sugar beet	157	2	1	4
Ginger	720	13	1	11	Sugar cane	156	4	0	1
Gooseberries	549	1			Sugar crops nes	161	0		
Grain, mixed	103	15	2	4	Sunflower seed	267	26	4	7
Grapefruit (inc. pomelos)	507	2			Sweet potatoes	122	4	1	7
Grapes	560	3	1	4	Tallowtree seed	305			
Groundnuts, with shell	242	34	4	7	Tangerines, mandarins, clementines	495	2	0	1
Gums, natural	839	148			Taro (cocoyam)	136	4	1	3
Hazelnuts, with shell	225	9	2	7	Tea	667	19	3	15
Hemp tow waste	777	3	1	3	Tobacco, unmanufactured	826	40	6	48
Hempseed	336	25	2	4	Tomatoes	388	1	0	2
Hops	677	21	3	17	Triticale	97	17	3	4
Joboba seed	277	56	12	37	Tung nuts	275	48		
Jute	780	3	1	3	Vanilla	692	11	1	16
Karite nuts (sheanuts)	263	11			Vegetables, fresh nes	463	6	1	3
Kiwi fruit	592	2	0	1	Vegetables, leguminous nes	420	14	1	3
Kola nuts	224	14			Vetches	205	32	4	19
Leeks, other alliaceous vegetables	407	3	1	3	Walnuts, with shell	222	26	5	12
Lemons and limes	497	2	0	1	Watermelons	567	1	0	1
Lentils	201	36	6	20	Wheat	15	21	4	5
Lettuce and chicory	372	2	0	3	Yams	137	4	1	3
Linseed	333	30	7	21	Yautia (cocoyam)	135	4	1	3

Additional Output – Crop residue removal

In the CNB, the default calculation of cropland nutrient balance and nutrient use efficiency only includes nutrient removal with the harvested crop products. However, because in some situations nutrient removal in the form of crop residue may also be significant, we provide this data as an additional variable that can be used for specific assessments. It only includes the direct removal of residue from the field, not losses that may occur due to residue burning.

Crop residue removal was calculated using the average values of dry matter content, harvest index, N, P and K concentrations shown in Table 5, based on data compiled by Aramburu-Merlos et al. (2025):

Aramburu-Merlos, F., Tenorio, F., Lim, Y.L., Carciochi, W., Dobermann, A., Grassini, P. (2025). Global dataset on nutrient removal with crop residues. Dryad data set, <https://datadryad.org/submission/410135>

$$\text{Total residue} \left(\frac{\text{kg DM}}{\text{ha}} \right) = \text{yield} \left(\frac{\text{kg}}{\text{ha}} \right) \times \frac{\text{DM HO}(\%)}{100} \times \left(\frac{1}{\text{HI}} - 1 \right)$$

Where DM is dry matter, HO is harvestable organ (hence, DM HO is dry matter content in harvestable organ), and HI is the harvest index. Crop yield is extracted from FAOSTAT.

$$\text{Residue removal} \left(\frac{\text{kg DM}}{\text{ha}} \right) = \text{Total residue} \left(\frac{\text{kg DM}}{\text{ha}} \right) \times \frac{\text{Crop residue removal} (\%)}{100}$$

$$\begin{aligned} \text{Nutrient removed with crop residue} \left(\frac{\text{kg}}{\text{ha}} \right) \\ = \text{Residue removal} \left(\frac{\text{kg DM}}{\text{ha}} \right) \times \frac{\text{Nutrient in crop residue} (\%)}{100} \end{aligned}$$

Table 5: Coefficients used for crop residue direct removal

Item	Item Code	Element	Unit	Value
Bananas	486	Dry matter content in harvestable organ	percentage	26
Bananas	486	Harvest Index	fraction	0.26
Bananas	486	N content in oven-dried crop residue	percentage	0.44
Bananas	486	P content in oven-dried crop residue	percentage	0.07
Bananas	486	K content in oven-dried crop residue	percentage	1.84
Barley	44	Dry matter content in harvestable organ	percentage	89
Barley	44	Harvest Index	fraction	0.43
Barley	44	N content in oven-dried crop residue	percentage	0.72
Barley	44	P content in oven-dried crop residue	percentage	0.15
Barley	44	K content in oven-dried crop residue	percentage	1.55
Beans, dry	176	Dry matter content in harvestable organ	percentage	91
Beans, dry	176	Harvest Index	fraction	0.51
Beans, dry	176	N content in oven-dried crop residue	percentage	1.57
Beans, dry	176	P content in oven-dried crop residue	percentage	0.11
Beans, dry	176	K content in oven-dried crop residue	percentage	2.06
Broad beans and horse beans, dry	181	Dry matter content in harvestable organ	percentage	87
Broad beans and horse beans, dry	181	Harvest Index	fraction	0.47
Broad beans and horse beans, dry	181	N content in oven-dried crop residue	percentage	1.23
Broad beans and horse beans, dry	181	P content in oven-dried crop residue	percentage	0.13
Broad beans and horse beans, dry	181	K content in oven-dried crop residue	percentage	3.89
Buckwheat	89	Dry matter content in harvestable organ	percentage	87
Buckwheat	89	Harvest Index	fraction	0.51
Buckwheat	89	N content in oven-dried crop residue	percentage	0.54
Buckwheat	89	P content in oven-dried crop residue	percentage	0.41
Buckwheat	89	K content in oven-dried crop residue	percentage	2.58
Cabbages	358	Dry matter content in harvestable organ	percentage	8
Cabbages	358	Harvest Index	fraction	0.56
Cabbages	358	N content in oven-dried crop residue	percentage	1.30
Cabbages	358	P content in oven-dried crop residue	percentage	0.26
Cabbages	358	K content in oven-dried crop residue	percentage	3.53
Cassava, fresh	125	Dry matter content in harvestable organ	percentage	33
Cassava, fresh	125	Harvest Index	fraction	0.45
Cassava, fresh	125	N content in oven-dried crop residue	percentage	0.54
Cassava, fresh	125	P content in oven-dried crop residue	percentage	0.11
Cassava, fresh	125	K content in oven-dried crop residue	percentage	0.16
Cereals n.e.c.	108	Dry matter content in harvestable organ	percentage	87
Cereals n.e.c.	108	Harvest Index	fraction	0.43
Cereals n.e.c.	108	N content in oven-dried crop residue	percentage	0.69
Cereals n.e.c.	108	P content in oven-dried crop residue	percentage	0.09
Chick peas, dry	191	Dry matter content in harvestable organ	percentage	86
Chick peas, dry	191	Harvest Index	fraction	0.36
Chick peas, dry	191	N content in oven-dried crop residue	percentage	0.76
Chick peas, dry	191	P content in oven-dried crop residue	percentage	0.32
Chick peas, dry	191	K content in oven-dried crop residue	percentage	0.74
Cow peas, dry	195	Dry matter content in harvestable organ	percentage	59
Cow peas, dry	195	Harvest Index	fraction	0.24
Cow peas, dry	195	N content in oven-dried crop residue	percentage	2.09
Cow peas, dry	195	P content in oven-dried crop residue	percentage	0.01
Cow peas, dry	195	K content in oven-dried crop residue	percentage	1.25
Groundnuts, excluding shelled	242	Dry matter content in harvestable organ	percentage	94
Groundnuts, excluding shelled	242	Harvest Index	fraction	0.50
Groundnuts, excluding shelled	242	N content in oven-dried crop residue	percentage	1.67
Groundnuts, excluding shelled	242	P content in oven-dried crop residue	percentage	0.22
Groundnuts, excluding shelled	242	K content in oven-dried crop residue	percentage	1.39
Lettuce and chicory	372	Dry matter content in harvestable organ	percentage	12
Lettuce and chicory	372	Harvest Index	fraction	0.90

Table 5 (continued): Coefficients used for crop residue direct removal

Item	Item Code	Element	Unit	Value
Linseed	333	Dry matter content in harvestable organ	percentage	87
Linseed	333	Harvest Index	fraction	0.32
Linseed	333	N content in oven-dried crop residue	percentage	0.51
Linseed	333	P content in oven-dried crop residue	percentage	0.20
Linseed	333	K content in oven-dried crop residue	percentage	2.90
Lupins	210	Dry matter content in harvestable organ	percentage	88
Lupins	210	Harvest Index	fraction	0.32
Lupins	210	N content in oven-dried crop residue	percentage	1.01
Lupins	210	P content in oven-dried crop residue	percentage	0.23
Lupins	210	K content in oven-dried crop residue	percentage	0.74
Maize (corn)	56	Dry matter content in harvestable organ	percentage	88
Maize (corn)	56	Harvest Index	fraction	0.46
Maize (corn)	56	N content in oven-dried crop residue	percentage	0.88
Maize (corn)	56	P content in oven-dried crop residue	percentage	0.18
Maize (corn)	56	K content in oven-dried crop residue	percentage	1.56
Millet	79	Dry matter content in harvestable organ	percentage	88
Millet	79	Harvest Index	fraction	0.38
Millet	79	N content in oven-dried crop residue	percentage	0.84
Millet	79	P content in oven-dried crop residue	percentage	0.33
Millet	79	K content in oven-dried crop residue	percentage	2.08
Oats	75	Dry matter content in harvestable organ	percentage	89
Oats	75	Harvest Index	fraction	0.43
Oats	75	N content in oven-dried crop residue	percentage	0.70
Oats	75	P content in oven-dried crop residue	percentage	0.38
Oats	75	K content in oven-dried crop residue	percentage	4.23
Okra	430	Dry matter content in harvestable organ	percentage	12
Okra	430	Harvest Index	fraction	0.64
Okra	430	N content in oven-dried crop residue	percentage	0.90
Okra	430	P content in oven-dried crop residue	percentage	0.09
Okra	430	K content in oven-dried crop residue	percentage	1.40
Onions and shallots, dry (excluding dehydrated)	403	Dry matter content in harvestable organ	percentage	13
Onions and shallots, dry (excluding dehydrated)	403	Harvest Index	fraction	0.82
Other fruits, n.e.c.	619	Dry matter content in harvestable organ	percentage	8
Other fruits, n.e.c.	619	Harvest Index	fraction	0.80
Other fruits, n.e.c.	619	N content in oven-dried crop residue	percentage	1.20
Other fruits, n.e.c.	619	P content in oven-dried crop residue	percentage	0.20
Other fruits, n.e.c.	619	K content in oven-dried crop residue	percentage	2.20
Other pulses n.e.c.	211	Dry matter content in harvestable organ	percentage	90
Other pulses n.e.c.	211	Harvest Index	fraction	0.33
Other pulses n.e.c.	211	N content in oven-dried crop residue	percentage	1.18
Other pulses n.e.c.	211	P content in oven-dried crop residue	percentage	0.11
Other pulses n.e.c.	211	K content in oven-dried crop residue	percentage	1.40
Peas, dry	187	Dry matter content in harvestable organ	percentage	87
Peas, dry	187	Harvest Index	fraction	0.41
Peas, dry	187	N content in oven-dried crop residue	percentage	0.99
Peas, dry	187	P content in oven-dried crop residue	percentage	0.10
Peas, dry	187	K content in oven-dried crop residue	percentage	1.37
Peas, green	417	Dry matter content in harvestable organ	percentage	44
Peas, green	417	Harvest Index	fraction	0.24
Potatoes	116	Dry matter content in harvestable organ	percentage	22
Potatoes	116	Harvest Index	fraction	0.78
Potatoes	116	N content in oven-dried crop residue	percentage	2.03
Potatoes	116	P content in oven-dried crop residue	percentage	0.33
Potatoes	116	K content in oven-dried crop residue	percentage	3.29
Quinoa	92	Dry matter content in harvestable organ	percentage	87
Quinoa	92	Harvest Index	fraction	0.37
Quinoa	92	N content in oven-dried crop residue	percentage	0.67
Quinoa	92	P content in oven-dried crop residue	percentage	0.27
Quinoa	92	K content in oven-dried crop residue	percentage	3.78

Table 5 (continued): Coefficients used for crop residue direct removal

Item	Item Code	Element	Unit	Value
Rape or colza seed	270	Dry matter content in harvestable organ	percentage	91
Rape or colza seed	270	Harvest Index	fraction	0.37
Rape or colza seed	270	N content in oven-dried crop residue	percentage	1.15
Rape or colza seed	270	P content in oven-dried crop residue	percentage	0.18
Rape or colza seed	270	K content in oven-dried crop residue	percentage	1.79
Rice	27	Dry matter content in harvestable organ	percentage	89
Rice	27	Harvest Index	fraction	0.39
Rice	27	N content in oven-dried crop residue	percentage	0.73
Rice	27	P content in oven-dried crop residue	percentage	0.14
Rice	27	K content in oven-dried crop residue	percentage	2.12
Rye	71	Dry matter content in harvestable organ	percentage	88
Rye	71	Harvest Index	fraction	0.38
Rye	71	N content in oven-dried crop residue	percentage	0.50
Rye	71	P content in oven-dried crop residue	percentage	0.20
Rye	71	K content in oven-dried crop residue	percentage	2.64
Seed cotton, unginning	328	Dry matter content in harvestable organ	percentage	90
Seed cotton, unginning	328	Harvest Index	fraction	0.24
Seed cotton, unginning	328	N content in oven-dried crop residue	percentage	0.74
Seed cotton, unginning	328	P content in oven-dried crop residue	percentage	0.19
Seed cotton, unginning	328	K content in oven-dried crop residue	percentage	1.70
Sesame seed	289	Dry matter content in harvestable organ	percentage	94
Sesame seed	289	Harvest Index	fraction	0.42
Sesame seed	289	N content in oven-dried crop residue	percentage	1.77
Sesame seed	289	P content in oven-dried crop residue	percentage	0.21
Sesame seed	289	K content in oven-dried crop residue	percentage	1.05
Sorghum	83	Dry matter content in harvestable organ	percentage	87
Sorghum	83	Harvest Index	fraction	0.36
Sorghum	83	N content in oven-dried crop residue	percentage	0.55
Sorghum	83	P content in oven-dried crop residue	percentage	0.10
Sorghum	83	K content in oven-dried crop residue	percentage	1.80
Soya beans	236	Dry matter content in harvestable organ	percentage	88
Soya beans	236	Harvest Index	fraction	0.34
Soya beans	236	N content in oven-dried crop residue	percentage	1.30
Soya beans	236	P content in oven-dried crop residue	percentage	0.14
Soya beans	236	K content in oven-dried crop residue	percentage	1.34
Strawberries	544	Dry matter content in harvestable organ	percentage	8
Strawberries	544	Harvest Index	fraction	0.45
Sugar beet	157	Dry matter content in harvestable organ	percentage	26
Sugar beet	157	Harvest Index	fraction	0.80
Sugar beet	157	N content in oven-dried crop residue	percentage	2.79
Sugar beet	157	P content in oven-dried crop residue	percentage	0.38
Sugar beet	157	K content in oven-dried crop residue	percentage	6.00
Sugar cane	156	Dry matter content in harvestable organ	percentage	23
Sugar cane	156	Harvest Index	fraction	0.83
Sugar cane	156	N content in oven-dried crop residue	percentage	0.79
Sugar cane	156	P content in oven-dried crop residue	percentage	0.08
Sugar cane	156	K content in oven-dried crop residue	percentage	1.30
Sunflower seed	267	Dry matter content in harvestable organ	percentage	92
Sunflower seed	267	Harvest Index	fraction	0.42
Sunflower seed	267	N content in oven-dried crop residue	percentage	2.20
Sunflower seed	267	P content in oven-dried crop residue	percentage	0.22
Sunflower seed	267	K content in oven-dried crop residue	percentage	2.72
Sweet potatoes	122	Dry matter content in harvestable organ	percentage	27
Sweet potatoes	122	Harvest Index	fraction	0.79
Sweet potatoes	122	N content in oven-dried crop residue	percentage	1.53
Sweet potatoes	122	P content in oven-dried crop residue	percentage	0.13

Table 5 (continued): Coefficients used for crop residue direct removal

Item	Item Code	Element	Unit	Value
Tomatoes	388	Dry matter content in harvestable organ	percentage	6
Tomatoes	388	Harvest Index	fraction	0.72
Triticale	97	Dry matter content in harvestable organ	percentage	89
Triticale	97	Harvest Index	fraction	0.38
Triticale	97	N content in oven-dried crop residue	percentage	0.58
Triticale	97	P content in oven-dried crop residue	percentage	0.16
Triticale	97	K content in oven-dried crop residue	percentage	1.85
Unmanufactured tobacco	826	Dry matter content in harvestable organ	percentage	21
Unmanufactured tobacco	826	Harvest Index	fraction	0.45
Watermelons	567	Dry matter content in harvestable organ	percentage	7
Watermelons	567	Harvest Index	fraction	0.72
Watermelons	567	N content in oven-dried crop residue	percentage	2.50
Watermelons	567	P content in oven-dried crop residue	percentage	0.24
Watermelons	567	K content in oven-dried crop residue	percentage	2.30
Wheat	15	Dry matter content in harvestable organ	percentage	89
Wheat	15	Harvest Index	fraction	0.38
Wheat	15	N content in oven-dried crop residue	percentage	0.65
Wheat	15	P content in oven-dried crop residue	percentage	0.11
Wheat	15	K content in oven-dried crop residue	percentage	1.87
Yams	137	Dry matter content in harvestable organ	percentage	34
Yams	137	Harvest Index	fraction	0.66
Yams	137	N content in oven-dried crop residue	percentage	3.92
Yams	137	P content in oven-dried crop residue	percentage	0.27
Yams	137	K content in oven-dried crop residue	percentage	2.48

Data Computed

Collection Method

Data Quality Data quality for the questionnaire-based domains (Crop Production and Fertilizers) is driven from their FAOSTAT processes. Data for the other inputs are calculated. The domain has coverage for 197 countries and territories.

Useful links <https://www.fao.org/faostat/en/#data/QCL>
<https://www.ifastat.org/databases/plant-nutrition>
<https://www.fao.org/faostat/en/#data/GU>

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<http://www.fao.org/faostat/en/#data/ESB>

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