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The Effects of Climate on Decomposition of Cattle, Sheep and Goat Manure in Kenyan Tropical Pastures

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Abstract

Decomposition of manure deposited onto pasture from grazing animals represents an important process for carbon (C) and nitrogen (N) cycles in grassland systems. However, most decomposition studies focus on plant litter while studies investigating manure decomposition are scarce; especially in sub-Saharan Africa (SSA). In this study, we measured decomposition of three types of animal manure (cattle, sheep, goat) over > 1 year using litter bags at four climatically different sites across Kenya. Manure dry matter, total C, total N and ammonium concentrations decreased exponentially, with the most rapid decrease occurring during the first few weeks following application, followed by slower changes during the following 2–3 months. Rates of N mineralisation were lower than those for C mineralisation, resulting in decreasing C/N ratios over time, indicating N retention and immobilisation by the decomposing manure. Generally, cattle manure decomposed faster than sheep or goat manure despite having a higher initial C/N ratio and lower N concentration, with decomposition rates for dry matter ranging from 0.200 to 0.989 k year⁻¹. Overall, we found that >30% of cattle manure mass and >50% of sheep and goat manure mass remained after 378 days. Cellulose decomposed first, while lignin concentrations increased among all manure types and at all sites. We found that total manure decomposition rates were positively correlated with cumulative precipitation and aridity index, but negatively correlated with mean temperature. Our results show much slower decomposition rates of manures in semi-arid tropical environments of East Africa as compared to the few previous studies in temperate climates.

Keywords: Cellulose, climatic conditions, lignin, litter bags, manure, mineralisation, sub-Saharan Africa (SSA)