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Estimation of Above-Ground Biomass using Vegetation Indices in a Selected Mangrove Vegetation in Thambalagam Bay, Trincomalee

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Abstract

Mangroves are extremely productive ecosystems along the coast that help to mitigate climate change by absorbing carbon dioxide from the atmosphere. Understanding the carbon storage capacity is critical for assessing these ecosystems' resilience and vulnerability to climate change. The aim of this study is to estimate carbon dioxide (CO₂) absorption by mangroves and to find the equation to derive AGB using the best vegetation index for mangrove forest in the selected site of Thambalagam Bay using GIS and remote sensing techniques. The purposive sampling method was used to select a site from the mangrove forest around Thambalagam Bay in Trincomalee District. A field survey was carried out in the selected and the site was divided into five strata based on the species' dominance and named according to the dominant species. The five stratas are *Avicenia marina*, *Rhizophora*, Multispecies, *Lumnitzera racemose*, *Avicenia officinalis*. The fishnet tool divided each stratum into plots (10m×10m). Twenty sampling plots were taken based on Simple random sampling. AGB was calculated using allometric equations of each mangrove species in each plot. Finally, the total AGB of each stratum was calculated as (ton/ha). The above-ground carbon stock and CO₂ absorption for each stratum were calculated as (ton/ha) using empirical equations;(AGC = AGB × 0.47), (Total CO₂ absorbed = AGC (ton/ha) × 44/12). Vegetation indices (NDVI, SAVI, GNDVI, RVI) maps of the selected site for the year 2022 were prepared using ArcMap 10.8. Polynomial regression analysis between vegetation indices and AGB was carried out to find the best vegetation index to predict AGB using Minitab 17 statistical software. The best vegetation index was selected based on the high R² value. Results of the polynomial regression analysis show NDVI had a strong correlation ($AGB = 7232 - 20420NDVI + 14482NDVI^2$; $r^2=92.10\%$) with above-ground biomass (AGB) in the Thambalagamam Bay mangrove forest. Increasing order of total absorbed CO₂ relevant to stratum are *Lumnitzera racemose* (186.195 ton/ha), Multi species (439.858 ton/ha), *Rhizophora mucronate* (453.825 ton/ha), *Avicena officinalis*(675.937 ton/ha), *Avicena marina* (2635.572 ton/ha). In total, 4391.387 ton/ha of CO₂ was absorbed by the selected site of the mangrove forest around Thambalagam bay. The study highlights the importance of efforts to preserve the long-term survival of mangrove ecosystems in the face of global climate change.

Keywords: Mangrove, Above-ground biomass (AGB), Above-ground carbon stock (AGC), CO₂ absorption, Climate change