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Greenhouse gas emissions from traditional livestock enclosures in Kenya and options for mitigation

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Abstract

Livestock in semi-arid pastoral rangelands is often corralled overnight in traditional enclosures ("bomas" or "kraals") to protect them from theft and predators. Manure is usually not removed from bomas but is left to accumulate, building thick manure layers that are hotspots for greenhouse gas (GHG) emissions in the landscape. Here, we present a full year of measurements of manure CH_4 and N_2O emissions from cattle bomas in Kenya. We found that GHG flux rates from bomas were elevated by several orders of magnitude compared to background savannah fluxes, with mean fluxes of 325 ± 11 μg N_2O-N m^{-2} h^{-1} and 3245 ± 234 μg CH_4-C m^{-2} h^{-1} for active bomas, and 610 ± 186 μg N_2O-N m^{-2} h^{-1} and 3127 ± 1262 μg CH_4-C m^{-2} h^{-1} for abandoned bomas, while surrounding savannah soils only emitted 2.5 ± 2.2 μg N_2O-N m^{-2} h^{-1} and 0.1 ± 0.7 μg CH_4-C m^{-2} h^{-1}. At the farm scale, boma manure contributed little (2.2 %) to total CH_4 emissions, which were dominated by enteric CH_4 emissions (97.6 %); but bomas were a substantial source for N_2O, contributing over 32 % to total N_2O emissions on the farm. Annual manure emission factors were 2.43 ± 0.42 %N for N_2O and 0.49 ± 0.07 %C for CH_4, which corresponds to 2.64 ± 0.37 g CH_4 kg^{-1} volatile solids (VS). However, boma emissions are currently not captured in IPCC inventories because there is no category for them, and countries do not collect activity data for this emissions source. This likely leads to an underestimation of livestock GHG emissions from pastoral rangelands in sub-Saharan Africa. To mitigate boma GHG emissions, we suggest that manure should be removed regularly, or bomas should be relocated every few days/weeks to prevent excessive manure build-up and redistribute nutrients across the landscape. Boma manure can be used as fertiliser to grow crops and livestock feeds, preventing nutrient mining and ensuring rangeland productivity and resilience.

Keywords: Boma, kraal, manure, methane, nitrous oxide

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