Fine Sediment Dynamics Across Vegetation Strata in the Anawilundawa Mangrove Restoration Site, Sri Lanka

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Sediments serve as a fundamental diagnostic tool for assessing mangrove health, influencing establishment, species succession, and propagation. Over 80% of sediments entering mangrove ecosystems are suspended, making fine sediments (particle diameter <63 µm) a significant proportion of the sediment load. The "fine sediment percentage" represents the proportion of total sediment. This study determines and compares fine sediment percentages across three vegetation strata: natural, restored, and degraded at the Anawilundawa Accelerated Natural Regeneration site, Sri Lanka, employing the methodology of Silburn et al. (2018). Stratified random core sampling was conducted across three ecological strata (natural, restored, and degraded) and three depth intervals (0–10, 10–20, and 20–30 cm) within land, main channel, and subchannel locations, yielding 30 cores and 90 soil samples in total (9, 54, and 27 samples per stratum, respectively). Samples were prepared using channel water, settled for 24 hours, and photographed from front and back orientations for analysis in R-Studio. The locator function in R was used to identify fines-water, sand-fines, and sediment-bottom interfaces, from which fines and total sediment heights were derived to calculate Percentage Fines Content. A Kruskal-Wallis test revealed significant distributional differences across all depths ($H = 14.38$, $p = 0.013$). The restored strata recorded a lower mean fines percentage (51.46 ± 22.27) compared to the natural (67.35 ± 13.94) and degraded (61.10 ± 19.02) strata. At the 0–10 cm layer, restored land had fewer fines (48.17 ± 21.16) than both natural (62.31 ± 11.50; $p = 0.003$) and degraded land (63.12 ± 23.13; $p = 0.003$). A five-year-old straight-palmate restoration plot exhibited a reduced fine sediment percentage (30.55 ± 15.09) relative to a three-year-old contoured-palmate plot (54.27 ± 14.81). Natural mangroves and restored subchannels (60.6 ± 20.4%) were statistically similar ($p = 0.425$). Fines increased with depth in both natural and restored strata. These findings indicate potential sediment loss in the restoration area, which could hinder seedling establishment and obstruct channels. Adaptive re-engineering and routine monitoring are recommended. The study also validates Silburn's method as a low-overhead technique for evaluating fines percentages in mangrove sediments.

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