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## Dataset Information:

Title	Manure management
<b>Abstract</b>	Greenhouse gas (GHG) emissions from manure management consist of methane and nitrous oxide gases from aerobic and anaerobic manure decomposition processes. Computed at Tier 1 following the 2006 IPCC Guidelines for National GHG Inventories (IPCC, 2006); available by country, with global coverage and relative to the period 1990-2010, with annual updates.
<b>Supplemental</b>	This domain contains data on GHG emissions, associated emission factors and underlying activity data. The FAOSTAT Emissions data are estimates by FAO and do not coincide with GHG data reported by member countries to UNFCCC. The database is intended primarily as a service to help member countries assess and report their emissions, as well as a useful international benchmark. The FAOSTAT Emissions data are disseminated publicly to facilitate continuous feedback from member countries.
<b>Creation Date</b>	2012
<b>Last Update</b>	2012
<b>Data Type</b>	Climate Change - Greenhouse Gases
<b>Category</b>	Environment
<b>Time Period</b>	1990 - 2010
<b>Periodicity</b>	Annual
<b>Geographical Coverage</b>	World
<b>Spatial Unit</b>	Country
<b>Language</b>	Multilingual (EN, FR, ES)

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## Methodology and Quality Information:

<b>Methods and processing</b>	<p>GHG emissions from manure management consist of methane and nitrous oxide gases from aerobic and anaerobic decomposition processes. The FAOSTAT emission data are computed at Tier 1 following IPCC, 2006, Vol. 4, Ch. 10 and 11.</p> <p>The term manure includes both urine and dung (i.e., both liquid and solid material) produced by livestock. More specifically, CH<sub>4</sub> gas is produced by anaerobic decomposition of manure stored or treated, while N<sub>2</sub>O is produced directly by nitrification and denitrification processes in the manure, and indirectly by nitrogen (N) volatilization and re-deposition processes, as well as from leaching of manure N.</p> <p>The CH<sub>4</sub> emissions are estimated at country level, using the formula:</p> $Emission = A * EF$ <p>Where:</p> $Emission = \text{GHG emissions in kg CH}_4 \text{ yr}^{-1};$ <p>A = Activity data, representing number of livestock in heads (1); EF = Tier 1, default IPCC emission factors, expressed in kg CH<sub>4</sub> head<sup>-1</sup> yr<sup>-1</sup> (2).</p> <p>(1) Data for buffalo, sheep, goats, camels, llamas, horses, mules, asses, pigs, ducks, turkeys, chickens and dairy cattle* are taken directly from FAOSTAT (domain: Production), non-dairy cattle is derived from FAOSTAT categories, specifically as cattle minus dairy cattle.</p> <p>*FAOSTAT livestock data include cattle and dairy cattle. Dairy cattle data are expressed as heads of cows producing milk, and can be found under the domain: Production/Livestock primary/producing animals cow milk, whole fresh.</p> <p>(2) The EF values are assigned to each country (IPCC, 2006: Tab. 10.14 for cattle, buffaloes and pigs and Tab. 10.15 for all other animals), as a function of country-level average annual temperature (°C). Average annual temperatures by country are taken from the</p>
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FAO Global Agro-Ecological Zones (GAEZ) dataset (IIASA/FAO, 2012), relative to the baseline period 1961-1990.

Direct N<sub>2</sub>O emissions are estimated at country level, using the formula:

$$Emission = A * EF$$

where:

*Emission* = GHG emissions in kg N<sub>2</sub>O-N yr<sup>-1</sup>;

*A* = Activity data, representing the total amount of N in manure treated in manure management systems (MMS) in kg N yr<sup>-1</sup> (3);

*EF* = Tier 1, default IPCC emission factors, expressed in kg N<sub>2</sub>O-N/kg N yr<sup>-1</sup> (4).

(3) It is the total amount of N excreted (see below, note i) from livestock (ii) treated in MMS (iii).

(i) Following IPCC, 2006: Vol. 4, Ch. 10 Eq. 10.30, the total amount of N excreted by each livestock category is calculated multiplying the number of livestock heads by two coefficients: a) the Typical Animal Mass (TAM) and b) the N excretion coefficient (N<sub>ex</sub>). Both parameters vary according to geographic region. TAM values are obtained from IPCC, 2006: Vol.4, Ch. 10, Annex 10A.2, Tabs. 10A-4 to 10A-9; N<sub>ex</sub> values are derived from IPCC, 2006: Vol.4, Ch. 10, Tab. 10.19.

(ii) Data for dairy cattle, non dairy cattle, buffaloes, sheep, goats, ducks, turkeys, chickens, market swine\* and breeding swine\*\*.

\* Calculated as 10% of FAOSTAT category pigs (IPCC, 2006, Vol.4, Ch.10, Tab.10.19).

\*\* Calculated as 90% of FAOSTAT category pigs (Following IPCC, 2006, Vol.4, Ch.10, Tab.10.19).

Following IPCC, 2006, Vol.4, Ch.10, Tab.10.19 (iii) Default IPCC percentages of total N treated in different MMS, by region and livestock category, are taken from IPCC, 2006: Vol.4, Ch. 10, Annex 10A.2 Tabs. 10A-4 to 10A-9 (for poultry: IPCC, 1997: Ch.4 Tab. 4.21).

(4) The EF values depend on the specific MMS, as per IPCC 2006, Vol.4, Ch. 10, Tab. 10.21.

Indirect N<sub>2</sub>O emissions are estimated at country level, using the formula:

$$Emission = A * EF$$

where:

*Emission* = GHG emissions in kg N<sub>2</sub>O-N yr<sup>-1</sup>;

*A* = Activity data, representing the fraction of total amount of nitrogen (N) in manure treated in MMS that volatilizes as NH<sub>3</sub> and NO<sub>x</sub> and is lost through runoff and leaching, in kg N yr<sup>-1</sup>(5);

*EF* = Tier 1, default IPCC emission factors, expressed in kg N<sub>2</sub>O-N/kg N yr<sup>-1</sup> (6).

(5) The fractions for volatilization by animal and MMS are taken from IPCC, 2006: Vol. 4, Ch. 10, Tab. 10.22. A mean fraction value of 10% for all countries is used for leaching (IPCC, 2006: Vol. 4, Ch. 10, note to Eq. 10.28).

(6) All countries are assigned global default EF values for volatilization and leaching (IPCC, 2006: Vol. 4, Ch. 11, Tab. 11.3).

Dimensionless conversion factors used are:

10<sup>-3</sup>, to convert the activity data from kg to tonnes;

44/28, to convert the emissions from kg N<sub>2</sub>O-N to kg N<sub>2</sub>O gas;

10<sup>-6</sup>, to convert kg to Gg; and

GWP-CH<sub>4</sub> = 21 and GWP-N<sub>2</sub>O = 310 (100-year time horizon global warming potential), to convert Gg CH<sub>4</sub> or Gg N<sub>2</sub>O to Gg CO<sub>2</sub>eq. (IPCC, 1996: Technical Summary, Tab. 4 pg. 22).

The manure management domain contains the following data categories available for

download: country-level GHG emissions, provided as total, direct and indirect amounts in Gg CH<sub>4</sub>, Gg N<sub>2</sub>O and Gg CO<sub>2</sub>eq, by livestock species and by species aggregates, as well as their total; implied emission factors; and activity data. Data is available for 220 individual countries and territories, as well as for standard FAOSTAT regional aggregations, plus Annex I and non-Annex I groups. The data period is 1990-2010, with annual updates.

Uncertainties in estimates of GHG emissions are due to uncertainties in emission factors and activity data. They may be related to, inter alia, natural variability, partitioning fractions, lack of spatial or temporal coverage, spatial aggregation. In the case of manure management, more detailed information are available in the guidelines (IPCC, 2006: Vol. 4, Ch. 10, Section 10.5.5).

#### *References*

IIASA/FAO. 2012. Global Agro Ecological Zones (GAEZ v3.0), IIASA, Laxenburg, Austria, and FAO, Rome. <http://www.fao.org/nr/gaez>

IPCC. 1996. Climate Change 1995 - The Science of Climate Change: Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge.

IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (Eds), IGES, Hayama, Japan.

**Data Collection Method** Computed

**Completeness** 100%

**Links** [www.fao.org/climatechange/micca/ghg/](http://www.fao.org/climatechange/micca/ghg/)  
[www.ipcc-nggip.iges.or.jp/public/](http://www.ipcc-nggip.iges.or.jp/public/)

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[www.faostat.fao.org](http://www.faostat.fao.org)

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