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Predicting methane emission from dairy farms in southwest Bangladesh: Steps toward supporting data-driven decision model

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Abstract

Enteric methane (CH_4) from ruminants is a significant contributor to anthropogenic greenhouse gas emissions (GHG). The amount of CH_4 lost through enteric fermentation is strongly impacted by the quantity of ingested feed and composition of the diet. However, limited access to advanced methods to measure CH_4 especially in developing countries, including Bangladesh, necessitates the use of modelling approaches, which require constant validation against biological measurements. Therefore, the objective of this study is to estimate and compare enteric CH_4 emission using a) International Farm Comparison Network (IFCN) partial life cycle assessment (LCA) model, which applies IPCC Tier 1 and Tier 2 methodologies to estimate farm-gate GHG, and b) a laboratory-based approach using in-vitro gas and CH_4 production measurements generated by Hohenheim Gas Test for farm specific diet ingredients. The input data for the IFCN model were collected from nine typical farms selected through a survey of approximately 400 dairy farms from the southwest region of Bangladesh. Feed samples were collected from these farms and analysed at the University of Göttingen. The daily dry matter intake (DMI; 8.6-13.6 kg/cow) and concentrate proportions of the diets (40.8-62.5 % DM) varied across farms. The NDF content of the diets was between 41.9 and 57.1 % DM. Among other factors, this likely contributed to the variability in CH_4 emissions. Annual *in-vitro* CH_4 emissions associated with DMI ranged from 1,705-2,676 kg CO_2-equivalent/cow, with emission intensities between 0.83 to 1.11 kg CO_2 equivalent/kg solid corrected milk (SCM). Model predictions differed in their agreement with *in-vitro* values, with farm level deviations. Emission intensities estimated by IFCN Tier 1 approach ranged from 0.78-1.13 kg CO_2 equivalent/kg SCM, with deviations of -15.90 % to +12.06 %, and an overall mean deviation of -1.20 ± 8.15 %, while the Tier 2 approach resulted in 0.84 – 1.20 kg CO_2 equivalent/kg SCM, with deviations between -18.2 % and +16.9 % (mean deviation −5.0 ± 10.14 %). Overall, both laboratory and model-based approaches showed similar trends depending on the specific farm conditions, indicating that the IFCN framework can serve as a viable alternative to laboratory-based estimation under certain conditions.

Keywords: IFCN, *in vitro*, LCA, methane emission, milk production

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