SIGNIFICANCE OF SOIL CARBON STUDIES IN PLANTATION BASED ECOSYSTEMS

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Carbon (C), is a major nutrient that is essential for plant growth and obtained from carbon-di-oxide (CO_2) in the atmosphere. Carbon sequestration is the process by which this C in atmosphere is captured and stored for a long term in plant and soil system which on the other hand would enable in mitigating the rising concerns of global warming. Soil organic carbon (SOC) forms the basis of soil fertility. It plays inevitable roles such as maintaining soil structure, serves as nutrient store house and in improving the overall health of soil. Through maintaining the physico-chemical and biological properties of soil, soil organic matter determines the soil fertility (Panakoulia et al. 2017).

Studies on organic carbon status and pools has assumed paramount importance in the present scientific research pertaining to soil as it is considered as one of the most reliable indicators of soil quality. Hence, SOC and its significance in soil system gains huge attention globally to understand its role in soil quality and mitigating elevated CO_2 levels in the atmosphere.

PLANTATION BASED ECOSYSTEMS

Major plantation crops include coconut, arecanut, oil palm, cashew, tea, coffee, rubber and cocoa, which have different agro-climatic requirements and are cultivated in different soils. Plantation based ecosystems have their own management regimes which usually focus more on the soil fertility aspects, management of crop as well as crop residue.

Crop management practices involve pruning in tea, shade regulation and pruning in coffee and cocoa, near zero tillage in coffee plantations. As crop residues from arecanut and cocoa are rich in lignin, cellulose and polyphenols (Bhat and Sujatha, 2007) they could be recycled to the soil so as to improve the soil fertility status. The return of residues to the base of palms ensures building up of SOC levels.

Figure1: Arecanut +Cocoa mixed cropping system

Figure 2: Coffee based mixed agro-ecosystem

Plantations play a very crucial role in sequestering carbon in soil as these crops are of longer duration and constitute major share of earth's biomass. Most of the present plantations are cleared forest lands which possess higher organic matter content due to the rich litter.

According to Sivasankaran et al. (1993) red and lateritic soils of South India under plantation crops recorded SOC between 1 to 10 per cent and it varied with altitude and cultural practices.

Studies on major coconut growing soils of Kerala revealed that the organic carbon content was low in the soils (both surface and sub-surface) of Central Kerala, Onattukara and Coastal Sandy plains (Nair et al. 2019). Surface organic carbon content of coconut growing soils of southern Karnataka varied from 0.42 to 1.49 per cent from Central Dry Zone to Coastal Zone (Avinash et al. 2019). SOC content in arecanut based mixed cropping system varied from 2.38 per cent in the surface (0-30 cm) which was higher than the arecanut sole cropping system (1.2%). Arecanut + cocoa cropping systems in Udupi recorded higher organic carbon content of 1.9 per cent.

Anil Kumar and Shalima Devi (2009) identified SOC as the most valuable land quality indicator in coffee production systems. The organic carbon content in the surface layers of the profiles ranged from 1.5 to 5.3 per cent in the major coffee growing soils of Karnataka. Coffee growing soils of the Western Ghats of South India recorded a surface SOC ranging from 1.5 to 2.5 per cent and it declined to 0.5 to 1.0 per cent into the sub-soils. The near zero tillage of coffee soils, complete canopy cover of the plantations and negligible soil erosion resulted in the high level of OC in coffee growing soils. (Karthika et al., 2019).

Cashew growing soils of Dakshina Kannada district of Karnataka are also high in organic carbon at the surface and low in sub-soils. It varied from 0.97 to 3.07 per cent at the surface (Srinivasan et al. 2013). It was found that the soils under rubber plantations too were rich in organic carbon status and it ranged from 1.00 to 3.00 per cent in the surface (Anil Kumar et al 2016). It was as good as that of the forest, due to near zero tillage in the plantations.

CONCLUSION

Plantation crops are perennial in nature and account for higher biomass. The produce is also in huge quantities from these crops. Invariably, all crop species absorb and store C during their life cycle in varying degrees, the perennial nature of plantation crops attributes towards improved contribution in fixation of C leading to its storage in soil. This contribution will be even higher when the crops are grown as mixed cropping or in high density planting system, owing to high density of vegetation per unit area. Higher biomass production in plantation based ecosystems would enhance returns to soil through leaf litter, crop debris, root exudates *etc* thereby enhancing soil carbon pools. However, the role of plantations in sequestering carbon is not fully evaluated. Proper and timely evaluations need to be carried out to discover the untapped potential of plantations in sequestering carbon and adding to the SOC pools.

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