

Comparing Predicted Methane Conversion Factors to Measured Values from Beef Cattle Feed Trials

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For the 1,224 housed beef cattle in the UK and Ireland included in this study, the IPCC Tier 2 Guidelines underestimate the proportion of energy consumed that was lost to enteric methane by an average of 10-16%.



Figure 1: Bar chart of Ym Δ per trial. Ym Δ = the percentage difference between the relevant Ym value from the IPCC Tier 2 Guidelines and the Ym value measured by each feed trial.

Background & Methods

- Carbon Calculators and LCAs often rely on the IPCC Tier 2 Guidelines¹.
- The proportion of energy consumed that is lost as enteric methane (Ym) is the most influential variable in these calculations for beef cattle².
- There is a lack of empirical validation of the IPCC Tier 2 Ym values.



- Through a systematic review, this study identified 79 feed trials that measured emissions from 1224 housed beef cattle. Additional trials from the METH-ABATE Project (DAFM No 2019R479) were also included.
- Measured Ym was calculated using reported gross energy intake (GEI) and CH_4 emissions and compared against the IPCC Tier 2 Ym values.



Figure 3: Jitter plot of Ym Δ categorised by grouped breed.

3 Conclusion & Implications

This study finds a systematic underestimation of Ym by the IPCC Tier 2 Guidelines¹ for housed beef cattle in the UK and Ireland.

Figure 2: Scatter plot of Ym Δ plotted against daily enteric methane emissions. Data points are categorised by the method used to measure enteric methane.

Results & Discussion

- The Ym values given by the IPCC underestimate measured Ym for housed beef cattle in the UK and Ireland by an average of 16% (Fig. 1).
- A significant correlation between measured emissions and Ym underestimation was found (Fig. 2).
- Studies using the SF_6 tracer method reported higher emissions (Fig. 2)
- Under certain conditions the SF₆ method can overestimate emissions³, which may be skewing the finding of this study.
- If SF₆ is excluded, the correlation between emissions and Ym Δ becomes non-significant and mean Ym Δ falls from 16% to 10%.
- Figures 3 and 4 show a non-significant correlation between breed, gross energy intake, or feed forage content and Ym Δ .
- Accurate Ym estimates are critical as Ym is directly proportional to total emissions from enteric fermentation.
- Given enteric methane's large contribution to beef sector emissions, minor inaccuracies in Ym can significantly impact emission inventories.
- This work underscores the need for regionally-specific Ym estimates that consider local climate, herd and feed characteristics.



Figure 4: Jitter plot of Ym Δ categorised by GEI and forage content.

- 1. IPCC, 2019. 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Published: IPCC, Switzerland.
- 2. Karimi-Zindashty, Y., Macdonald, J.D., Desjardins, R.L., Worth, D.E., Hutchinson, J.J., Vergé, X.P.C., 2012. Sources of uncertainty in the IPCC Tier 2 Canadian livestock model. J. Agric. Sci. 150, 556–569.
- 3. Deighton, M.H., O'Loughlin, B.M., Williams, S.R.O., Moate, P.J., Kennedy, E., Boland, T.M., Eckard, R.J., 2013. Declining sulphur hexafluoride permeability of polytetrafluoroethylene membranes causes overestimation of calculated ruminant methane emissions using the tracer technique. Animal Feed Science and Technology 183, 86–95.



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