Coastal Protection Measures for Shoreline of Mumbai: Review and Case Studies

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Abstract— **Mumbai is a thickly populated city of Maharashtra, India where the coastal lines are heavily developed on infrastructure. According to Maharashtra Shoreline Management Plan 2017, the continuous coastal erosion over the past years poses a high risk to the infrastructure. Dadar beach, Priyadarshani Park in Malabar Hill, Mahim and Versova are subjected to major erosion risk whereas areas like Girgaum Chowpatty, Aksa and Gorai beaches has 'minor' erosion risk to infrastructure. If critical evaluation and preventive measures are not taken at this juncture as early as possible, it would be hazardous by 2050 [1]. The aim of this paper is to propose soft measure solutions for this adverse condition in Mumbai, analysing reviews and a few case studies which had happened across India.**

Keywords—c Soft measure solutions, Coastal Protection, Geotextile, Artificial reef

I. INTRODUCTION

The Indian peninsula is bordered by the Arabian Sea in the west and south-west, Indian Ocean in the south and the Bay of Bengal in the east and south-eastern part. The total coastal length of India is 7516.6 km. Out of this length, Maharashtra has originally 512km long coastal stretch but In the 11th Meeting of CPDAC (January, 2010) a re-evaluation of coastal length is being taken up based on Survey of India wherein Maharashtra now has 896.98km of coastal line available [2]. Mumbai, the state capital of Maharashtra and the Financial capital of India, is the most populous city with a population of 13 Million. [3] The city has an enviable 149-km coastline and nearly 16 km of beaches stretching from Colaba in the south to Madh and Marve up north. [4]. The coastal length of Maharashtra has 17% of Sandy beach, 37% of rocky coast and 46% of muddy flats.

Fig 1 The Coastal Zone of India

One of the prime threat which Mumbai and other fast-growing coastal megacities in Asia are facing is the climate-related flooding. Out of the thirty-one megacities, twenty-one hug a coastline, of which half of them are in Asia. According to a report, in addition to flooding, these megalopolises could face water supply disruptions, dangerous heatwaves, increased food insecurity and many epidemic outbreaks. Mumbai's flood risk makes the city a "high risk" place for climate change vulnerability — the second-most worrying category after "extreme risk," according to Verisk Maplecroft's 2018 hazard index. Mumbai ranks as the ninth riskiest megacity in the list of 31, based on 50 factors from preparedness to exposure to climate shocks like heat waves, drought, hurricanes and flooding. As a result of Global warming, there is a change in the climate, which changes the ocean temperatures, including in the Arabian Sea, causing both sea-level to rise and the rainfall pattern to change across India. Moreover, Mumbai's west coast is predicted to receive more of cyclones than previous years as per the data provided by the government. The seasonal shift in winds adds an extra layer of uncertainty to projecting the amount of sea level rise in Mumbai. Many of the coastal cities are at high risk, as the frequency of extreme weather is alarmingly increasing, resulting in a significant rise of sea level. Places like Marie Drive is risky and comprises of marginal land which is completely unstable and unsafe to build on. [5]
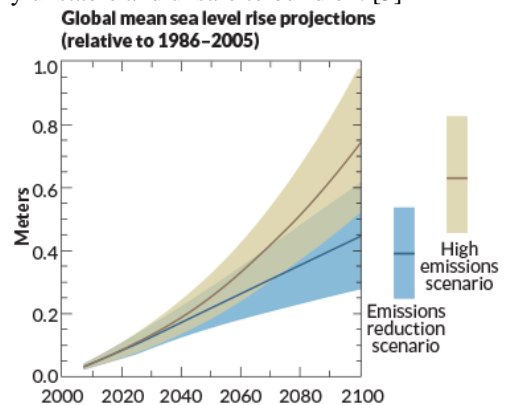

Fig 2: Global Mean sea level rise [6]

II. CAUSES OF COASTAL EROSION

Coastal Erosion a physical process where the sediments of the shoreline are weared off and redistributed by natural forces such as waves, tidal and currents. Erosion occurs when the material removed exceeds the supply, which results in the reduction of beachline and landward shifting of the shoreline.

Waves, the major cause of coastal erosion are developed in the mid ocean and moves towards the shore. Waves bring an enormous amount of energy to the coast that is dissipated through wave breaking, water level changes, and movement of sediment. Wave energy is the result of the speed of the wind