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Soil Fertility Gradients in the Smallholder Cropping Systems in Limpopo Province, South Africa

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Abstract

Maintaining soil fertility is key for the low input smallholder cropping systems in southern Africa. However, due to resource limitations, these farmers are often constrained to provide the necessary input to avoid nutrient mining. Hence, farmers tend to apply the available fertiliser in the nearby homestead fields, while the remote fields are typically neglected, causing a decline in soil fertility. Nevertheless, these patterns are known to be very site-specific (climate, inherent soil properties, socioeconomic conditions). To verify this hypothesis, we assessed in smallholder systems of Limpopo, four distinct sites (Selwana, Gabaza, Tsiphuseni, and Mafarana). Only farmers (58) with both field types were assessed. In total, 116 soil samples were collected and analysed following the indicators of soil fertility. The differences between field types were evaluated across all sites by Tukey's test. The results indicated that, across all sites, the fields that are close to home have a conducive pH (6.0 – 7.5) while remote fields remained acidic (4.0 – 4.8). Furthermore, the mean available P and extractable Zn were also significantly higher on homestead fields (63.95 mg kg^{-1} dry soil and 25.62 mg kg^{-1}, respectively) and lower on distant fields (13.61 mg kg^{-1} and 1.36 mg kg^{-1} respectively). However, no significant differences were observed across all sites for SOC between homestead fields (0.97 %) and remote fields (0.98 %). Additionally, the mean extractable K was significantly higher on homesteads in Gabaza (573 mg kg^{-1} against 99.1 mg kg^{-1}) while the mean extractable Cu and Mn remained significantly lower on homesteads in Gabaza and Mafarana (9.22 mg kg^{-1} against 11.16 mg $kg^{-1}$for Cu and 14.33 mg kg^{-1} against 22.46 mg kg^{-1} for Mn). Soil fertility variability in smallholder systems of Limpopo can be explained by farmer's management practices that resulted in the allocation of nutrient resources on preferred fields. Consequently, soil fertility gradient patterns are true, and strongly observed for pH, available P, and extractable Zn. SOC, on the other hand, was found to be driven by the inherent soil properties – soil texture. This study suggested that soil fertility gradients should be considered when sustainable intensification pathways are discussed for the region.

Keywords: Organic carbon, smallholder systems, soil fertility gradients

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