Effects of Different Land Uses on Availability of Three Major Soil Nutrients in Wet Zone Low Country 3 (WL3) Agro-Ecological Region, Sri Lanka

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Introduction

High population density and population distribution percentage coupled with uncontrolled industrialization and urbanization due to the expansion of development activities, increase the pressure exerted on land resource, especially in peri-urban areas such as Gampaha District in Sri Lanka. Hence, land area under the administrative boundary of Gampaha District belongs to Wet zone Low country 3 (WL3) agro ecological regions, also shows a higher affinity to population pressure exerted on land resource. Furthermore, soil quality decline due to the extensive pressure on land is one of the three major soil degradation processes of Sri Lanka. Also, an anthropogenic induced variation in soil nutrient dynamics plays a key role in soil quality decline in the country (Mapa, 2003). Thus, if the depleted nutrients are not properly replenished or surplus inputs were not remediated properly, decline of soil quality will be accelerated. It is therefore necessary to determine the extent to which land use affects nutrient availability of soil to maintain and improve soil quality of different land uses such as agriculture.

Research Problem

Since extensive land use patterns lead to a variations in soil nutrient dynamics, there's a growing need for information relating to the current status of the soil nutrient availability along with its responses to different land uses in order to prioritize soil nutrient management specially in the areas with high population pressure exerted on the land in Sri Lanka.

However, the availability of such information is limited in Sri Lanka, in comparison to the global scale. According to the studies conducted in different regions of the world, soil quality declines with the intensive use of land (Carmen et al, 2008; Chhetri, 2007; Gebrelibanos and Assen, 2013).A similar trend was observed in the studies conducted in the Wet zone Low country 2 (WL2) agro ecological region in Matara District (Wanniarachhi and Shyamalee, 2005). Hence, the significance of conducting a comparative study in other agro ecological regions to acknowledge the effect of land use on soil quality

can be understood. Wet zone Low country 3 (WL3) agro ecological region of Gampaha District is significant among other agro ecological regions due to its vulnerability towards the reduction of soil quality. Since the official authorities intend to expand development activities to peri-urban areas from the Colombo metropolitan region, peri-urban areas such as Gampaha District, may face rapid land use changes.Since uncontrolled industrialization and urbanization also a source of environmental pollution, unsustainable use of natural resources such as soil may result. Furthermore, high population density coupled with a high population distribution percentage will result in a competition among land uses further increasing the pressure exerted on land resource. It is also observed that the area have naturally acidic soil further increasing the vulnerability towards the reduction of soil quality.Therefore, the significance of data related to the influence of land use on soil bio-chemical quality is evident in regions susceptible to decline in soil quality such as Wet zone Low country3(WL3) agro ecological region. Additionally, generated data could be utilized in prioritizing land management activities and sustainable use of soil.

Objective

The main objective of the study was to assess the effect of four different land uses (built-up, intensive agricultural - Coconut plantation, home garden, and natural vegetation) on the availability of three major soil nutrients (Available Nitrogen, Available Phosphate and Exchangeable Potassium) in WL3 agro ecological region, Sri Lanka.

Research Methodology

The study was based on the primary data generated by quantitatively analysing concentrations of major soil nutrients of surface soil samples from randomly selected four replicated (n=4) land use types (built-up, intensive agricultural - Coconut plantation, home garden, and natural vegetation) in the WL3 agro ecological region of Sri Lanka. A total of sixteen soil samples were collected in July, 2014. Subsequently, the air dried samples were analysed for Available Nitrogen (KCl extraction method), Available Phosphorus (Olsen method) and Exchangeable Potassium (Ammonium acetate extraction). The results were statistically analysed using analysis of variance (ANOVA) for significant difference between land uses and the respective nutrient concentrations.

Key Findings

The comparison of major soil nutrient concentrations between four different land uses indicated that the different land uses have different effect on soil nutrient availability.According to the statistically analysed results shown in Table 1, P values were lower than 0.05 in Available Phosphorus and Available Nitrogen with reference to the land uses indicating a significant variation among four land uses at 95% confidence level. Furthermore, it was also noted that Available Phosphorus and Available Nitrogen were significantly higher in intensive agricultural land use (Coconut plantations) than that of other land uses. However, Exchangeable Potassium did not show significant variation among four land uses at 95% confidence level.

Table 1: Mean Values of Soil Nutrient Availability under Different Land Uses and Variance Analysis Results Used to Test for Significant Differences in Means of Land Uses

Land use	N	Available N (mg/kg NO_3^- as N)	Available P (mg/kg as P)	Exchangeable K (mg/kg as K)
NV	4	6.476	6.677	60.85
HG	4	7.829	6.528	101.59
IA	4	11.722 *a*	15.801 *a*	49.97
BA	4	7.861	8.086	70.22
P value		**0.001**	**0.008**	**0.523**

Key: BA – Built-up Area, HG – Home garden, IA – Intensive Agriculture land (Coconut plantation), NV – Natural Vegetation
***a* – mean value significantly differs from the corresponding value of natural vegetation at 95% confidence level**

Observation of the highest mean of Available Phosphorus and Available Nitrogen in intensive agricultural lands may be primarily due to the application of chemical inorganic fertilizers. The lower Phosphorus content recorded in the natural vegetation and home garden land uses may be due toavailability of high soil organic matter percentage, which absorb larger amounts of Available Phosphorus causing reduced concentrations in soil(Gebrelibanos and Assen, 2013).Increase of Available Nitrogen in intensive agricultural lands than other land uses may be due to the notably reduced immobilizationrate of inorganic Nitrogen into organic Nitrogen under agricultural soilscompared to soil fund innatural vegetation land use. However, there was no statistically significant difference of Exchangeable Potassium concentrations

between the studied land uses. In addition, the slow release of organic Potassium through the mineralization process, followed by the quick absorbance of Potassium from the soil solution by plants might be the reason behind the overall lower exchangeable Potassium concentrations observed.

Conclusions

The significant increase of Available Nitrogen and Phosphorus in intensive agricultural lands compared to other land uses, further prove the effect on soil nutrientdynamicsbyanthropogenic interventionson land resource such as chemical fertilizer application. Therefore, greater attention is needed to conserve soil nutrientavailability by a proper nutrient management in agricultural land uses.

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