



Valuing Blue Carbon: Geospatial Assessment of Carbon Sequestration, Vulnerability, and Market Potential in the Muthurajawela-Negombo Coastal System, Sri Lanka

V.N. Udani*, J.M.C.K. Jayawardana, D.N.S. Wanniarachchi

Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Sri Lanka.

**nawanjanaudani@gmail.com*

In the carbon market, blue carbon is gaining recognition as an affordable nature-based solution in climate mitigation. However, significant knowledge gaps remain regarding these ecosystems' vulnerability, market, and actual carbon sequestration potential. To identify this potential in the Sri Lankan context, Muthurajawela marsh and Negombo lagoon were studied as a pilot study area, highlighting the blue carbon ecosystems. The study area complex was categorized using spectral indices such as NDVI, NDWI, MNDWI, NDMI, and EVI. Sentinel-2-surface reflectance images (10 m resolution) (2025-2026) were analyzed via Google Earth Engine and QGIS. The classification was achieved with an overall accuracy of 84% and a kappa coefficient of 0.79. Total carbon stock is derived from 3 carbon pools: aboveground biomass, belowground biomass, and soil organic carbon. For the overall estimation, literature-derived density values (2015-2026) were applied to the belowground biomass and soil organic carbon. And also, literature-based factors can have a substantial impact on carbon accumulation rates. The results indicate that mangroves are the most dominant ecosystem within the study area, contributed 95.9% of the total carbon stock, calculated to be 334,644.66 Mg C (1,228,145.93 Mg CO₂e). Soil organic carbon constitutes 61.6% of the total carbon pool, indicating the critical importance of sediment management. About 88.7% of the region has moderate vulnerability, while 6.3% has high-to-very-high vulnerability, according to a composite Blue Carbon Vulnerability Index (BCVI) that integrates anthropogenic pressure, erosion risk, pollution intensity, and development proximity. A potential stock value of USD 9.8–36.8 million is estimated based on the voluntary carbon market price for 2025. These results indicate that the Muthurajawela–Negombo system's blue carbon conservation is a strong climate mitigation asset with real potential for carbon finance. Furthermore, analyzing the carbon sequestration potential of coastal ecosystems in the broader context of Sri Lanka will help to restore the natural assets.

Keywords: *Blue carbon ecosystems, Mangroves, Carbon credits, BCVI, Muthurajawela, Negombo lagoon*