Tropentag, September 10-12, 2025, hybrid conference

"Reconcile land system changes
with planetary health"

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

Shahin Alam[1], Mullakkalparambil Velayudhan Silpa[2], Christian Bateki Adjogo[1], Sven König[2], Eva Schlecht[1]

[1] *University of Kassel / University of Goettingen, Animal Husbandry in the Tropics and Subtropics, Germany*

[2] *Justus Liebig University Giessen, Inst. of Animal Breeding and Genetics, Germany*

Abstract

With a population of > 193 mi cattle, India is the largest milk producer globally but equally a significant driver of enteric methane ($EntCH_4$) emissions. Direct measurements of $EntCH_4$ through respiration chambers are precise, it is resource-intensive and impractical for large-scale implementation. Mathematical models offer a cheap alternative for estimating $EntCH_4$ emissions by utilising feeding (trial) data, specifically accounting for feed intake and feed quality characteristics. Hence, this study estimated $EntCH_4$ emissions from 441 dairy cattle (milking: 329, dry: 96, and inseminated heifers: 16) in monsoon-2020 (143 number of cows), winter-2021 (147), and summer-2022 (151) whose feed intake and diet quality had been determined via repeated visits to 39 farms in Bengaluru, Karnataka. Of these, 237 animals were Holstein-Friesian, 67 Jersey, 24 native zebus and 113 were exotic × native crossbreeds., were selected, given their suitability for tropical contexts. A recently developed $EntCH_4$ model based on dry matter intake (DMI) (g $EntCH_4$/cow/day =2.82+17.43 × (kg DMI), R^2 = 0.78, Relative prediction error: 9.9) developed for Indian circumstances was selected as it outperformed existing models. The mean body weight, daily DMI per tropical livestock unit (TLU, 250 kg body weight), and daily milk yield were 383.6±61.8 kg/cow, 6.61±1.61 kg/TLU, and 8.86±4.47 kg, respectively. Across all cattle, estimated daily $EntCH_4$ emission was 118 ±28.0 g/TLU. Across seasons, summer showed lower (111±27.7 g/TLU) $EntCH_4$ emissions than monsoon (119±26.9 g/TLU) and winter (124±27.3 g/TLU) ($p < 0.05$). Lactating cows showed higher $EntCH_4$ emissions (120±27.9 g/TLU) than dry cows (113±28.5 g/TLU) and heifers (104±19.6 g/TLU) ($p < 0.05$), while no significant differences ($p > 0.05$) in $EntCH_4$ emissions between breeds. In conclusion, model-based estimation offers an effective and scalable approach for quantifying $EntCH_4$ emissions in Indian dairy systems, with significant seasonal and physiological variation, highlighting opportunities for targeted mitigation strategies within tropical farming contexts.

Keywords: Enteric emission model, enteric methane, feeding trials, tropical livestock unit

Contact Address: Shahin Alam, University of Kassel / University of Goettingen, Animal Husbandry in the Tropics and Subtropics, Steinstrasse 19, 37213 Witzenhausen, Germany, e-mail: shahindps@uni-kassel.de