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Improved Greenhouse Gas Emissions and Nutrient Losses Estimates from Manure of Kenyan Smallholder Dairy Farmers

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Abstract

African agriculture produces 15 % of the global agricultural greenhouse gas (GHG) emissions, with 25 % of these GHG emissions from the African continent attributed to manure and manure management. To date few studies are available that focus on manure management within smallholder dairy farming systems and the subsequent GHG emission estimates. There is need to improve GHG inventories in sub-Saharan African (SSA) countries. The study region was located in western Kenya and prior to data collection stratified into three agro-ecological zones (AEZs). From the zones, we identified animal confinement systems, main manure management systems and duration of storage of manure. CH_4 and N_2O emissions from manure management were then estimated for the region using both Tier 1 and Tier 2 IPCC guidelines. GHG flux measurements from manure piles that were collected from the animal confinements previously characterised, were carried out using non-flow through, non-steady state GHG chambers. Measurements lasted for a period of 90 days. Leachate was collected daily via an inbuilt drainage tube with solid manure sampled from the heaps periodically. Annual CH_4 and N_2O emissions from manure management systems in Nandi County using Tier 1 were 0.22 Gg CH_4 yr^{-1}, 0.16 Gg N_2O yr^{-1} and categorization of manure management systems for SSA leads to lower Bo and hence lower MCF and lower Tier 2 CH4 emissions (0.002 Gg CH_4 yr^{-1} and 0.031 Gg N_2O yr^{-1}) than Tier 1. Methane emission factors from manure management were higher using the Tier 2 than the currently used Tier 1. The confinement systems "Fence Only", "Fence and Roof" and "Fence, Roof and Floor had significant differences in cumulative CH_4 but not for cumulative N_2O emissions. Mean nitrogen (N) lost from the manure through leaching ranged from 2.0 g N to 2.1 g N. This study provides a mechanism to improve Tier 2 GHG emission calculations for manure management in smallholder farming systems in SSA that could help identify practices to reduce GHG emissions originating from agriculture. The over 40 % loss of nutrient N from manure provides for further justification on the need to improve manure management for smallholder farmers. Furthermore, improved manure management allows smallholder farmers to benefit from the manure are fertiliser by returning essential nutrients to the soil.

Keywords: Dairy, East Africa, greenhouse gases, manure, smallholder

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