

**ASSESSING COASTAL HYDRODYNAMICS AND
SEDIMENT DYNAMICS IN THE MONSOON
AFFECTED WESTERN COAST OF SRI LANKA**

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Degree of Doctor of Philosophy

Department of Earth Resources Engineering

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DECLARATION OF THE CANDIDATE

I declare that this is my own work, and this thesis does not incorporate without acknowledgment of any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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DECLARATION OF THE SUPERVISORS

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Abstract

Coastal regions along the west coast of Sri Lanka have undergone significant morphodynamic changes over the past decade, shaped by the interplay of natural processes and human activities. These changes, which include shifts in coastal landforms and sediment distribution, have been driven by modifications in hydrodynamics and sediment dynamics, resulting from activities such as river sand mining, harbor expansions, breakwater construction, sand nourishment programs, and flood control measures. These factors have led to notable patterns of coastal erosion and accretion. This study aims to comprehensively assess the coastal hydrodynamics and sediment dynamics influenced by a combination of anthropogenic activities and natural processes along the monsoon-affected west coast of Sri Lanka, with a specific focus on the regions of Kalutara, Ratmalana, and Mount Lavinia, in order to understand the resulting coastal morphodynamic changes. The representative locations (Kalutara, Ratmalana, and Mount Lavinia) were selected for this investigation, as they have experienced notable impacts on sediment transport patterns and erosion/accretion processes, through a combination of field measurements, remotely sensed data, and numerical modeling. Empirical findings from the study reveal distinct seasonal contrasts in coastal erosion and accretion, attributed to the influence of the southwest and northeast monsoons, respectively. During the southwest monsoon season, waves originating from the southwest impact the west coast, triggering heightened longshore currents that transport sediment northward along the coast. Conversely, during the northeast monsoon season, waves approach the west coast from the northwest, initiating longshore currents that move sediment southward along the shoreline. Moreover, the deliberate opening of a sand spit barrier for flood mitigation at the Kalu Ganga (River) resulted in severe erosion at the river outlet. This event hindered the barrier's redevelopment and exacerbated offshore erosion, with depths reaching 1–2 m over a 2 km area. In addition, coastal protection structures like groynes and breakwaters significantly impact beach morphology and sediment distribution. For instance, groynes trap sediment and stabilize beaches, while breakwaters reduce wave energy, mitigating erosion. In contrast, unprotected areas exhibit greater variability in beach width, slope, and sediment characteristics. The shape and orientation of the Ratmalana coastal area strongly influence beach landform development, while the presence of a natural headland in Mount Lavinia affects coastal dynamics. The knowledge gained from this study can inform the implementation of measures to protect and sustainably manage coastal zones. By bridging the gap between scientific understanding and practical application, this study plays a crucial role in promoting resilience and reducing vulnerabilities in the face of changing coastal conditions.

Key words: Coastal erosion, Morphodynamic changes, Hydrodynamics, Monsoon-induced variations, Sediment dynamics

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Airborne LIDAR Bathymetry	
ALB.....	39
Climate Change	
CC	23
Coast Conservation and Coastal Resource Management Department	
CC and CRMD.....	2
Commonwealth Scientific and Industrial Research Organization	
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