

Research Article

Evaluation of Physicochemical Properties of Sandy-Textured Soils under Smallholder Agricultural Land Use Practices in Sarawak, East Malaysia

Soo Ying Ho , Mohd Effendi Bin Wasli , and Mugunthan Perumal 

Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

Correspondence should be addressed to Soo Ying Ho; sherylsooying@gmail.com

Received 11 October 2018; Revised 21 December 2018; Accepted 3 January 2019; Published 6 February 2019

Academic Editor: Rafael Clemente

Copyright © 2019 Soo Ying Ho et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

A study was conducted in the Sabal area, Sarawak, to evaluate the physicochemical properties of sandy-textured soils under smallholder agricultural land uses. Study sites were established under rubber, oil palm, and pepper land uses, in comparison to the adjacent secondary forests. The sandy-textured soils underlain in all agricultural land uses are of Spodosols, based on USDA Soil Taxonomy. The soil properties under secondary forests were strongly acidic with poor nutrient contents. Despite higher bulk density in oil palm farmlands, soil properties in rubber and oil palm land uses showed little variation to those in secondary forests. Conversely, soils under pepper land uses were less acidic with higher nutrient contents at the surface layer, especially P. In addition, soils in the pepper land uses were more compact due to human trampling effects from regular farm works at a localized area. Positive correlations were observed between soil total C and soil total N, soil exchangeable K, soil sum of bases, and soil effective CEC, suggesting that soil total C is the determinant of soil fertility under the agricultural land uses. Meanwhile, insufficient K input in oil palm land uses was observed from the partial nutrient balances estimation. In contrast, P and K did not remain in the soils under pepper land use, although the fertilizers application by the farmers was beyond the crop uptake and removal (harvesting). Because of the siliceous sandy nature (low clay contents) of Spodosols, they are poor in nutrient retention capacity. Hence, maintaining ample supply of organic C is crucial to sustain the productivity and fertility of sandy-textured soils, especially when the litterfall layers covering the E horizon were removed for oil palm and pepper cultivation.

1. Introduction

In recent decades, the transition of agrarian land uses from traditional shifting cultivation to commercial cash crops systems in Sarawak, Malaysia, has been widely discussed [1–7]. Following the trends of growth in socioeconomic conditions and needs for monetary economy, the reduction and intensification of shifting cultivation practices, formerly known as the central agricultural practices, in Sarawak were highlighted by many researchers [8–11]. Nonetheless, the introduction of high-input agriculture, that is, pepper and oil palm cultivation starting in the 1960s under various government subsidy schemes is rapidly expanding among the smallholder farmers across the regions of Sarawak [4–7, 12–15]. As reported by various researchers [8–10, 12, 13, 16, 17], the initiation of permanent cash crop

farmlands, shortening of fallow period, and increasing dependency to agrochemicals in management practices are the indication of intensification in agricultural land use practices in Sarawak.

Expansion of monocropping plantation and establishment of permanent forest estates or national parks have put an immense pressure on the availability of arable land for agricultural activities among smallholder farmers [2, 4, 6, 12, 18]. On the other hand, factors such as vegetation cover, soil fertility, road accessibility, and labour availability strongly influence the farmer's decision-making in site selection for crops cultivation [8, 9, 19]. Under the current regional pressure of socioeconomic condition and land use change, some farmers have no other alternatives but to conduct the agricultural activities on any available land, including the gray or white sandy-textured soils, considering