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

Sonja Leitner1, Donal Ring2, George Wanyama1, Daniel Korir1, David Pelster3, John Goopy1, Lutz Merbold1

1 International Livestock Research Institute (ILRI), Mazingira Centre, Kenya
2 Trinity College Dublin, Dept. of Botany, Ireland
3 Agriculture and Agri-Food Canada, Canada

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. CH4 and N2O 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 N2O 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 N2O. Across all diets, manure N2O and CH4 emissions were lower than IPCC default factors. 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 CH4 emissions, whereas manure from the Brachiaria diet had a slightly better fertiliser quality. N2O emissions did not differ between diets. Again, CH4 and N2O 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

Contact Address: Sonja Leitner, International Livestock Research Institute (ILRI), Mazingira Centre, Kabete Campus, Old Naivasha Rd., 00100 Nairobi, Kenya, e-mail: s.leitner@cgiar.org