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Geomorphology and Physical Oceanography of the Lakshadweep Coral Islands in the Indian Ocean



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Preface

Islands are often subjected to ecological, economic, and natural vulnerabilities. The Lakshadweep archipelago, a small group of coral islands in the Indian Ocean, is less prone to natural hazards such as cyclones, storm surges, tsunami, etc., due to its position. But the sea level rise, though a long-term threat, is an important natural hazard concerning the islands. Among the natural hazards, coastal erosion is the most serious problem faced by the Lakshadweep Islands due to their small size and topography. Erosion in the islands is caused by both natural and anthropogenic activities. The natural factors that contribute to erosion are high wave activity, strong winds, and currents, whereas the anthropogenic activities are mostly due to human intervention in the form of destruction of corals, construction of jetties, and other hard structures adopted including coastal protection. The erosion in the islands is also attributed to shifting beach sediments by the along-shore currents, energy concentration at certain segments due to wave diffraction, and reduction in the height of reef edge over a period of time. The relatively low land elevation of the islands makes them more susceptible to damage from high waves and flooding during adverse weather conditions. Though shore protection structures have been built in the islands by the Union Territory Administration, a long-term monitoring study is important to precisely identify the shoreline locations prone to erosion. A comprehensive study of the wave climate and coastal processes at work to delineate the factors responsible for shoreline changes and to identify the locations that need protection is needed. Simulation of the coastal processes can be effectively illustrated through numerical modeling. The impact of erosion on the islands can very well be demonstrated using this tool. Modeling results can provide vital information for the efficient formulation of disaster mitigation and management measures.

Energy requirement in the islands is met mostly through diesel. The fuel has to be transported from the mainland in large quantities and is stored in barrels, and in case of a spillage the sensitive island environment may be affected. Owing to fuel transportation, the cost of power generation is very high compared to the mainland. Non-conventional energy sources like solar, wave, and wind power can be alternative energy resources in the islands. Due to the geographical position of

the islands, solar energy is available throughout the year except during the monsoon period. During this period, wave and wind energy is at its highest which could be tapped. In addition, the wave power potential of the Lakshadweep Sea is higher compared to the coastal seas. Similarly, due to their exposure to the sea the wind speeds on the islands are higher than on the mainland. Preliminary studies on the economics of power indicate that the cost of wave/wind power generation becomes comparable with the existing rates for which the fuel has to be transported from the mainland. A multisource power generation system is considered as a technically and economically viable alternative source of energy for the islands.

Although the islands have long conjured up images of '*paradise*', their amazing lagoons and coral reefs show signs of increasing stress. The island communities are striving to raise their living standards and as the population increases, there is always a tendency to disturb the fragile ecosystem, which is one of the most valuable assets as far as the islands are concerned. At times there is a tendency to overexploit these natural resources and damage the environment. Another aspect is the rising sea level due to global warming which is likely to damage the coastal areas and even submerge some of the low-lying islands. This will certainly affect the island economies with a negative impact on property, fisheries, tourism, coral reefs, and freshwater resources. Islands are also important contributors to global biodiversity as the lagoons and coral reefs are home to many rare species. There are indications that these environmentally sensitive habitats are under increased stress, which badly affects the flora and fauna of the islands, and in the case of some of the native endangered species it may even lead to irreparable loss. To integrate all these activities, an Integrated Coastal Zone Management (ICZM) plan is required that would help to address the sustainable management of the islands.

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FOREWORD

The Lakshadweep Archipelago, a group of numerous coral islands situated about 400 km off the west coast of India in the Arabian Sea has become strategically and economically, one of the most important regions in the country. These islands are unique for its aquatic bio-diversity with coral sands fringed by blue lagoon shallow waters having an Exclusive Economic Zone (EEZ) covering nearly 4 lakh sq.km. During the past couple of decades, there has been a sharp increase in the coastal developmental activities largely due to port and harbor development, shore protection and mainly recreation activities. These activities and their interactions with coastal processes have caused erosion at many places. This erosion is mainly attributed to high wave activity during the SW monsoon period.

The National Centre for Earth Science Studies (NCESS) (formerly CESS) has been conducting a number of studies for systematic collection of baseline data on erosion/accretion and wave measurements. This monograph resulting from the valuable studies is a significant contribution of beach changes, wave climate and coastal processes which will ultimately address the issue of shoreline changes and locations that need protection. It also projects the simulation of coastal processes which can be effectively done through numerical modeling. For the first time, an Integrated Coastal Zone Management (ICZM) plan was prepared for efficient formulation of disaster mitigation measures and sustainable management of the island coastline. In addition, the power situation in the islands is reviewed and a multi-source power generation system has been suggested as a technically and economically viable alternative source of energy in the islands.

I am sure this monograph will form a valuable baseline data on the Lakshadweep Islands for the planners, researchers and students. This is definitely a step forward for the overall development plan of the islands.

(Shailesh Nayak)

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