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Greenhouse Gas Emissions and Fertiliser Quality from Cattle Manure Heaps in Kenya

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Abstract

Livestock farming is essential for smallholder farmers in sub-Saharan Africa (SSA) whose livelihoods depend on it. In addition, manure is an important nitrogen source for croplands, because mineral fertiliser is often unaffordable for smallholders. But manure emits 10–25 % of agricultural greenhouse gases (GHG), and due to poor feeding and manure management manure fertiliser quality is low. There are few *in situ* measurements of manure GHG emissions from SSA, and agricultural GHG budgets from African nations rely largely on IPCC default values, which might not represent smallholder farms well. To address this knowledge gap, we conducted two manure incubation experiments in Kenya, using manure from local Boran (*Bos indicus*) cattle fed with local feeds. Manure was collected daily and piled in uncovered heaps, representing the most common manure storage in Kenyan smallholder systems. CH_4 and N_2O emissions were measured over 140 days. In the first trial, cattle were either fed at 120 % maintenance-energy requirement (i.e. receiving enough food to support their metabolism), or at sub-maintenance energy levels to simulate feed scarcity, common particularly during the dry season. Manure N_2O emissions from hungry cows were lower than from cattle fed at maintenance energy levels because of lower manure-N concentration and a wider C:N ratio, indicating lower fertiliser quality. Furthermore, in sub-maintenance cows excreted N shifted from urine-N (mostly inorganic) to faecal-N (mostly organic), indicating higher resistance to decomposition and conversion to N_2O. Across all diets, manure N_2O and CH_4 emissions were lower than the IPCC default emission factors for solid storage in tropical regions. In the second trial, Boran cattle were fed with three tropical forage: Napier (*Pennisetum purpureum*), Rhodes (*Gloris gayana*), and *Brachiaria* (*Brachiaria brizantha*). Manure from the Rhodes grass diet had the lowest N concentration and the lowest CH_4 emissions, whereas manure from the *Brachiaria* diet had a slightly better fertiliser quality. N_2O emissions did not differ between diets. Again, CH_4 and N_2O emissions were lower than IPCC default factors. These results help reducing uncertainties in agricultural GHG emissions in SSA. If African nations use IPCC default values for GHG reporting, emissions are likely to be overestimated.

Keywords: Boran cattle, fertiliser quality, methane, nitrous oxide, smallholder farms

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