Dataset Information:

Title	**Manure Left on Pastures**
Abstract	Greenhouse Gases (GHG) emissions data from manure left on pasture consist of nitrous oxide gas from nitrogen additions to managed soils from grazing livestock. Computed at Tier 1 following the 2006 IPCC Guidelines for National GHG Inventories, Vol. 4 (IPCC, 2006); available by country, with global coverage and relative to the period 1961 to present, with annual updates, and projections for 2030 and 2050.
Supplemental	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.
Creation Date	2012
Last Update	2013
Data Type	Climate Change - Greenhouse Gases
Category	Environment
Time Period	1961-present; projections for 2030 and 2050
Periodicity	Annual
Geographical Coverage	World
Spatial Unit	Country
Language	Multilingual (EN, FR, ES)

Methodology and Quality Information:

Methods and processing

GHG emissions from manure left on pastures consist of direct and indirect nitrous oxide (N_2O) emissions from manure nitrogen (N) left on pastures by grazing livestock. Specifically, N_2O is produced by microbial processes of nitrification and de-nitrification taking place on the deposition 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.

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

*Emission = A * EF*

where:

Emission = GHG emissions in kg yr^{-1};
A = Activity data, representing the total amount of manure N left on pasture in kg N yr^{-1} (1);
EF = Tier 1, default IPCC emission factors, expressed in kg N_2O-N/kg N yr^{-1} (2).

(1) Computed as per IPCC, 2006: Vol.4, Ch. 11, Eq. 11.5, as the amount of total N excreted (see below, note i) by livestock (ii) and left on pastures as urine and dung (iii).

(i) Following IPCC, 2006: Vol.4, Ch. 10, Eq. 10.30, the total *amount of nitrogen excreted in manure* is calculated, for each livestock category, by the number of livestock heads by two coefficients: a) the Typical Animal Mass (TAM) and b) the N excretion coefficient (N_{ex}). 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_{ex} values are derived from IPCC, 2006: Vol.4, Ch. 10, Tab. 10.19.

(ii) Livestock data cover the following animal categories: buffalo, sheep, goats, camels, llamas, horses, mules, asses, ducks, turkeys, dairy and non-dairy cattle*, chickens layers and broilers** and market and breeding swine***. For the period 1961-present, activity

data are taken directly from FAOSTAT (domain: Production/Live animals).
Projections of activity data for 2030 and 2050 for the following categories: dairy and non-dairy cattle, buffaloes, sheep, goats, pigs and poultry, are computed with respect to a baseline, defined as the 2005-2007 average of the corresponding FAOSTAT activity data, and by applying percentage growth rates from FAO perspective studies (Alexandratos and Bruinsma, 2012). Activity data for animal categories for which FAO projections were not available were set to the most recent available FAOSTAT value. The FAO projections used cover some 140 countries. Projections of activity data for countries not included assume the same growth rate of neighboring countries.

*FAOSTAT livestock data include the items 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. Non-dairy cattle is derived from FAOSTAT categories, specifically as cattle minus dairy cattle;

**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. Chickens broilers is derived from FAOSTAT categories, specifically as chickens minus chickens layers;

***FAOSTAT livestock data include the item pigs. Market and breeding swine are calculated respectively as 90% and 10% of item pigs (IPCC, 2006, Vol.4, Ch.10, Tab.10.19).

(iii) Default IPCC percentages of total excreted N in different Manure Management Systems (MMS) by region and livestock category, as per 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). Specifically with reference to these tables, the amount of manure left on pasture contributing to GHG emissions is the sum of 100% of total excreted N left on pasture as per IPCC percentage value “Pasture/Range/Paddock”, and 50% of total excreted N as per IPCC percentage value “Burned for Fuel” (IPCC, 2006: Vol. 4, Chapter 10 Page 10.58).

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

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

*Emission = A * EF*

where:

Emission = GHG emissions in kg yr^{-1};
A = Activity data, representing the fraction of manure N left on pastures that volatizes as NH_3 and NO_x and is lost through runoff and leaching in kg N yr^{-1} (3);
EF = Tier 1, default IPCC emission factors, expressed in kg N_2O-N/kg N yr^{-1} (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. 11.1.

Dimensionless conversion factors used are:
44/28, to convert the emissions from kg N_2O-N to kg N_2O gas;
10^{-6}, to convert the emissions from kg N_2O to Gg N_2O; and
GWP-N_2O = 310 (100-year time horizon global warming potential), to convert Gg N_2O to Gg CO_2eq (IPCC, 1996: Technical Summary, Tab. 4 pg. 22).

The manure left on pastures domain contains the following data categories available for download: country-level GHG emissions, provided as total, direct and indirect amounts in both Gg N_2O and Gg CO_2eq; 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.

	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 left on pastures 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* Alexandratos, N. and J. Bruinsma. 2012. World agriculture towards 2030/2050: the 2012 revision. ESA Working paper No. 12-03. Rome, FAO. 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/ www.ipcc-nggip.iges.or.jp/public/

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