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BASELINE STUDY OF MANGROVE ECOSYSTEMS RESTORATION IN RABIGH LAGOON, SAUDI ARABIA

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Abstract

This baseline study evaluates the health and spatial distribution of mangrove ecosystems in Rabigh Lagoon, located along Saudi Arabia's eastern Red Sea coast. It aims to support integrated ecotourism development, conservation planning, and sustainable coastal management. The study adopted a multi-scale, data-driven approach combining field-based ecological assessments with advanced remote sensing technologies. Fieldwork at six representative sites involved analyzing chemical, physical, biological, and nutritional parameters, including water salinity, pH, sediment granulometry, mangrove species composition, and nutrient content (carbon, nitrogen, phosphorus). Results indicated spatial variability in salinity, sediment characteristics, and biological indicators, suggesting localized environmental stress and potential nutrient limitations. Complementing the field study, remote sensing analyses were conducted in the initial phase using drone-based surveys and satellite imagery. High-resolution drone data (over 1,200 images across 6.2 km²) were processed to generate orthomosaics, digital surface models, land cover classifications, and 3D reconstructions. This enabled assessment of mangrove canopy structure, vegetation gaps, and spatial distribution, leading to the identification of 12 priority zones for

restoration. Notably, a 23% decline in healthy mangrove cover was observed since 2015, underscoring the urgency of intervention. The ongoing phase of the project focuses on evaluating restoration potential and developing a preliminary action plan. Using integrated geospatial outputs, field data, and ecological criteria, intervention sites have been identified and assessed. A conceptual framework has been developed to guide site-specific restoration actions, outline expected ecological benefits and establish monitoring strategies. Future work includes extended seasonal sampling, satellite analysis from 1984 to 2024, and the integration of artificial intelligence and hyperspectral data to enhance mangrove health and carbon stock assessments. These efforts collectively establish a foundation for resilient ecosystem management, restoration planning, and the promotion of blue carbon and biodiversity conservation initiatives in Rabigh Lagoon.

Keywords:
Mangrove Ecosystems, Remote Sensing, Restoration Planning, Rabigh Lagoon