

Assessing Soil Quality and Carbon Sequestration Potential in Western Ghats Forests, Karnataka, India: Implications for Sustainable Forest Management

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Abstract

The Western Ghats (WG) tropical forests in peninsular India are recognized for their capacity to sequester carbon, owing to their diverse geology, topography, and ecology. To ensure sustainable forest management and ecosystem services (ESs), it is crucial to evaluate the Soil Quality Index (SQI) across various forest types and vegetation. However, comprehensive profile data on soil quality in relation to total soil organic carbon (SOC) stock and biomass stand particularly under different forest types, and its drivers is limited. In this study, we evaluated SQI and SOC stock of three forest types, i.e., tropical wet evergreen (TWE), tropical semi evergreen (TSE) and tropical moist deciduous (TMD) from nine forest stands under WS range of Karnataka. SQI was estimated through selection of minimum data set (MDS) using principal component analysis (PCA) and two indexing approaches (i.e., additive index and weightage index) and scoring methodologies, i.e., linear scoring function (LSF) and non-linear scoring function (NLSF) were involved in calculating SQI. Study resulted significant correlation ($p < 0.05$) and superiority of weightage indexing through NLSF over other methodologies for detection of forest above ground bio mass (AGB). Within the forest types, mean SQI-NLSF resulted as TMD > TWE > TSE, ranging from 0.28 (Rippon pet RF) in control section (0-100cm) to 0.68 (Mookambika RF) in surface (0-30cm) soils. Total SOC stock follows the similar trend as SQI over forest types, whereas highest found under Kollegal RF (339.3 MG ha⁻¹) and lowest in Rippon pet RF (102.5 MG ha⁻¹) under TMD and TSE forest type respectively. Higher rhizodeposition and soluble acid formation may induce aluminium toxicity in Poomale RF, indicative of potential forest soil degradation. Our results demonstrate that the SQI along with SOC estimation could be a useful tool to indicate the soil ESs in forest systems and can be used as a key indication of sustainable forestry practises.

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