Greenhouse gas emissions: A dairy systems approach

The Challenge

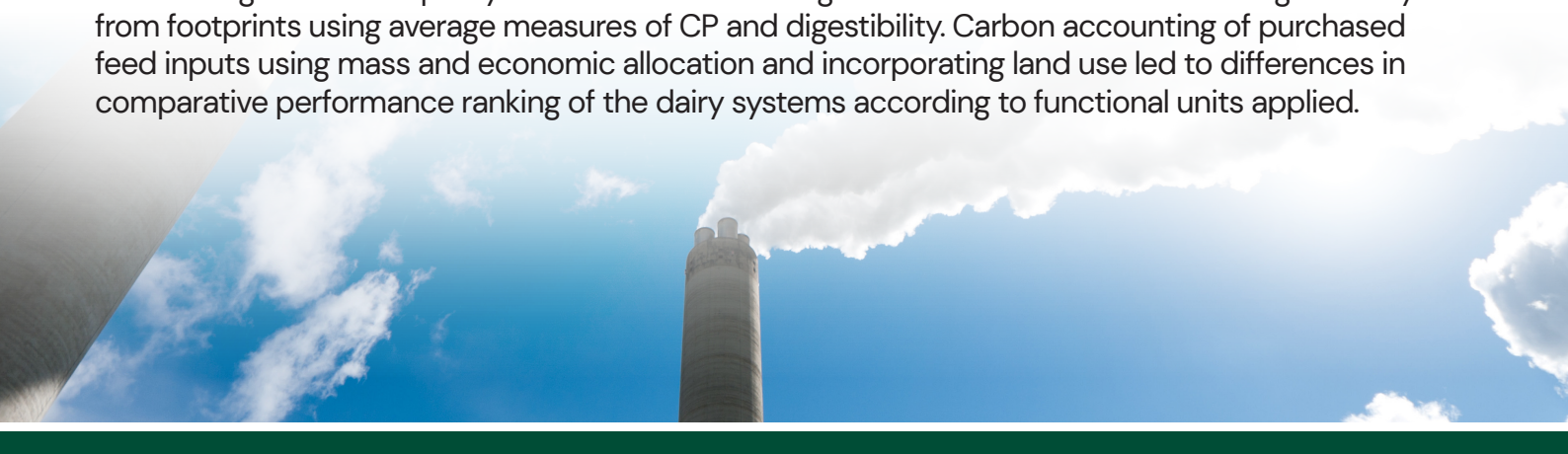
The science and practise of farming is changing to meet the needs of the environment. One key challenge is to reduce greenhouse gas (GHG) emissions by lowering the carbon footprint associated with dairy production. To meet mandatory emissions targets, mitigation measures implemented based on farm management type will become increasingly important. An improved understanding of emission sources across a range of production systems is required.

The Research

Dairy production systems data was gathered from diverse lines of Holstein Friesians managed on a range of diets during several phases of the Langhill study. The dataset provides a unique resource to allow life cycle assessment (LCA) and modelling of GHGs associated with the production of milk within different feeding and housing regimes. The research focussed on assessing differences in GHG emission types stemming from high production and UK average production cows managed within Low Forage and By-product housed, and High Forage and Homegrown grazed dairy systems. GHG's were calculated using SRUCs Agrecalc carbon foot-printing tool. The effect of introducing home grown legumes and co-product feeds was determined and further investigations were carried out to determine the effect of nutritional quality brought about through changes in diet digestibility and dietary crude protein (CP).

The Results

Control merit footprints across each of the management regimes were significantly higher in comparison with Select merit (i.e. higher producing) cattle, on average by 15%. In comparison with Select merit animals, livestock emissions and embedded emissions (purchased feeds, fertilizer, and pesticides) were significantly higher for the Control merit herds. GHGs emitted from the systems were shown to be significantly different in total and source category emissions. Figure 1 shows system differences in the high production Select merit footprints by emission source. Results considering nutritional quality of the rations stemming from natural variation differed significantly from footprints using average measures of CP and digestibility. Carbon accounting of purchased feed inputs using mass and economic allocation and incorporating land use led to differences in comparative performance ranking of the dairy systems according to functional units applied.



The Impact

Dairy system carbon footprint results should be expressed using multiple units and where possible calculations should incorporate variation in diet digestibility and crude protein content. Using an economic allocation, a localised home-grown feeding regime had the highest carbon footprint, however, this more self-sufficient system was associated with the lowest footprint using mass allocation and attracted the lowest area-based emissions, when not considering milk output. This result suggests the need for dairy system carbon footprint results to be expressed in multiple units and to be mindful that methods used to allocate inputs can affect outcomes.

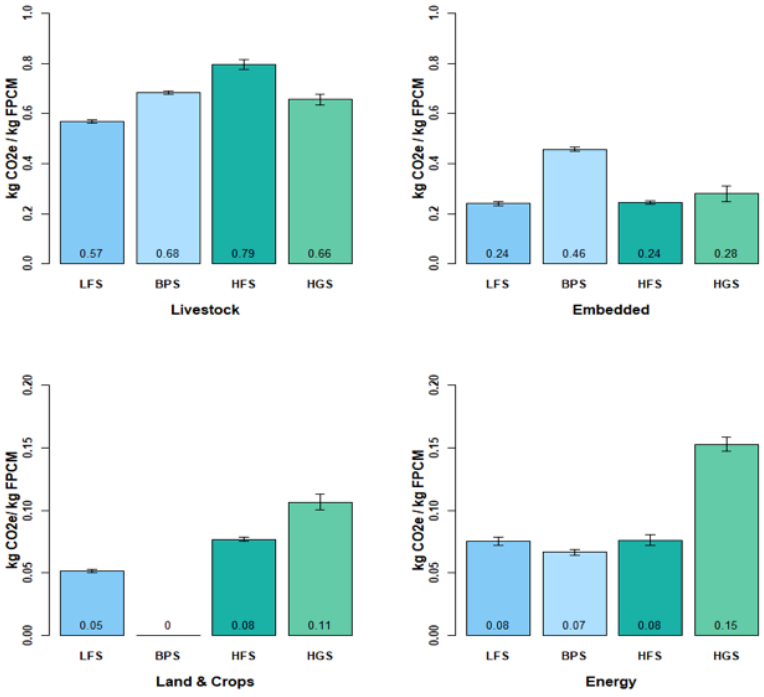
The Future

It is expected that to achieve economy-wide reductions in agricultural greenhouse gas emissions, a series of indicators should be considered alongside methods using fat and protein corrected milk output in order to guide the delivery of policy objectives.

Additional Information:

March et al., 2021. Effect of nutritional variation and LCA methodology on the carbon footprint of milk production from Holstein Friesian dairy cows, Frontiers in Sustainable Food Systems-Climate-Smart Food Systems. Links to website: **https://www.true-project.eu/about-true/**

Figure 1. Dairy system mean GHG's by emission source type with standard error



LFS=Low Forage Select, BPS=By-product Select, HFS=High Forage Select, HGS=Home Grown Select

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