Dataset Information:

Title	**Emissions intensities**
Abstract	The **Emissions intensities** domain of the *FAOSTAT Agri-Environmental Indicators* section contains analytical data on the intensity of greenhouse gas (GHG) emissions by commodity. This agri-environmental indicator is defined as greenhouse gas emissions per unit of product. Data are available for a set of agricultural commodities (e.g., cereals, rice, meat, milk, eggs), and expressed in kg of CO_2eq per kg of agricultural commodity.
Supplemental	The **Emissions intensities** agri-environmental indicators are computed from FAO statistics, available in the *Emissions* and *Production* sections of FAOSTAT. The indicator is furthermore consistent with the System of Environmental and Economic Accounts for Agriculture, Forestry and Fisheries. Indicator data are available by country and by year, for the period 1961–2016, with global coverage and annual updates. FAOSTAT agri-environmental indicators aim at facilitating national and regional agri-environmental trends analysis, and are open to user feedback towards continuous product improvement.
Creation Date	2016
Last Update	2018
Data Type	Agri-Environmental Indicators
Category	Agriculture; Environment
Time Period	1961–2016
Periodicity	Annual
Geographical Coverage	World
Spatial Unit	Country
Language	Multilingual (EN, FR, ES)

Methodology and Quality Information:

Methods and processing	*Overview* The FAOSTAT **Emissions intensities** indicators are computed by country as the ratio between FAOSTAT GHG emissions data associated to a given commodity, and the underlying national production data. The data provide first-order analyses of the GHG performance of a range of commodities, based on their efficiency of production, by country and over time. Derived by using a transparent methodology, the estimates are easily reproducible from the underlying FAOSTAT national data. At the same time, the GHG emissions used in the computation of the FAOSTAT Emissions Intensities indicator are limited to emissions *generated within the farm gate*. Additional emissions from upstream and downstream production and consumption processes and trade are excluded. This represents a simplification with respect to more complex estimations methods, typically based on life-cycle analyses, to which these FAOSTAT indicator data should not be compared. *Structure*

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 CO_2eq per kg of product);

b) GHG emissions associated to the production of each commodity, generated within the farm gate (in Gg CO2eq); and

c) Production quantities of each commodity (in tons).

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.

Emission Intensities are estimated at country level and for each year with the generic formula:

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

Where, for each country A and year Y:

$EI_{C,\ A,\ Y}$ = Emission intensities, in kg of CO_2eq 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.

For the nominator in equation (1), data of GHG emissions are derived from the FAOSTAT domain "Emissions-Agriculture," as highlighted in sections below. For the denominator in equation (1), data on production are derived from the FAOSTAT domain "Production/Crops"; "Production/Livestock primary". In addition, data from the FAOSTAT domain Production/Live animals" and other external parameters are also used in the analysis, as specified below.

For use in equation (1), FAOSTAT GHG emissions data are converted from Gg to kg of CO_2eq (multiplication by 10^6). Likewise, FAOSTAT "Production/Crops" and "Production/Livestock primary" data on production quantities of commodities are converted from tons to kg of commodity (multiplication by 10^3).

Note that because the methodology follows the underlying FAOSTAT data, it does not cover intermediate cases when animals are involved in the production of both milk and meat. Finally, please note that 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.

Estimation of emissions intensities

1) Cereals

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

In order to compute the numerator in equation (1), the emissions associated to crop cultivation considered herein for each one of these cereals are those of nitrous oxide gas (N_2O) from: Crop Residues; Burning of Crop Residues; Synthetic Fertilizers; and for rice only, of methane gas (CH_4) from paddy rice fields. Specifically:

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

Where: β =1 when *C* = Rice and β =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 $\alpha_{C,A} = F_C/F_A$. 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

The commodities of animal origin included in this domain are indicated below.

Meat	Milk	s
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		

For the denominator in equation (1), production values for each country A and year Y are found under the "Production/Livestock primary" domain of FAOSTAT. 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).

For the numerator in equation (1), emissions include those of nitrous oxide gas (N_2O) and methane gas (CH_4) from manure management systems (MM); nitrous oxide gas (N_2O) from the application of manure to soils (MAS) and manure left on pastures (MLP); and of methane gas (CH_4) from enteric fermentation, for applicable animal categories.

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".

The association of GHG emissions to commodity required an additional computational step for those animal categories for which the FAOSTAT Emissions-Agriculture domain does not distinguish milk and meat production, namely sheep, goats, camel and buffalo. To this end, information from the FAOSTAT domains "Production/Live Animals" and "Production/Livestock primary" was used to scale the GHG emissions for the total animals in equation (4). The resulting scaling factor, $\boldsymbol{\delta}_{C,A,Y}$, 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 producing animals was calculated as follows:

$$(5)\ \boldsymbol{\delta}^{\mathbf{milk}}{}_{C,A,Y} = \boldsymbol{PAS}_{C,A,Y} \,/\, \boldsymbol{TS}_{C,A,Y}$$

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

$\boldsymbol{PAS}_{C,A,Y}$ = Heads of animals producing milk commodity *C*, from the FAOSTAT domain "Production/Livestock primary", element "Producing animals/Slaughtered-Milk animals";
$\boldsymbol{TS}_{C,A,Y}$ = Total heads of animals species associated to milk commodity *C*, from the FAOSTAT domain "Production/Live animals".

Finally, in order to avoid double counting in the total emissions corresponding to a given producing animal species, for meat commodities "Meat, sheep"; "Meat, goat"; and "Meat, buffalo", $\boldsymbol{\delta}^{\mathbf{meat}}{}_{C,A,Y} = 1 - \boldsymbol{\delta}^{\mathbf{milk}}{}_{C,A,Y}$.

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Data Collection Method	Computed
Completeness	100%
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