Unravelling Emissions Calculators for Small-Scale, Diversified Farms

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Background

Small-scale diversified agriculture plays a critical role in sustainable food systems, yet its greenhouse gas (GHG) emissions are poorly understood due to data gaps and modeling challenges. The Intergovernmental Panel on Climate Change (IPCC) provides tiered methods for estimating emissions (Fig. 1).

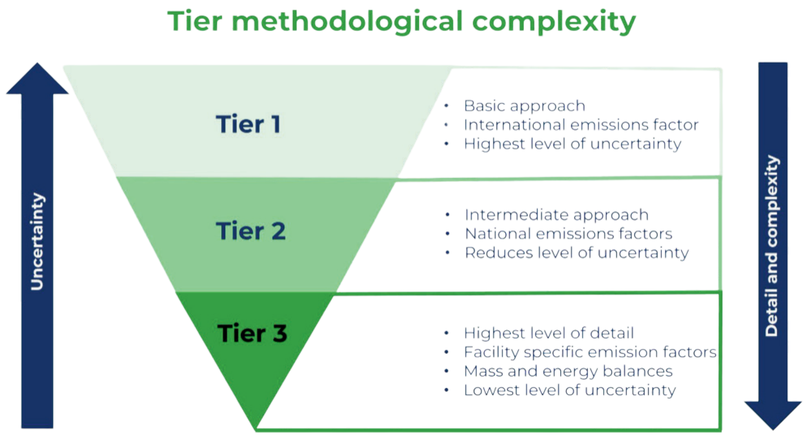

Figure 1: Tier methodological Complexity [1]

Objectives

Evaluate the capacity of existing GHG emission calculators to model emissions from small-scale diversified farms and propose a framework to enhance these models for better accuracy and applicability.

Case Study

- Nitrous oxide emission measurements collected from a farm research site in central Alberta
  May through September 2024
- Results show a discrepancy between measured and predicted emissions (Fig. 2)
  Estimated values were generated using Holos, a tool for Canadian farms to estimate GHG emissions and explore mitigation strategies [2], and the Cool Farm Tool, a global tool to measure carbon footprint and identify mitigation options for crops and livestock [3].
- This highlights the need for locational specificity and alignment on methodology

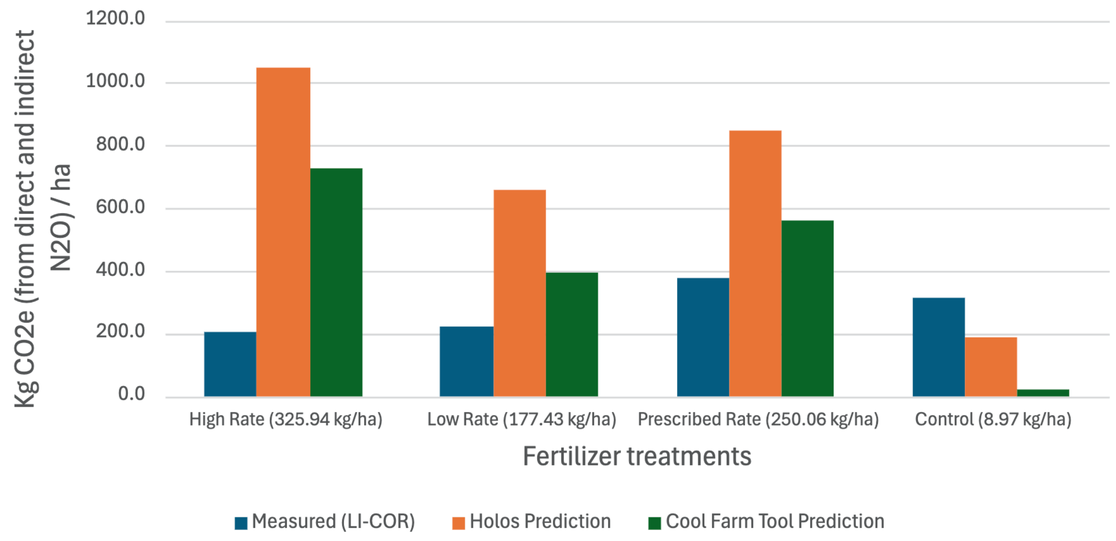

Figure 2: Comparison between measured and predicted (modelled) emissions for varying fertilization treatment plots.

Challenges

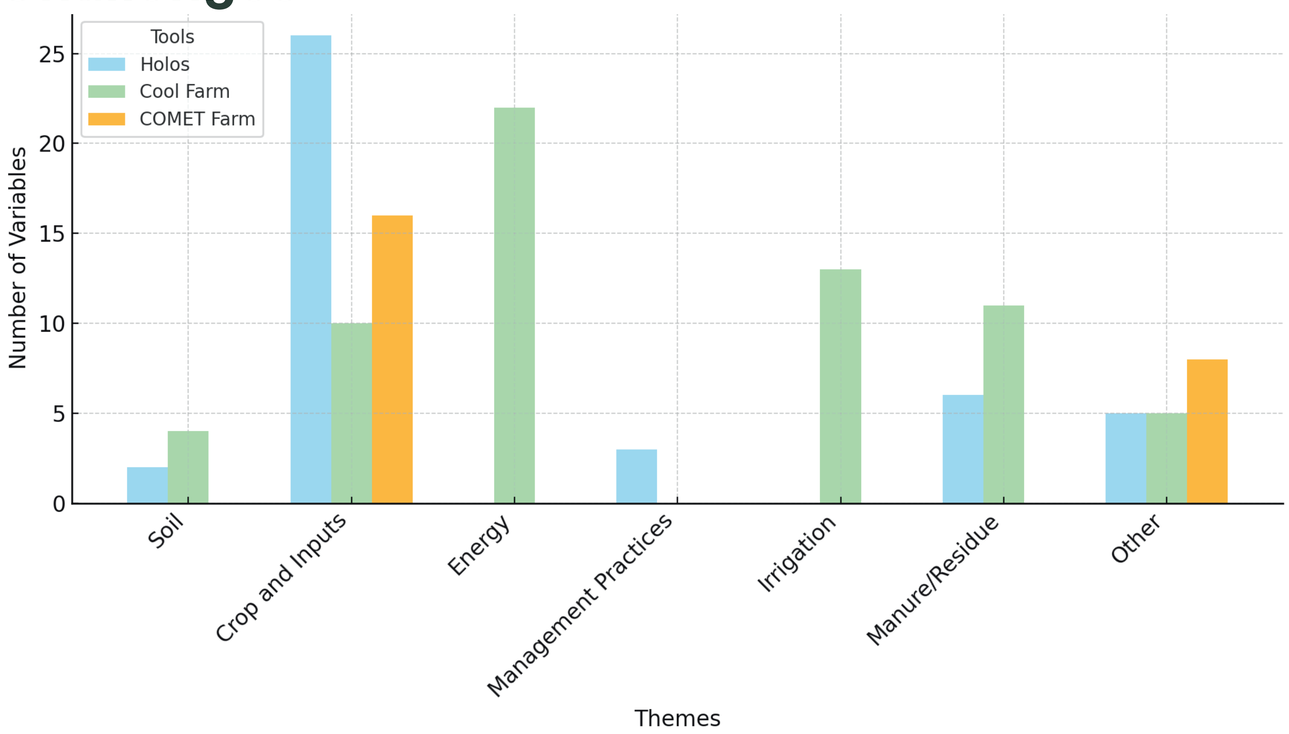

Figure 3: Variable Distribution Across Holos, Cool Farm Tool, and COMET Farm

Key challenges for emissions estimation

Technical Challenges

- Hierarchy of modelling approaches
- Trade-offs: scientific rigour vs farm realities
- Aggregation and information loss
- Heterogenous variable requirements

Practical Challenges

- Extensive but diverse documentation
- Minimizing data entry for farmers
- High certainty needed for adoption
- Prioritizing variables for documentation recommendation

Next Steps

Workflow of Common Farm Convention Tool:

Step 1. Data Collection

Farmers use the LiteFarm app to log detailed farm data, including fertilizer usage and crop types, which is stored in a centralized database for processing.

Step 2. Data Standardization

The Common Farm Convention schema is applied to format the collected data consistently for integration with GHG emission estimation tools.

Step 3. GHG Estimation

Standardized data serves as input for GHG emission models like Cool Farm Tool and Holos to calculate a farm's emissions. Users can select their preferred calculator, though some may need extra data inputs.

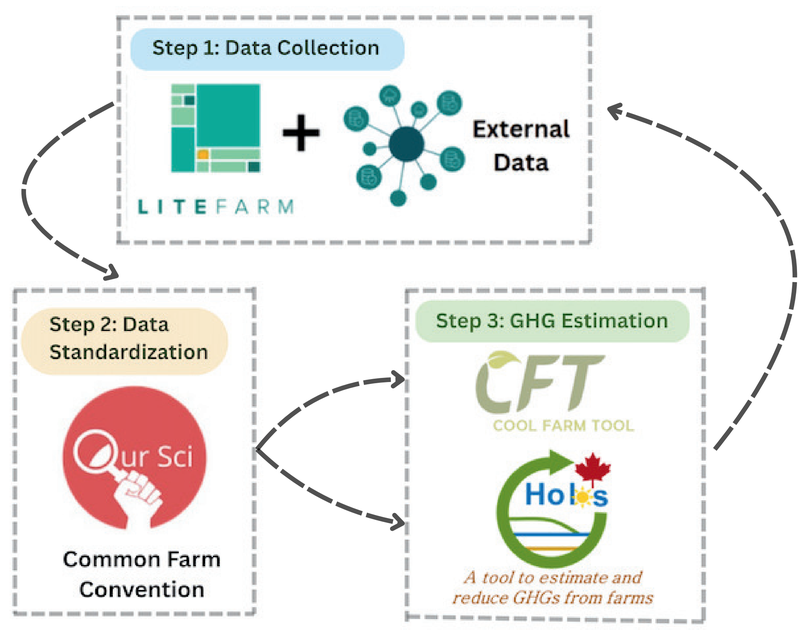

Figure 4: Framework of the Common Farm Convention

Reference:
[1] Booysen, J., Booysen, W., & Kleingeld, M. (2018). A RISK MANAGEMENT STRATEGY TO IDENTIFY AND PRIORITISE FACTORS AFFECTING INDUSTRY'S CARBON TAX LIABILITY. The South African Journal of Industrial Engineering, 29(3), 26–39. https://doi.org/10.7166/29-3-2046
[2]Canada, A. and A.-F. (2023, October 11). Government of Canada. Agriculture and Agri-Food Canada. https://agriculture.canada.ca/en/agricultural-production/holos
[3]Carbon Footprint Calculator: Measure Water & Biodiversity. Cool Farm Tool | An online greenhouse gas, water, and biodiversity calculator. (2024, October 17). https://coolfarm.org/