

Effect of the organic materials application on soil properties of the banana-based homegardens in northwestern Tanzania

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Key Words: Livestock, banana-based farming, soil nutrient, Kagera, Tanzania

The Haya people in Kagera region located in northwestern Tanzania have mostly grown bananas as a staple food in a unique farming system for centuries. The farming system is characterized by the intensive banana-based homegardens with nutrient input as livestock manure and mulch grass from the open common grassland. In this study, to reveal relationship of the organic materials application to agricultural productivity in the study site (Kamachumu ward located in Kagera region), effect of livestock manure on soil properties was quantitatively evaluated with a focus on soil pH, total carbon (TC), total nitrogen (TN), available phosphorus (AvP), cation exchange capacity (CEC) and total exchangeable base (K^+ , Na^+ , Ca^{2+} , Mg^{2+}) in the soil profile (0-60-cm depth).

Field survey was conducted in Kamachumu ward (1°37' S and 31°37'E) in 2018 and 2019. In order to understand the actual way of farming, mainly focusing on their application of organic materials, questionnaire survey was conducted at 46 households where soil samples were collected from two layers (0-30 and 30-60 cm depth) and each homegarden size was also measured by using a portable GPS. Relationships between livestock density and soil properties in each soil layer were analyzed for 22 homegardens out of the 46 households.

The results revealed that livestock density in each household had a positive correlation with soil pH, AvP and CEC in the soil profile (0-60 cm) while it didn't have a significant correlation with TC, TN and total exchangeable base (Table 1). It is, therefore, suggested that the soil characteristics (soil pH, AvP and CEC) in the homegardens can be improved by applying the organic materials originating from open common grassland as manure obtained through biological concentration with livestock. Thus, it is concluded that organic materials application affects the soil properties in the homegardens by neutralizing soil pH, increasing AvP, and enhancing the soil nutrient-holding capacity which are expected to lead to improvement of banana productivity in the study site.

Table 1. Correlation coefficient between livestock density and soil properties across the two layers (N = 22)

| | pH (H ₂ O) | pH (KCl) | TC (g kg ⁻¹) | TN (g kg ⁻¹) | AvP (mg kg ⁻¹) | CEC (cmol _c kg ⁻¹) | TEB (cmol _c kg ⁻¹) |
|--------------------|-----------------------|----------|--------------------------|--------------------------|----------------------------|---|---|
| Livestock density | | | | | | | |
| Topsoil (0-30 cm) | 0.61* | 0.65* | 0.27 | 0.41 | 0.67* | 0.58* | 0.29 |
| Subsoil (30-60 cm) | 0.41 | 0.50* | -0.01 | 0.14 | 0.52* | 0.38 | 0.26 |

* = P < 0.05 (the Student's t-test)