# Model-based estimation of methane emissions in Indian cows using seasonal feeding trial data

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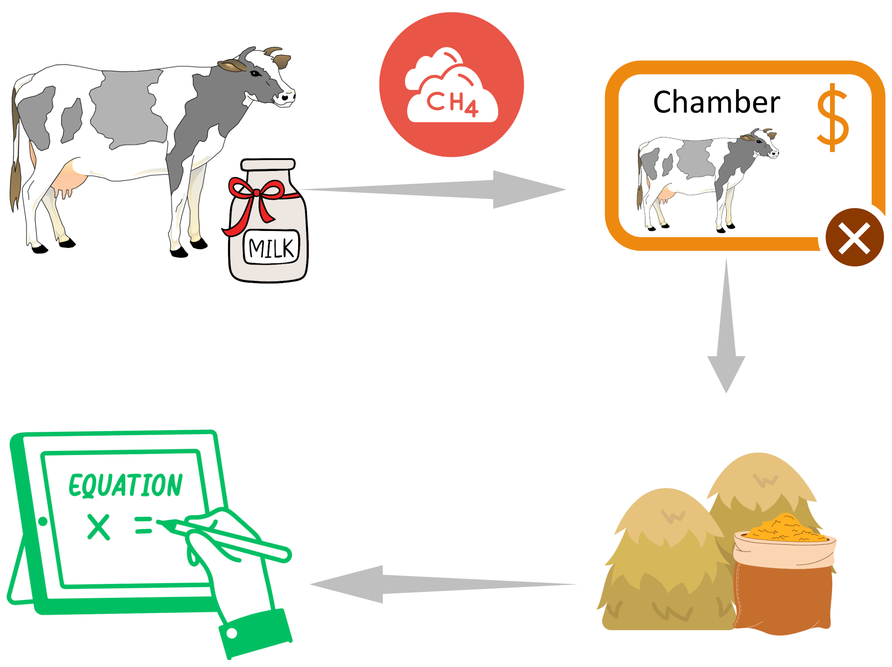
## Background

- India: home of over 193 million cattle
- World's largest milk producer
- Major source of enteric methane ($EntCH_4$)
- Respiration chambers: precise but resource-intensive, impractical
- Models estimate $EntCH_4$ using feed data: cost-effective alternative




**Aim:** Estimate $EntCH_4$ emissions from dairy cattle using equation across seasons, breeds and cattle types under tropical farming systems considering dry matter intake (DMI).

## Methodology

**1 Location**
- Bengaluru, India

**2 Period**
- Year: 2020 - 2022

**3 Approach**
- Measuring DMI for cattle
- Total cattle: 441

**4 Our model**
- g $EntCH_4$/cow/day = 2.82+17.43 × (kg DMI)
- $R^2$ = 0.78
- relative prediction error: 9.9%

**5 Data analysis**
- R software (version 4.2.1)

## Results

There are differences among cattle types and breeds in terms of tropical livestock units (TLU), while DMI/TLU (kg/day) and the R:C ratio (Tab. 1) vary across seasons and cattle types ($P < 0.05$).

**Tab. 1** Tropical livestock units (TLU), dry matter intake (DMI), roughage (R) to concentrate (C) ratio across seasons, cattle, and breed types.

| Variables | TLU (n) | DMI/TLU (kg/d) | R:C ratio |
|---|---|---|---|
| **Season** | | | |
| Monsoon-2020 | 1.54 (143) | 6.69[a] | 0.83[a] |
| Winter-2021 | 1.55 (147) | 6.93[a] | 0.38[b] |
| Summer-2022 | 1.51 (151) | 6.22[b] | 0.37[b] |
| *Standard error of mean* | *0.02* | *0.13* | *0.04* |
| **Cattle's** | | | |
| Milking cows | 1.56[a] (329) | 6.73[a] | 0.60[a] |
| Dry cows | 1.51[a] (96) | 6.33[b] | 0.32[b] |
| Heifers | 1.26[b] (16) | 5.82[b] | 0.23[b] |
| *Standard error of mean* | *0.04* | *0.18* | *0.03* |
| **Breed** | | | |
| Crossbred | 1.52[b] (113) | 6.74 | 0.61 |
| Holstein-Friesian | 1.59[a] (237) | 6.53 | 0.50 |
| Jersey | 1.43[c] (67) | 6.59 | 0.50 |
| Indigenous | 1.33[c] (24) | 6.91 | 0.46 |
| *Standard error of mean* | *0.03* | *0.17* | *0.06* |

Across all cattle types, estimated daily $EntCH_4$ emission was 118±28 g/TLU. Across seasons, summer showed lower (111±28 g/TLU) emissions than monsoon (119±27 g/TLU) and winter (124±27 g/TLU). Lactating cows showed higher emissions (120±28 g/TLU) than dry cows (113±29 g/TLU) and heifers (104±20 g/TLU) ($p<0.05$), while there were no significant differences in emissions between breeds (Fig. 2).

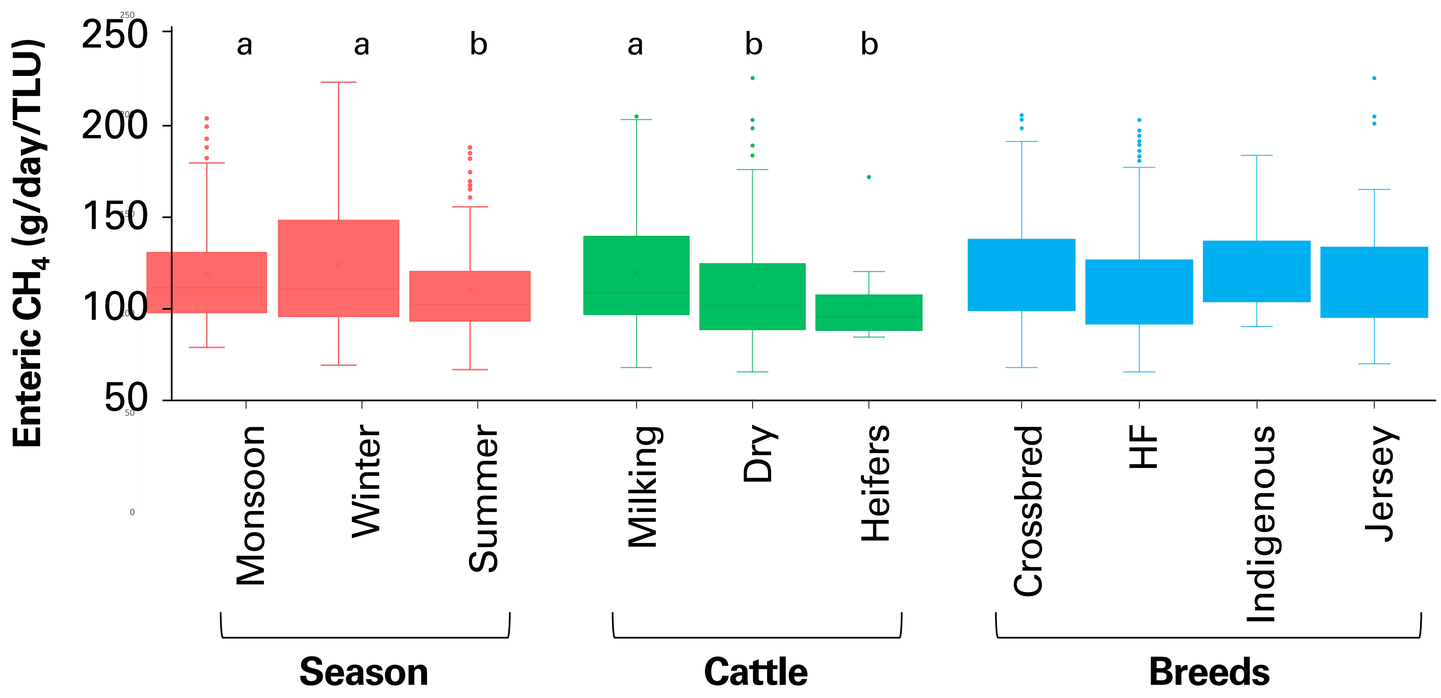



**Fig. 2** Enteric $CH_4$ emissions across seasons, cattle and breed types.

### *Highlights*

There are
- Seasonal and physiological variations in emissions
- Effective, scalable model-based $EntCH_4$ quantification is possible
- Mitigation opportunities for tropical dairy systems can be identified

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