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Assessment of Variability of Carbon Stocks, Physicochemical Parameters, Growth Dynamics of Mangrove Soil and Mangrove Ecosystem in Koggala Lagoon, Sri Lanka

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Abstract

Mangrove forests are unique and invaluable ecosystems due to their role in carbon sequestration. This study examined the spatial variability of selected physicochemical parameters of mangrove soil and total soil carbon distribution at the Koggala lagoon. One hundred core samples were selected from 0-10 and 10, 20 cm depths from the surface based on stratified random sampling techniques. Further, a vegetation survey was conducted to identify mangrove species in the same areas. Soil temperature (°C), pH, Oxidation Reduction Potential (ORP), Total Dissolved Solids (TDS), electrical conductivity, and salt as the physicochemical parameters and carbon contents (inorganic and organic) were analyzed using a standard laboratory method as Loss of Ignition (LOI) involving simple gravimetric equations. The results revealed that soil temperature had the greatest impact on changing carbon content, followed by moisture and dry bulk density. That temperature spatially consistent vertical variation from 29.0 °C to 32.0 °C, with the highest temperature recorded in the top layer. The soil pH values for both depth intervals ranged approximately between 5.0 and 7.0 across all plots. The plots dominated by *Rhizophora mucronata* achieved mean DBH values of 13-16.4 cm and heights of 5.1-5.7 m under low to moderate salinity, higher soil temperatures and more alkaline pH. *Bruguiera sexangula* exhibited lower DBH (8.6-11.7 cm) and heights (3.0-4.3 m) in high-salinity plots. Finally, the widening of the channel acted as a primary driver of environmental changes in the lagoon, significantly altering carbon content, physicochemical parameters, and ecosystem dynamics. Therefore, long-term monitoring of soil carbon content and its seasonal and spatial variations, using advanced remote sensing tools and field measurements, will improve the assessment of mangrove ecosystems. Additionally, clear awareness about the ecological importance of the Koggala lagoon area and management strategies and policy developments is very urgent to the resilience and sustainability of this valuable mangrove ecosystem in the face of environmental changes and anthropogenic pressures.

Keywords: *Mangrove soil carbon, Physicochemical parameters, Growth dynamics, Koggala lagoon, Ecosystem resilience*