TRAINING & WORKSHOP

PREVENTION AND SUSTAINABILITY IN THE INDIAN DAIRY SECTOR

FOR PRODUCTIVITY, LIVELIHOOD GENERATION AND CLIMATE RESILIENCE



GHG emissions from Indian livestock sector

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Status of livestock emissions with focus on methane

What are greenhouse gases?

- Greenhouse gases (GHGs) are gases in the air that trap heat and make the Earth warmer.
- They come from sources such as vehicles, factories, livestock and burning fuels.
- Too much of these gases leads to global warming and climate change

Carbon dioxide (CO_2)

Mainly from fossil-fuel use, industry and land-use change. It is also a common reference unit for comparing other gases.

Methane (CH_4)

A potent, shorter-lived GHG. In livestock, it is produced mainly during digestion by ruminants and from manure.

Nitrous oxide (N_2O)

A powerful GHG associated with nitrogen transformations, including manure management and agricultural soils.

Where do livestock emissions come from?

1. Enteric fermentation

- Microbes ferment fibrous feed in rumen.
- **Methane (CH_4)** is formed during digestion and released through belching
- Key animals: cattle, buffaloes, goats and sheep
- Feed quality and digestibility influence emissions

2. Manure management

- Stored or poorly managed dung can release **methane**
- Nitrogen in manure can also lead to **nitrous oxide** (N_2O) emissions
- Handling, storage and treatment determine the pathway

Enteric methane emissions are a big part of agriculture emissions

222.6 $MtCO_2e$

Enteric fermentation emissions (2020)

13.07 $MtCO_2e$

Manure management emissions (2020)

8%

Percentage of country's total emissions

0.44%

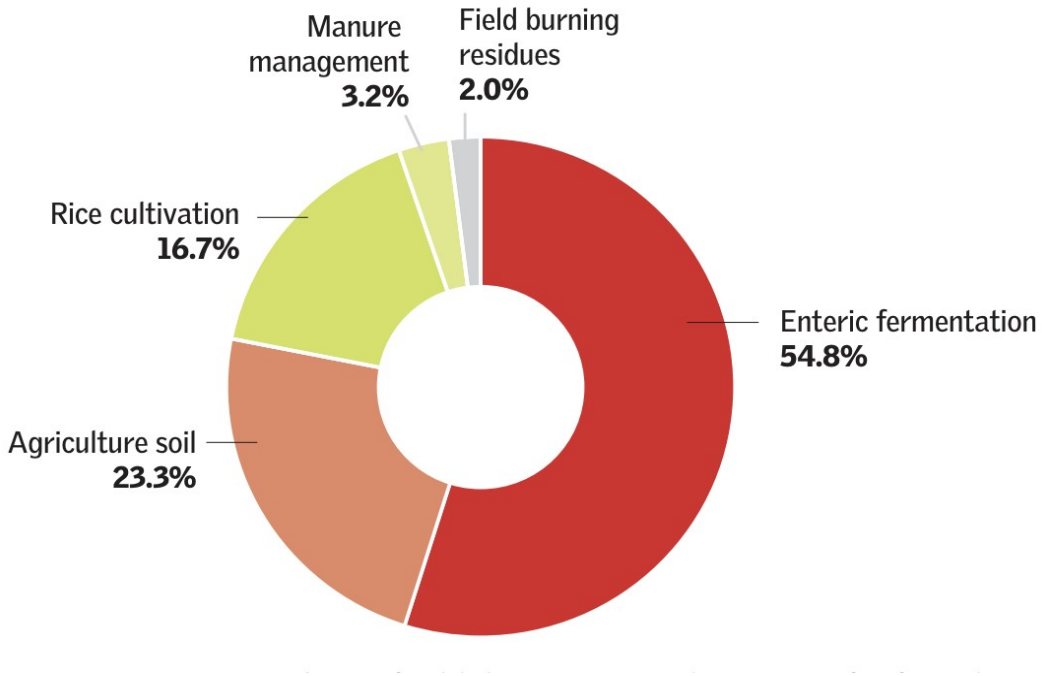
Percentage of country's total emissions

54.8%

Share of enteric emissions from agricultural emissions

3.2%

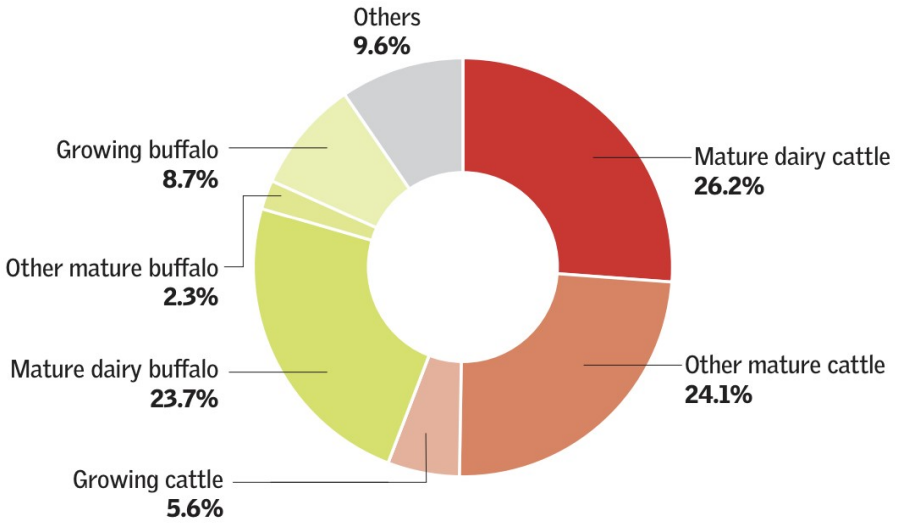
Share of enteric emissions from agricultural emissions



Source: Emissions are reported for 2020 in India's Fourth Biennial Update Report (BUR-4), published in December 2024.

Dairy cattle and buffalo emit half of enteric emissions

- Cattle and buffaloes contributed 90% of total enteric emissions; 10% from other livestock (sheep, doe, swines, camels, mules, horses)
- Cattle accounted for 55.8% of enteric emissions, 34.6% from buffaloes
- ‘Mature dairy cattle’ and ‘mature dairy buffalo’ together emitted about 49.8 of the enteric emissions

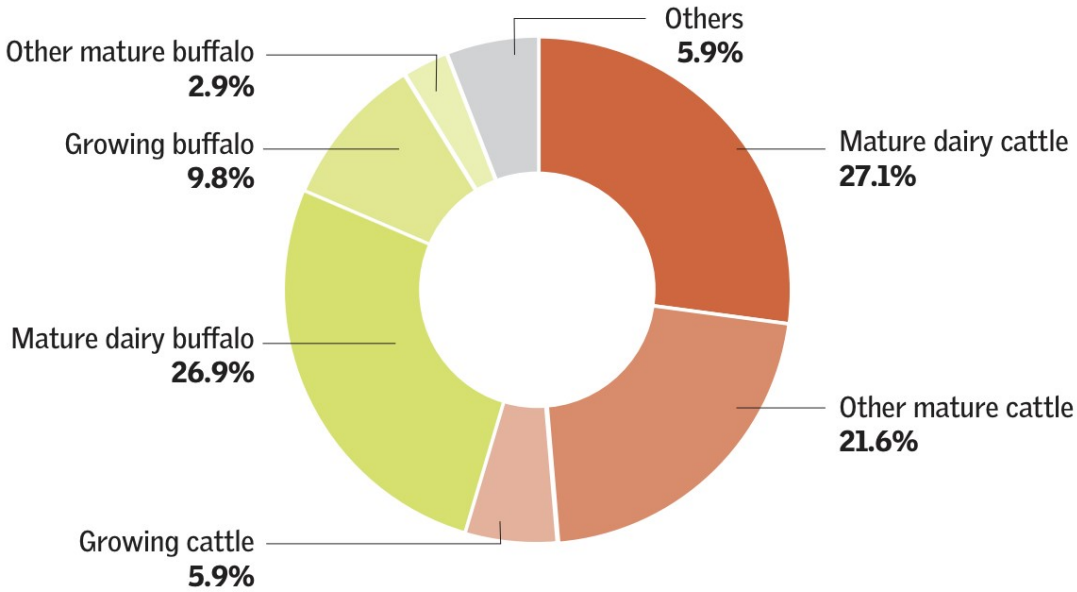


Share of enteric emissions from cattle and buffalo in livestock emissions

Source: Emissions are reported for 2020 in India’s Fourth Biennial Update Report (BUR-4), published in December 2024.

Similarly, dairy cattle and buffalo emit half of methane from manure management

- 94% of total methane emissions from manure management were from cattle and buffaloes
- 54.6% emissions are from manure management of cattle; more than that of buffaloes (39.5 per cent)
- Mature dairy cattle' and 'mature dairy buffalo' together emitted over half (54 %) of the emissions
- Manure management of 'growing buffalo' and 'growing cattle' together emitted 15.7%



Share of methane emissions from management of cattle and buffalo manure

Source: BUR-4; Note: BUR-4 reports the use of a global warming potential (100 years) of 21 for methane.

Measurement of GHG emissions

Estimation methods: Tier 1 and Tier 2

TIER 1: SIMPLIFIED

- Calculated by multiplying default emission factors (given by IPCC) by basic population data
- Useful where detailed feed and animal data are unavailable
- Does not capture changes in productivity or diet

TIER 2: COUNTRY-SPECIFIC

- Recommended for major emission sources or large livestock categories
- Uses data on animal weight, milk yield, feed intake and diet quality
- Mostly countries uses this method
- Needs reliable and regularly updated data

Emission factors and its calculation: two broad approaches

ESTIMATION-BASED | TOP-DOWN

- Uses livestock population and emission factors
- Supports national inventories and broad coverage
- Depends on assumptions, data quality

$$EF = \left[\frac{GE \times \left(\frac{Y_m}{100}\right) \times 365}{55.65} \right]$$

EF: Emission factor (kg CH_4/head/year), GE: Gross Energy intake (MJ/head/day) , Ym: Methane conversion factor (percentage of GE converted to methane); 55.65: The energy content of methane (MJ/kg CH_4)

DIRECT MEASUREMENT | BOTTOM-UP

- Measures emissions from animals under controlled or semi-controlled conditions
- Helps develop country-specific emission factors
- Captures biological data, but usually from smaller samples
- Equipment, cost and field feasibility can limit scale

1. Respiration chamber method
2. SF_6 tracer technique
3. GreenFeed system
4. Laser Methane Detector (LMD)

Mitigation of GHG emissions

GHG Mitigation Approaches: Overview

- **Improve feed and fodder quality**
  - Ration Balancing Programme
  - Feed supplements (e.g., Harit Dhara)
- **Breed improvements**
  - Rashtriya Gokul Mission
- **Manure management**
  - Biogas
  - Organic fertilizer

Feed additives with potential to reduce enteric emissions from livestock

Feed additive/ Supplement	Developer	Details	Advantages
Harit Dhara	ICAR-National Institute of Animal Nutrition and Physiology	An anti-methanogenic feed supplement prepared from tannins and saponins containing natural phytosources	Helps to reduces enteric methane emissions by ~17-20 per cent when included in feed
GRAND (Gruel Rooted Additive Nourishment Drops)-TANUVAS	Tamil Nadu Veterinary and Animal Sciences University	An aqueous nutritional feed supplement for cattle, especially those on a gruel-based, nitrogen-deficient diet common in small-holder dairy farms	Potential to reduce methane emission per animal by 20 per cent12
Red seaweed-based animal feed additive	CSIR-Central Salt and Marine Chemicals Research Institute	It is linked to the *Asparagopsis* genus, contains active compound bromoform, a powerful methane inhibitor	Can bring down methane emission
Tamarin Plus	ICAR-National Institute of Animal Nutrition and Physiology	It is an anti-methanogenic feed supplement prepared from tannins and saponins containing natural phytosources	Supplementation of TSH at 5 per cent level decreased methane emission by 17 per cent in cattle
RESMI-Composite feed additive	ICAR-Central Institute for Research on Buffaloes	Composite feed additive consisting of methane inhibitors and alternate hydrogen sinks	Supplementation can reduce methane emission by 30 per cent,

Key challenges in mitigation

- Feed additives: Their methane-reduction benefits may decline over time. It require assessment of long-term effectiveness.
- For Ration balancing wider adoption, small farmers need affordable inputs and practical guidance, software-based feeding plans can be difficult
- Scaling up solutions: Green fodder and Total Mixed Ration (TMR) show potential, but adoption remains limited
- With green fodder shortages and expensive concentrates limit uptake; financial incentives are needed
- For carbon credits, reliable monitoring, reporting and verification (MRV) systems and technologies are needed to support credible livestock methane credits

Thank you

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