ASSESSMENT OF SELECTED SOIL PROPERTIES OF DIFFERENT LAND USE TYPES OF ESTATES OF LALAN RUBBERS PVT LTD.

Prepared By

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Introduction

Growing condition of rubber vary greatly due to the variation in soil types, topography, elevation, climatic conditions, and also due to varying management practices implemented by different plantation companies (Yogarathnam, 1992). In general soil fertility especially in the wet zone are relatively lower and continued to degrade due poor land management in most of the land used systems. One of the major reasons for low productivity in plantation sector relates to the poor soil status of most of cultivating lands. It can be due to soil erosion, physical and chemical fixation, and leaching of nutrients. Significant amount of nutrients are removed from the land with the latex harvesting and removal of tree biomass at maturity. To compensate those losses, external supply of all essential nutrients is needed for a sustainable rubber production. In Sri Lanka, nutrients are generally supplied as chemical fertilizers. Ability of obtaining nutrients by rubber is depend on several factors such as nutrient supply capacity of the soil, colonel variation, stage of growth and ground cover management etc.

Nutrient use efficiency (NUE) of applied fertilizer for most of the crops is lower than 40%. One of the reasons for lower NUE is the low organic matter content of the soil. Most of our agricultural lands are having soil organic matter content less than 1%. Variation of organic matter content in the soil medium could be used as a good indicator to compare soil fertility status and overall chemical, physical and biological properties of the soil. Any attempts to enhance the soil organic matter content of the soil either *in-situ* or *ex-situ* means is needed to ensure higher productivity and to improve the buffering capabilities of the soil. Thus, we design this study to compare the important soil properties such as soil organic matter content, pH, and EC of different land use systems in all Estates of Lalan Rubbers (Pvt) Ltd. These information provides a direct indication of the cumulative land and soil management measures implement by the Company.

Methodology

Two soil samples up to a soil depth of 20 cm were collected from each permanent sampling plots (total of 89 plots) established is each land use types from 15 Estates of Lalan Rubbers Pvt Ltd for chemical analysis (Table 1). Using standard analytical procedures soil pH, electrical conductance (EC), soil organic carbon and soil organic matter contents were measured at the Laboratory Complex of the Department of Crop Science, Faculty of Agriculture, University of Peradeniya.

Table 1. Permanent sampling plots of different land use types of 15 Estates where soil samples were taken for analysis

Group/Estate		Different Land use types
Group 1: Sapumalkanda		
Estate: 1	Illukthenna	Natural forest
		Rubber (young)
		Rubber (mature)
		Rubber (old)
		Tea
2	Reucastle	Natural forest
		Rubber (young)
		Rubber (mature)
		Rubber (old)
		Oil palm1
		Oil palm2
		Oil palm3
		Timber (Albizia)
		Timber (Torelliana)
3	Sapumalkande-upper	Natural forest
		Rubber (young)
		Rubber (mature)
		Rubber (old)
		Oil palm1
		Oil palm2
		Oil palm3
		Tea
		Cinnamon
Group 2: Maha Oya		
4	Woodend	Natural forest
		Rubber (young)
		Rubber (mature)
		Rubber (old)
		Oil palm
		HCV Stream
		Coconut
		Tea
		Cinnamon
		Timber
5	Densworth	Natural forest
		Rubber (young)
		Rubber (mature)
		Rubber (old)

		Rubber up-root
6	Mahaoya	Natural forest (PSP)
		Rubber (young)
		Rubber (mature)
		Rubber (old)
		Rubber up-root
		Coconut
Group 3: Udabage		
7	Udabage	Natural forest
		Rubber (young)
		Rubber (mature)
		Rubber (old)
8	Eila	Natural forest
		Rubber (young)
		Rubber (mature)
		Rubber (old)
9	Udapola	Forest PSP
		Rubber (Y)
		Rubber (M)
		Rubber (O)1999
		Tea
		Rubber uprooted
Group 4: Miyanawita		
10	Miyanawita	Natural Forest
		Timber (Turpentine)
		Tea
		Rubber (Y) 2011
		Rubber (M) 2003
11	Dabar	Timber
		Rubber (Y) 2012
		Rubber (M) 2003
		Rubber up-rooting
Group 5: Pitiyakanda		
12	Notinghill	Natural Forest
		Rubber (Y) 2006
		Rubber (M) 2002
		Rubber (O) 1985
		Timber (Kaya)
		Coconut
13	Muwankanda	Natural Forest
		Rubber (Y) 2010
		Rubber (M) 2002
		Rubber (O) 1989
		Coconut
		Cinchona
		Cinnamon
14	Pitiyekanda	Natural Forest
		Rubber (Y) 2010
		Rubber (M) 2003
		Rubber (O) 1991
		Coconut
15	Keppetigala	Natural Forest
		Rubber (Y)
		Rubber (M)1989
		Coconut

Results

Results of each soil parameter measured are compared across different land use types for a given estate of major groups of Lalan Rubbers Pvt Ltd are presented separately.

Group 1: Sapumalkanda

Estate 1: Illukthenna

a) Soil pH

The pH values of all the land use types are ranged between 4.5and 5.5. Suitable pH range for rubber growth is around 4.5. Therefore, the pH levels of all most all the land use types of Illukthenna estate are in the acceptable range (Figure 1a).

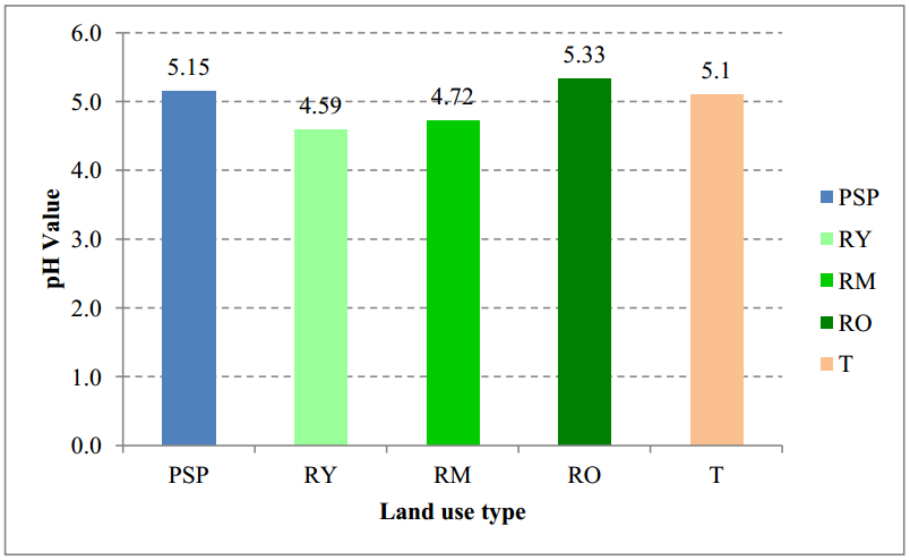

Figure 1a: Variation of pH values in different land use types of Illukthenna estate. (Abbreviations: PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, T:Tea).

b) Electrical conductivity (Ec) of soil

The variation of Ec of different land use types are shown in the figure 1b. Ec is lower in the land use types of Young Rubber (YR) and Tea (T) cultivations. None of the fields were having salinity issues since all Ec values are well below the 4000 µS/cm or 4 dS/m (USDA Standard level of soil salinity).

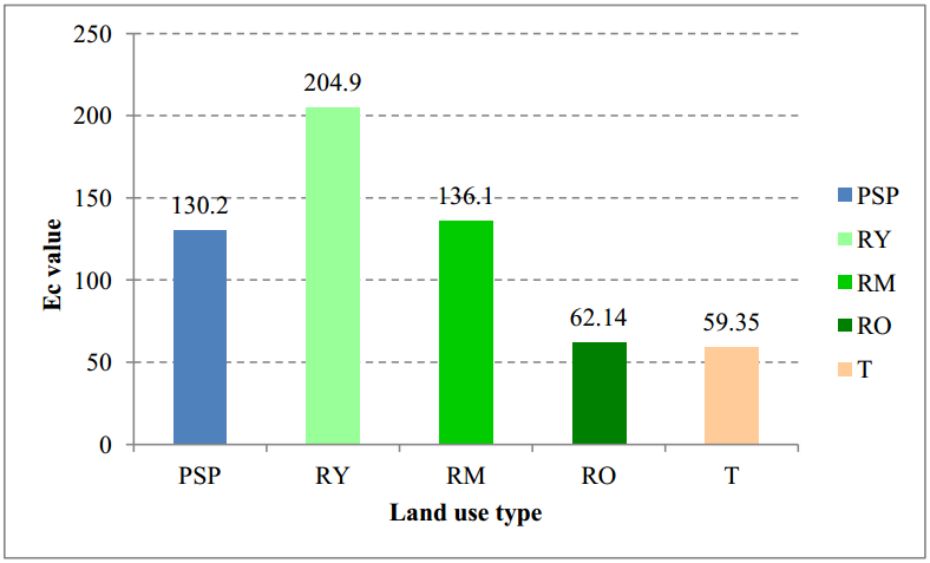

Figure 1b: Variation of Ec (µS/cm) values with different land use types of Illukthenna estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, T:Tea).

c) Soil organic matter (OM) content

Soil organic matter percentage is high in all the land use types of illukthenna estate except in mature rubber fields (Figure 1c). High soil organic matter percentage is an indication of higher fertility status of the soil. When the rubber fields became mature, the growth of cover crops is reduced. That may be the reasons for having low organic matter in the mature rubber fields.

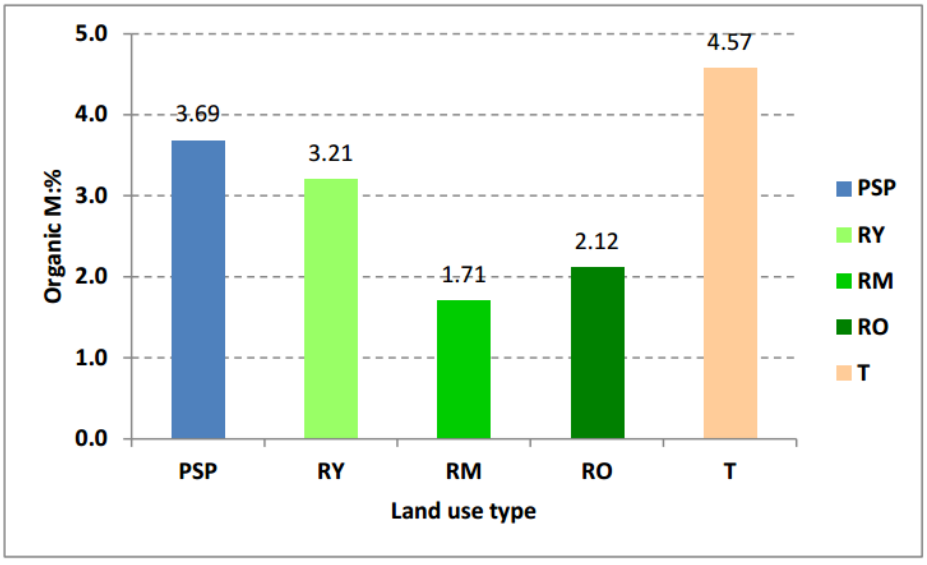

Figure 1c. Variation of soil organic matter percentage in different land use types of Illukthenna estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, T:Tea).

Estate 2: Rucarstle

a) Soil pH

The pH value of all the land use types are ranged around pH level of 4.5 (Figure 2a). Therefore, soil pH levels are in suitable range and it has not been affected by agronomic practices carried out by the Estate.

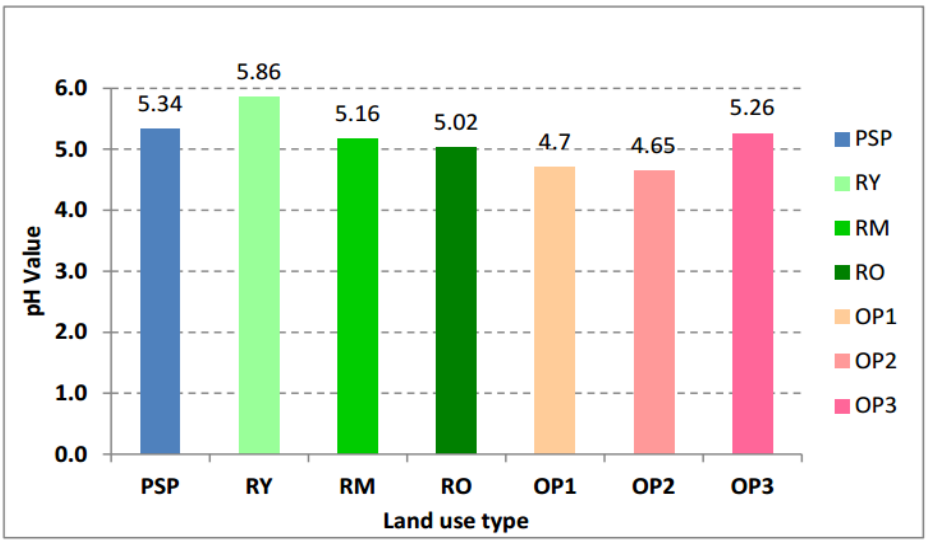

Figure 2a. Variation of soil pH in different land use types of Rucarstle Estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm).

b) Soil Ec

The soil Ec values of all the land use types in Rucarstle estate are lower and there is no any salinity developments (Figure 2b)

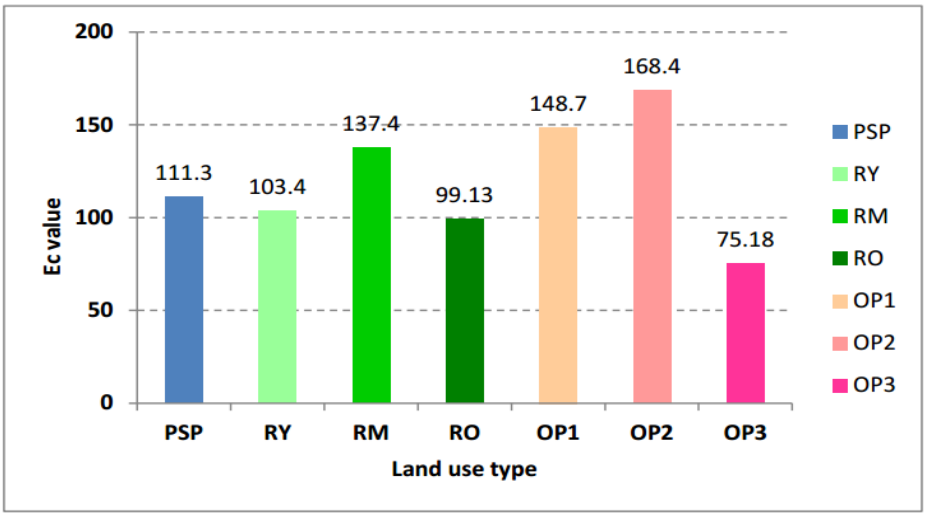

Figure 2b. Variation of Ec levels (µS/cm) in different land use types of Rucarstle Estate. (Abbreviations used,PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm).

c) Soil organic matter content

Soil organic matter percentages are comparatively high in all the land use types in Rucarstle estate except in the Rubber Mature (RM) and Rubber Old (RO) (Figure 2c). This low amount of soil organic matter percentages may be due to the suppression of growth of cover crops with the age of rubber filed due to increase shading.

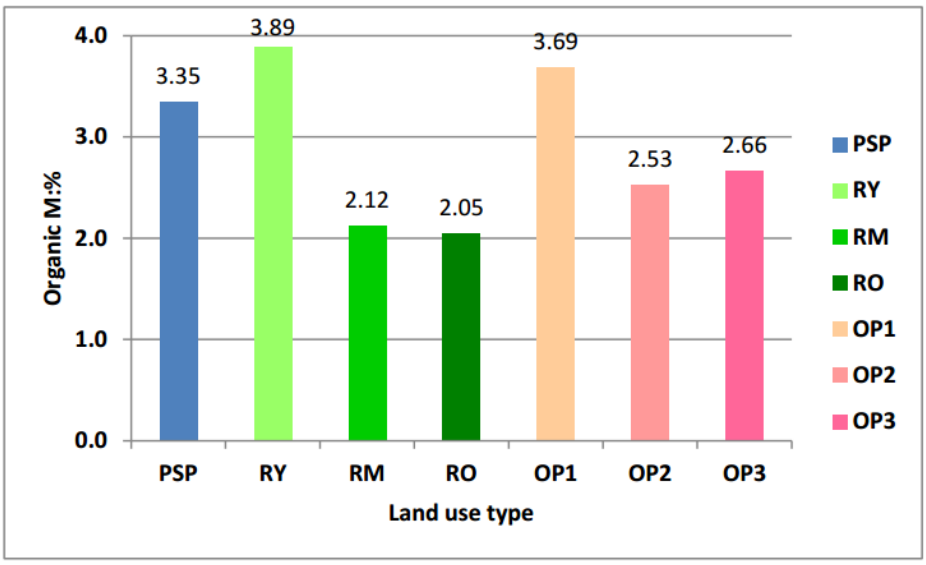

Figure 2c. Variation of soil organic matter content in different land use types of Rucarstle Estate (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM: Mature Rubber, RO:Old Rubber, OP: Oil Palm).

Estate 3: Sapumalkanda

a) Soil pH

All land use types of Sapumalkanda estate were having pH levels in the acceptable range (figure 3a)

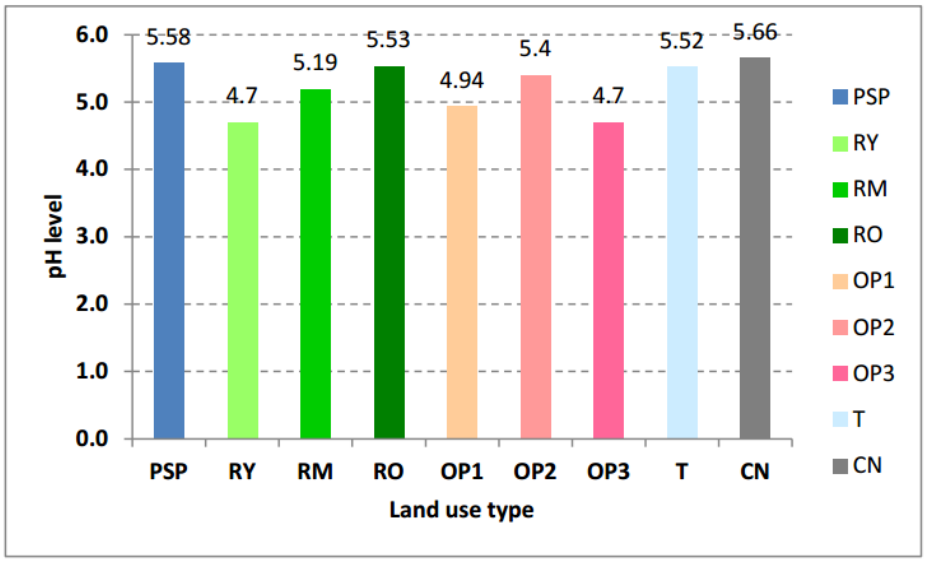

Figure 3a. Variation of soil pH in different land use types of Sapumalkanda estate.(Abbreviations used; PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm,T:Tea,CN: Cinnamom).

b) Soil Ec

Though the Ec values are comparatively high in the land use type of Tea (T) and Oil palm of site 3 (OP3), values are well below the threshold level of soil salinity level (Figure 3b).

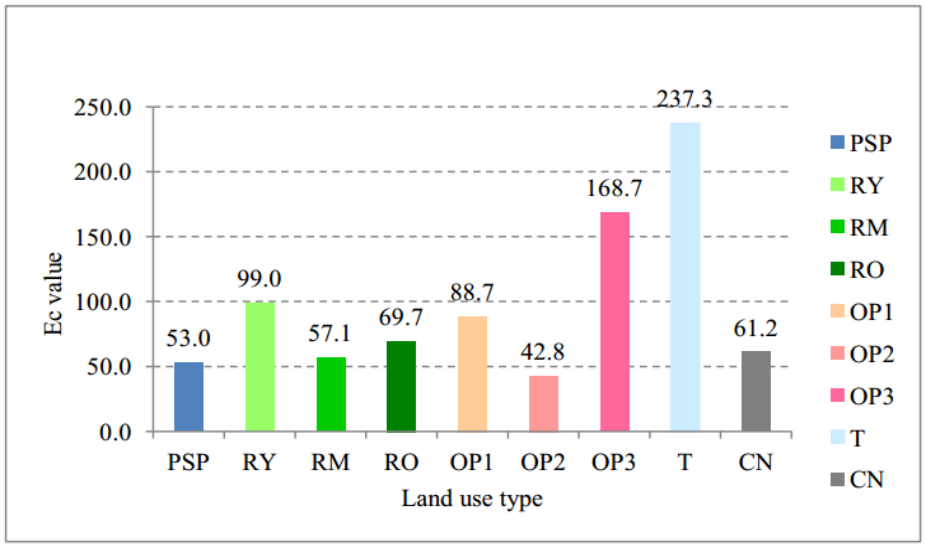

Figure 1 3b: Variation of soil Ec levels (µS/cm) in different land use types of Sapumalkanda estate. (Abbreviations: PSP:Natural forest, RY: Young Rubber, RM: Mature Rubber, RO:Old Rubber, OP: Oil Palm,T:Tea,CN: Cinnamon).

c) Soil organic matter content

Soil organic matter contents were high in all the land use types except in the land use type of Oil Palm of site 3 (OP2) (Figure 3c). This is due to fact that this field was recently uprooted and soil was exposed.

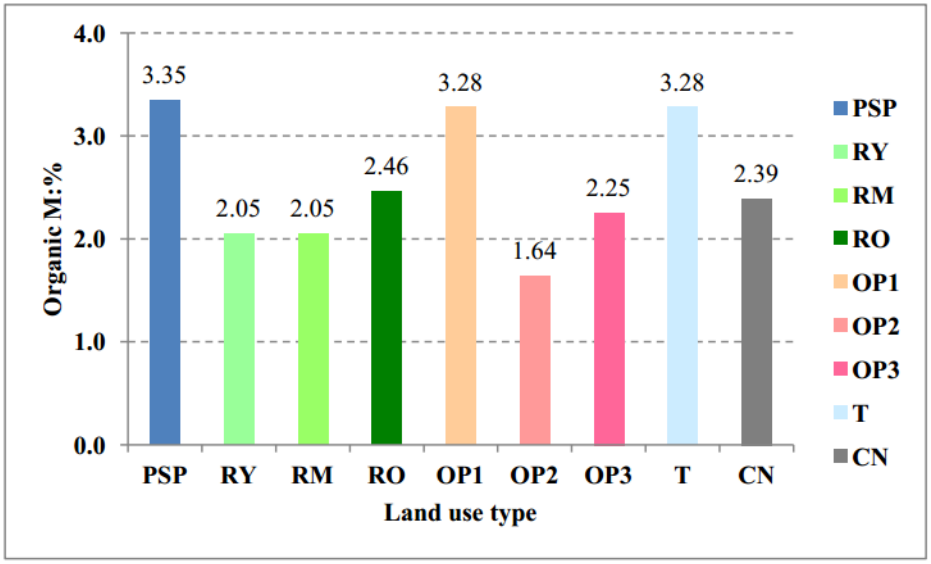

Figure 3c: Variation of soil organic matter percentage in different land use types of Lalan rubber (Pvt). (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm, T:Tea, CN: Cinnamom).

Group 2: Maha Oya Group

Estate 4: Woodend

a) Soil pH

Soil pH values of all the land use types are ranging from 4.4 and 5.7 and are in the acceptable range (Figure 4a).

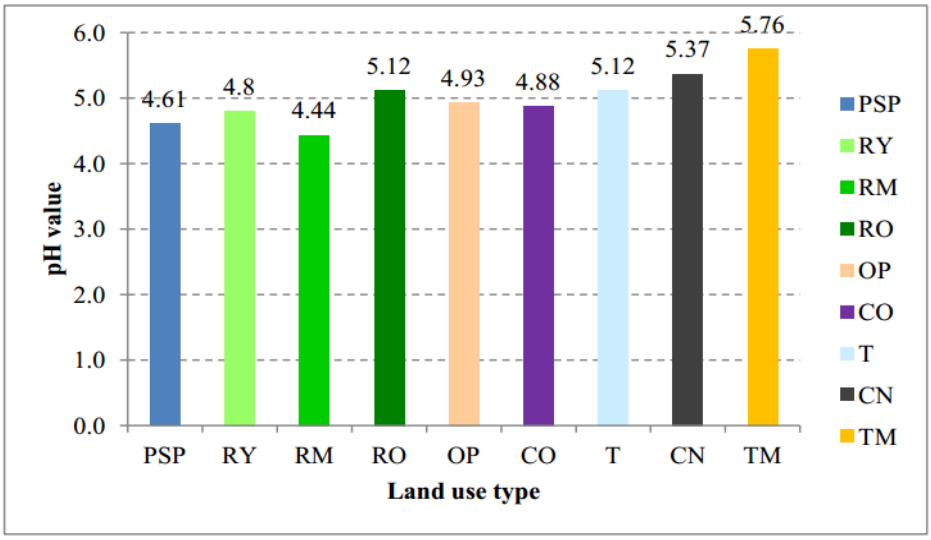

Figure 4a: Variation of soil pH levels in different land use types of Woodend estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm, T:Tea, CN: Cinnamon, TM: timber).

b) Soil Ec

The Ec values of all land use types are lower than the threshold soil salinity level (figure 4b).

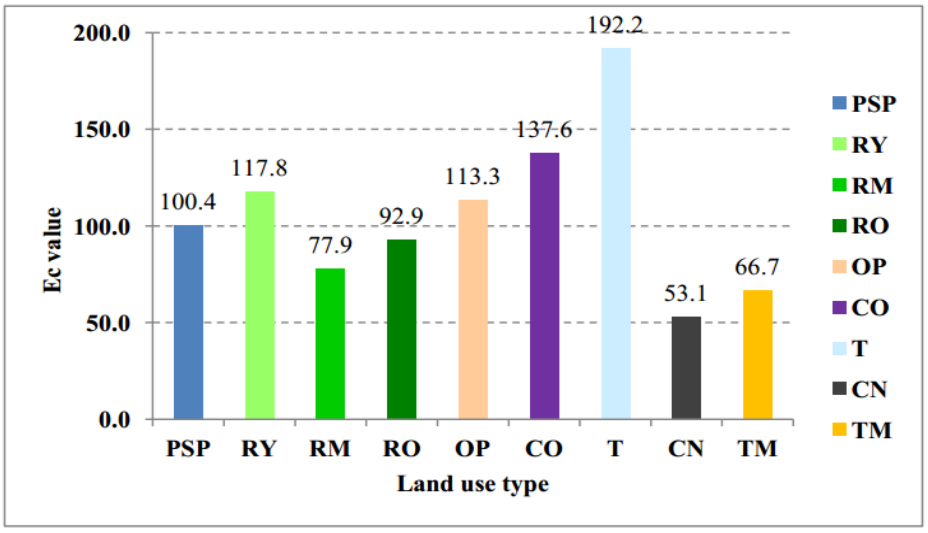

Figure 4b: Variation of soil Ec values (µS/cm) in different land use types of Woodend estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM: Mature Rubber, RO:Old Rubber, OP: Oil Palm, T:Tea, CN: Cinnamon, TM: Timber).

c) Soil organic matter content

Soil organic matter contents were higher in natural forest and timber blocks compared to other land use types (Figure 4c).

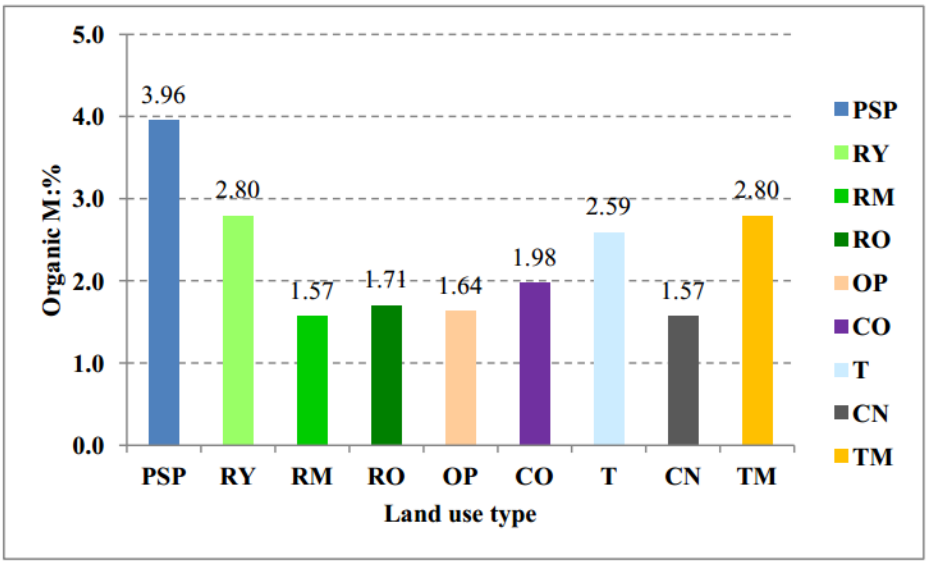

Figure 4c: Variation of soil organic matter percentages in different land use types of Woodend estate. (Abbreviations used, PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm, T:Tea, CN:Ccinnamon, TM: Timber).

Estate 5: Denseworth estate

a) *Soil pH*

Soil pH values of all land use types are in the acceptable range (Figure 5a)

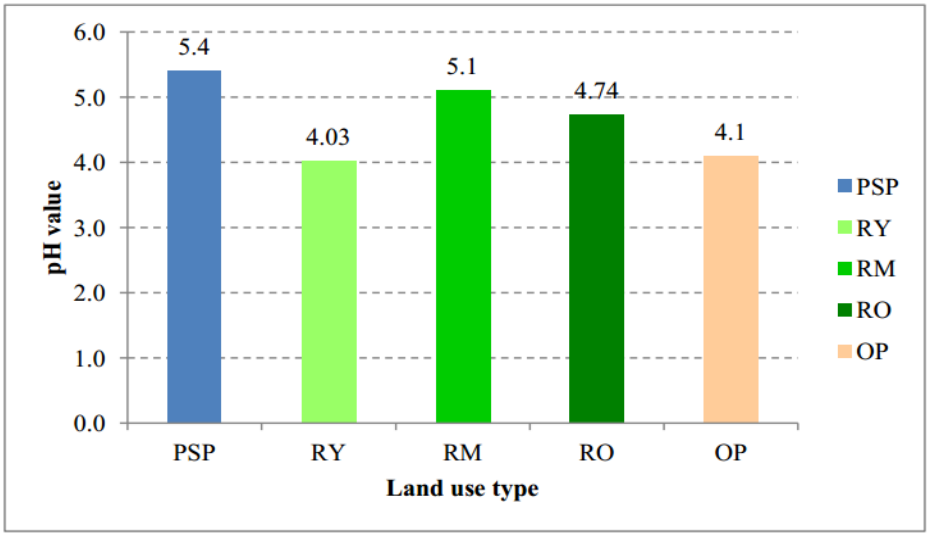

Figure 5a: Variation of soil pH level in different land use types of Denseworth estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm).

b) Soil Ec

The Ec values of all the land use types are lower than the threshold salinity level (Figure 5b).

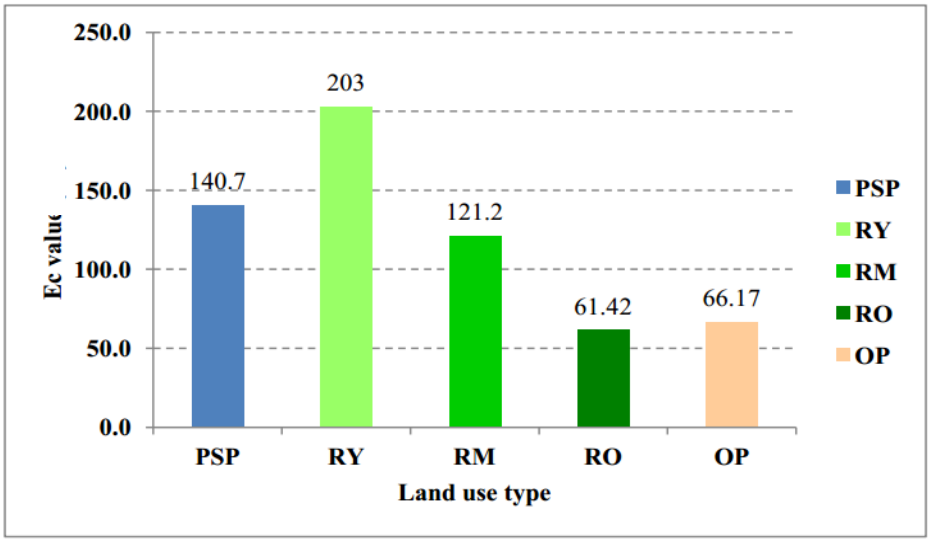

Figure 5b: Variation of soil Ec (µS/cm) level in different land use types of Denseworth estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm).

c) Soil organic matter content

Soil organic matter percentages of all the land use types in Denseworth estate have shown higher levels. Oil Palm fields are having somewhat lower values compared to other land use types (Figure 5c).

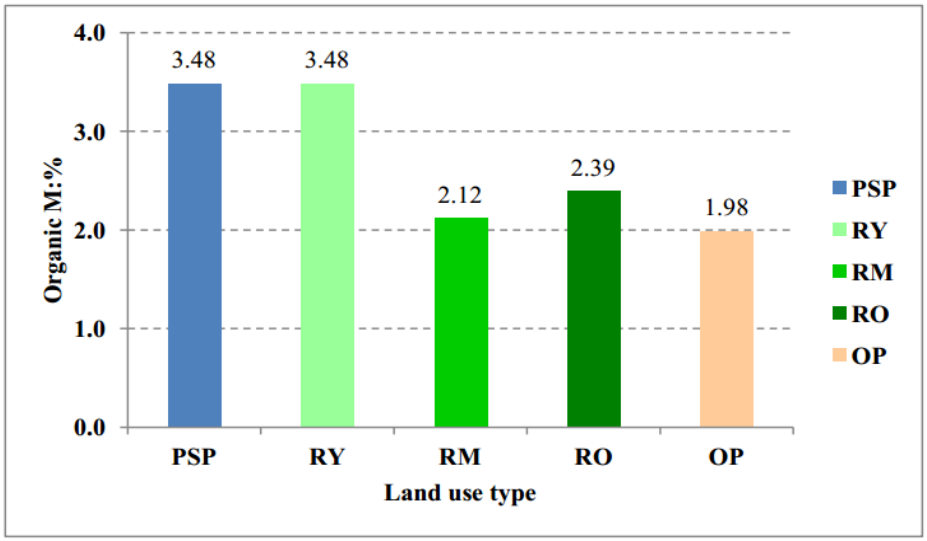

Figure 5c: Variation of soil organic matter percentages in different land use types of Denseworth estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm).

Estate 6: Mahaoya

a) Soil pH

All land use types were having pH levels within the acceptable range (figure 6a)

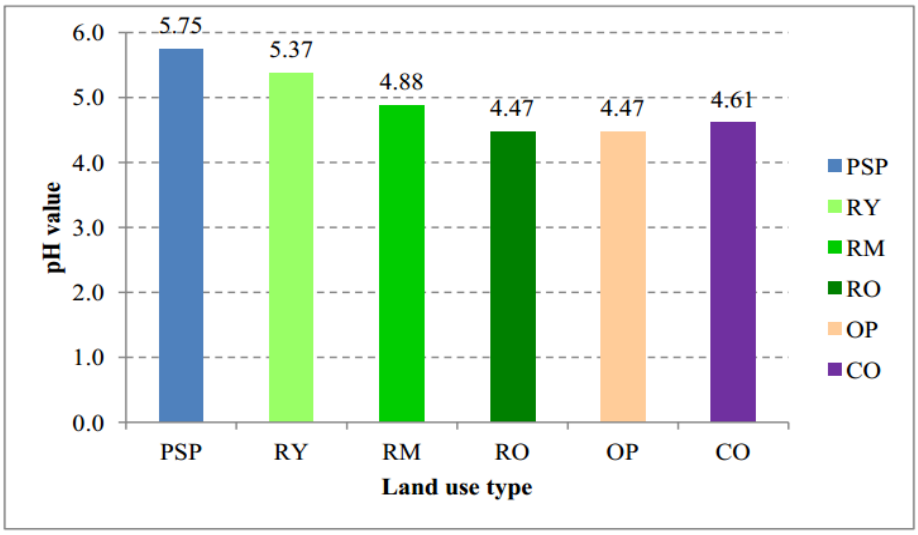

Figure 6a: Variation of soil pH levels in different land use types of Mahaoya estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm, CO: Coconut).

b) Ec value

All land use type are having lower EC values (Figure 6b).

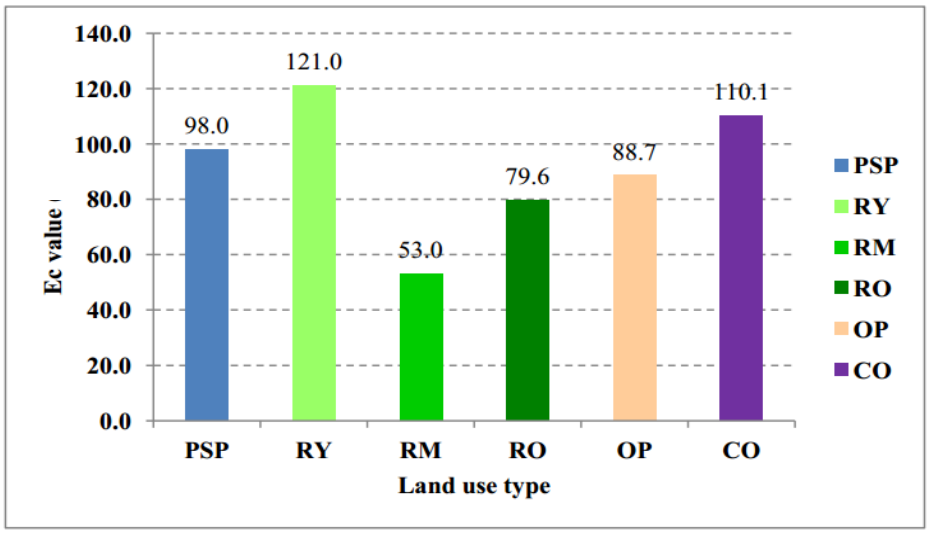

Figure 6b: Variation of soil Ec levels (µS/cm) in different land use types of Mahaoya estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm, CO: Coconut).

c) Soil organic matter content

All the land use types are having higher organic matter contents (Figure 6c).

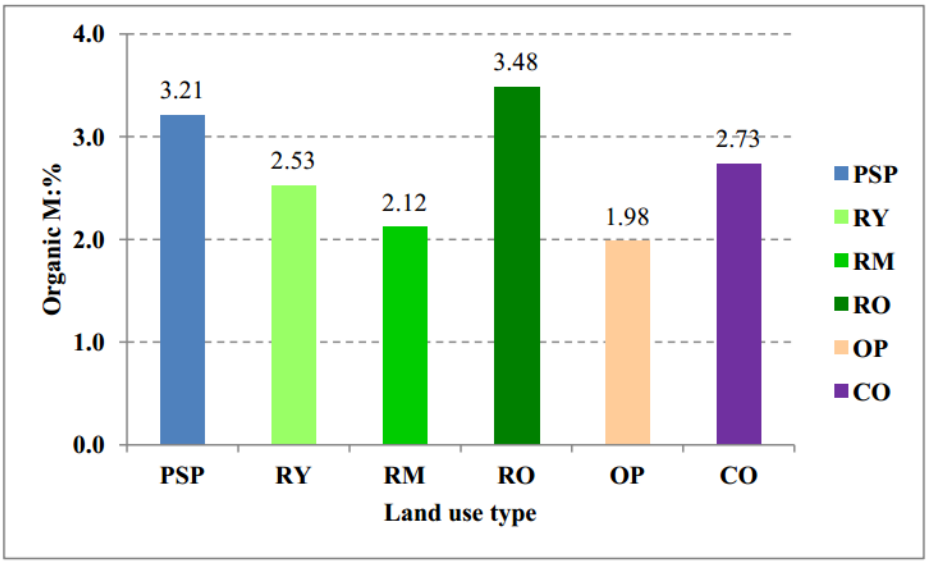

Figure 2.III.c: Variation of soil organic matter percentages in different land use types of Mahaoya estate. (Abbreviations used, PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm, CO: Coconut).

Group 3: Udabage

Estate 7: Udabage

a) Soil pH

Though all land use types are having slightly acidic soil, pH levels are in the acceptable rage for rubber cultivation (Figure 7a).

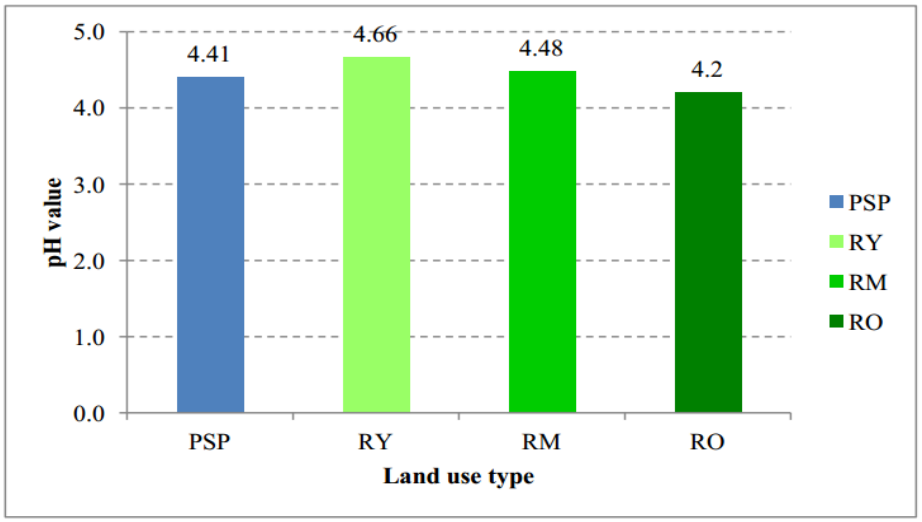

Figure 3.I.a: Variation of soil pH levels in different land use types of Udabage estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber) (Figure 7b).

b) Soil Ec

All land use types were having lower EC values.

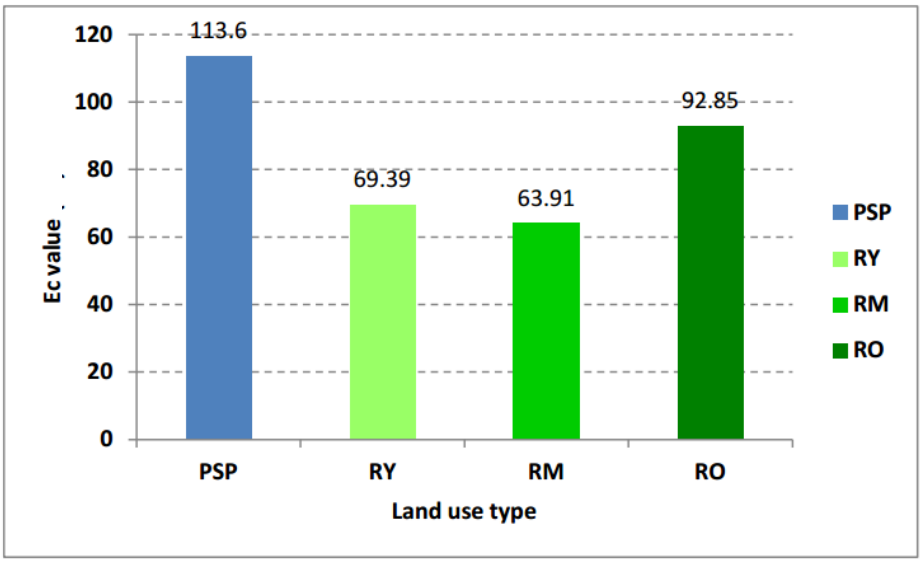

Figure 7b: Variation of soil Ec levels (µS/cm) in different land use types of Udabage estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber).

c) Soil organic matter content

All land use types are having relatively higher organic matter contents (Figure 7c).

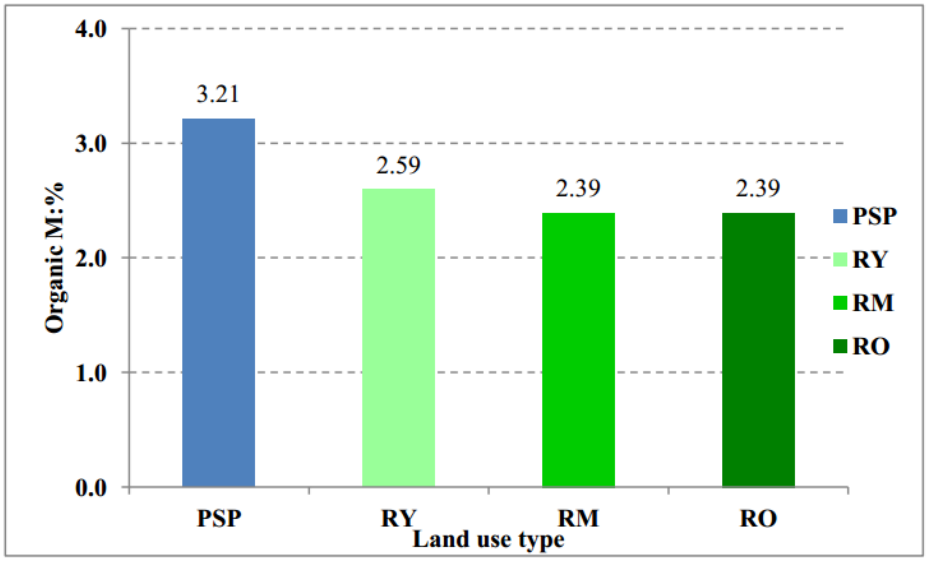

Figure 7c: Variation of soil organic matter percentages in different land use types of Udabage estate. (Abbreviations: Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber).

Estate 8: Eila estate

a) Soil pH

In Eila estate pH levels of all the land use types are in the acceptable range for rubber cultivation (Figure 8a).

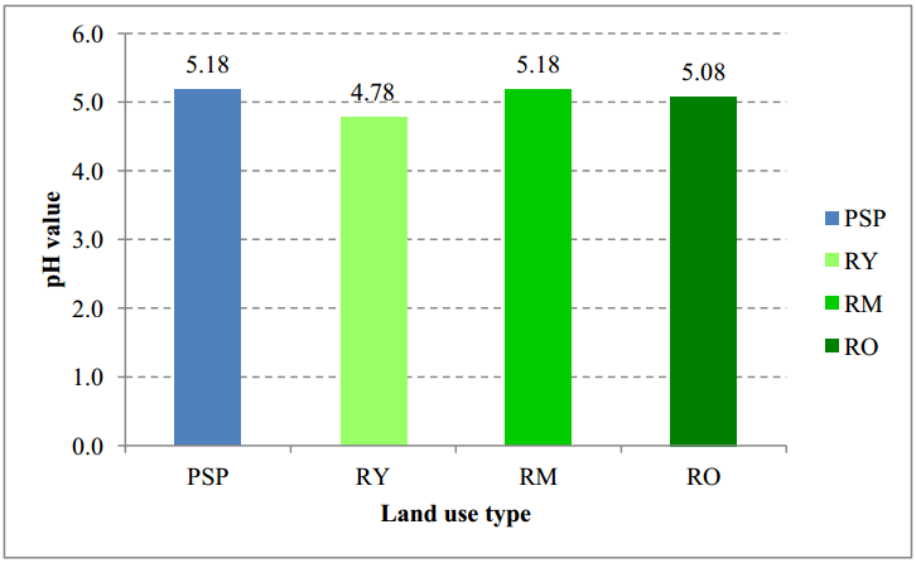

Figure 8a: Variation of soil pH values in different land use types of Eila estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber).

b) Soil Ec

All the land use types of Eila estate were having lower Ec levels (Figure 8b)

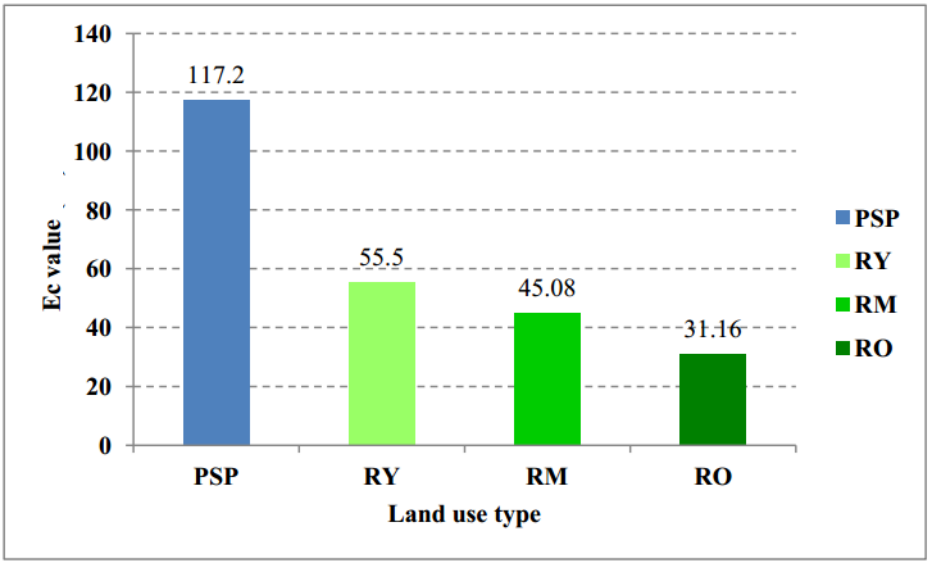

Figure 8b: Variation of soil pH (µS/cm) levels in different land use types of Eila estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber).

c) Soil organic matter content

Soil organic matter percentage was higher in natural forests and it was somewhat loer in mature rubber fileds (Figure 8c).

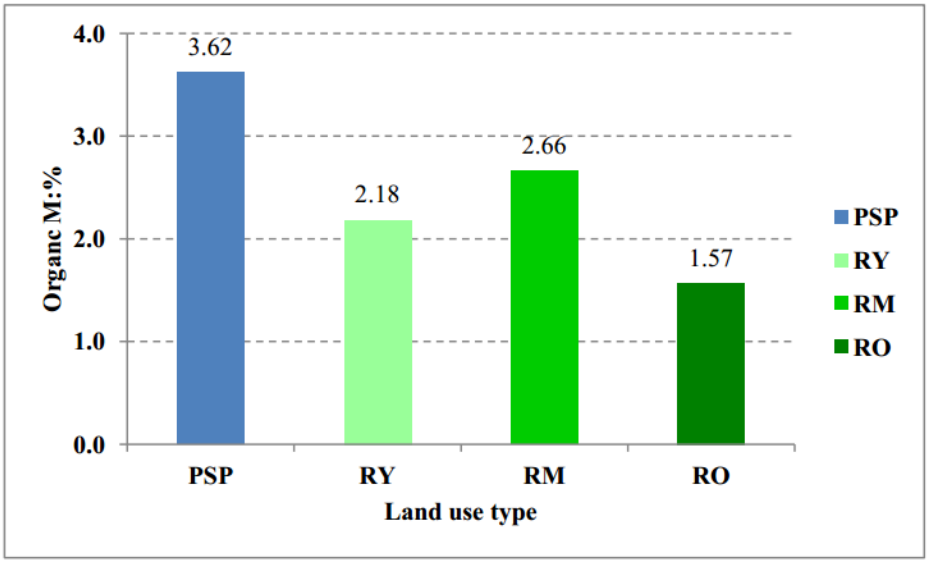

Figure 8c: Variation of soil organic matter percentage in different land use typse of Eila estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber).

Estate 9: Udapola

a) Soil pH

Soil pH levels of all land use types were within the acceptable range (Figure 9a).

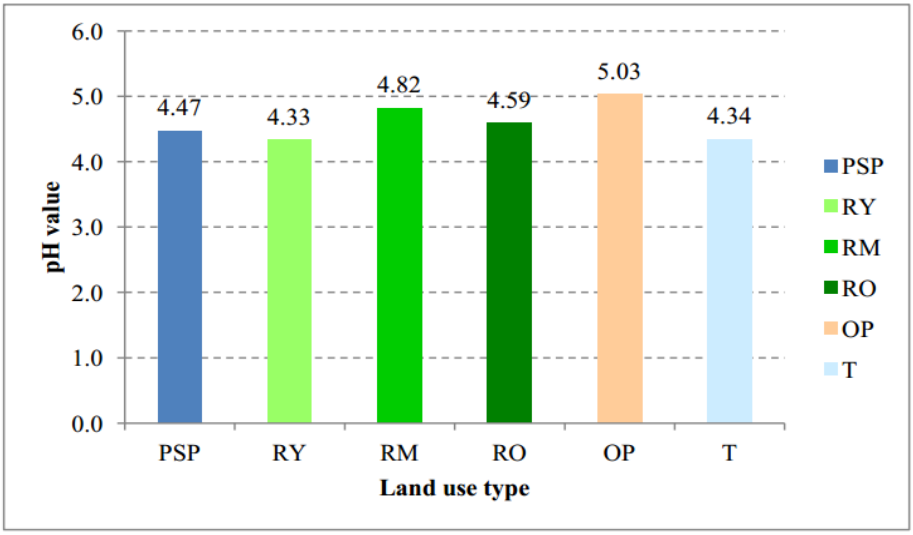

Figure 9a: Variation of soil pH values in different land use types of Udapola estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM: Mature Rubber, RO:Old Rubber, OP: Oil Palm, T: Tea).

b) Soil Ec

Soil Ec values of all land use types are lower and there is no issue of soil salinity (Figure 9b).

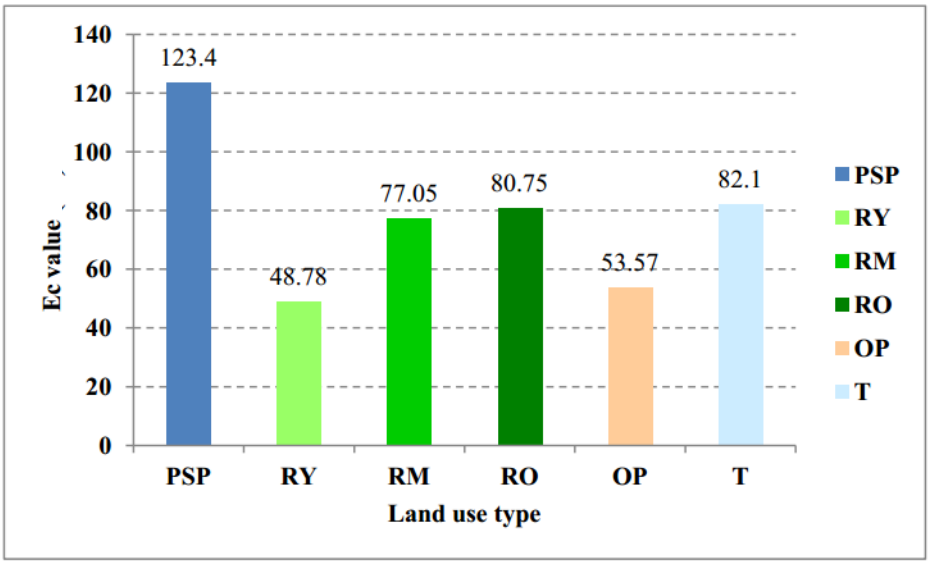

Figure 9b: Variation of soil Ec levels (µS/cm) in different land use types of Udapola estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm, T: Tea).

c) Soil organic matter content

The land use type of Oil Palm (OP) has shown a lower level of soil organic matter percentage than the other land use types (Figure 9c)

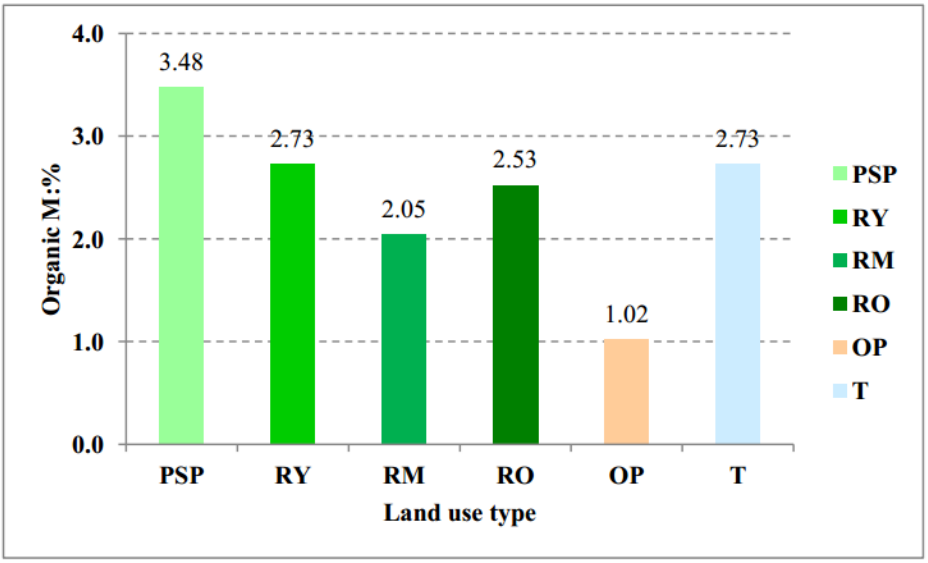

Figure 9c: Variation of soil Organic matter percentage in different land use types of Udapola estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, RO:Old Rubber, OP: Oil Palm, T: Tea).

Group 4:Miyanavita

Estate 10: Miyanavita

a) Soil pH

The pH values of all land use types in Miyanavita estate were more or less similar and are within the acceptable range for rubber cultivation (Figure 10a)

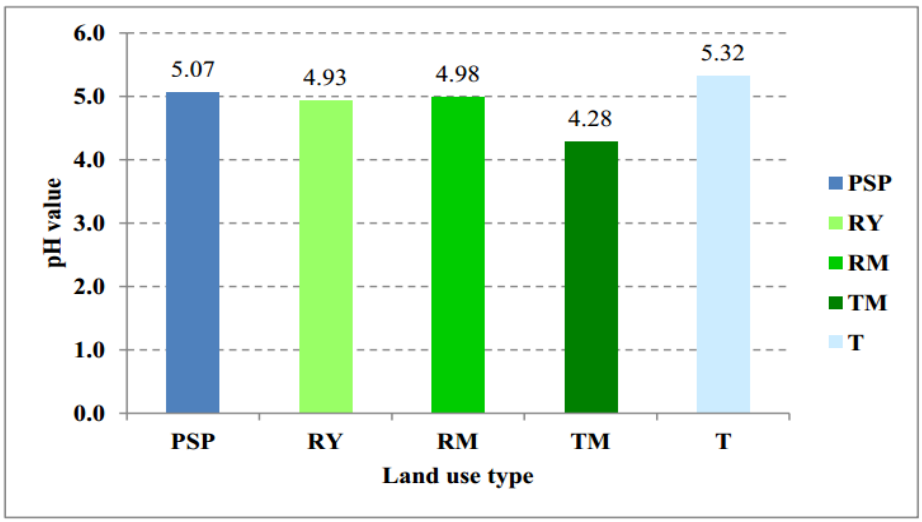

Figure 10a: Variation of soil pH levels in different land use types of Miyanavita estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, TM:Timber, T: Tea).

b) Soil Ec

Though slightly higher EC value was observed in the timber block, it was well below the threshold level of salinity (Figure 10a)

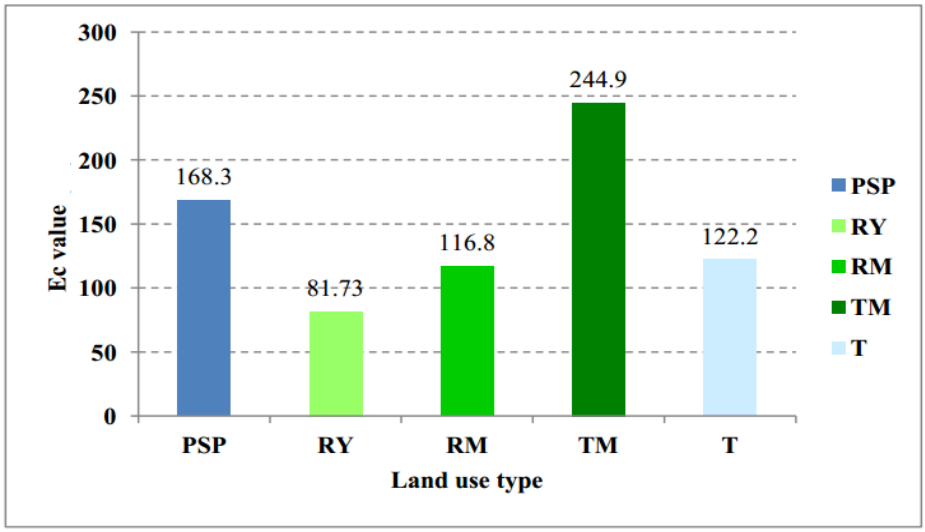

Figure 10b: Variation of soil Ec levels (µS/cm) in different land use types of Miyanavita estate. (Abbreviations used, PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, TM:Timber, T:Tea).

c) Soil organic matter content

Relatively higher soil organic matter content was present in all land use types except the mature rubber fields (figure 10c)

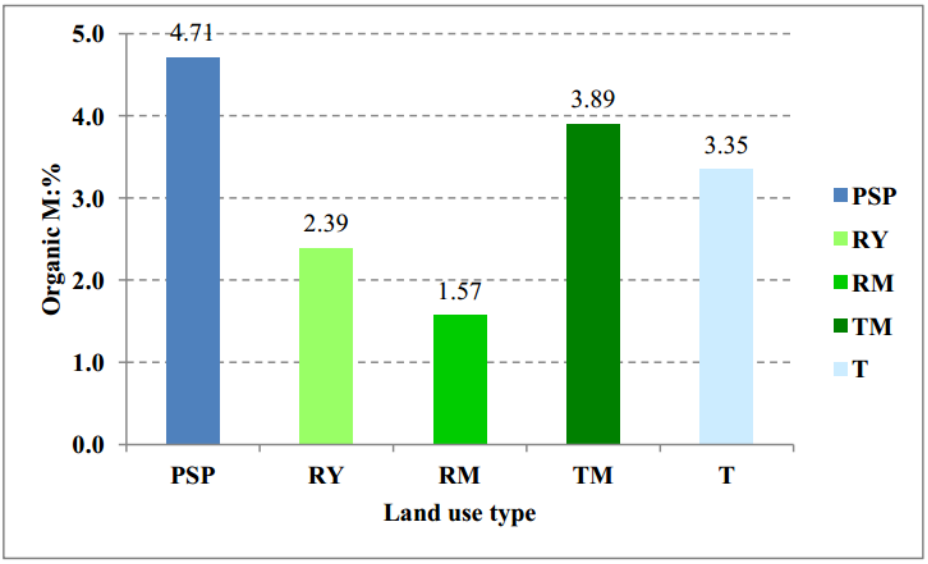

Figure 10c: Variation of soil organic matter percentages in different land use types of Miyanavita estate. (Abbreviations: PSP:Natural forest, RY:Young Rubber, RM:Mature Rubber, TM:Timber, T: Tea).

Estate 11: Dabar

a) Soil pH

The pH of all the land use types in Dabar estate show similar values.

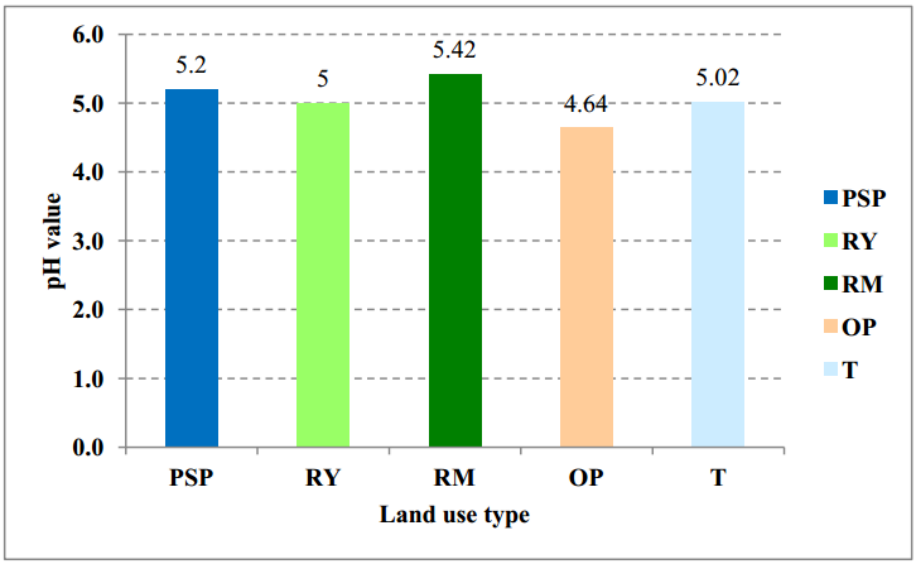

Figure 11a: Variation of soil pH in different land use types of Dabar estate. (Abbreviations: RY:Young Rubber, RM:Mature Rubber, OP: Oil Palm, T: Tea).

b) Soil Ec

The Ec values of all land use types were quit similar and lower than the threshold levels (Figure 11b)

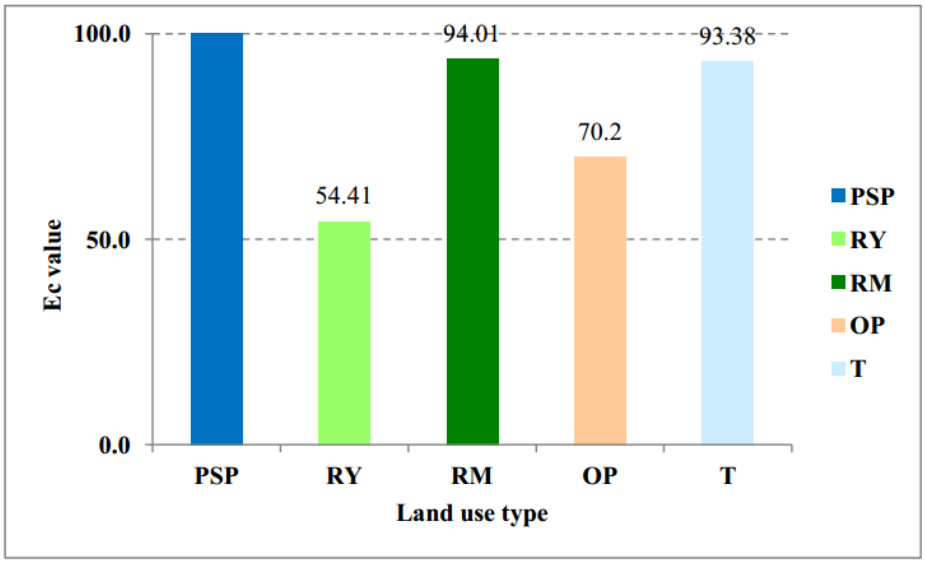

Figure 11b: Variation of soil Ec levels (µS/cm) in different land use types of Dabar estate. (Abbreviations: RY:Young Rubber, RM:Mature Rubber, OP: Oil Palm, T: Tea).

c) Soil organic matter content

The soil organic matters of the land use type of oil Palm (OP) was lower hcompare to other land use types (Figure 11c).

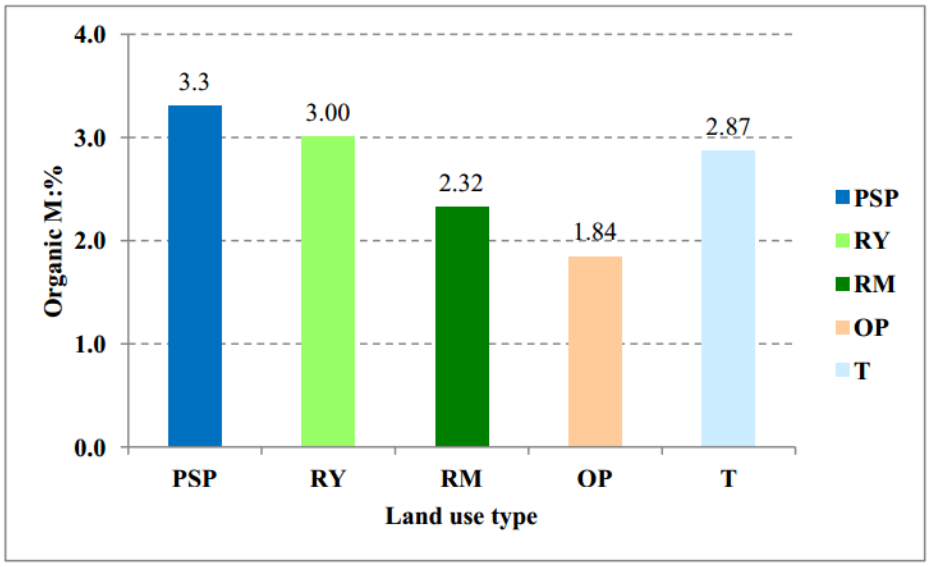

Figure 11c: Variation of soil Organic matter percentages in different land use types of Dabar estate. (Abbreviations: RY:Young Rubber, RM:Mature Rubber, OP: Oil Palm, T: Tea).

Group 5: Pitiyakanda

Estate 12: Notting hill

a) Soil pH

The soil pH of all land use types are similar and are at the acceptable range for rubber cultivation (Figure 12a).

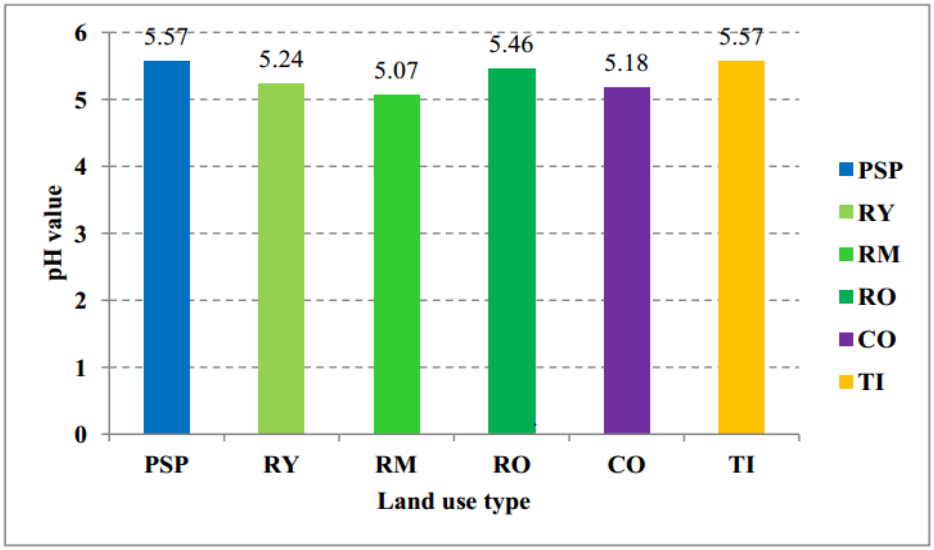

Figure 12a: Variation of soil pH levels in different land use types of Notting hill estate. (Abbreviations: PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, CO: Coconut, TI: Timber).

b) Soil Ec

The soil Ec values were lower in all land use types.

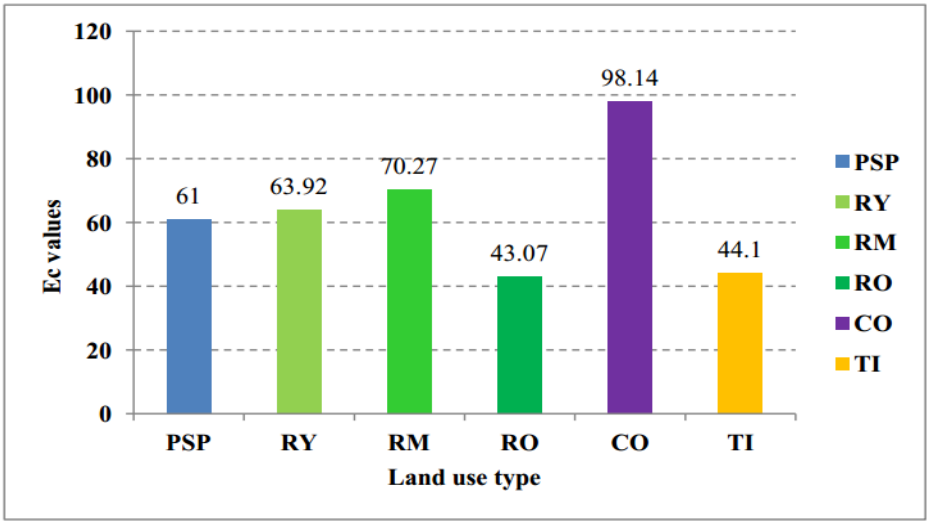

Figure 12b: Variation of soil Ec levels (µS/cm) in different land use types of Notting hill estate. (Abbreviations used: PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, CO: Coconut, TI: Timber).

c) Soil organic matter content

The soil organic matter percentages of all the land use types were more or less similar though the young rubber field was slightly lower.

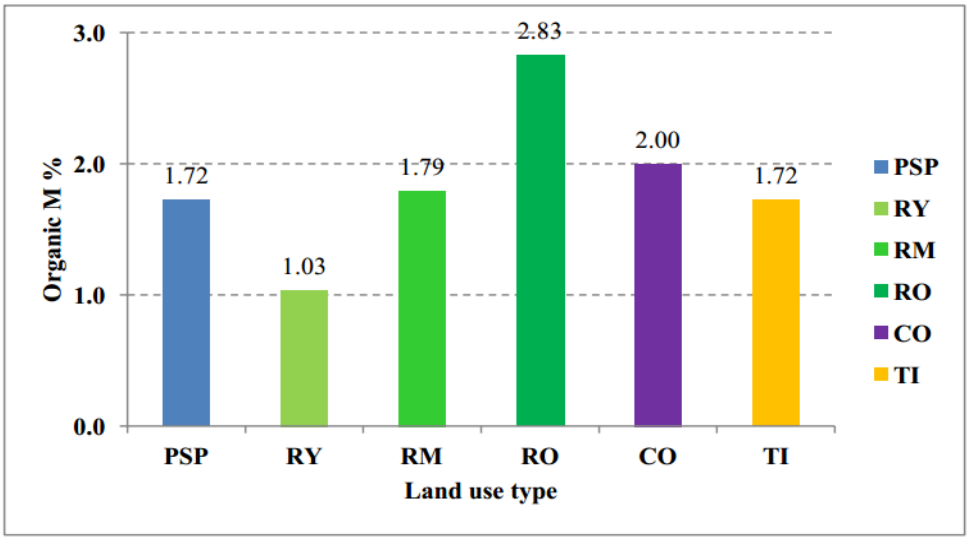

Figure 12c: Variation of Organic matter percentages in different land use types of Notting hill estate. (Abbreviations: PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, CO: Coconut, TI: Timber).

Estate 13: Muwankanda estate

a) Soil pH

Soil pH levels of all the land use type of Muwankanda were in the acceptable range for rubber cultivation (Figure 13a).

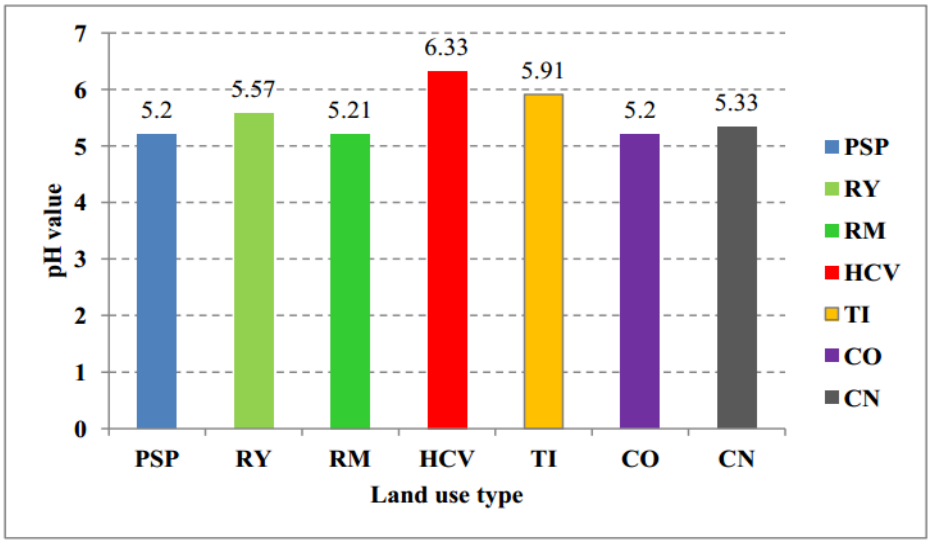

Figure 13a: Variation of pH vales with different land use type of Muwankanda estate. (Abbreviations: PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, HCV:High Conservation Value Forest, CO: Coconut, CN: Cinnamon).

b) Soil Ec

The soil Ec level of High Conservation Forest has shown a higher value than the other land use types. However, it was well within the normal range (Figure 13b)

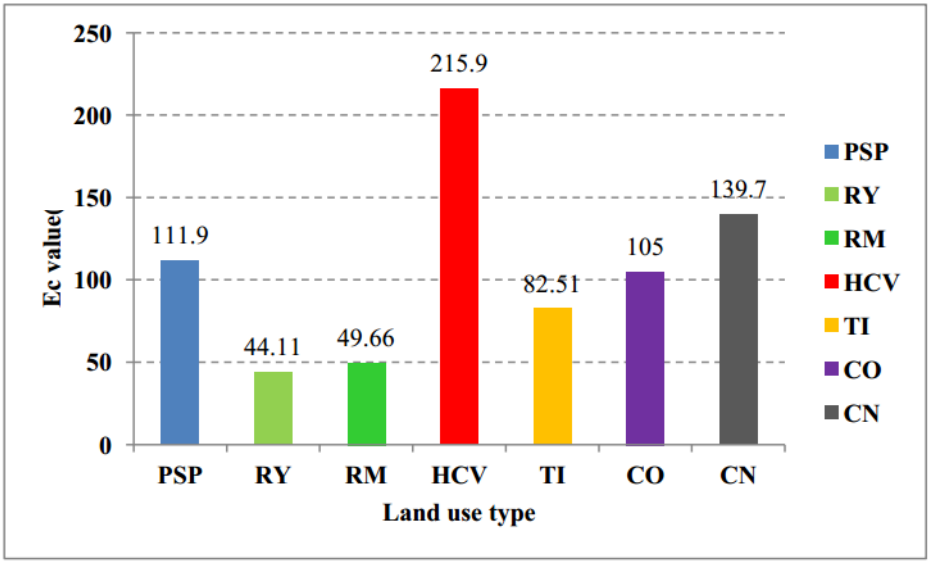

Figure 13b: Variation of Ec levels (µS/cm) in different land use types of Muwankanda estate. (Abbreviations: PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, HCV:High Conservation Value Forest, CO: Coconut, CN: Cinnamon).

c) Soil organic matter percentage

Natural forest and timber blocks were having higher organic matter contents compared to other land use types (Figure 13c).

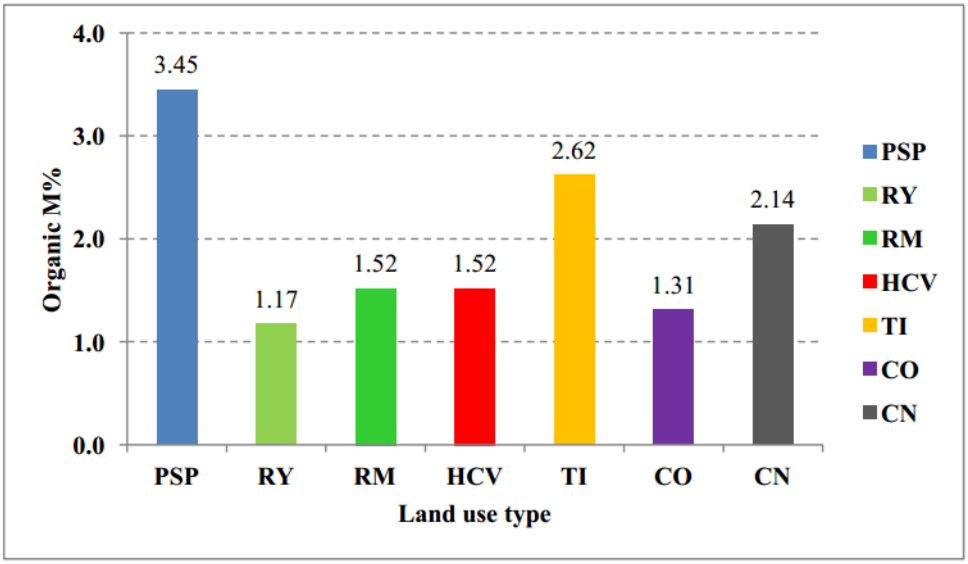

Figure 13c: Variation of organic matter percentages with different land use type of Muwankanda estate. (Abbreviations: PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, HCV:High Conservation Value Forest, CO: Coconut, CN: Cinnamom,. TI: Timber).

Estate 14: Pitiyakanda

a) Soil pH

Soil pH levels of all land use types in Pitiyakande estate were more or less similar and within the acceptable range for rubber cultivation (Figure 14a).

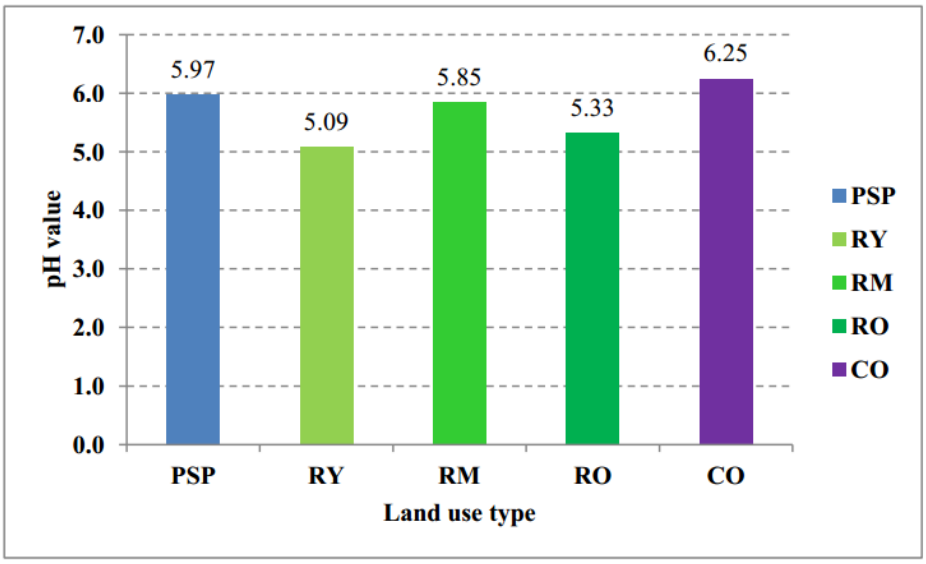

Figure 14a: Variation of pH levels in different land use types of Pitiyakanda estate. (Abbreviations: PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, HCV:High Conservation Value Forest, CO: Coconut).

b) Soil Ec

EC values of all land use types are lower and there is no salinity issue (Figure 14b).

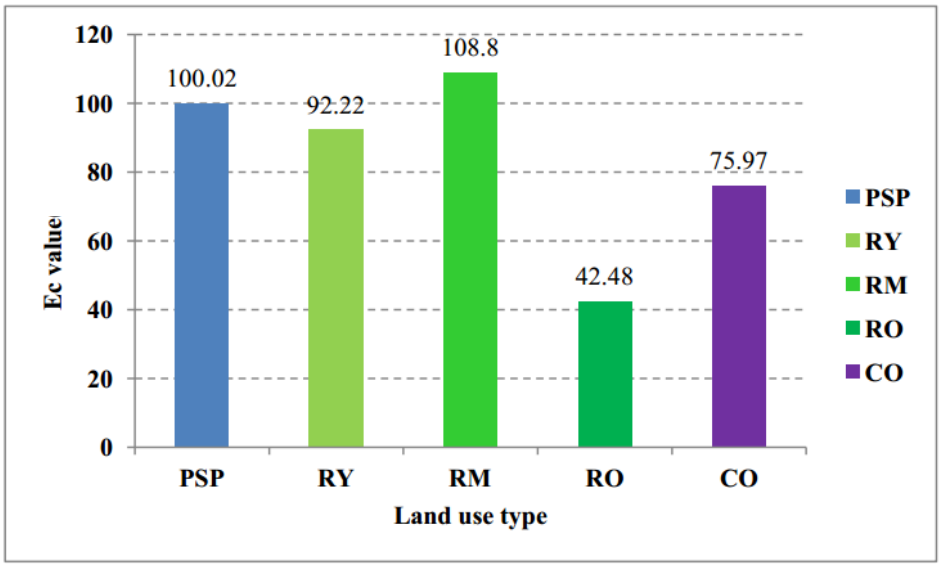

Figure 14b: Variation of Ec levels (µS/cm) in different land use types of Pitiyakanda estate. (Abbreviations used, PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, HCV:High Conservation Value Forest, CO: Coconut).

c) Soil organic matter content

Mature rubber field and old fields of this Estate were having lower organic matter contents (Figure 14c).

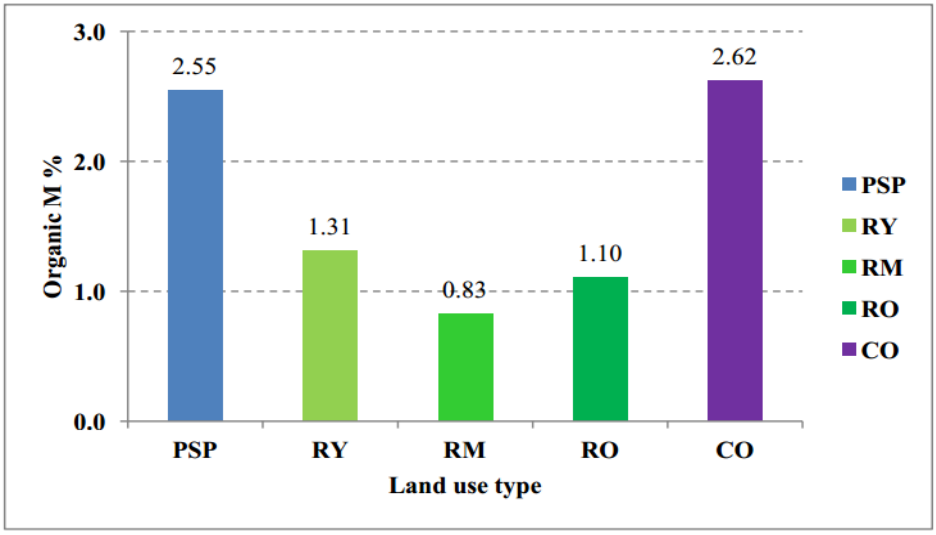

Figure 14c: Variation of organic matter percentages in different land use types of Pitiyakanda estate. (Abbreviations: PSP: Natural forest, RY:Young Rubber, RM:Mature Rubber, HCV:High Conservation Value Forest, CO: Coconut).

Estate 15: Kappitigala

a) Soil pH

Slightly higher soil pH was observed in all land use types in this estate (Figure 15a).

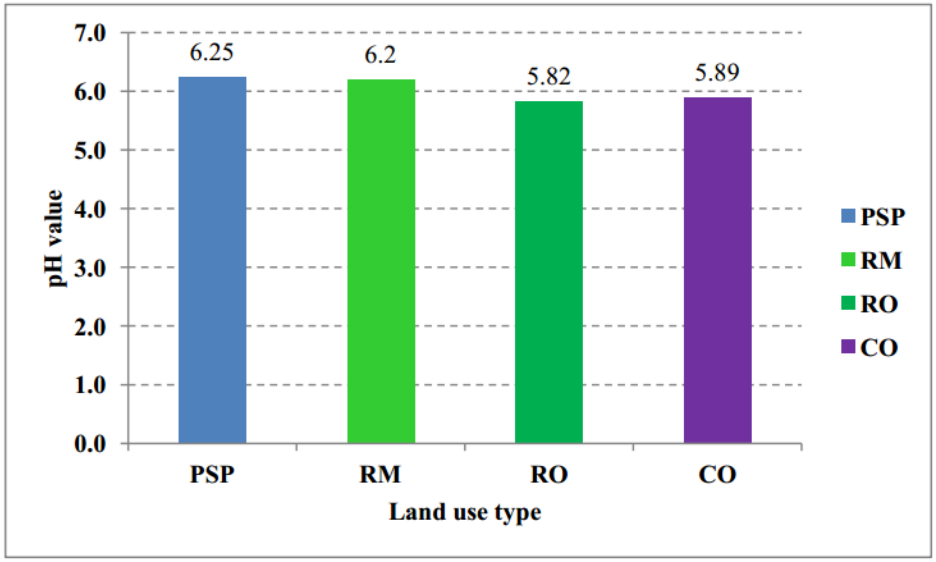

Figure 15a: Variation of soil pH levels in different land use types of Kappitigala estate. (Abbreviations: PSP: Natural forest, RM:Mature Rubber, RO :Rubber Old (RO) , CO: Coconut).

b) Soil Ec

All land use types were having lower Ec levels in this estate (Figure 15b).

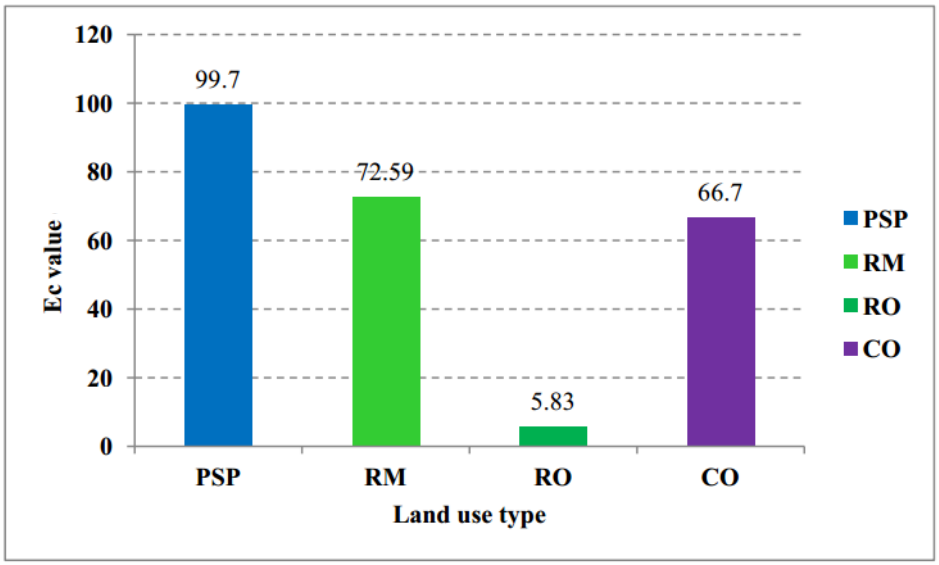

Figure 15b: Variation of soil Ec levels (µS/cm) in different land use types of Kappitigala estate. (Abbreviations: PSP: Natural forest, RM:Mature Rubber, RO :Rubber Old (RO) , CO: Coconut).

c) Soil organic matter content

Compared to other estates this estate was having lower soil organic matter content across all land use types (Figure 15).

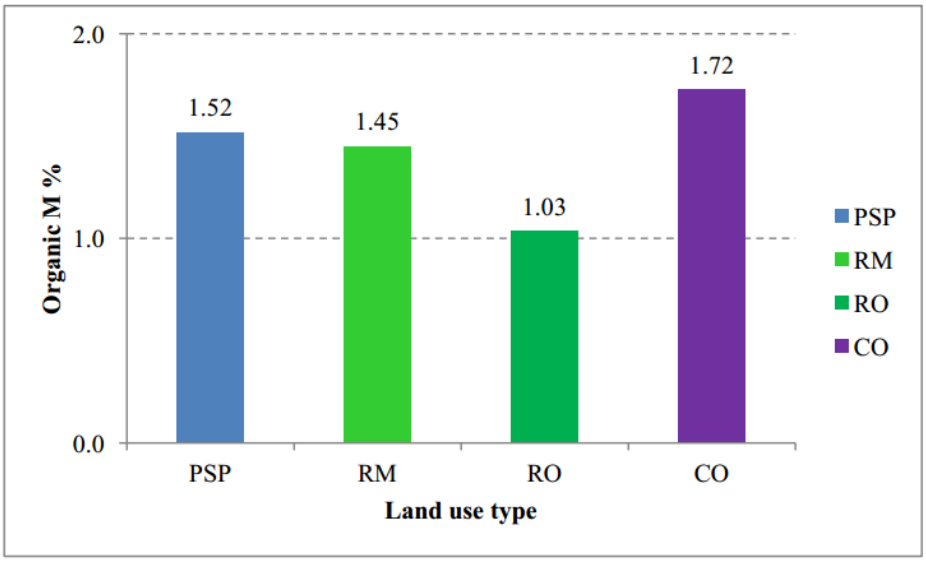

Figure 15c: Variation of soil organic matter percentages in different land use types of Kappitigala estate. (Abbreviations: PSP: Natural forest, RM:Mature Rubber, RO :Rubber Old (RO), CO: Coconut).

Overall results suggested that;

- Soil pH of all land use types revealed that they are slightly acidic. pH values were slightly lower in old rubber fields and selected uprooted fields for oil palm cultivation. However, pH level of all land use types are in the acceptable range for rubber cultivation.
- Though Electrical conductivity values range from 40 – 250 µS/cm, they all are well below the threshold values of any salinity development.
- Significant variation of soil organic matter (OM) content was recorded in different land use types and different estates. It ranges from 1.02% to 5.86%. In average, all most all natural forest and timber blocks recorded high OM contents across all estates. There is a tendency to reduce the OM content with age of the rubber fields recoding the lowest values in mature and old rubber fields. Overall, relatively lower OM contents were observed in uprooted fields that are being prepared for oil palm cultivation.

Overall analysis suggest that soils of all land use types, in general, could be considered as normal and are in good condition based on the three soil parameters measured. Though there is a significant variation in soil OM contents, even the lowest recorded were relatively higher than most of the agricultural lands in the country. This higher OM contents observed especially in young rubber fields may be due the proper way of establishing and maintaining cover crops and adoption of relatively better soil conservation measures by the Company. Relatively lower OM contents in older rubber fields and uprooted rubber field may be due to exposure to light and subsequent higher rate of microbial decomposition of OM.

Water Quality Monitoring Report

Surface water quality monitoring at natural streams of Muwankanda, Miyanawita, Densworth, Reucastle, and Eila Estates

For

Lalan Rubbers Pvt Ltd

Agri Division, No 54, Kirulapone Avenue, Colombo 05.

September 2016

Prepared by

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University of Peradeniya

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Water Quality Monitoring Report

Lalan Rubbers Pvt Ltd, Agri Division, No 54, Kirulapone Avenue, Colombo 05.

INTRODUCTION: Project Overview

Water quality has turned into one of the major ecological concerns overall and is affected by common and anthropogenic unsettling influence, for example, change in land use pattern, degree of soil surface cover, topography, wastewater, overflow effluents, land recovery and environmental change. Surface waters are helpless against contamination because of common land use activities, such as cultivation, land clearing, extraction and discharge of contaminated water. The nature of stream anytime reflects a few significant impacts, environmental inputs, and climatic conditions and represented by both characteristic procedure and anthropogenic impacts. Water quality in any area not yet influenced by human activity or least disturbed as compared to natural settings like rubber plantations is likely depend on upon a mix of the accompanying environmental factors; the occurrence of highly dissolvable or easily weathered minerals, the rainfall or river runoff, the occurrence of settlements in upper catchment, discharge of extensive amounts of disintegrated natural matter including organic debris. Clean stream water is a crucial product for the prosperity of human social orders and ecological sustainability. Since, river water forms the principle inland water asset for plantation, residential, industrial and farming purposes, it is basic to deflect and control surface water contamination and to have certified data on water quality for successful administration.

Characterization of the spatial variety and source allotment of water quality parameters can deliver an enhanced understanding of the ecological circumstance and aid strategy producers to plan needs for practical plantation management. The substance of physical, concoction, and natural parameters accessible in it dictates the level of water quality.

This study marked the comprehensive effort made by the Lalan Rubbers (Pvt) Ltd at evaluating baseline water quality conditions and water quality impacts from plantation management activities on surface water resources.

INTRODUCTION: Background

This water quality-monitoring scheme was conducted to gain a better understanding of the types and extent of pollutants contributed by plantation management and operational procedures, which alter the storm water and low flow runoff, as well as to address current and future regulatory requirements. The purpose of this sampling effort was to conduct a broad screening of water quality in Lalan Rubber Plantations in order to ascertain which contaminants are present at significant levels, and which watersheds exhibit consistently higher levels of contaminants. Once this is determined, a more informed approach can be made in identifying in need of improved land management or source control.

METHODOLOGY: Study Area

Lalan Rubbers Pvt Ltd manages 17,000 acres of plantations in 15 estates. This study is focus on four major estates; Muwankanda Estate in Mawathagama, Kurunegala; Densworth Estate, Reucastle Estate, Miyanawita Estate, and Eila Estate in Deraniyagala, Sabaragamuwa Province of Sri Lanka where perennial water streams are flowing. The location and sampling points are shown in Table 1.

Table 1. Surface water sampling locations and types of land use

Name of Estate	Location		Type of plantation	Sampling location
Muwankande Estate	N 07.40692°	E 080.40410°	Rubber	Natural spring/stream
Miyanwita Estate	N 06.88333°	E 080.35000°	Rubber	Natural spring/stream
Densworth Estate	N 06.94219°	E 080.28397°	Rubber	Natural spring/stream
Reucastle Estate	N 06.93302°	E 080.29626°	Rubber	Natural spring/stream
Eila Estate	N 06.98830°	E 080.32127°	Rubber	Natural spring/stream

METHODOLOGY: Water Sampling

A preliminary training session was held for the staff members and workers that would be on participating in the sampling. The training was extended water quality monitoring in order to train all executives and workers involve in plantation management to better understand the principles and need of accurate water sampling.

All sample bottles were labeled, handled and transported following the standard protocols. Chain of custody forms identified sample locations, date and time of collection, samplers and time of delivery to testing laboratory. All water samples were taken from natural perennial springs/streams originates from upper sub-catchment of the terrain and then flow through the plantation. Once grab sampling was over, samples were immediately transfer to water quality testing laboratory of Department of Agricultural Engineering, University of Peradeniya.

METHODOLOGY: Laboratory Analysis

Once arrive at the laboratory, all water samples were immediately tested for following parameters; pH, salinity, total dissolved solids (TDS), electrical conductivity (EC) and dissolved oxygen (DO) according to Standard Methods using electronic water quality meter (Thermo Scientific, Model Orion 2 star).

The rest of samples were preserved at 4 ^{o}C in a refrigerator until further analysis were conducted. Then, all undiluted absolute samples were tested for BOD_5 using Winkler's titration method, with standard seeding. COD of the water samples were measured by automated COD meter (HACH DRB 200) on absolute samples.

WATER QUALITY: Test Results

The test result of the water quality is shown in Table 2.

Table 2. Water quality test results

Date Sample	Parameter							
	pH	Salinity (‰)	TDS (mg/L)	EC (µs)	DO (mg/L)	COD (mg/L)	BOD_5 (mg/L)	Coliform (MPN/100ml)
Muwankanda Estate (stream)								
8/8/2016 Upstream	7.05	0	12	34	6.9	4	3	25
8/8/2016 Downstream	6.75	0	20	48.8	6.8	8	4	20
Miyanawita Estate (stream)								
8/8/2016 Upstream	7.65	0	20	43.7	7.6	3	N/D	N/D
8/8/2016 Downstream	7.57	0	10	20.9	7.3	2	1	10
Denswerth Estate (stream)								
8/10/2016 Upstream	7.22	0	23	53	7.5	4	N/D	15
8/10/2016 Downstream	7.26	0	23	53.3	7	4	2	25
Reucastle Estate (stream)								
8/10/2016 Upstream	6.59	0	21	49.6	6.5	4	2	20
8/10/2016 Downstream	6.87	0	18	42.3	6	5	1	20
Eila Estate (stream)								
8/10/2016 Upstream	6.89	0	17	38.4	7	3	1	20
8/10/2016 Downstream	7.01	0	13	31	6.5	5	1	20
Definitions								
TDS= Total Dissolved Solids								
EC= Electrical Conductivity								
DO= Dissolved Oxygen								
COD= Chemical Oxygen Demand								
BOD_{5C}= 5 days Biochemical Oxygen Demand								
Coliform= Total coliform MPN (Most Probable Number)/100 ml								
N/D = not detected								

WATER QUALITY: Implication and Perspective

Although each site was only sampled once in August during the dry spell of the year, a substantial amount of information could be obtained from the test results.

The preliminary analysis of the results reveals that none of the surface water sources are contaminated significantly with pollutants. As shown in Table 3, all tested water quality parameters in samples were well within the CEA stipulated discharge qualities.

Table 3. Comparison of recorded maximum and minimum parameter values with CEA standards

	Parameter							
	pH	Salinity	TDS	EC	DO	COD	BOD_5	Coliform
Recorded maximum	7.65	0	23	53.3	7.6	8	4	
Recorded minimum	6.59	0	10	20.9	6	2	1	
CEA standards for effluent discharge into inland water bodies								
Maximum	6		2500*	2250**	N/R	250	30	N/R
Minimum	8.5	N/R	N/R	N/R	N/R	N/R	N/R	40***
* As TSS								
** For irrigation purpose								
*** Faecal Coliform								

The observed slight changes of pH in streams can be caused by carbon dioxide dissolved in water, tannic acid from the decomposition of natural organic matter in aquatic environment and surface inflow from point sources (that are very unlikely to occur in any of the studies plantations). Therefore, it is reasonable to assume that the water quality, in term of pH (and associated parameters such as EC, Conductivity and Salinity), is not differ from background surface water quality of the area.

COD and BOD_5 indicate the level of anthropogenic organic pollutants presence in surface water. As shown in the Table 3. None of the water sources has been contaminated with excessive amount of neither biodegradable organic pollutants (as indicated by BOD_5) nor oxidizable chemical pollutants (COD). This implied that the land management activities, especially organic waste and wastewater disposal in the studied plantations have lesser impact on surface water resources. Recorded microbiological pollutants (indicated by total corliform) in some locations may possibly due to the contamination with animal feacal materials rather than sewage discharge. Because, it should be noted that the presence of coliform bacteria cannot be attributed entirely due to the disposal of raw sewage since natural sources such as birds, wildlife and even domestic cattle could contribute too. The natural coliform sources may also include certain species that have been reported to occur in the environment or grow in soils.

In perspective, it is evident that the background quality of water flowing through the five studied rubber plantations is within the acceptable level once could expect from a least disturb plantation setting.