

Dataset Information:

Title	Emissions intensities
Abstract	The FAOSTAT domain Emissions intensities contains analytical data on the intensity of greenhouse gas (GHG) emissions by agricultural commodity, defined as greenhouse gas emissions per kg of product. Data are available for a set of agricultural commodities (e.g. rice and other cereals, meat, milk, eggs), by country, with global coverage and relative to the period 1961–2021.
Supplemental	<p>Data in the domain Emissions intensities are computed from FAO statistics, disseminated in the Production and Climate Change, Agrifood systems emissions sections of FAOSTAT. The following data categories for each agricultural commodity are available for download: production quantities (in tonnes); emissions (in kilotonnes of CO₂eq); and emissions intensity (in kg of CO₂eq per kg of product). Data are updated yearly and are available for all individual countries and territories, for standard FAOSTAT regional aggregations, as well as for UNFCCC Annex I and non-Annex I groups.</p> <p>FAOSTAT agri-environmental indicators aim at facilitating national and regional agri-environmental trend analysis and to support member countries with country-level reference information.</p>
International Standards	The indicator is consistent with the System of Environmental and Economic Accounts for Agriculture, Forestry and Fisheries (SEEA AFF).
Creation Date	2016
Last Update	2023
Data Type	Agrifood systems emissions
Category	Agrifood systems; Farm gate; Environment
Time Period	1961–2021
Periodicity	Annual
Geographical Coverage	World
Spatial Unit	In 2021, 187 countries and 7 territories
Language	Multilingual (EN, FR, ES)

Methodology and Quality Information:

Methods and processing	<p>Overview</p> <p>FAOSTAT Emissions intensities indicators are computed as the ratio between FAOSTAT GHG emissions data associated to a given commodity, and the underlying national production data.</p> <p>The data provide first-order analyses of the GHG performance of a range of commodities, by country and over time. Derived by using a transparent methodology, the estimates are easily reproducible from underlying FAOSTAT national data. The GHG emissions used in the computation of the FAOSTAT Emissions Intensities indicator correspond to those generated within the farm gate. Additional emissions from upstream and downstream production and consumption processes and trade are excluded due to the lack of granular information needed for this analysis. This represents a simplification with respect to more complex estimations methods, typically based on life-cycle analyses (LCA), to which these FAOSTAT indicator data should not be compared.</p> <p>Structure</p>
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The Emissions Intensities domain contains the following analytical data for the years in the time series, by country:

- a) Emissions intensity for meat, milk, egg, cereals and rice (in kg of CO₂eq per kg of product);
- b) GHG emissions associated to the production of each commodity, generated within the farm gate (in kilotonnes of CO₂eq); and
- c) Production quantities of each commodity (in tonnes).

The emission intensities are estimated by commodity, country, and year with the generic formula:

$$(1) \quad EI_{C, A, Y} = \Sigma GHG_{C, A, Y} / P_{C, A, Y}$$

Where, for each country *A* and year *Y*:

$EI_{C, A, Y}$ = Emission intensities, in kg of CO₂eq per kg of commodity *C*;

$\Sigma GHG_{C, A, Y}$ = Total greenhouse gas emissions associated to the production of commodity *C*, generated within the farm gate

$P_{C, A, Y}$ = Quantity of Production (in kg) of commodity *C*.

GHG emissions data for the nominator in equation (1) are derived from the FAOSTAT Emissions database. Production data for the denominator in equation (1) are derived from the FAOSTAT domain "Production/Crops and Livestock". External parameters are also used in the analysis, as specified below.

For use in equation (1), FAOSTAT GHG emissions data are converted from kilotonnes to kg of CO₂eq (multiplying by 10⁶). Likewise, the production quantities from FAOSTAT "Production/Crops and Livestock" are converted from tonnes to kg of commodity (multiplying by 10³).

Because the methodology follows the underlying FAOSTAT data, it does not cover cases when animals are involved in the production of both milk and meat. It should also be noted that, a consistent comparison of different livestock products (e.g. meat, milk, eggs) would require further conversion of the data provided to a common dietary unit, such as protein or energy content.

The single gas emissions are converted to kilotonnes of CO₂eq by using the IPCC Fifth Assessment report global warming potentials, AR5 (IPCC, 2014);

Estimation of the emissions intensities

The calculation of the emissions intensities is made by commodity as follows:

1) Cereals

The analysis includes the following cereal crops : Barley, Maize, Millet, Oats, Rice, Rye, Sorghum and Wheat. Emissions intensities are computed and disseminated for Rice and for the aggregate "Cereals excluding rice".

The emissions associated to crop cultivation considered herein for each one of these cereals (numerator of equation 1 above) are those of nitrous oxide gas (N₂O) from: Crop Residues; Burning of Crop Residues; Synthetic Fertilizers; and for rice only, of methane gas (CH₄) from paddy rice fields. These emissions are disseminated in the FAOSTAT domain [Emissions from crops](#). Specifically:

$$(2) \quad \Sigma GHG_{C, A, Y} = GHG_{Crop\ Residues, C, A, Y} + GHG_{Burning, C, A, Y} + GHG_{Fert} \\ C, A, Y + + \beta * GHG_{Paddy, C, A, Y}$$

Where: $\beta = 1$ when $C = \text{Rice}$ and $\beta = 0$ otherwise, and

$GHG_{Fert\ C,A,Y}$ represents the emissions from fertilizers applied to commodity crop C in country area A and year Y , expressed as a share, $\alpha_{C,A}$, of the GHG emissions from total fertilizers applied to all crops:

$$(3) \quad GHG_{Fert\ C,A,Y} = \alpha_{C,A} * GHG_{Fertilizer,A,Y}$$

The coefficient $\alpha_{C,A}$ was obtained from existing FAO information (2002) on N fertilizers use by crop, relative to a 1995–2000 average. For the 88 countries for which information was available on both the total amount of N applied in the country, F_A , and on the amount of N applied by crop $F_{C,A}$, then $\alpha_{C,A} = F_{C,A}/F_A$. For countries not covered by FAO (2002), $\alpha_{C,A}$ was imputed by assigning an average sub-regional value. Where no data was available to compute sub-regional averages, the corresponding regional average was applied.

2) Meat, milk, and eggs

Animal products in the scope of this domain are reported in Table 1.

Table 1. Agricultural products of animal origin in the EI domain

Meat	Milk	Eggs
Meat, cattle	Milk, whole fresh cow	Eggs, hen, in shell
Meat, goat	Milk, whole fresh goat	
Meat, buffalo	Milk, whole fresh buffalo	
Meat, sheep	Milk, whole fresh sheep	
Meat, pig	Milk, whole fresh camel	
Meat, chicken		

The GHG emissions for these commodities – numerator in equation (1) above – include those of nitrous oxide gas (N₂O) and methane gas (CH₄) from manure management systems (MM); nitrous oxide gas (N₂O) from the application of manure to soils (MAS) and manure left on pastures (MLP); and of methane gas (CH₄) from enteric fermentation, for applicable animal categories. These emissions are available from the FAOSTAT domain [Emissions from Livestock](#).

Specifically:

$$(4) \quad \Sigma GHG_{C,A,Y} = GHG_{MM\ C,A,Y} + GHG_{MAS\ C,A,Y} + GHG_{MLP\ C,A,Y} + GHG_{Enteric\ C,A,Y}$$

The GHG emissions associated to a given commodity in equation (4) are those associated to each animal category and stock actually involved in the production of that commodity. More in detail, emissions for the animal category “Cattle, non dairy” were associated to the commodity “Meat, cattle”; emissions for the animal category “Cattle, dairy” were associated to the commodity “Milk, whole fresh cow”; and emissions for the animal category “Swine, total” were associated to commodity “Meat, pig”. Likewise, emissions for the animal category “Chickens, layers” were associated to commodity “Eggs, hen, in shell” and emissions for the animal category “Chickens, broilers” were associated to commodity “Meat, chicken”.

Production data for each country A and year Y – denominator in equation (1) above – are found under the “Production/Crops and Livestock” domain of FAOSTAT. To note that milk production is expressed in FAOSTAT as quantities of raw milk, not standardized for fat and proteins content. It is acknowledged that a conversion of milk raw amounts into fat and protein corrected milk (FPCM) would be needed to allow comparisons of the emission intensities for milk produced by the same species in farms with different breeds and regimes (IDF, 2010).

Additional computational steps were made to associate GHG emissions for the animal categories for which the FAOSTAT Emissions database does not distinguish milk and meat production. Thus, for sheep, goats, camels and buffalos, information from the FAOSTAT domain on animal stocks and production was also used to scale the GHG emissions for the total animals in equation (4). The resulting scaling factor, $\delta_{c,A,Y}$, represents the share of the total livestock numbers involved in the production of each commodity C.

In particular, for milk commodities “Milk, whole fresh sheep”; “Milk, whole fresh goat”; “Milk, whole fresh buffalo”; and “Milk, whole fresh camel”, the fraction of animals directly involved in the production of milk ($\delta^{\text{milk}}_{c,A,Y}$) was calculated as follows:

$$(5) \delta^{\text{milk}}_{c,A,Y} = \text{PAS}_{c,A,Y} / \text{TS}_{c,A,Y}$$

Where for each country area A and year Y:

$\text{PAS}_{c,A,Y}$ = Heads of animals producing milk commodity C, using FAOSTAT information from element “Producing animals/Slaughtered-Milk animals”;

$\text{TS}_{c,A,Y}$ = Total heads of animals species associated to milk commodity C, from the FAOSTAT “Live animals” in the Production\Crops and Livestock domain.

Finally, the total emissions corresponding to meat commodities “Meat, sheep”; “Meat, goat”; and “Meat, buffalo”, were calculated from $\delta^{\text{meat}}_{c,A,Y} = 1 - \delta^{\text{milk}}_{c,A,Y}$.

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Data Computed

Collection Method

Completeness 100%

Useful Links <http://www.fao.org/faostat/en/#data/GCE>
<http://www.fao.org/faostat/en/#data/GLE>
<http://www.fao.org/faostat/en/#data/QCL>

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