



Assessment of Biophysicochemical Conditions in the Mulli Mangrove Ecosystem, Northern Sri Lanka

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Mangrove ecosystems in Northern Sri Lanka, particularly the Jaffna District, remain ecologically significant, but their biophysicochemical conditions have not been adequately documented. The Mulli mangrove ecosystem is a fragmented coastal habitat within the Thondaimanaru–Vadamarachchi Lagoon system, influenced by restricted tidal exchange and increasing anthropogenic pressures. This study used a stratified random sampling design across 150 ha during 2025, with ten plots (100m × 100m) each divided into five subplots (10m × 10m), and a 0.5 ha area was used for detailed analysis. Vegetation composition, diversity indices, leaf functional traits (Specific Leaf Area, SLA; Leaf Dry Matter Content, LDMC), soil parameters (pH, electrical conductivity, EC, total nitrogen, TN; available phosphorus, P; total organic carbon, TOC) and water parameters (pH, salinity, EC, turbidity, chemical oxygen demand, COD; biochemical oxygen demand, BOD₅) were assessed following standard American Public Health Association protocols. A total of 1242 individuals of two true mangrove species, namely *Excoecaria agallocha* and *Lumnitzera racemosa*, were recorded. *E. agallocha* was dominant (88%), giving low diversity (Shannon–Wiener index $H' = 0.373$; Simpson's index $1-D = 0.218$) and low evenness ($J = 0.54$). *E. agallocha* had higher SLA ($101.9 \text{ cm}^2 \text{ g}^{-1}$), indicating a resource-acquisitive strategy, while *L. racemosa* showed lower SLA and LDMC, indicating stress tolerance. Soils were alkaline (pH 8.3 – 9.1) with low to moderate EC ($360\text{--}602 \mu\text{Scm}^{-1}$), TOC of 3.39–5.79%, while C/N (20.97–88.1) and low available phosphorus levels (11.2–14.6 mg/kg) indicated slow decomposition. Water quality showed low salinity (3–9ppt), near-neutral to slightly alkaline pH (7.15–8.92), low turbidity (1.16–4.15 NTU), and elevated COD ($160\text{--}640 \text{ mgL}^{-1}$) and BOD₅ ($5.8\text{--}7.2 \text{ mgL}^{-1}$), indicating organic loading. Overall, restricted tidal flushing, low phosphorus availability, and elevated organic loading were associated with ecological simplification, highlighting the need for improved hydrological connectivity and pollution management for long-term sustainability.

Keywords: Mangrove ecosystem, Biophysicochemical characteristics, Vegetation diversity, Tidal connectivity, Nutrient limitation