

## Dataset Information:

Title	Emissions intensities
<b>Abstract</b>	The <b>Emissions intensities</b> domain under the FAOSTAT <i>section of</i> Agri-Environmental Indicators contains analytical data on the intensity of greenhouse gas (GHG) emissions by commodity. This indicator is defined as greenhouse gas emissions per unit 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 1961–2017.
<b>Supplemental</b>	<p>Data in the domain Emissions intensities are computed from FAO statistics, disseminated in the Emissions and Production sections of FAOSTAT. The following data categories for each agricultural commodity are available for download: production quantities (in tonnes); emissions (in gigagrams of CO<sub>2</sub>eq); and emissions intensity (in kg of CO<sub>2</sub>eq 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>
<b>International Standards</b>	The indicator is consistent with the System of Environmental and Economic Accounts for Agriculture, Forestry and Fisheries (SEEA AFF).
<b>Creation Date</b>	2016
<b>Last Update</b>	2019
<b>Data Type</b>	Agri-Environmental Indicators
<b>Category</b>	Agriculture; Environment
<b>Time Period</b>	1961–2017
<b>Periodicity</b>	Annual
<b>Geographical Coverage</b>	World
<b>Spatial Unit</b>	Country
<b>Language</b>	Multilingual (EN, FR, ES)

## Methodology and Quality Information:

<b>Methods and processing</b>	<p><b>Overview</b></p> <p>FAOSTAT <b>Emissions intensities</b> 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, based on their efficiency of production, 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 are limited to the emissions <i>generated within the farm gate</i>. 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.</p> <p><b>Structure</b></p> <p>The Emissions Intensities domain contains the following analytical data for the years in the time series, by country:</p> <p>a) Emissions intensity for meat, milk, egg, cereals and rice (in kg of CO<sub>2</sub>eq per kg of product);</p>
-------------------------------	--

b) GHG emissions associated to the production of each commodity, generated within the farm gate (in Gg CO<sub>2</sub>eq); 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 CO<sub>2</sub>eq 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 domain “Emissions–Agriculture”. Production data for the denominator in equation (1) 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 used in the analysis, as specified below.

For use in equation (1), FAOSTAT GHG emissions data are converted from gigagrams to kg of CO<sub>2</sub>eq (multiplying by 10<sup>6</sup>). Likewise, the production quantities from FAOSTAT “Production/Crops” and “Production/Livestock primary” are converted from tonnes to kg of commodity (multiplying by 10<sup>3</sup>).

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.

### ***Estimation of the emissions intensities***

The calculation of the emissions intensities differ 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 (N<sub>2</sub>O) from: Crop Residues; Burning of Crop Residues; Synthetic Fertilizers; and for rice only, of methane gas (CH<sub>4</sub>) from paddy rice fields. 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* = 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

The commodities of animal origin 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 (N<sub>2</sub>O) and methane gas (CH<sub>4</sub>) from manure management systems (MM); nitrous oxide gas (N<sub>2</sub>O) from the application of manure to soils (MAS) and manure left on pastures (MLP); and of methane gas (CH<sub>4</sub>) from enteric fermentation, for applicable animal categories.

Specifically:

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

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/Livestock primary” 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–Agriculture domain does not distinguish milk and meat production. Thus, for sheep, goats, camels and buffalos, information from the FAOSTAT domains “Production/Live Animals” and “Production/Livestock primary” 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:

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

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

$PAS_{c,A,Y}$  = Heads of animals producing milk commodity  $C$ , from the FAOSTAT domain “Production/Livestock primary”, element “Producing animals/Slaughtered-Milk animals”;

$TS_{c,A,Y}$  = Total heads of animals species associated to milk commodity  $C$ , from the FAOSTAT domain “Production/Live animals”.

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

### References

**Tubiello F, Salvatore M, Rossi S and Ferrara A. 2012.** Analysis of global emissions, carbon intensity and efficiency of food production. EAI research papers 2012, 4–5. Available from: [https://www.enea.it/it/seguici/pubblicazioni/pdf-eai/luglio-ottobre-2012/prima-parte/studi-research-analysis-emissions-food-production-/at\\_download/file](https://www.enea.it/it/seguici/pubblicazioni/pdf-eai/luglio-ottobre-2012/prima-parte/studi-research-analysis-emissions-food-production-/at_download/file)

**IPCC 2014.** IPCC AR5 WGIII AFOLU, Smith P., M. Bustamante, H. Ahammad, H. Clark, H. Dong, E.A. Elsiddig, H. Haberl, R. Harper, J. House, M. Jafari, O. Masera, C. Mbow, N.H. Ravindranath, C.W. Rice, C. Robledo Abad, A. Romanovskaya, F. Sperling, and F. N. Tubiello, 2014: Agriculture, Forestry and Other Land Use (AFOLU). In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

**FAO 2002.** Fertilizer use by crop. By International Fertilizer Industry Association; International Fertilizer Development Center, Muscle Shoals, AL (USA); FAO, Rome, Statistics Division. 5th edition. Rome (Italy).

**IDF 2010.** A common carbon footprint approach for dairy. The IDF guide to standard lifecycle assessment methodology for the dairy sector. Bulletin of the International Dairy Federation. 445/2010. Available from: [http://www.fil-idf.org/wp-content/uploads/2016/09/Bulletin479-2015\\_A-common-carbon-footprint-approach-for-the-dairy-sector.CAT.pdf](http://www.fil-idf.org/wp-content/uploads/2016/09/Bulletin479-2015_A-common-carbon-footprint-approach-for-the-dairy-sector.CAT.pdf)

**Data Collection Method** Computed

**Completeness** 100%

**Useful Links** <http://www.fao.org/faostat/en/#data/GT>  
<http://www.fao.org/faostat/en/#data/QC>  
<http://www.fao.org/faostat/en/#data/QA>  
<http://www.fao.org/faostat/en/#data/QL>

FAOSTAT domain [Emissions intensities](#). Methodological note, release 2019

<b>Owner</b>	FAO
<b>Provider</b>	FAO
<b>Source</b>	FAO
<b>Citation</b>	FAO, 2019. FAOSTAT Climate Change, Emissions intensities <a href="http://www.fao.org/faostat/en/#data/EI">http://www.fao.org/faostat/en/#data/EI</a>
<b>Acknowledgements</b>	The FAOSTAT Agri-Environmental Indicators in the “Emissions Intensities” domain are developed and maintained by the Statistics Division with FAO Regular Programme funding under O6 and SO2. The “Agriculture Emissions” database, also used in this domain, was produced with initial support kindly provided by Norway and Germany under Trust Funds GCP/GLO/286/GER and GCP/GLO/325/NOR.

[Statistical Database Terms of Use](#)



*This work is made available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO license (CC BY-NC-SA 3.0 IGO; <https://creativecommons.org/licenses/by-nc-sa/3.0/igo>). In addition to this license, some database specific terms of use are listed: [Terms of Use of Datasets](#).*