

Short Communication

Impact of Intensive Farming on Soil Fertility Status in Regosols in the Kalpitiya Peninsula

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Introduction

Sandy Regosols of the Kalpitiya peninsula covers a land extent of about 15,420 ha (DS, 2018) and supports a few land uses such as natural shrubs associated with sand dunes, coconut plantations, intensively farmed crop lands and home gardens. Among them, intensively farmed crop lands have been the most profit making agricultural land-use in the peninsula. Major crops cultivated on these intensively farmed crop lands include red onion, chilli, capsicum, cabbage, cauliflower, beet, radish, brinjal, bitter gourd, yard long bean, watermelon, okra and tobacco. Being commercial cultivations, most farmers have used chemical fertilizers, organic manure, agro-chemicals and irrigation through exploitation of groundwater for their cultivations. Factors such as sandy nature of this soil (Dassanayake and De Silva, 2010), over use of chemical fertilizers and organic manure, frequent use of agrochemicals and daily crop irrigation, particularly during dry spells (Kurupparachchi, 1995) collectively contribute to significant changes in soil fertility status towards land degradation. Furthermore, changes

in soil characteristics due to farming activities could adversely affect farm income and pollute groundwater resource in the peninsula (Kumuduni *et al.*, 2020). Thus, the objective of this research was to investigate the present status and periodical changes of pH, electrical conductivity, available phosphorus (P), and exchangeable potassium (K) in kinds used for intensive vegetable cultivation and coconuts in Kalpitiya peninsula.

Materials and Methods

This study was conducted in a transect from Daluwa village near Palaviya to Kandankuliya village near Kalpitiya on Regosols (*Quartzipsamments*) soil in the Kalpitiya peninsula in March 2018 and March 2019. Composite samples from surface (0 – 25 cm) soil were collected from 19 intensively farmed crop lands. Soil samples were collected after harvesting the crops in each location. For comparison purpose, another surface soil sample was drawn from an adjacent coconut land, 6 months after the last fertilizer application. Approximately 0.2 ha of homogenous land unit was selected from both farmed lands for sampling purpose.

Soil samples were air dried and passed through 2 mm sieve were analyzed for pH in 1:1 soil: water suspension, EC in 1:5 soil: water suspension, available P and exchangeable K at the laboratory of Sustainable Agriculture Research and Development Center, Makandura and Agriculture Research Station, Kalpitiya.

The pH and EC were determined by a bench type pH meter (Elemetron pH 5003), by a bench type conductivity bridge (Elemetron conductivity meter) respectively. Available P was determined using Olsen method (Olsen and Sommers, 1982). Exchangeable K was extracted using 1 N ammonium acetate at 7 pH and determined using a flame photometer (Single channel flame photometer 360). Soil test results were analyzed using one way ANOVA at 0.05% level of significance using SAS Statistical package.

Results and Discussion

Changes in soil fertility due to intensive farming

Mean pH of surface soil was 7.0 in 2018 and 7.3 in 2019 in intensively cultivated

lands where as it was 6.9 in 2018 and 7.1 in 2019 in coconut lands. Surface soil pH was similar between the two land-uses ($P>0.05$). Kendaragama (1997) reported a mean pH of 6.5 in surface soils in intensively cultivated lands. This shows an increasing trend in surface soil pH in this soil. Further, soil reaction has a great influence on the availability of plant nutrients, which is generally the highest between pH 6.5 and 7.5 (FAO, 1984). This study shows the occurrence of pH beyond the optimum range in some locations in intensively cultivated and coconut lands in the Kalpitiya peninsula (Table 1).

Mean EC in surface soil was 0.05 dS m^{-1} in 2018 and 0.15 dS m^{-1} in 2019 in intensively cultivated lands, and 0.22 dS m^{-1} in 2018 and 0.07 dS m^{-1} in 2019 in coconut lands. Surface soil EC was similar between the two land-uses ($P>0.05$). Kendaragama (1997) reported a mean EC of 0.06 dS m^{-1} in surface soil in intensively cultivated lands. Mean available P level in surface soil was 48.9 mg kg^{-1} in 2018 and 43.5 mg kg^{-1} 2019 in coconut lands. Mean exchangeable K content in surface soil was 74.5 mg kg^{-1} in 2018 and 69.4 mg kg^{-1}

Table 1. Soil fertility characteristics of intensively vegetable cultivated and coconut cultivated soils in Kalpitiya peninsula

Soil property	March 2018				March 2019			
	Coconut lands		Intensively cultivated lands		Coconut lands		Intensively cultivated lands	
	Mean±SE	Range	Mean	Range	Mean	Range	Mean	Range
pH	6.9±0.16	5.5-7.9	7.0±0.17	5.3-8.4	7.1±0.13	5.9-8.0	7.3±0.13	5.8-7.9
Electrical conductivity (dS m^{-1})	0.22±0.01	0.01-3.0	0.05±0.01	0.02-0.11	0.07±0.01	0.02-0.18	0.15±0.07	0.02-1.57
Available P (mg kg^{-1})	15.2±5.8	3.3-45.3	48.9±6.8	9.6-104.7	21.5±3.7	2.2-56.1	43.5±8.1	5.5-98
Exchangeable K (mg kg^{-1})	51.2±1.42	20-82	74.5±8.45	40-165	46±2.2	12-94	69.4±7.4	31-129

in intensively cultivated lands, and 51.2 mg kg⁻¹ in 2018 and 46.0 mg kg⁻¹ in 2019 in coconut lands. The available P and K levels in surface soil were significantly different between the two land uses ($P < 0.05$). Kendaragama (1997) reported a mean available P level of 39 mg kg⁻¹ in the surface soil in intensively cultivated lands. It shows an increasing trend in available P in surface soil of the intensively cultivated lands. This building up of P and K in intensively cultivated lands has contributed to groundwater pollution (Kumuduni *et al.*, 2020).

Soil fertility changes in intensive farming villages

Mean pH of surface soils in coconut lands showed a significant spatial variation ($P < 0.05$). However, no such variation was observed in intensively cultivated lands. In intensively cultivated lands, the lowest (6.20) and the highest (8.15) mean pH values were recorded from Ethalai Colony and Nawakkaduwa villages, respectively. In contrast, the lowest (6.9) and highest (7.7) mean pH values were recorded from Daluwa and Illanthadi coconut lands, respectively (Table 1). Plant nutrients availability is generally the highest between pH 6.5 and 7.5 (FAO, 1984). However, 21% of the intensively cultivated lands had mean soil pH less than 6.5 and 37% had pH values more than 7.5.

Mean EC of the surface soils in coconut lands and intensively cultivated lands showed a significant spatial variation ($P < 0.05$). In intensively cultivated lands, the lowest (0.025 dS m⁻¹) and the highest (0.84 dS m⁻¹) mean EC values were recorded from Thalawila (South)

and Mampuriya villages, respectively. In coconut lands, the lowest (0.02 dS m⁻¹) mean EC value was recorded from Thalawila (South) and Mampuriya villages, and the highest (0.30 dS m⁻¹) from Daluwa and Kandankuliya villages. Soil EC value was more than 0.1 dS m⁻¹ are generally considered as salt affected due to sea water intrusion towards land and locations such as Manpuriya and Narakkaliya (South) showed this influence.

Mean available P in surface soil in both land-uses showed significant spatial variation ($P < 0.05$). In intensively cultivated lands, the lowest and the highest mean available P values were recorded from Pathimapura and Kandankuliya villages, respectively. In contrast, in coconut lands, the lowest and the highest mean available P values were recorded from Nawakkaduwa and Nawakkaliya (North) villages, respectively.

The critical levels of soil Olsen P for optimal crop yield ranged from 10.9 to 21.4 mg kg⁻¹ (Bai *et al.*, 2013). Over 79% of the intensively cultivated lands had available soil P levels more than 21.4 mg kg⁻¹.

Mean exchangeable K in surface soil had significant spatial variation in both intensively cultivated lands and coconut lands ($P < 0.05$). The lowest (14.5 mg kg⁻¹) and the highest (140.5 mg kg⁻¹) mean exchangeable K values in vegetable lands were recorded from Illanthadi and Daluwa villages, respectively. Similarly, the lowest (16.0 mg kg⁻¹) and highest (85.0 mg kg⁻¹) mean exchangeable K in coconut lands were recorded from Ethalai Colony and Sothapitiya villages, respectively.

Conclusion

The pH and EC were similar between the land uses while available P and exchangeable K concentrations were significantly higher in intensively cultivated lands. It could possibly be due to the excessive application of chemical fertilizers and organic manures in intensively cultivated lands. Moreover, significant variation in P and K was observed among farming villages along the Kalpitiya peninsula. This study suggests the need of modifying farmer practices in chemical fertilizers and organic manure use in intensively farmed crop lands.

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