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Characterization of Shimoga Taluk Soils under different Land Use Systems

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Abstract

A study was conducted to know the Physico-chemical properties of soils in Shimoga taluk at different land use system, reveled that land use systems significantly affected sand, the clay and silt fractions of the soil. Irrespective of land use systems sand and silt percentage decreased with depth and clay percentage increased with it, also Bulk Density increased with increase depth of soils in all the land use system. pH of the soil under different land use systems was acidic and all most all the land use systems were found to be low in electrical conductivity. Organic Carbon was low to medium and calcium was dominate cation over magnesium in all the surface and subsurface soils of different land use system. The available nitrogen, Phosphorus and Potassium content in surface layer soils were higher than subsurface soils under different land use systems, present study indicates that the soil property land use and management practice have profound influence on physico and chemical properties of soils

Key words: Land use systems, Physico-chemical properties.

Introduction

Effect of land use systems on soil properties provides an opportunity to evaluate sustainability of land use systems and thus the basic process of soil degradation in relation to land use and hence the soil and crop management must be given high research priority (Woldeamlak et.al. 2003). However, the information on effect of land use systems on soil quality to give recommendations for optimal and sustainable utilizations of land resources is scanty.

Research of impacts on the soil is important to determine how soil fertility can be maintained and the land-use systems improved. Shepherd *et al.* (2008) observed no change in particle size distribution and significant modifications in chemical properties in the top-soil that affects agricultural productivity. Soil quality mainly depends on the response of soil to different land use systems and management practices, which may often modify the soil properties and hence soil productivity.

Materials and Methods

The present investigation was taken up to know the physical and chemical characteristics of soils under different land use systems in Abbalagere, representing agro climatic zone -7 the study was conducted during 2010. Abbalagere is situated between 13^{o} 59' 30" N latitude and 73^{o} , 35' 30" E longitude. The study site is located at an altitude of 590 mtrs. above the mean sea level. Physiographically study areas are characterized by undulating to rolling topography. Study area enjoys sub-humid to sub-tropical climate with mean annual rainfall of 888.3 mm. Mean monthly maximum and minimum temperatures are being 32.9 and 20.1^{o}C respectively. Soils under cultivated land use ecosystems are under monocropping system.

Soil parameters investigated included physical (soil bulk density, texture), chemical (pH, soil organic carbon and available N, P and K status, assessing land use-induced changes in soil is essential for addressing agro ecosystem transformation and sustainable land productivity issues.

Surface (0-15 cm) and subsurface (15-30cm, 30-45cm, 45-60cm) soil samples under different land use systems viz, Agri system (Rice and Maize), Horti system (Arecanut) and silvi system (Eucalyptus) were collected. The soil samples were analyzed for their bulk density by keens cup method as explained by Bernard A Keen and Henry Razkowski (1921), particle size distribution by international pipette method and pH, EC, CEC, Organic carbon, Exchangeable calcium and Magnesium, available phosphorus and potassium were determined as per the standard procedures (Jackson, 1973). Available nitrogen was analyzed by potassium permanganate method as per the procedure outlined by Subbaiah and Asija (1973).

Results and Discussion

The results on particle size analysis revealed that the soils were found to contain more than 50 per cent of sand. Hence, the texture of the soils varied from loamy sand to sandy clay loam. The soils were dominant in sand but accumulation of clay and silt was observed in the sub surface layers with a simultaneous decrease in sand content. Higher content of finer fractions (silt + clay) in lower depths might be due to the translocation of finer particles from the surface horizons and subsequent illuviation in sub surface horizons. These observations are in accordance with the results of Khan and Chatterjee (2001). Land-use systems significantly affected the sand, the clay and the silt fractions of the soils. Clay accumulation in the sub-soil could result in reduced porosity, increased water retention and reduced drainage.

Bulk density of the profile soil samples ranged from 1.49 to 1.65 Mg m3 and the bulk density increased with increase in depth of soils in all the land use systems due to low organic matter content of lower layers and compaction from the pressure of the upper layers. Similar fmdings were also reported by Patil and Jagdish Prasad (2004).

Physical, chemical and biological properties of soil are very much influenced by soil reaction. The data on chemical properties of soil indicates that soils were found to be slightly acidic in soil reaction (Table 1). This may be attributed to the fact that, soils are derived from acidic igneous granite and /or gneiss (Ananthanarayana and Perur, 1973). Irrespective of land use ecosystems, general increase in pH down the profile in all the land use systems up to certain depth could be due to leaching and accumulation of basic cations in the lower depth of the profiles.

Acidic pH of soils under different land use ecosystems other than that of arecanut land use ecosystem might be due to the fact that the soils under the former land use ecosystems are derived from acidic igneous granite and metamorphic gneiss. Intensive cultivation, monocropping, use of chemical acidifying fertilizers, continuous removal of basic cations and or leaching of basic cations lead to the more acidification of soils. Low pH in surface and general increase in pH down the profile in the soil under paddy land use ecosystem could be attributed to the seasonal flooded conditions (Elahi, *et al*.1996).

The results also indicated that all most all the land use system soils were found to be low in electrical conductivity indicating low amount of soluble salts in the soils. Electrical conductivity of the soils increased slightly with increasing depth under agri system (Rice) and values ranged from 0.02 to 0.12 dS m^{-1}. Whereas, in other land use systems the electrical conductivity of soils did not show any definite relationship with depth. The low Electrical conductivity values of surface layer soils as compared to lower depths is probably due to leaching of salts from surface to sub surface layers through irrigation and accumulation at the lower depths because of poor internal drainage (Katti and Rao, 1979).

Irrespective of the land use systems soluble salts concentration (EC) was comparatively more in the surface horizons than in the immediate subsurface horizons and however in sub-soil Solum water extractable ions showed more or less increasing trend with depth. Soils under cultivated land usesystems recorded higher EC values especially at the surface than in that of forest land use ecosystem.

In general, the organic carbon content of the soils under all the land use systems was low to medium. The organic carbon content in subsurface soils under different land use system ranged from 2.50 to 6.50 g kg-1. This may be due to tillage operations by which the organic carbon build up would be low especially under continuous cultivation. The organic carbon content in all the land use systems decreased with increase in depth of soils. The high organic carbon content at the surface layers of the soil was due to the accumulation of organic matter in surface horizon and recycling of organic matter, addition of organic manure and also because of crop residues remaining in soil surface. Whereas, high organic carbon content in silvi system (Eucalyptus) and horti system (Arecanut) might be due to litter fall.

Calcium was dominant cation over magnesium in all the surface and sub surface soils. The exchangeable calcium and magnesium content was higher in lower depths of profiles as compared to surface layers. This could be attributed to leaching of bases from surface to sub surface and adsorption of the cations by higher content of clay in the sub surface (Ashok, 1998)

The available nitrogen, phosphorus and potassium content in all the soil samples of the different land use systems varied widely from 130 to 350 kg ha^{-1}, 25 to 68 kg ha^{-1} and 69 to 128 kg ha^{-1} respectively (Table 1). The available nitrogen was low to medium, while available phosphorus was medium to high and available potassium was low in all the soils of the land use systems. The available nitrogen, phosphorus and potassium content in surface layer soils were higher than sub surface soil under different land use systems. This could be due to low organic matter status in sub soil and management practices like addition of fertilizers and FYM to surface soil.

Table 1. Physico-Chemical properties of soil profiles under different land use systems

Sl no	Land use system/ Depth in cm	Textural classes	Bulk density ($Mg\ m^{-3}$)	pH 1:2.5	EC dSm^{-1}	OC ($g\ kg^{-1}$)	CEC	Exch Ca	Exch. Mg	Avail. N	Avail. P	Avail. K
							<—[cmol (p+)kg^{-1}]—>			($kg\ ha^{-1}$)	($kg\ ha^{-1}$)	($kg\ ha^{-1}$)
1.	Agri system- Paddy											
	0-15	SL	1.52	6.10	0.02	5.5	9.50	4.30	2.42	295.30	55.00	110.00
	15-30	SL	1.54	6.14	0.05	5.2	10.00	4.98	2.50	280.00	45.00	102.00
	30-45	SL	1.58	6.17	0.09	4.0	10.90	4.80	3.35	219.00	43.00	89.00
	45-60	SL	1.64	6.44	0.12	3.60	11.95	5.55	3.23	190.00	34.00	75.00
2.	Agri system- Maize											
	0-15	SL	1.54	6.01	0.06	3.59	8.50	3.08	1.14	250.00	68.00	128.00
	15-30	SL	1.58	5.89	0.09	3.87	9.00	3.50	1.30	207.00	50.00	115.00
	30-45	SL	1.62	6.11	0.08	3.20	9.20	3.40	2.20	187.00	36.00	102.80
	45-60	SL	1.65	6.13	0.15	2.50	9.67	3.70	2.00	130.00	25.00	95.00
3.	Horti system-Arecanut											
	0-15	SL	1.55	5.75	0.06	5.50	8.05	3.10	1.10	310.00	57.00	112.00
	15-30	SL	1.57	5.70	0.11	5.46	9.00	2.80	1.83	290.00	54.00	108.00
	30-45	SL	1.60	5.84	0.09	4.40	11.83	3.70	1.65	254.00	49.00	85.00
	45-60	SL	1.64	5.90	0.13	3.20	11.90	4.50	2.32	168.00	35.00	69.00
4.	Silvi System - Eucalyptus											
	0-15	SL	1.49	5.76	0.08	6.50	8.50	3.00	1.60	350.00	56.30	120.27
	15-30	SL	1.50	5.80	0.10	5.50	8.72	2.81	1.53	295.00	46.00	113.00
	30-45	SL	1.57	6.10	0.09	5.10	8.78	3.36	1.80	205.00	39.00	103.00
	45-60	SL	1.62	6.15	0.15	4.81	9.05	2.60	1.40	213..00	34.00	86.00

Note : SL- Sandy loam

In cropped fields, exposure of the soil surface to heavy rains brings about erosion, rapid decomposition and mineralization of soil organic matter and intense leaching of nutrients. Important changes could therefore occur in base saturation and in soil nutrient levels.

The low cation exchange capacity values of soils were observed under all the land use systems, which may be attributed to low clay content and dominance of Kaolinite type of clay (Walia and Chamuah, 1988). The increase in CEC of soils with depth in all the land use systems may be due to increase in clay content of soils with depth (Khan and Chatterjee, 2001). Present study indicates that the soil properties, land use and management practices have profound influence on physico and chemical properties of soils.

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