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Mangrove Based Resilience Strategies in Sri Lanka's Coastal Ecosystems: Addressing Climate Change for Sustainable Environmental Management

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Abstract

Climate change presents increasing threats to biodiversity, natural resources, and livelihoods dependent on Sri Lanka's coastal ecosystems, particularly mangrove forests. This study evaluates the resilience mechanisms and adaptation capacity of coastal forests under growing climatic threats, such as sea level rise, saltwater intrusion, extreme weather events, and shifting monsoon patterns. A qualitative thematic analysis was conducted using a systematic assessment of nearly 50 secondary sources from 2000 to 2025 obtained from important academic databases, government, non-governmental, and policy publications. The review focused on degradation patterns, institutional responses specific to Sri Lanka's coastal forests, and adaptive strategies, including indigenous ecological knowledge. Findings reveal that Sri Lanka's mangroves, which once covered over 15,670 hectares, have lost 25-35% of their area since the 1980s due to pollution, aquaculture, and coastal development. Important ecosystem services such as habitat support, carbon sequestration, and coastal stabilization are provided by key mangrove species like *Avicennia* and *Rhizophora.* Since the 2000s, restoration efforts covering more than 1,000 hectares have resulted in up to 78% seedling survival in sites that combine significant community involvement with scientific input. There are at least ten different adaptation strategies that have been discovered, such as Integrated Coastal Zone Management (ICZM) initiatives involving local stakeholders, indigenous management of fisheries and harvesting, and community-based conservation. According to climate estimates, sea levels will rise by 0.1 to 0.6 m by 2050, and storm frequency will increase. This endangers the mangrove's health and the stability of the shore. Comparative analysis reveals that while Sri Lanka has similar problems as other tropical coastal countries such as the Philippines and Indonesia, it also benefits from a distinctive form of governance that combines policy-driven adaptation with indigenous expertise. Policy recommendations emphasize strengthening coastal and forestry institutions, filling enforcement and coordination gaps, expanding community-led restoration connected to livelihoods and incorporating climate adaptation into planning. Indigenous practices such as traditional planting aligned with natural flooding and sustainable harvesting require formal recognition to enhance resilience. Future studies should focus on monitoring the long-term outcomes of restoration efforts, assessing the effectiveness of indigenous practices, evaluating governance structures, and conducting socio-economic analyses to strengthen policy and management frameworks. This synthesis presents new perspectives by combining data from multiple disciplines, providing a systematic assessment of degradation and restoration outcomes, and identifying key institutional and knowledge gaps that require attention. The study concludes that ensuring long-term environmental sustainability in Sri Lanka's coastal regions requires adaptive and inclusive management within strengthened institutional frameworks to protect coastal mangrove ecosystems, maintain their services, and enhance community resilience against increasing climate change.

Keywords: *Climate change, Mangroves, Coastal ecosystems, Resilience, Sri Lanka*