



Assessment of Mangrove Sustainability using the Analytic Hierarchy Process (AHP) in Chilaw Lagoon, Sri Lanka

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Mangrove ecosystems provide critical ecological, economic, and social services to coastal communities, yet have faced persistent and intensifying pressure from natural and anthropogenic activities for more than four decades. Effective management requires systematic, multi-criteria frameworks that integrate ecological and socio-economic dimensions. No integrated Sustainability Assessment has previously been conducted for Chilaw Lagoon. This study addresses that gap by applying the Analytic Hierarchy Process to assess Mangrove Sustainability across seven criteria representing three pillars of sustainable development: environmental sustainability (water quality, climate vulnerability, and natural hazards), economic sustainability (shrimp farms, fishing, and tourism), and social sustainability (governance). Expert opinions were collected from five purposively selected stakeholder groups via Google Forms and analyzed using Saaty's pairwise comparison method, with weighted overlay risk mapping conducted in ArcGIS. The consistency ratio of 0.019, well below the 0.10 threshold, confirms acceptable consistency in judgment. Water quality ranked highest in relative importance at 20.40%, followed by shrimp farm at 19.30%, governors at 13.40%, fishing at 13.30%, natural hazard (flood) at 12%, tourism at 11.50%, and climate vulnerability (sea level rise) at 10.10%. Special risk mapping of the 481ha mangrove extent (2025) identifies 2.29 ha (~1%) as high risk (low sustainability), 367.23 ha (~76%) as moderate risk, and 111.48 ha (~23%) as low risk (high sustainability). These findings indicate that the current state of mangrove sustainability in Chilaw Lagoon is critically fragile, driven primarily by poor water quality, weak enforcement of governance, and unregulated stream-farm effluents. Priority management actions include water-quality monitoring, influence regulation, strengthening governance, and immediate, targeted interventions in high and moderate-risk zones to balance ecosystem conservation with local neighborhood needs.

Keywords: Mangrove sustainability assessment, Analytic Hierarchy Process (AHP), Chilaw lagoon, Coastal management, Risk mapping