

Quantifying the Carbon Sequestration Potential of Mangrove Restoration in a Degraded Kenyan Creek: A Five-Year Assessment

K, a, m, a, u, O, t, i, e, n, o, ,, F, a, t, u, m, a, A, b, u, b, a, k, a, r, ,, W, a, n,
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| Abstract

Mangrove ecosystems provide vital coastal protection and contribute to climate change mitigation via carbon sequestration. In Kenya, widespread degradation of these forests, as seen in Mida Creek, has reduced these benefits. There is a scarcity of quantitative, multi-year data on the carbon sequestration outcomes of engineered mangrove restoration projects in the region. This study quantified the carbon sequestration potential of a restored mangrove wetland in a degraded Kenyan creek over a five-year period. Its primary objective was to measure and compare above-ground biomass carbon stocks and sediment organic carbon accumulation between restored and natural reference mangrove stands. A field monitoring programme was implemented. Above-ground biomass was estimated using species-specific allometric equations applied to periodic diameter and height measurements from permanent plots. Sediment cores were analysed to determine organic carbon density and accumulation rates. Restored *Rhizophora mucronata* stands were compared with adjacent natural mangrove areas serving as a reference. The restored mangrove area exhibited a significant increase in carbon stocks. Above-ground biomass carbon accumulation in restored stands attained approximately 60% of that in natural reference stands by the end of the monitoring period. Sediment organic carbon accumulation rates at the restoration site became comparable to those in natural sites within

three years. Engineered mangrove restoration in degraded coastal creeks can effectively recover carbon sequestration functions within a relatively short timeframe. This supports the viability of such projects for climate change mitigation alongside coastal protection goals. Restoration projects should integrate long-term biomonitoring to validate carbon sequestration models. Engineering designs must prioritise hydrological restoration to optimise sediment carbon capture. These practices should be formally incorporated into national blue carbon strategies and coastal management policies. Blue carbon, coastal restoration, mangrove rehabilitation, climate change mitigation, biomass, sediment carbon, Kenya This research provides critical, empirically derived data on the carbon recovery trajectory of an engineered mangrove restoration project in East Africa, directly informing the planning and valuation of nature-based coastal engineering solutions.
