Dataset Information: Livestock Manure

Title	Livestock Manure
Abstract	The FAOSTAT Livestock Manure domain contains estimates of nitrogen (N) inputs to agricultural soils from livestock manure. These estimates are compiled using official FAOSTAT statistics of animal stocks and by applying the internationally approved Guidelines of the Intergovernmental Panel on Climate Change (IPCC). Statistics on the use of synthetic and organic fertilizers help to inform policies and planning toward the design and implementation of more sustainable agricultural systems (FAO, 2017). Data are available by country, with global coverage and relative to the period 1961–2019, with annual updates.
Supplemental	The FAOSTAT domains Livestock Manure disseminates information on N inputs from livestock manure and their deposition on pasture, treatment in manure management systems, and availability for application to agricultural soils as organic fertilizer. Specific data on the N losses to air and water are also disseminated. These estimates may be used as an input to calculate soil nutrient budgets and greenhouse gas (GHG) emissions. Emissions from livestock manure are disseminated in the FAOSTAT Emissions-agriculture sub-domains "Manure Management," "Manure left on pasture" and "Manure applied to soils". The FAOSTAT Livestock Manure data are FAO estimates; as such they may not coincide with data on organic fertilizers that are reported by countries to international processes, including to FAO within the FAOSTAT Fertilizers Questionnaire. The database is rather intended primarily as a global knowledge product, with country-level information compiled transparently and in a comparable manner.
International Standards	The FAO manure estimates are computed using the Tier 1 approach of the IPCC (2006) Guidelines, and are thus aligned to methods used for reporting climate change statistics to the UN Framework Convention on Climate Change. They are furthermore consistent with the supply and use tables of the System of Environmental-Economic Accounting Central Framework (SEEA CF) and of the SEEA for Agriculture Forestry and Fisheries (SEEA AFF). Manure statistics and indicators are covered by the Framework for the Development of Environmental Statistics 2013 (FDES, 2017).
Last Update	2021
Data Type	Agri-Environmental Indicators
Category	Agriculture; Environment
Time Period	1961 – 2019
Periodicity	Annual
Geographical Coverage	World
Spatial Unit	In 2019, 191 countries and 25 territories
Language	Multilingual (EN, FR, ES)

Methodology and Quality Information:

Methods and processing	***Overview*** The **Livestock Manure** domain of the FAOSTAT "Agri-environmental Indicators" provides information on the availability and management of livestock manure-N for applications to agricultural soils and their N losses to air and water. The following Elements are disseminated in the Livestock Manure domain:

ELEMENTS IN THE LIVESTOCK MANURE DOMAIN
Stocks
Amount excreted in manure (N content)
Manure left on pasture (N content)
Manure left on pasture that volatilises (N content)
Manure left on pasture that leaches (N content)
Manure treated (N content)
Losses from manure treated (N content)
Manure applied to soils (N content)
Manure applied to soils that volatilises (N content)
Manure applied to soils that leaches (N content)

Estimates on manure are made from the **Stocks** of the following animal categories: buffalo, sheep, goats, camels, llamas, horses, mules, asses, ducks, and turkeys, dairy and non-dairy cattle*, chickens layers and broilers** and market and breeding swine*** and are taken from FAOSTAT domains: Production/Livestock Primary and Production/Live animals (http://www.fao.org/faostat/en/#data/QA and http://www.fao.org/faostat/en/#data/QL). In particular:

*FAOSTAT Production-Livestock domains include data for (total) cattle (C) and for the subset dairy cattle (DC). Data on the number of heads of cattle are available in the FAOSTAT domain "Production/Live animals" as item "Cattle" and element "Stocks". Data on the number of heads for dairy cattle are available in the FAOSTAT domain "Production/Livestock Primary" as item "Milk, whole fresh cow" and element "Producing Animals/Slaughtered: Milk Animals".
In the FAOSTAT Emissions – Agriculture domains, cattle data are reported separately for "Cattle, dairy" (DC) and "Cattle, non-dairy" (NDC). The number of heads of non-dairy cattle is calculated as heads of cattle minus heads of dairy cattle (NDC = C – DC).
As the number of heads for cattle and for dairy cattle derive from two different FAOSTAT domains, their values may not be fully harmonized. For this reason, the following corrections and imputations have been applied to the data for dairy cattle (DC):

- If the number of heads for dairy cattle is higher than those for cattle (DC > C), the number for cattle is assigned to dairy cattle (and therefore DC = C).
- If there are missing data only for dairy cattle:
  - If no data are available for an entire time series, a regional average value for the share "S" of dairy cattle in cattle (S = DC/C) is applied. Therefore: $DC_i = S_R * C_i$ where "i" is a country and "R" a region or group of countries.
  - If one or more values are available in the time series, missing values between two available data are filled by linearly interpolating the share "S", and data points outside the time series of available data are filled by keeping constant the share value "S" of the closest available year.

**FAOSTAT Production-Livestock domains include data for (total) chicken (CH) and for the subset chicken layers (CHL). Data on the number of heads (in 1000 heads) for chicken are available in the FAOSTAT domain "Production/Live animals", as item "Chickens" and element "Stocks". Data on the number of heads (in 1000 heads) for chicken layers are available in the FAOSTAT domain "Production/Livestock Primary" as item "Eggs, hen, in shell" and element "Producing Animals/Slaughtered: Laying".
In the FAOSTAT Emissions-Agriculture domains, chicken data are reported separately for "Chickens, layers" (CHL) and "Chickens, broilers" (CHB). The number of heads of broilers is calculated as heads of (total) chickens minus heads of layers (CHB = CH – CHL).
As the number of heads for chickens and for layers derive from two different FAOSTAT domains, their values may not be fully harmonized. For this reason, the following corrections and imputations have been applied to the data for layers (CHL):

- If the number of heads for layers is higher than those for chickens (CHL > CH), the number for chickens is assigned to layers (and therefore CHL = CH).
- If there are missing data only for chicken layers:
  - If no data are available for an entire time series, a regional average value for the share "S" of layers in chickens (S = CHL/CH) is applied. Therefore: $CHL_i = S_R * CH_i$ where "i" is a country and "R" a region or group of countries.
  - If one or more values are available in the time series, missing values between two available data are filled by linearly interpolating the share "S", and data points outside the time series of available data are filled by keeping constant the share value "S" of the closest available year.

[***]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).

This FAOSTAT domain disseminates the total **Amount of N excreted** for the livestock categories above. Yearly country estimates are calculated multiplying the total number of livestock heads by coefficients of: *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.

The **N content in manure left on pasture**, range and paddock as urine and dung is calculated multiplying the total amount of N excreted by the share of manure that is deposited on pasture and by summing half of the N excreted that is burned for fuel to account for the N excreted in the urine. Shares of N excreted by livestock species that is deposited on pasture, range and paddock are derived from Table 10.A4-9 pp. 10.77-10.82 of the 2006 IPCC Guidelines and from Table 4.7, pp. 4.11-13 of the 1996 IPCC Guidelines (1997). Calculations are as follows:

$$N_{PRP(C,y,T)} = \left[\left(Nex_{(C,y,T)}\right) \times MS_{PRP(T)}\right] + \frac{\left[Nex_{(C,y,T)} \times MS_{BurnedForFuel(T)}\right]}{2}$$

Where, for country *C* and year *Y*:

$N_{PRP(C,y,T)}$ N content in manure left of pasture for animal category *T*, in kg of N

$Nex_{(C,y,T)}$ Amount of total N excreted for animal category *T*, in kg of N

$MS_{PRP(T)}$ Share of total N excreted for animal category *T* that is deposited on pasture, range and paddock

$MS_{BurnedForFuel(T)}$ Share of total N excreted for animal category *T* that is burned for fuel

The **N content** in manure left on pasture **that volatilises and that leaches** is calculated by multiplying the amount of N in manure left on pasture by the corresponding fractions for N that volatilises (FracGASM) and N that leaches (FracLEACH). Values for these fractions are derived from the 2006 Guidelines, Vol 4, Table 11.3 p.11.24. Calculations assume that leaching occurs in all areas.

The **N content in manure treated** is calculated by multiplying the amount of N excreted by the share of manure treated ($MS_{(s)}$) in each manure management system (MMS). The following MMS are included: Lagoon, Slurry, Solid Storage, Drylot, Daily Spread, Digester, Other, Pit below 1 Month, Pit above 1 Month. Manure burned for fuel and manure deposited on pasture, range and paddock (needed to make the sum of $MS_{(s)}$ = 1) are not included. Information on manure N content in each MS by livestock type is derived from

	Table 10.A4-9 pp. 10.77-10.82 of the 2006 IPCC Guidelines and from Table 4.7, pp. 4.11-13 of the 1996 IPCC Guidelines (1997). **N losses** occur in manure stored and **treated** in forms of NH_3, NO_x, N_2O and N_2 as well from leaching and runoff (2006 IPCC Guidelines, Table 10.23, page 10.67). Default IPCC values for total N losses from MMSs 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. Estimates are made for these losses multiplying the amount of N treated in each MMS by the fraction of N lost from each system. 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. The total **N content applied to soils** also considers the N additions associated with bedding in solid storage and deep bedding systems, which in a few cases exceed the N losses. Finally, the N from livestock **manure applied to soils that volatilises and leaches** is calculated multiplying the N manure applied to soils by the corresponding fractions for the N that volatilises (FracGASM) and N that leaches (FracLEACH). The following additional information is accessible under the Related Documents section of the EMN domain: a) TAM values by country and livestock type in "TAM_Country.csv"; b) N excreted by country and livestock type in "N_ExcrRate_Country.csv"; c) Shares of manure treated by country, MMS and livestock type in "Share_MMS_Lvstck_Country.csv"; and d) Fraction of N lost by country, MMS and livestock type in "FracLoss_MMS_Lvstck_Country.csv". ***References*** IPCC **1997**. *Revised 1996 IPCC Guidelines for National Greenhouse Inventories*. Houghton J.T., Meira Filho L.G., Lim B., Tréanton K., Mamaty I., Bonduki Y., Griggs D.J. Callander B.A. (Eds). Intergovernmental Panel on Climate Change (IPCC), IPCC/OECD/IEA, Paris, France. Available at https://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html 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). Published: IGES, Japan. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html FAO **2017**. *Nitrogen inputs to agricultural soils from livestock manure: new statistics*. Integrated Crop Management, vol. 27–2017. Food and Agriculture Organization of the United Nations, Rome, 2017. Available at http://www.fao.org/documents/card/en/c/I8153EN
Data Collection Method	Computed
Completeness	100%
Useful links	http://www.fao.org/documents/card/en/c/I8153EN http://www.fao.org/documents/card/en/c/cb1922en http://www.fao.org/agriculture/crops/agp-home/en/?no_cache=1 http://www.fao.org/food-agriculture-statistics/statistical-domains/environment/en/

Distribution Information:

Owner	FAO
Provider	FAO
Source	FAO
Citation	FAO, 2021. FAOSTAT Land, Inputs and Sustainability, Livestock Manure, http://www.fao.org/faostat/en/#data/EMN
Acknowledgements	The FAOSTAT "Livestock Manure" domain are developed and maintained by the FAO Statistics Division (ESS).