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## Dataset Information:

<b>Title</b>	<b>Manure applied to soils</b>
<b>Abstract</b>	Greenhouse gas (GHG) emissions from manure applied to soils consist of nitrous oxide gas from nitrogen additions to managed soils from treated manure. Computed at Tier 1 following the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC,2006); available by country, with global coverage and relative to the period 1990 onwards, with annual updates.
<b>Supplemental</b>	<p>This domain contains data on GHG emissions, associated emission factors and underlying activity data.</p> <p>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.</p>
<b>Creation Date</b>	2012
<b>Last Update</b>	2013
<b>Data Type</b>	Climate Change - Greenhouse Gases
<b>Category</b>	Environment
<b>Time Period</b>	1990 onwards
<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 applied to soils consist of direct and indirect nitrous oxide (N<sub>2</sub>O) emissions from manure nitrogen (N) added to agricultural soils by farmers. Specifically, N<sub>2</sub>O is produced by microbial processes of nitrification and de-nitrification taking place on the application site (direct emissions), and after volatilization/re-deposition and leaching processes (indirect emissions). The FAOSTAT data are estimated at Tier 1 following the IPCC, 2006, Vol. 4, Ch. 10 and 11.</p> <p><u>Direct</u> emissions are estimated at country level, using the formula:</p> $Emission = A * EF$ <p>where:</p> <p><i>Emission</i> = GHG emissions in kg N<sub>2</sub>O-N yr<sup>-1</sup>;</p> <p><i>A</i> = Activity data, representing the total amount of N in manure applied to soils in kg N yr<sup>-1</sup> (1);</p> <p><i>EF</i> = Tier 1, default IPCC emission factors in kg N<sub>2</sub>O-N/kg N yr<sup>-1</sup> (2).</p> <p>(1) It is the amount of N excreted (see below, note <i>i</i>) by livestock (<i>ii</i>), treated in manure management systems (MMS) (<i>iii</i>) and net of losses through volatilization, runoff and leaching from MMS, and other human use (<i>iv</i>), plus the N contribution from bedding materials when present (<i>v</i>).</p> <p>(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.</p>
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(ii) Data for buffalo, sheep, goats, camels, llamas, horses, mules, asses, ducks, turkeys, dairy cattle\* and chickens layers\*\* are taken directly from FAOSTAT (domain: Production); non-dairy cattle is derived from FAOSTAT categories, specifically as cattle minus dairy cattle; chickens broilers is derived from FAOSTAT categories, specifically as chickens minus chickens layers; market and breeding swine are calculated respectively as 10% and 90% of FAOSTAT category pigs (IPCC, 2006, Vol.4, Ch.10, Tab.10.19).

\* 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 by selecting the item cow milk, whole fresh and the element producing animals.

\*\* FAOSTAT livestock data include the items chicken and chicken layers. Chicken layers are expressed in 1000 heads of hens which have laid eggs in the reference period, and can be found under the domain Production/Livestock Primary by selecting the item hen eggs, in shell and the element producing animals.

(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: Vol. 3, Ch.4, Tab. 4.21).

(iv) Default IPCC values for total N losses from different MMS depend on the livestock category as per IPCC, 2006: Vol.4, Ch. 10, Tab. 23. Losses of treated manure due to use for construction, feed or fuel are set to zero, as per IPCC, 2006: Vol.4, Ch. 11, page 11.13. It is assumed that all treated manure, net of the above losses, is applied to soils following IPCC, 2006: Vol.4, Ch. 11, page 11.13.

(v) Default amounts of N used in bedding (for solid storage and deep bedding) as per IPCC, 2006: Vol.4, Ch. 10, page 10.66.

(2) Global IPCC default EF values are taken from IPCC, 2006: Vol. 4, Ch. 11, Tab. 11.1.

Indirect emissions are estimated at country level, using the formula:

$$Emission = A * EF$$

where:

*Emission* = GHG emissions in kg yr<sup>-1</sup>;

*A* = Activity data, representing the fraction of manure N applications 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> (3);

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

(3) Obtained through the volatilization and leaching factors in IPCC, 2006: Vol.4, Ch. 11, Tab. 11.3.

(4) Global IPCC default EF values from IPCC, 2006: Vol.4, Ch. 11, Tab. 11.3.

Dimensionless conversion factors used are:

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 the emissions from kg N<sub>2</sub>O to Gg N<sub>2</sub>O; and

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

The manure applied to soils domain contains the following data categories available for download: country-level GHG emissions, provided as total, direct and indirect amounts in both Gg N<sub>2</sub>O and Gg CO<sub>2</sub>eq; implied emission factors; and activity data. Data are available for all countries and territories, as well as for standard FAOSTAT regional aggregations, plus Annex I and non-Annex I groups. The data period is 1990 onwards, 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 applied to soil more detailed information is available in the guidelines (IPCC, 2006: Vol.4, Ch. 11, Section 11.2.1.4 for direct emissions, and Section 11.2.2.4 for indirect emissions).

#### *References*

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. 1997. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. OECD, Paris, France.

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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