



Assessment of Total Ecosystem Carbon Stock Dynamics in Natural, Restored Mangrove and Abandoned Shrimp Pond Areas in the Pubudugama Accelerated Natural Regeneration of Mangroves Site, Sri Lanka

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Mangroves act as critical blue carbon sinks and play a vital role in climate change mitigation. Mangroves in Pubudugama, Puttalam district, have been extensively destroyed for aquaculture. Currently, abandoned shrimp ponds in the area are being restored through the Accelerated Natural Regeneration of Mangroves (ANRM) project. This study aimed to determine the Total Ecosystem Carbon Stocks (TECS) in natural mangroves, degraded areas, and areas under restoration, commenced in 2019, 2020, 2020/2021, and 2024. TECS were quantified by measuring four primary pools: above-ground, below-ground, soil, and downed wood carbon. The stratum consists of three 50 m × 50 m main plots, each containing five 7m radius subplots (one central, four at corners). Soil samples were collected to a depth of 1 m across four intervals, yielding 5 samples per main plot for a total of 15 samples per strata. Other carbon pool data were collected from these same locations. Soil organic carbon was determined by loss on ignition (LOI), and vegetation biomass was estimated using allometric equations. Mean TECS values varied significantly across the six sites, according to the one-way ANOVA. Mean TECS was highest at the natural site (860±201 Mg ha⁻¹), next at the 2019 restoration site 625±17.4 and the lowest at the 2020/2021 and 2020 sites (136±17.6 Mg ha⁻¹, 131±67.2 Mg ha⁻¹). The degraded area contained only soil organic carbon and exhibited no above and below-ground carbon pools. All forms of carbon were present only in the natural environment. The 2019 restoration site recorded the highest mean above-ground (123±68.2 Mg ha⁻¹) and below-ground (92.3±52 Mg ha⁻¹) carbon stocks. These findings show that natural mangroves in Pubudugama possess significantly higher carbon stocks than degraded or actively restored areas, with restoration efforts able to recover lost carbon reserves gradually. The results serve as a baseline for adaptive management of the ANRM project and inform blue carbon accounting in Sri Lanka.

Keywords: Above ground carbon, Below ground carbon, Mangroves, Total organic carbon