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## Soil Fertility Variability Influenced by Resource Endowment and Farmer Knowledge in Smallholder Farming Systems of DR Congo

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### Abstract

Variability in soil fertility was investigated in eastern DR Congo. Three farmers' typologies were defined based on their resource endowment (wealthy, intermediate and poor status), where land size and market access were considered as the main criteria. It was hypothesised that the level of resource endowment is reflected in soil fertility status. Hence, based on farmers' perception on soil fertility, a gradient of 96 households was investigated in four field survey implementation sites: Bushumba centre, Mulengeza, Madaka and Luduha characterized by contrasting agro-ecologies and market access. A total of 384 soil samples from randomly selected farms were collected and analysed for their major nutrients. To reduce laboratory chemical analysis, about 30% of the samples set was subjected to wet lab analysis, whereby the remainder was calculated by midMIDRIFT-PLSR based predictions. Accuracies of midMIDRIFT-PLSR based predictions across resource endowment were, on basis of the residual prediction (RPD), “acceptable” for soil total carbon ( $R^2 = 91.58$ ; RPD = 3.46), total nitrogen ( $R^2 = 85.6$ ; RPD = 2.71), and pH ( $R^2 = 88.7$ ; RPD = 3.02). The measured and predicted values were then subjected to analysis of variance using a mixed model that considered agro-ecology, typology (resource endowment), and soil depth as random terms. This statistical analysis revealed a large variability among farms in total soil C (1.13–3.33 %), total soil N (0.08–0.53 %), available soil P (0.72–97.16 mg kg<sup>-1</sup>), soil Ca (1.02–1.42 cmol(+) kg<sup>-1</sup>), and soil Mg (0.81–0.99 cmol(+) kg<sup>-1</sup>). Moreover, variability in pH (4.06–6.07) differed significantly between the studied sites (agro-ecology effect), while only exchangeable K exhibited a difference (29–870 cmol(+) kg<sup>-1</sup> with marginal farms having low extractable K content compared to fertile plots, respectively) regarding farmers' knowledge on soil fertility status. Generally, soil nutrients decreased significantly with reduced farm resource endowment with respect to land size and distance to market access which were identified as entry points to approach soil fertility improvement in the studied area. In conclusion, variability between sites, agroecology and market access provided certain evidence on the soil nutrient status serving as baseline for adequate interventions on prospective soil productivity management of smallholder farms in the studied region.

**Keywords:** Agroecology, market access, soil variability, typology classes