Exploring diversity in soil fertility management of smallholder farms in western Kenya II. Within-farm variability in resource allocation, nutrient flows and soil fertility status

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Received 26 May 2004; received in revised form 14 March 2005; accepted 6 April 2005
Available online 10 May 2005

Abstract
Strong gradients of decreasing soil fertility are found with increasing distance from the homestead within smallholder African farms, due to differential resource allocation. As nutrient use efficiency varies strongly along these gradients, such heterogeneity must be considered when designing soil management strategies, aimed at an improved overall resource use efficiency at farm scale. Here, we quantify the magnitude and study the origin of farmer-induced, within-farm soil fertility gradients as affected by biophysical and socio-economic conditions, and investigate farmers' perceptions of such heterogeneity. Farm transects, participatory resource flow mapping, farmers' classification of land qualities, and soil sampling for both chemical and spectral reflectance analyses were performed across 60 farms in three sub-locations (Emuhaia, Shinyalu, Aludeka) representing the variability found in the highlands of western Kenya. Differences between the various field types of a farm were observed for input use (e.g. 0.7–104 kg N ha_1), food production (e.g. 0.6–2.9 t DM ha_1), partial C (e.g._570 to 1480 kg ha_1) and N (e.g. _92 to 57 kg ha_1) balances and general soil fertility status, despite strong differences across sub-locations. Concentration of nutrients in the home fields compared with the remote fields were verified for extractable P (e.g. 2.1–19.8 mg kg_1) and secondarily for exchangeable K (e.g. 0.14–0.54 cmol(+) kg_1), on average, whereas differences for soil C and N were only important when considering each individual farm separately. Farmers managed their fields according to their perceived land quality, varying the timing and intensity of management practices along soil fertility gradients. Fields classified by them as poor were planted later (up to 33.6 days of delay), with sparser crops (ca. 30% less plants m_2) and had higher weed infestation levels than those classified as fertile, leading to important differences in maize yield (e.g. 0.9 versus 2.4 t ha_1). The internal heterogeneity in resource allocation varied also between farms of different social classes, according to their objectives and factor constraints. Additionally, the interaction of sub-location-specific socio-economic (population, markets) and www.elsevier.com/locate/agee

Agriculture, Ecosystems and Environment 110 (2005) 166–184
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