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Soil Related Constraints for Sustainable Intensification of Cereal-based Systems in Semi-arid Central Tanzania

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Abstract

Improved management of land is critical to overcome soil related constraints to sustainable food production in degraded soils. However, limited availability of site-specific nutrient management guidelines for semiarid zones in Tanzania may undermine efforts to target technologies to biophysical and/or socio-economic conditions in which they operate. Thus technologies adopted under these circumstances may be risky to farmers. We characterised soils in Kongwa and Kiteto districts to assess the nature and fertility status and drivers of land degradation so as to inform the development of integrated land management options for sustainable intensification. Both landscape- (Land Degradation Surveillance Framework-LDSF) and field-based sampling approaches were used to collect soil data (nutrients, carbon levels, infiltration rates and types) and ecological data (land use types, tree cover and density). Remote sensing and GIS techniques were used to prepare base-maps and generate clusters of plots within a 10m × 10m block (sentinel). At field level, standard mapping techniques were used to open, describe, and sample soils from profile pits in 5 villages in Kongwa and Kiteto districts. Results showed that soils belonged to Lixosols (Laikala, Mlali and Molet Villages), Luvisols (Manyusi, Njoro and Laikala villages) and Vertisol (Mlali) orders. Generally soils in these villages had poor to moderate fertility, especially for CEC and exchangeable bases. Soil total nitrogen and organic carbon ranged from very low to low. Aridity indices revealed that Molet has steppe characteristics while other villages are semi-arid with a very short growing period of 2–3 months. Only 9% of land in the Njoro sentinel is under cultivation and the rest is grazing land and forests (Acacia woodlands). The carrying capacity for livestock exceeded the optimum and tree cover was low 84.3 stems ha⁻¹ compared to 268.9 stems ha⁻¹ for shrubs. These factors are the major reasons for high land degradation noted in the district. To sustain crop production, soils will require inputs of fertilisers (N&P) and manure to replenish nutrients and build-up of organic carbon. Additionally integrating leguminous trees/shrubs or retention of trees in agricultural landscapes would enhance vegetation cover, carrying capacity of grazing lands in addition to improving soil health and land productivity.

Keywords: Carrying capacity, land management, LDSF, livestock, soil health