Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

Improved manure management towards sustainable agri-food systems

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Overview

- Magnitude of the problem
- Measurement of greenhouse gases from manure management
- Pathways and potential for methodologies to reduce emissions from manure
- Co-benefits and synergies

Drivers

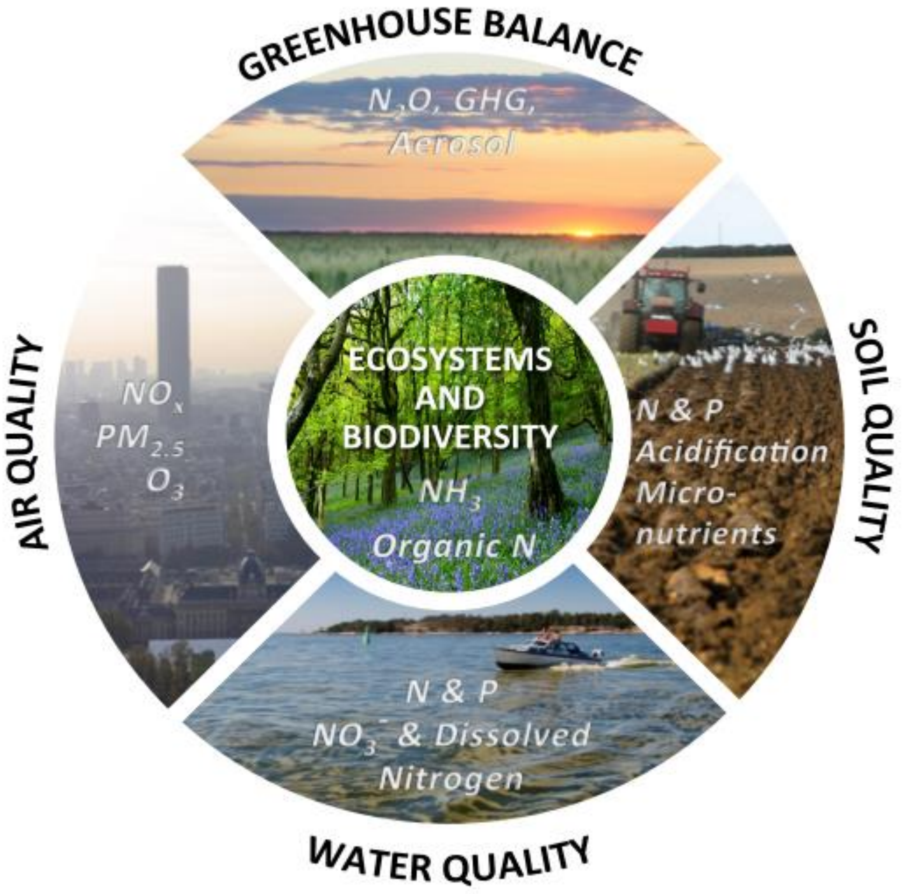
- Demand for animal source foods continues to rise
- Often rapid, poorly regulated intensification of livestock production
- Geographical separation of production units from feed resources results in broken natural cycles
- Large sizes and geographical concentration of intensive production units results in large quantities of manure – far in excess of the absorption capacity of the surrounding land

Consequences of poor management

- Nutrients and energy are lost and wasted from the system; resulting in opportunity costs to not managing manure efficiently
- Greenhouse gases are emitted, contributing to climate change
- Ammonia gas from manure is a major contributor to acidification; threatening ecosystem health and biodiversity
- Nutrients such as ammonium hydroxide lost to water bodies contribute to eutrophication and aquatic toxicity; threatening ecosystem health and biodiversity

5 Key threats of excessive nutrient

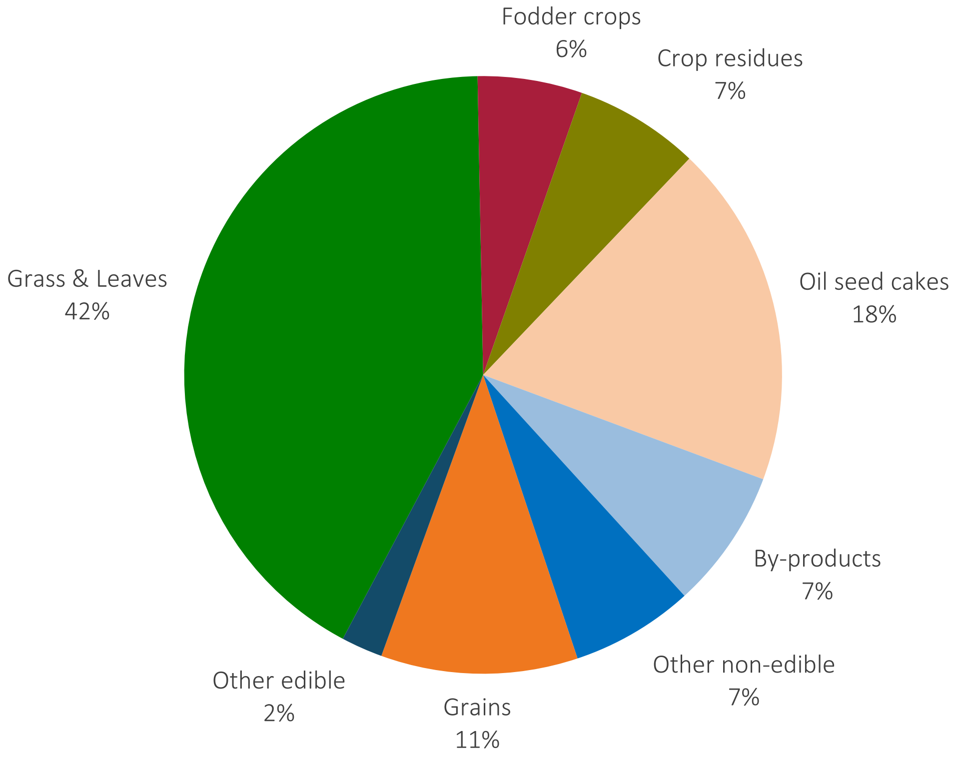
Water quality
Air quality
Greenhouse balance
Ecosystems
Soil quality

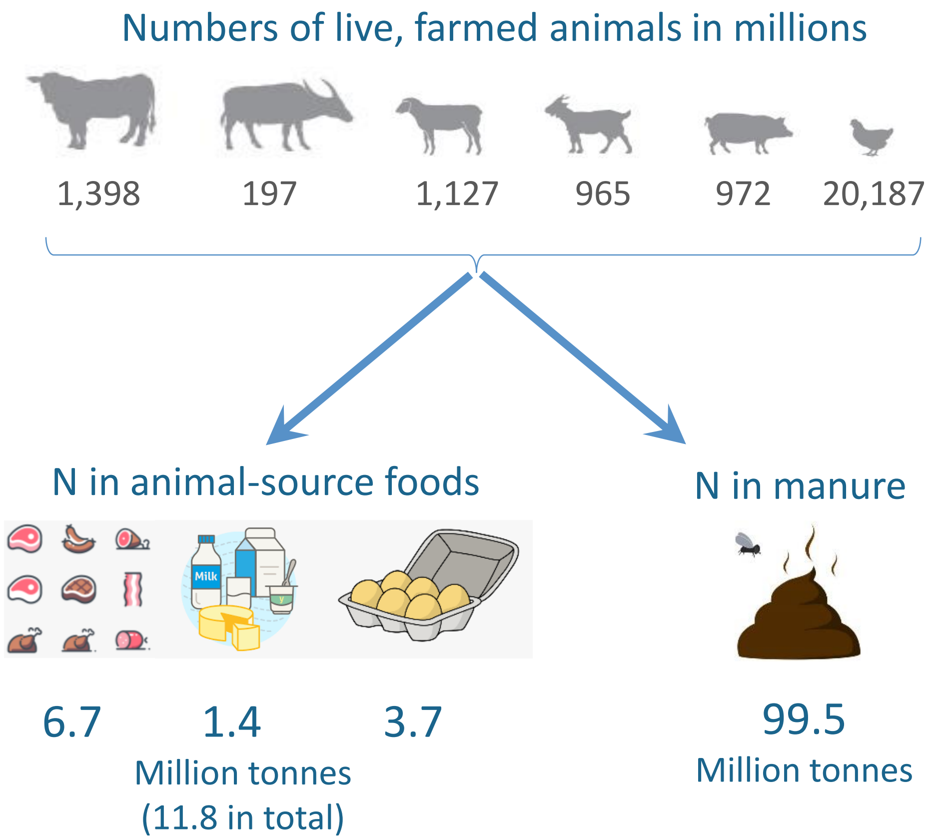


Source: Sutton et al. 2013

The fate of the nitrogen fed to farmed animals

120 million tonnes of N in animal feed



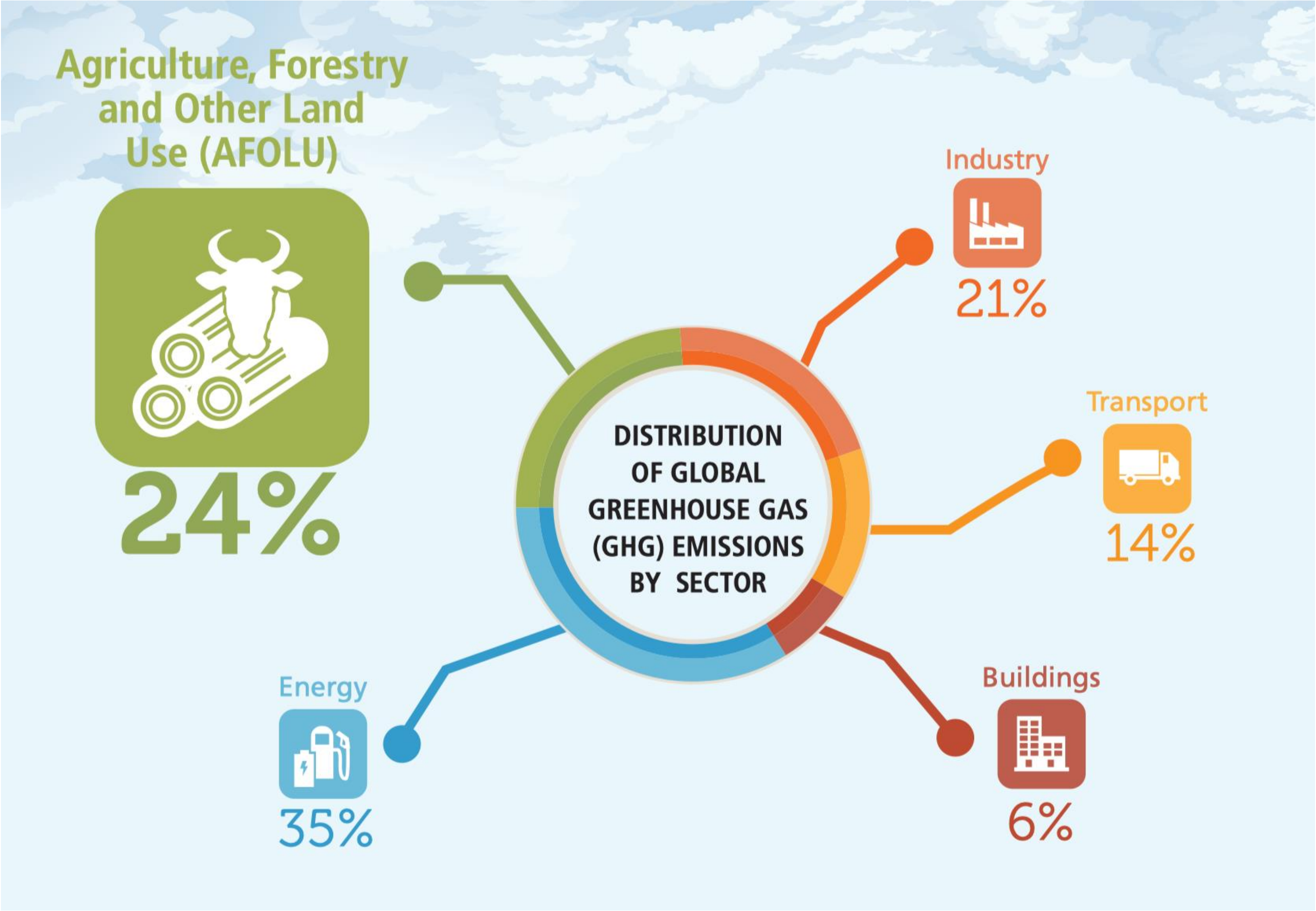


Source: *GLEAM 2*

GHG emissions from Agriculture, Forestry and Other Land Use (AFOLU)

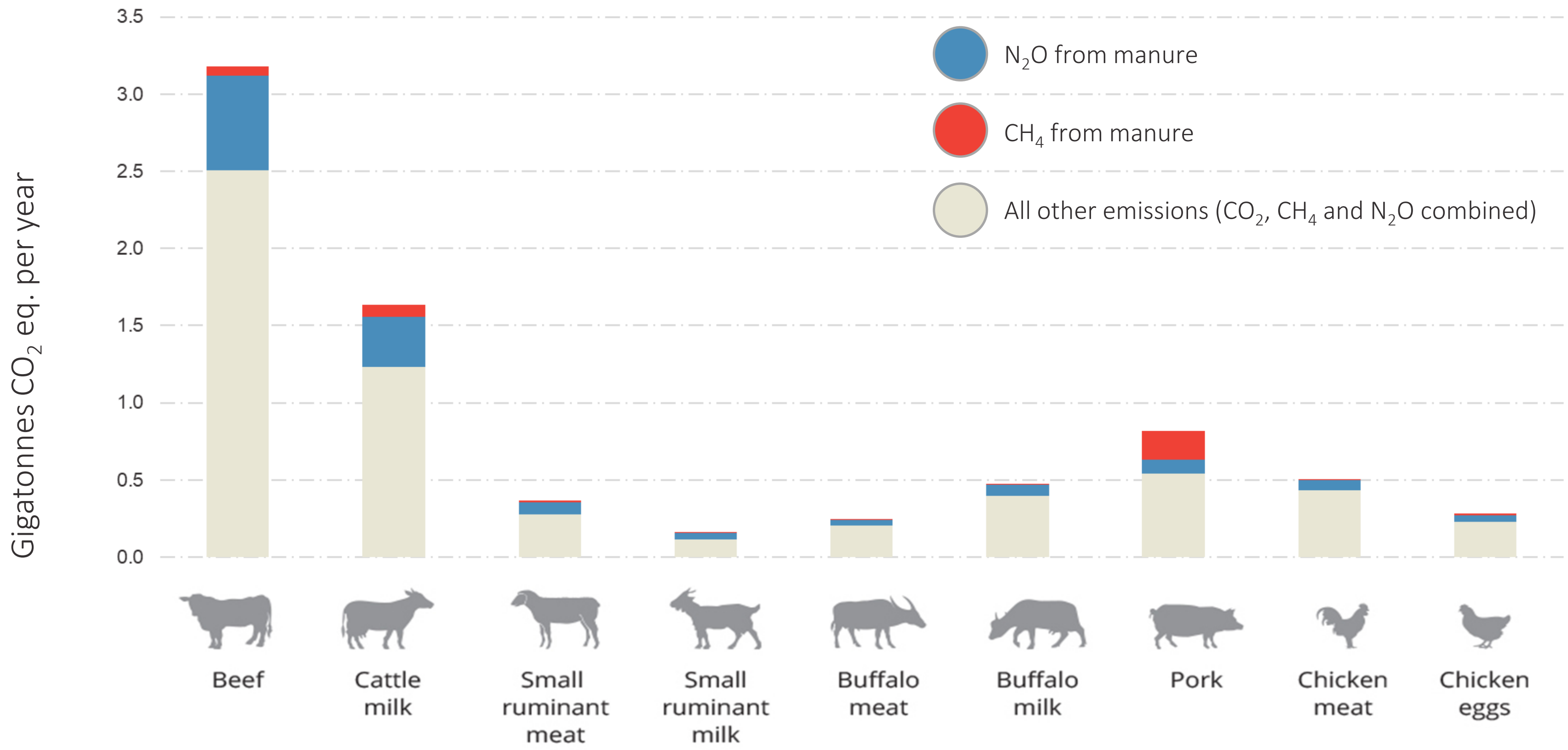
Total emissions (direct and indirect) from livestock account for 14.5% of anthropogenic emissions

Nearly a quarter of these come from manure



Source: IPCC 2014

Emissions from manure by commodity



Total livestock emissions (allocated)
7,663 Gt CO_2 eq. per year

Emissions from manure
1,728 Gt CO_2 eq. per year (23%)

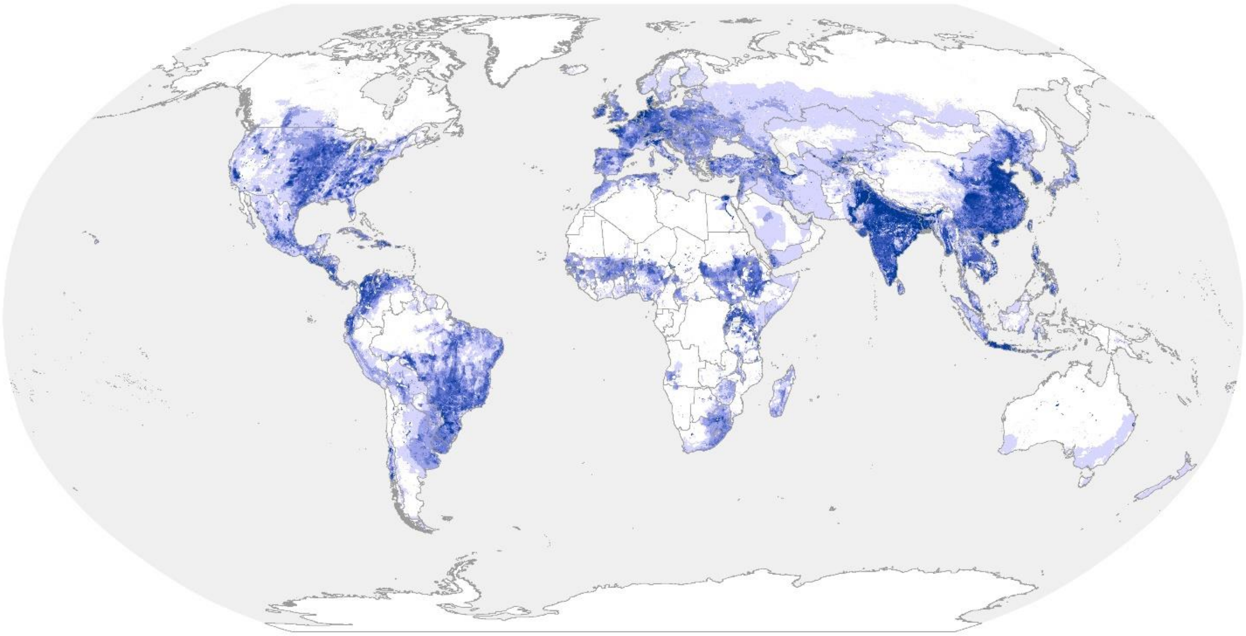
N_2O
1,352 (18%)

CH_4
376 (5%)

Source: *GLEAM 2.0*

Global distribution of total GHG emissions (N_2O and CH_4) from manure

N_2O

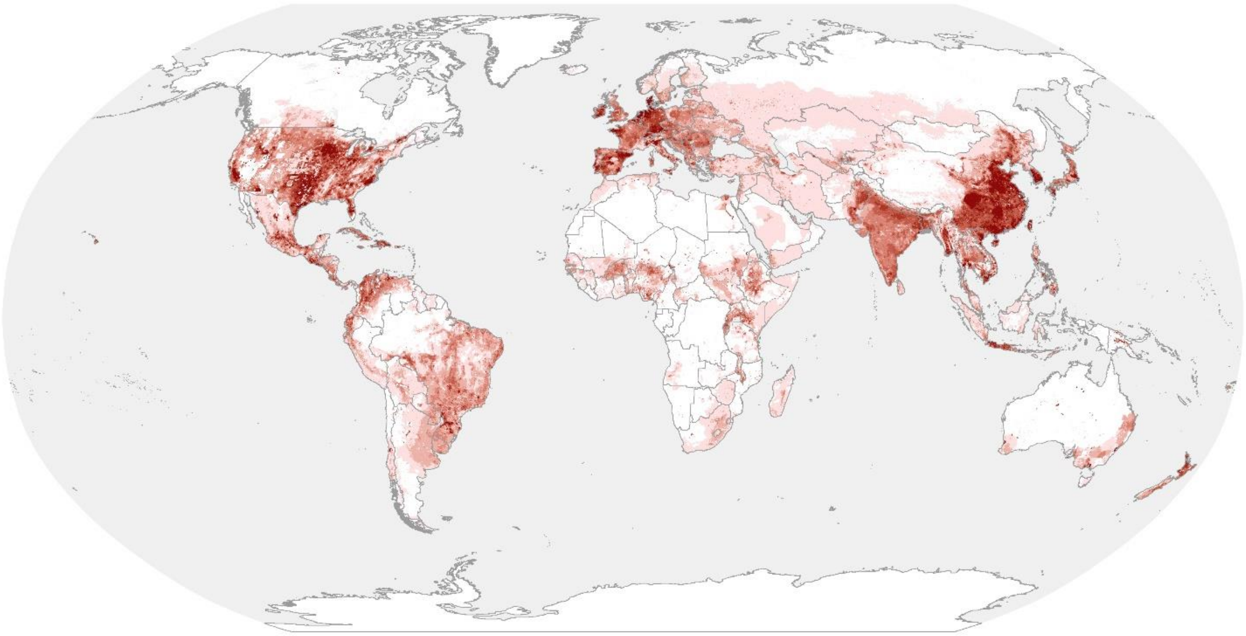


Thousand tonnes CO_2 eq. year

< 0.1 | 0.1 - 0.25 | 0.25 - 0.5 | 0.5 - 1.0 | 1.0 - 2.0 | > 2.0

Protein production < 50 kg per sq. km

CH_4



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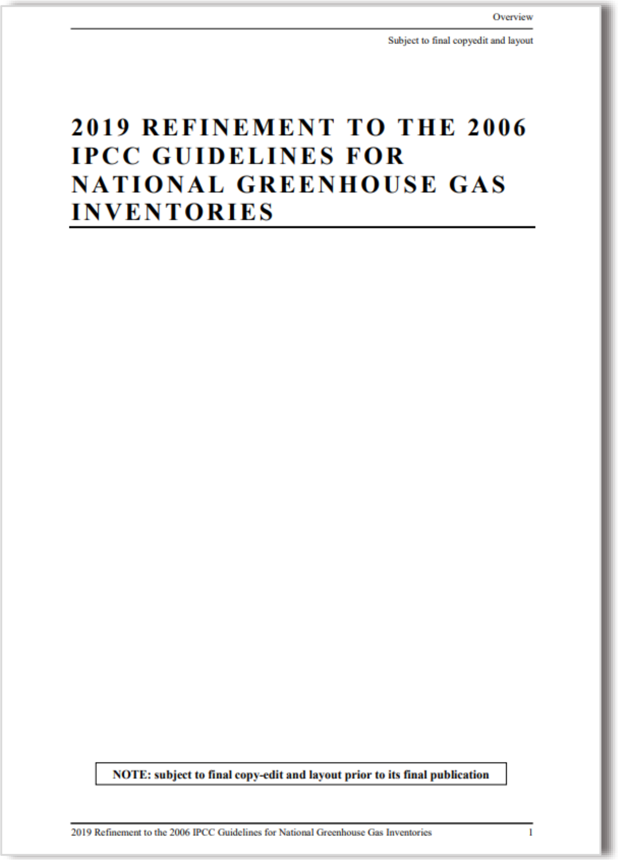
Protein production < 50 kg per sq. km

Source: *GLEAM 2*

Chemical characteristics of manure are dependent on the production system

		Dairy cattle	Beef cattle	Chicken	Pig
Dry Matter Content (%)					
Solid		26	23	55	9
Liquid (fresh, diluted)		7	8	17	6
Total Nutrient Content (Approximate)					
Nitrogen					
	kg/ton	4.5	6.3	11.3	4.5
	kg/1 m^3	2.9956	4.6732	8.3878	3.3551
Phosphate, as P_2O_5					
	kg/ton	2.7	4	11.3	2.7
	kg/1 m^3	1.0784	2.9956	8.3878	1.0784
Potash, as K_20					
	kg/ton	3.2	5	5.4	4.1
	kg/1 m^3	2.3965	3.7146	3.9542	4.0741

Quantification of greenhouse gases from manure management: IPCC Guidelines


Overview

Subject to final copyedit and layout

2019 REFINEMENT TO THE 2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES

NOTE: subject to final copy-edit and layout prior to its final publication

2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories 1

- Tier 1 emission factors (EFs) have been updated for **high and low productivity systems**.
- For major animal categories, **Tier 1 parameters** such as enteric fermentation EFs, volatile solids and **nitrogen excretion** are derived based on consistent data sources.
- The Tier 1 method to estimate **CH_4 emissions from manure management** has been updated for consistency with N_2O emissions.
- Certain Tier 2 parameters have been refined. The methane conversion rate (Ym) for cattle and buffalo, varies based on animal diet and level of productivity. The **methane conversion factor (MCF) for animal waste management systems** are presented based on climatic regions, as opposed to annual temperatures and a simple calculation model for deriving the MCF based on monthly temperature regimes has been presented.
- Improved guidance has been developed for the treatment of **nitrogen transfers** among livestock emission source categories and transfers to agricultural soils. (Chapter 10)

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Nutrient use efficiency and life cycle assessment: guidance, methodology and action

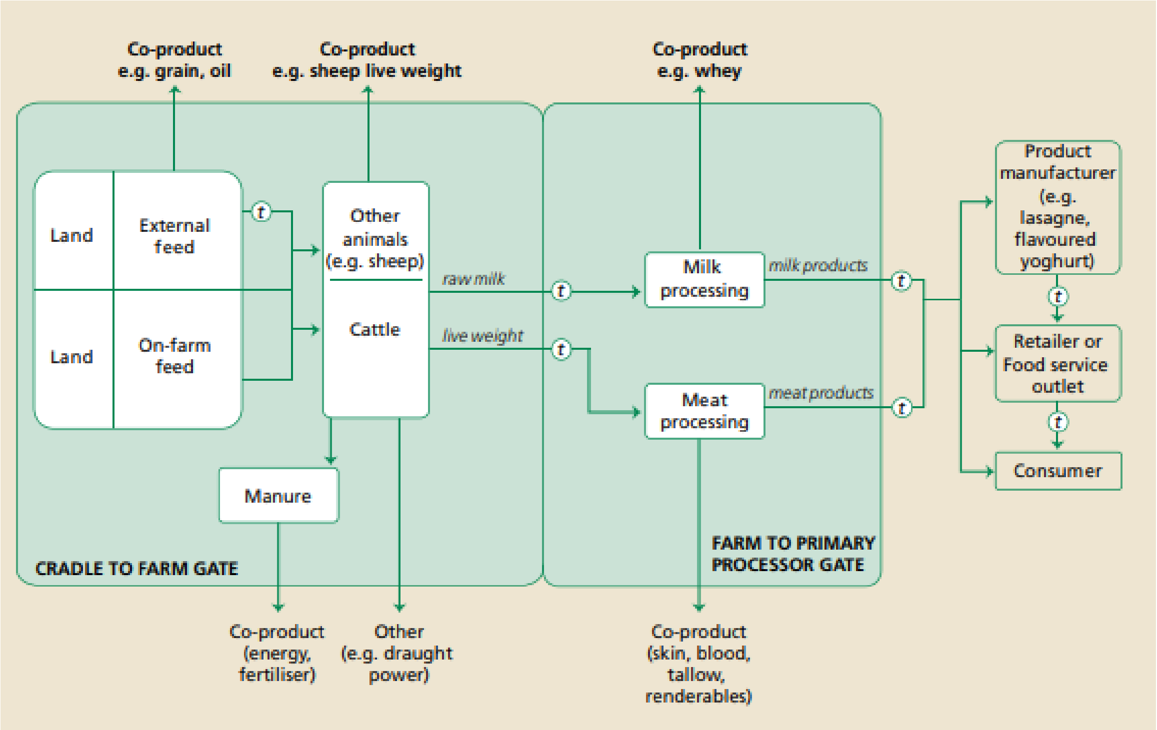
leap | LIVESTOCK ENVIRONMENTAL ASSESSMENT AND PERFORMANCE PARTNERSHIP

LEAP event at COP25
Room 5, 12 December 2019, 11:30-13:00

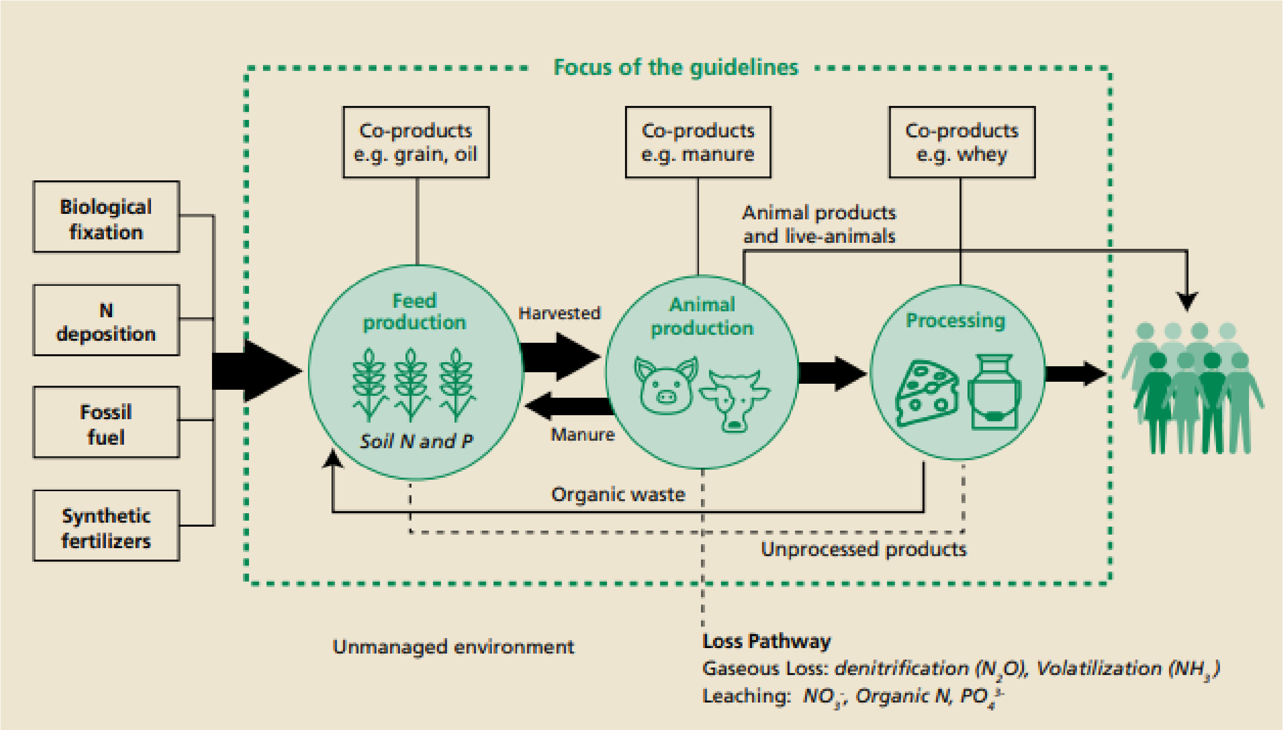
- Livestock Environmental Assessment and Performance (LEAP) Partnership is a multi-stakeholder initiative that seeks to improve the environmental sustainability of the livestock sector through better methods, metrics and data
- FAO LEAP guidelines on GHG emissions, nutrient flows and impact assessment (GHG emissions, acidification and eutrophication), and on the environmental footprint of feed additives are relevant for assessment of baselines and mitigation options also for alternative manure management

http://www.fao.org/partnerships/leap/en/

Life cycle assessment and nutrient flows (FAO LEAP guidelines)



Source: FAO. 2016. Environmental performance of large ruminant supply chains: Guidelines for assessment. Livestock Environmental Assessment and Performance Partnership. FAO, Rome, Italy.



Source: FAO. 2018. Environmental performance of large ruminant supply chains: Guidelines for assessment. Livestock Environmental Assessment and Performance Partnership. FAO, Rome, Italy.

Mitigation options for GHG emissions from animal manure

Improved livestock feeding

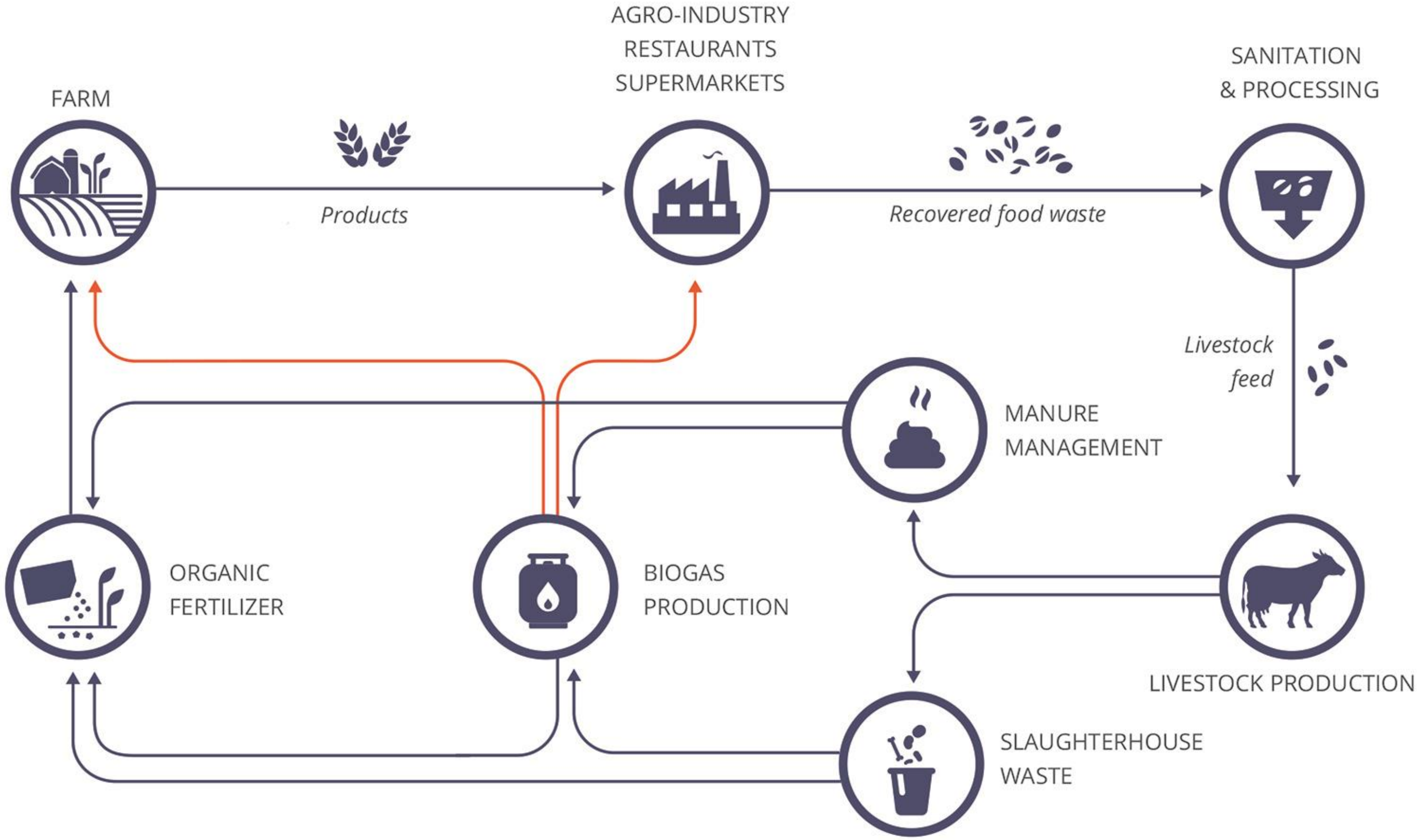
- Forage quality and grassland management
- Dietary ingredients and feed additives
- Precision feeding of livestock

Manure management

- Coverage of slurry stores
- Active aeration of stored manure
- Acidification of slurry
- Timing and methods of application to crop and pasture

Circular bio-economy

- Extraction of biogas
- Recycling manure as organic fertilizer



Co-benefits to reducing GHG emissions

- Soil health and productivity
- Environmental benefits: water, biodiversity, odour
- Greater food security and resilience, energy savings
- Improved human health

Risks and barriers to better manure management

Health and safety

- Antimicrobial resistance (AMRs)
- Hormones and growth promoters
- Chemical compounds, including heavy metals and other toxic molecules

Accessibility and availability

- Volumes of waste and residues depends on location and time
- Economic feasibility of solutions

Missing links

- Logistics and innovation (IT)
- enabling environment and governance partnerships

How FAO can help

Strengthening the **knowledge and evidence base** by developing baselines, assessments and projections of emissions

- Global Livestock Environment Assessment Model (GLEAM)

Developing **tools, methodologies and protocols** to measure emissions, developing and assessing technical and policy options

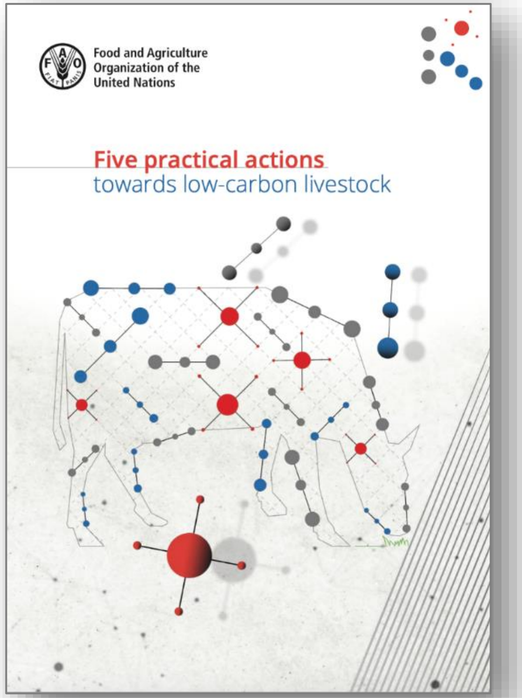
- Livestock Environmental Assessment and Performance (LEAP) Partnership
- Policy briefs and technical documents

Piloting and validating technical and policy options through projects and support to up-scaling and investments

- Climate and Clean Air Coalition (CCAC)

Facilitating multi-stakeholder partnerships and better integration of broad sustainability objectives, creation of synergies and mitigation of trade-offs

- Global Agenda for Sustainable Livestock Model (GASL)
- Global Soil Carbon Partnership (GSP)



Conclusions

- Animal manure – an obvious opportunity for climate action
- Different emission pathways for nitrous oxides and methane
- Technical options are available – local, integrated solutions are required (circular bio-economy)
- Regulations and prices often not supportive of efficient manure management
- Spatial planning particularly important where livestock are expanding
- Question of trade-offs and shift of burden

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Thank you