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Vertical Profiles of Selected Soil Physico-Chemical Parameters in Natural, Restored, and Degraded Mangrove Ecosystems of Sri Lanka

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Abstract

The growth of mangroves is profoundly influenced by the physio-chemical properties of their pedosphere. For the successful management and restoration of mangrove ecosystems, information on these properties is crucial. In this study, vertical profiles of soil characteristics, including pH, salinity, electrical conductivity (EC), wet soil colour, and dry bulk density (DBD) were examined to a depth of 50 cm in five distinct mangrove restoration sites of Sri Lanka: Anawilundawa, Pubudugama, Achchankulum, Trincomalee, and Batticaloa. These sites encompassed natural mangrove ecosystems, adjacent restored areas, and degraded mangrove lands. The study assessed variations among different depths, sites, restoration statuses (natural, restored, degraded), mangrove composition (*Avicennia marina* dominant, *Rhizophora mucronata* dominant, mixed species), and time elapsed since restoration (10 and 18 months). Stratified random sampling was employed and three replicates were taken from each stratum in each site resulting in the analysis of a total of 1,650 soil samples. In natural mangrove areas, the mean soil pH was 7.4±1.00, displaying no significant variation with depth. Conversely, EC (mean 6.502±4.605 $mScm^{-1}$), salinity (mean 5,020±3,804 mgL^{-1}) and DBD (mean 1.217±0.4898 gcm^{-3}) of natural mangroves exhibited depth-dependent trends. The EC and salinity decreased with depth whilst bulk density increased. The lowest pH (7.4±1.00) was recorded in the natural ecosystems and showed a distinct increase with the age of the mangroves (restored 7.92±0.87, degraded 8.02±0.72). EC was lowest in restored areas (4.9739±2.9931 $mScm^{-1}$) and highest in degraded lands (7.880±6.651 $mScm^{-1}$). Bulk density was highest in degraded lands (1.3894±0.2770 gcm^{-3}), with a similar inverse relationship with the age of mangrove as soil pH. Soil pH at Pubudugama and Trincomalee was significantly higher (8.4±0.41) compared to the other three sites (7.4±0.96), while the lowest EC (2.1685±1.6002 $mScm^{-1}$) and the highest DBD (1.4732±0.4743 gcm^{-3}) were observed in Batticaloa. Mangrove soil dominated by *A. marina* displayed the highest pH (7.8±0.91) and EC (6.21±4.678 $mScm^{-1}$). The brownness of the soil increased with depth while the blackness of the soil increased with the maturity of the mangroves. These findings establish essential baseline data for restoring degraded mangrove. The observed variations in soil physico-chemical parameters provide valuable insights into the dynamic changes induced by restoration. The regional variation and depth-based differences in studied parameters, should be further investigated with carbon loads.

***Keywords**:* Mangrove soil, Physio-chemical parameters, Spatial variation, Vertical profile