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Conversion of Marginalized Tea Lands into Timber Plantations and its Impact on Soil Organic Carbon Content: A Case Study in Central Highlands of Sri Lanka

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Abstract

Tea (*Camellia sinensis*) plantations can be in production for about 100 years under well-managed conditions. However, soil degradation makes the tea lands marginalized and uneconomical. Land use conversion is an option for marginalized tea lands that could gain numerous environmental and economic benefits. This study estimated and compared the soil organic carbon stocks (SOC) in the surface soil layer (0–30 cm) of marginalized tea lands against those converted to timber plantations in the Badulla and Nuwaraeliya districts. Disturbed and undisturbed soil samples were collected from the top layer (0-30 cm) of the selected sites of marginalized tea lands and those converted to timber plantations for analysis. Organic matter percentage in the site-level dry soil samples was analysed using the loss on ignition method. The final carbon stocks (t C ha^{-1}) for samples from both land use types were then estimated using the SOC percentages and bulk density estimates. The carbon stocks for the soil samples collected at marginalized tea lands and the marginalized tea lands converted to timber plantations were then statistically analysed (descriptive statistics, normality tests and two-sample t-tests) using Minitab 21.2 software. The pH of marginal tea lands (5.34±0.14) and the marginal tea lands converted to timber plantations (5.20±0.13) was slightly acidic in nature. The bulk density estimates of marginalized tea lands and marginalized tea lands converted to timber plantations were very close and estimated as 1.15±0.02. The statistical analysis showed that overall mean SOC was significantly higher under the marginalized tea lands converted to timber plantations (155.3±10.0 t C ha^{-1}) compared to the marginalized tea lands (126.7±5.8 t C ha^{-1}). Land use conversion has increased the SOC stocks gradually after forest establishment. The increased carbon stocks could be attributed to consistent addition of litter layer on the soil, less soil disturbance, and retarded soil erosion contributing to the buildup of soil organic matter and SOC. On the other hand, low carbon stocks in the marginalized tea land could be attributed to unsustainable agronomical practices. Our findings suggest that converting marginalized tea lands in central highlands into timber plantations could enhance the sequestration of atmospheric CO_2, significantly contributing to climate change mitigation.

Keywords: Soil organic carbon, Land use change, Climate change, Tea plantations