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SOIL ORGANIC CARBON STOCK IN DRY DECIDUOUS FOREST OF SESHACHALAM HILL RANGES, SOUTHERN EASTERN GHATS, INDIA

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ABSTRACT

Forest soils are considered as one of the major carbon sinks in terrestrial ecosystems owing to their higher amounts of soil organic carbon (SOC). The objective of the study is to estimate spatial variations in the SOC content in randomly selected 18 (1^{-ha}) study sites in a dry deciduous forest in Seshachalam Biosphere reserve. The soil samples were estimated by Walkey and black method alongwith various physico-chemical parameters. The range of higher SOC values (0.49 % - 2.16%) were recorded at 0-10cm depth and lower (0.16 % - 1.29%) at 10-30cm of the soil depth. A decrement of 58.26% was observed between SOC values of top soil and below ground soil. A negative relationship between SOC and bulk density was recorded.

Key Words: Soil organic carbon, Bulk density, Dry deciduous forest, Seshachalam hill ranges

INTRODUCTION

Eastern Ghats constitute discontinuous low mountain ranges that spread along the east coast from Mahendragiri hill ranges in Odisha to Shevaroy hill ranges in Tamil Nadu (Gopalakrishna et al. 2015). Eastern Ghats extend across the five Indian states Odisha, Andhra Pradesh, Telangana, Karnataka and Tamil Nadu and those occurring in southern Andhra Pradesh can be referred as southern Eastern Ghats. Soils are considered as the largest carbon reservoirs of the terrestrial carbon cycle In these terrestrial ecosystems, Soil Organic Carbon (SOC) pool stores an estimated 1500 PgC which is nearly two times the carbon stored in the atmosphere (800 PgC) and thrice the carbon present in the vegetation (500 PgC) (Clara et al. 2017). Especially forest soils under natural vegetation are regarded as one of the major sinks of carbon (Dinakaran et al. 2011). The primary way that carbon is stored in soil is soil organic carbon (SOC) which mainly includes plant, animal and microbial residues in all stages of decomposition (Lal 2004). Tree density is the most important factor for carbon stock (Gupta et al. 2019). The presence of high organic input in the form of litter makes the top 0-30 cm soil profile more dynamic which plays a significant role in the carbon cycle (Gandhi and Sundarapandian 2017). The soil organic carbon concentration varies across land use types as a function of climate, and vegetation (Sreenivas et al. 2016). Soil carbon has much longer residence time than the carbon in the vegetation and thus carbon sequestration in soils and plants is the only strategy that can remove carbon from the atmosphere and, overtime, reduce atmospheric concentration of CO_2 (Clara et al. 2017). The rate of carbon sequestration varies with the species composition, forest site, climate, topography and management practices (Gandhi and Sundarapandian 2017).

MATERIALS AND METHODS

Study Area

Seshachalam Hill ranges of southern eastern Ghats lies between 13°38' and 13°55'N and 79°07' and 79°24' E. These hill ranges are designated as Seshachalam Biosphere Reserve in 2011 which extends over 4755.99 Km. The part of the Seshachalam hill ranges that occur in YSR Kadapa district forms the foot hills of Seshachalam Biosphere Reserve which include low hill ranges such as Thurupukondalu, Palakondalu and Veligondalu, which occur in between ($14^{0}04^{1}24.3$ N 78^{0} 57^{1} 44.2 E and $13^{0}48^{1}25.1$ N 79^{0} 25.1^{1} 13.9 E of southern Eastern Ghats. A total of 18 (1-ha) forest study sites were randomly selected for the estimation of spatial soil organic carbon in Seshachalam Biosphere Reserve. These hill ranges mainly comprise of dry deciduous forests with an elevation range of (160-851m). *Pterocarpus santalinus*

(Red sanders) was found to be the most dominant tree followed by *Anogeissus latifoliia* and *Chloroxylon swietenia* (Mastan et al. 2016). The climate is hot and dry with a maximum mean temperature rising to 45.3°C and the minimum mean temperature of 16°C. The mean annual normal rainfall is 677 mm. The study sites comprise of shallow red ferruginous loam soil derived from Shales, Quartzites and Sandstone primary rocks. Soils are acidic in nature in the range of 5.8 to 6.5, soil organic carbon (SOC) was in the range of 0.34 % to 1.59% and soil bulk density in the range of 1.13 g/cm^3 to 1.67 g/cm^3 (Ramana and Reddy 2019).

RESULTS

The physico-chemical properties of the soil are in Table 1. The range of soil pH was 5.8 – 6.8 and the range of electro conductivity values was (18.1 - 136 µs/cm) were recorded in 18 (1-ha) study sites. The mean (0.91±0.40) and range (0.34 % – 1.72 %) of the SOC percentage values were recorded up to 30cm of the soil depth. The range of higher SOC values (0.49 % - 2.16%) were recorded at 0-10cm depth and lower amount of the SOC range (0.16 % - 1.29%) was observed in 10-30cm of the soil depth. A decrement of 58.26% was observed between SOC values of top soil and below ground soil. The mean soil organic carbon (SOC) was 36.84±12.54 t/ha and the values are in the range of 15.81 t/ha–58.3 t/ha (Table 1). A strong negative relationship (r = 0.83) between soil organic carbon (SOC) and bulk density (Fig.1).

Table 1. Physico-chemical properties and soil organic carbon (SOC) stock in 18 study sites

S.no	Soil Parameters (Mean & Range)	Soil depth (0-10 cm)	Soil depth (10-30 cm)	Soil depth (0-30 cm)
1	Soil pH	5.97 – 6.91	5.79 – 6.8	-
2	Electrical Conductivity (µs/cm)	18.1 – 107 µs/cm	25.7 – 136 µs/cm	-
3	Soil organic carbon (%)	1.15±0.49 0.49% – 2.16%	0.67±0.34 0.16% - 1.29 %	0.91±0.40 0.34% -1.72%
4	Soil organic carbon (t/ha)	46.63 t/ha ±14.97 24.18 - 73.22 t/ha	27.15 t/ha ±11.52 7.44 - 43.73 t/ha	36.84 t/ha ±12.54 15.81-58.3 t/ha
5	Bulk density (g/cm^3)		1.17 – 1.67 g/cm^3	

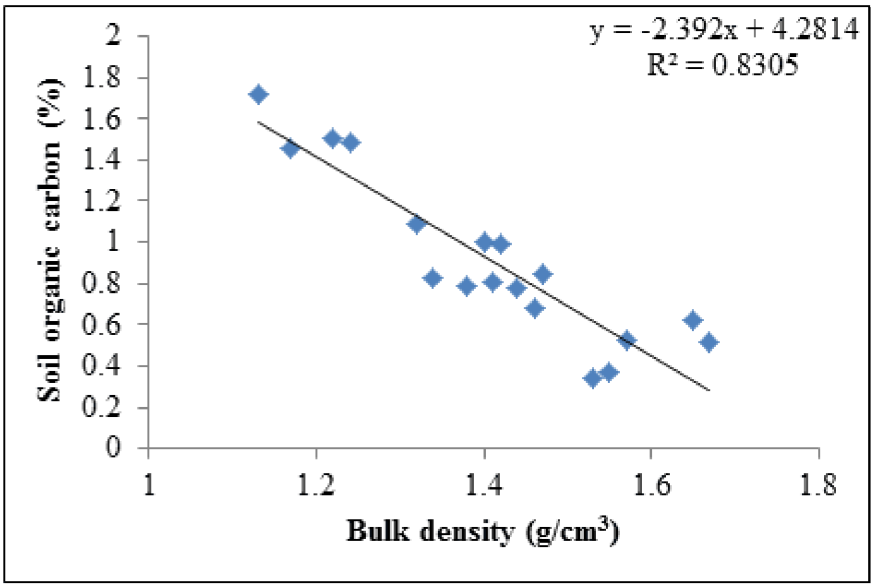

Fig. 1. The relationship between Soil Organic Carbon and Bulk density

DISCUSSION

The mean SOC mean value was (36.84 t/ha) in the present study and the value is found to be in the range of Sathanur reserve forest 16 t/ha – 47 t/ha (Gandhi and Sundarapandian 2017), tropical dry forest Haryana 37.6 t/ha (Gupta et al. 2014), tropical dry forest of Uttar Pradesh 21.8 t/ha (Chaturvedi et al. 2011) but lower than Simplipal biosphere reserve Odisha 55.4 t/ha – 61.8 t/ha (Mohanta et al. 2020). High coefficient variation (34.03%) of soil organic carbon stock was recorded among the study sites revealing high spatial variability. This may arise due to the variation in the litter input which depends on the species composition and the microbial activity (Dinakaran and Krishnaiah 2010).

CONCLUSION

A decrement of 58.26% was observed between SOC values of top soil and below ground soil. The distribution of SOC values across the 18 study sites showed high coefficient variation (CV=34.03%) indicating considerable spatial variation.

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