Tropentag, September 9-11, 2020, virtual conference

"Food and nutrition security and its resilience to global crises"

Quantifying On-farm Greenhouse Gas Emissions in Smallholder Livestock Systems in Western Kenya: Life Cycle Assessment

Phyllis Ndung'u[1], Taro Takahashi[2], Linde Du Toit[1], Melanie Robertson-Dean[3], Lutz Merbold[4], Svenja Marquardt[4], John Goopy[4]

[1] *University of Pretoria, Dept. of Animal and Wildlife Sciences, South*
[2] *Rothamsted Research, United Kingdom*
[3] *University of New England, School of Science and Technology, Australia*
[4] *International Livestock Research Institute (ILRI), Mazingira Centre, Kenya*

Abstract

Low productivity combined with increasing livestock populations is resulting in negative environmental effects such as greenhouse gas (GHG) emissions (methane (CH_4) and nitrous oxide (N_2O)) among African livestock systems. This study aims at quantifying the GHG emissions intensities (EIs) of cattle in smallholder farms in Western Kenya using primary field data in order to show the distribution of farm EIs across counties and assess the total crude protein (CP) output. Emission intensities were quantified using the life cycle assessment (LCA) technique, a "cradle to farm gate" systems boundary was adopted, and with milk and meat being the primary outputs. Crude protein was chosen as the functional unit to harmonise milk and meat outputs. Enteric CH_4 emissions were estimated with a metabolisable energy requirement (MER) approach. Simultaneously, three manure management systems were identified i.e. manure left on pasture, cattle enclosures such as bomas, and manure piles and subsequent emissions of CH_4 and N_2O were estimated using accurate and appropriate yield conversation factors for CH_4-C and N_2O-N. The median farm emission intensity for the counties Nandi, Bomet and Nyando were 67, 66 and 135 kg CO_2-eq/kg CP respectively. Despite the fact that all investigated smallholder farms are low-input systems, farm EIs varied substantially with Nyando having higher variation than Nandi and Bomet counties caused by a wider range of production level. Milk CP contributed 80–85 % and meat CP 15–20 % to the total farm output. Enteric CH_4 contributed the largest proportion (up to 95 %) of all GHG emission sources. Quantile regression analysis revealed that specific management features such as herd size, proportion of females in the herd and average parity were highly influential to EI at the farm level, irrespective of agro-ecology. Both meat and milk were significant drivers of EI across all quantiles but mean milk yield per cow, (rather than milk production per farm) was the most important driver of EI. Pursuing these characteristics as focused management objectives have the potential to move low input smallholder farms towards high emissions efficiency operations, reducing GHG emissions per unit of milk and meat produced and potentially lowering GHG emissions from ruminant production.

Keywords: African livestock system, crude protein, emission intensity, GHG emission, primary field data, quantile regression analysis

Contact Address: Phyllis Ndung'u, University of Pretoria, Dept. of Animal and Wildlife Sciences, Lynnwood road, Hatfield, 0002 Pretoria, South, e-mail: wanjuguphyllis@ymail.com