Coastal Problems Associated with Southern Colombo Harbour Expansion Project

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Abstract: Colombo is the major commercial harbour in Sri Lanka and the government has started to expand this harbour to increase its capacity. Therefore, a breakwater has started to build perpendicular to the shoreline. Due to these types of offshore structures wave patterns as well as current patterns changes to a large extent, leading to detrimental effects on the coastal beaches on either side of the harbour. In this study, we are planning to understand coastal effects due to the harbour expansion by studying 8 transects selected from each side of the harbour and measuring beach width, profile changes and grain size variation at mean sea level at monthly interval. This information along with previous shoreline data collected from the Survey department of Sri Lanka can be used to understand the coastal sediment dynamics including the erosion and deposition characters in the nearby beaches.

Keywords: Coastal Erosion, Sediment Transportation, Southern Colombo Harbour Expansion Project, Monsoon, Longshore drift

1. Introduction

Sri Lanka is advantageously situated in the Indian Ocean close to India, along the main East-West shipping route and is therefore prepared to be a strong challenger in the world shipping market. Therefore, the government has started the Colombo Harbor expansion project to increase its capacity by building several kms long breakwater perpendicular to the coastline. The adverse effects on the coastal environment due to construction of obstacle perpendicular to the shore line is well-known (1987, Launceston). The major costal problems are change in the coastal currents and wave patterns in the area leading to change in the sediment transportation patterns. This can result erosion and deposition (Bryceson, 1978) in nearby beaches and also serious sedimentation problems inside the harbour. Knowledge about the costal responses to the perpendicular structures is very much of importance in predicting about the future costal problems due to such constructions and also greatly important in planning environment friendly costal constructions (Paul et. al., 1996). Since Colombo is the commercial capital and also bears huge population in addition, to the large influx of tourists to the city year around, beaches in the capital have become important recreational places for all these people. Therefore, beach erosion would severely affect the country's economy. The present study focuses on the sediment dynamics and resulting coastal morpho-dynamic changes due to construction of shore perpendicular coastal structures. This study would gives us a clear understanding on the effects of harbour expansion project and help to take

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remedial measures to prevent coastal problems.

1.1. Objectives

- To determine beach width and profile variation due to the Colombo harbour expansion project compared to the seasonal variations.
- To identify the long show sediment transportation and predict future variations.

2. Methodology

In this study, 8 transects of beaches (Fig. 1) were selected from both sides of the breakwater representing the important beaches in the Colombo area .and monthly beach profile variations were measured from 2011 April to 2011 November from 2 m beneath the mean sea level (MSL) to a fixed point in the backshore such as lamp post, railway line, etc.

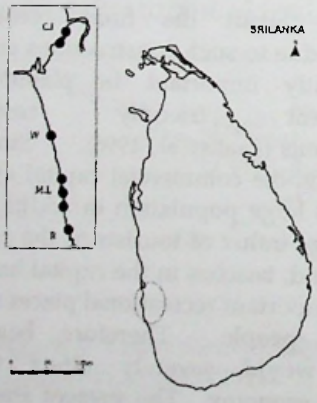

Figure 1—Location map of the beach profiles. Note: CI: Crow Island, W: Wellawatha, M.L: Mount Lavina, R: Rathmalana

At each profile location, measurements were taken perpendicular from the fixed land reference point to the shoreline. Therefore, the positions of the transects and bearings were accurately reproduced at each repeated monthly measurements. Vertical measurements were taken with 1 m shore along intervals using Surveying Level.

In addition, sediment samples were taken from the MSL of the each transect for the grain size analysis. Grain size analysis was carried out using 15 set of sieves with mesh size ranging from 2000 microns to 45 microns. GRADISTAT (version 4.0) software was used to analyse the particle sizes. Information on grain size characteristics were used to interpret the depositional environment and transport mechanism of sediments.

Changes in shoreline due to accretion and erosion were analysed by measuring differences in past shoreline data of year 2000 collected from the survey department and the present measurements (year 2011). Beach width changes from present and past were compared from a fixed location (Railway line) to MSL and used to calculate the rate of beach width change.

3. Results and Discussion

Results shows beach width and the profiles considerably changes (Fig. 2 and 3) with the seasonal change due to monsoonal effects. Maximum beach width variation during 2011 April to November is recorded of 55 m at location Crow Island 1 where beach is relatively flat while shortest beach width variation of 7 m is recorded at location Crow Island 2 where beach is relatively steep. Other locations of Rathmalana, Wellawatta, and Mount Lavinia (1, 2 and 3) had variations ranging from 12 m to 34 m. In general, all the beaches were wider and less steep during April and May and gradually started to shorten the width and increase the steepness with time. Shortest and steepest beach were recorded during months of August and

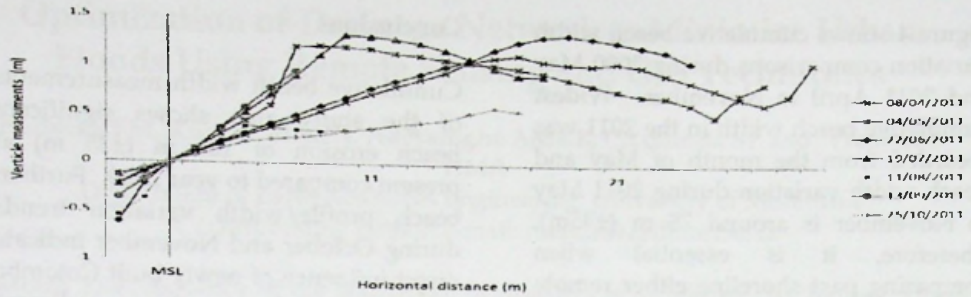

Figure 2 - Beach profile variation at location Crow Island- 01– 04/2011 to 10/2011

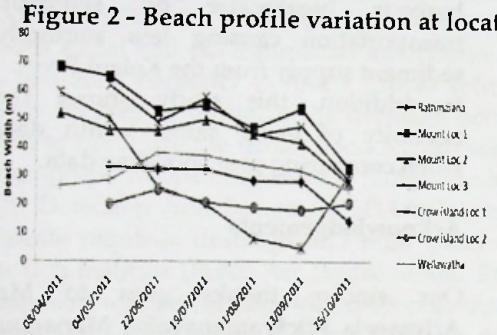

Figure 3 - Beach width variation 04/2011 to 10/2011

shore direction and depositing them offshore as longshore ridges near the wave breaker zone. During fair weather, those sediments in the longshore ridges transport back to the beaches making them wider and less steep. Sediment not only transports cross shore direction but also shore along direction as longshore drift. Usually, a large amount of sediment load is supplied to the northern side of the Colombo Harbour by Kelani River and transports them along the beaches

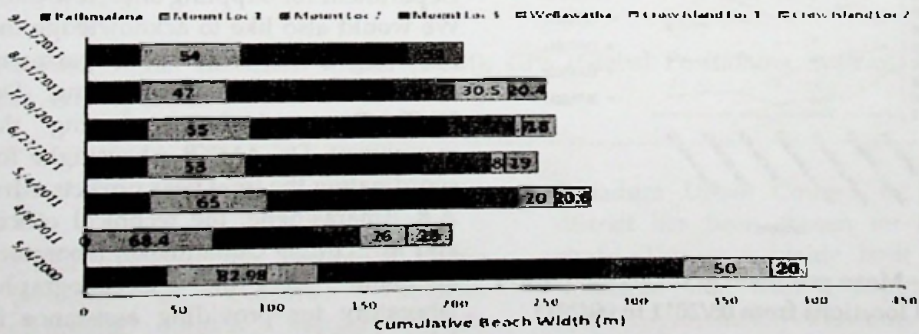

Figure 4- Cumulative Beach Width variations of the present study compared to the year 2000

September. However, during the moths of October and November beaches at northern side of the harbour have started to widen and flattened while Beaches from Sothern section remained unchanged much. This could be because during stormy rough condition beaches are subjected to erosion causing them to widen and flattened transporting eroded sediments cross towards both northern and southern direction as longshore currents. Since the newly built Colombo harbour breakwater, these sediment do not have a chance to transport to the Sothern beaches causing sediment starvation at these beaches. Present results confirm this by beach width variations trends during months of October and November (Fig. 3).

Figure 4 shows cumulative beach width variation comparisons during 2000 May and 2011 April to November. Widest cumulative beach width in the 2011 was recorded from the month of May and beach width variation during 2011 May to November is around 75 m (±35m). Therefore, it is essential when comparing past shoreline either remote sensing or measured data, to use same month measurements. When comparing the beach width in 2000 May and 2011 May, present day beaches cumulatively has eroded by 125 m (±35 m). Therefore, country has lost 11 to 12 m of cumulative beach from the commercial capital each year for the last 11 years. However, it is noteworthy that during this period, there were two drastic events that can cause considerable amount of beach erosion; tsunami and the building of the Colombo Harbour

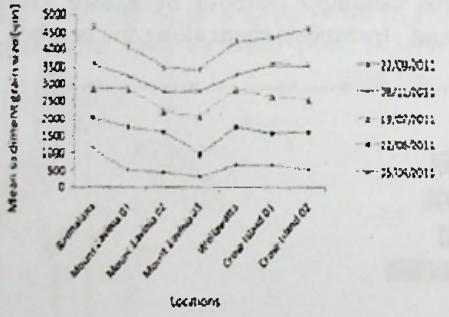

Figure 5 - Mean sediment grain size variation off all locations from 05/2011 to 09/2011

breakwater. In addition grain size shows decreasing tendency from Rathmalana towards mount Lavinia indicating predominant northerly longshore direction. On the other hand, grain size decrease from crow island location 1 to Wellawatta indicates predominant southerly longshore current drift. Therefore, it is conclusive that Wellwatta situated at the southern section from the Harbour still receive sediments from Kelani River.

Conclusions

Cumulative beach width measurements of the study area shows significant beach erosion of 125 m (±35 m) at present compared to year 2000. Further, beach profile/width variation trends during October and November indicate direct influence of newly built Colombo harbour breakwater on sediment transportation causing less southerly sediment supply from the Kelani River. In addition, this study shows the necessity of using same month data when comparing past shoreline data.

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