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COASTAL PROCESSES AND CAUSES OF SHORELINE EROSION AND ACCRETION OF THE BATHTHALANGUNDUWA ISLAND IN SRI LANKA

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ABSTRACT: Baththalangunduwa is an elongated sandy island. It is located in the Portugal Bay extending about 16 km long from north to south, and maximum width is about 680m east to west. Coastal processes mainly erosion, transportation and deposition of the Baththalangunduwa island has been calculated from the period from 1985 to 2017. After analyzing data spatially, erosion can be seen especially in the western flank of the island. The area is faced with waves, swells, storm winds and tides of the Palk Strait during the southwest monsoon period and vice versa accretion can be seen especially in the northern and eastern flanks and along the southern corner during the northeast monsoon period. The waves, wind pattern and tide of the Portugal Bay are responsible for the transportation and deposition in the area. Due to these processes, along the eastern and southern flanks of the island, there form micro landforms such as sandy lobes and hooks, mud flats, sea grass beds, mangrove patches, incomplete small bays and lagoon features. Most of these features are temporal, and limited to a week or a month or a season. According to the results, about 1 km erosion measured from the farthest point to the present coastal line, and total land extent change from 501 ha to 226 ha.

1. INTRODUCTION

A shoreline is a dynamic environment that evolves under the effects of both natural and human influences. Baththalangunduwa is an elongated sandy island located in the Portugal Bay in Sri Lanka, extending about 16.0 km long from to south (8°26'55"N Latitude & 79°48'17"E Longitude) to north (8°32'37"N Latitude & 79°47'06"E Longitude), and maximum width is vary 680-700m from east to west (Figure 1). Many areas along shorelines are naturally subject to erosion and accretion seasonally. Although, human actions can impact the erosion process. Natural coastal processes such as wind, waves or current movement is constantly eroding and/or building up the shoreline of the Baththalangunduwa Island. This paper describes the erosion and accretion of the Baththalangunduwa Island resulting from the seasonal winds, waves and storm surges, but there are no man made coastal structures. As well, there is no any detailed research undertaken previously and there is a big gap in secondary data in relation to the Physical Geography as well as socioeconomic data of the island.

2. PHYSICAL SETTING OF THE STUDY AREA

Baththalangunduwa is one of the few inhabited islands to the north of Puttalam Lagoon. The sea to the west of Puttalam and Mannar lies a string of about 13 islands in number in the Dutch and Portugal bays. Some are inhabited and the others are being completely wild. There are no gravel or tar roads in the island, but narrow sandy paths lined with houses created a convoluted network of routes. Furthermore, the mode of transportation was on portage while bullock carts were employed at times to haul heavy loads such as bring water barrels.

Sandy beaches, incipient sand dunes, scrub vegetation and mangrove patches in the middle and to the northward. Bar Reef, the Marine Sanctuary, is a few killometers west and to the northwest, marine mammals, including whales, dugongs, dolphins and porpoises are in offshore named Pearl Banks. On the east side of the island in Portugal Bay, a well developed sea grasses cover and these are significant for fish and bird life as well as maybe dolphins.

These sands were piled up by waves and winds. No hard or any types of rocks are appearing on this sandy island. However, the basement of this island should be Miocene limestone. The evolution patten and trends the sandy islands of the western and northwestern Sri Lanka can identify as Holocene islands, which developed since Fladrian Transgressoin (Coora and Katupotha, 191; Katupotha, 2013; Deraniyagala, 1956).

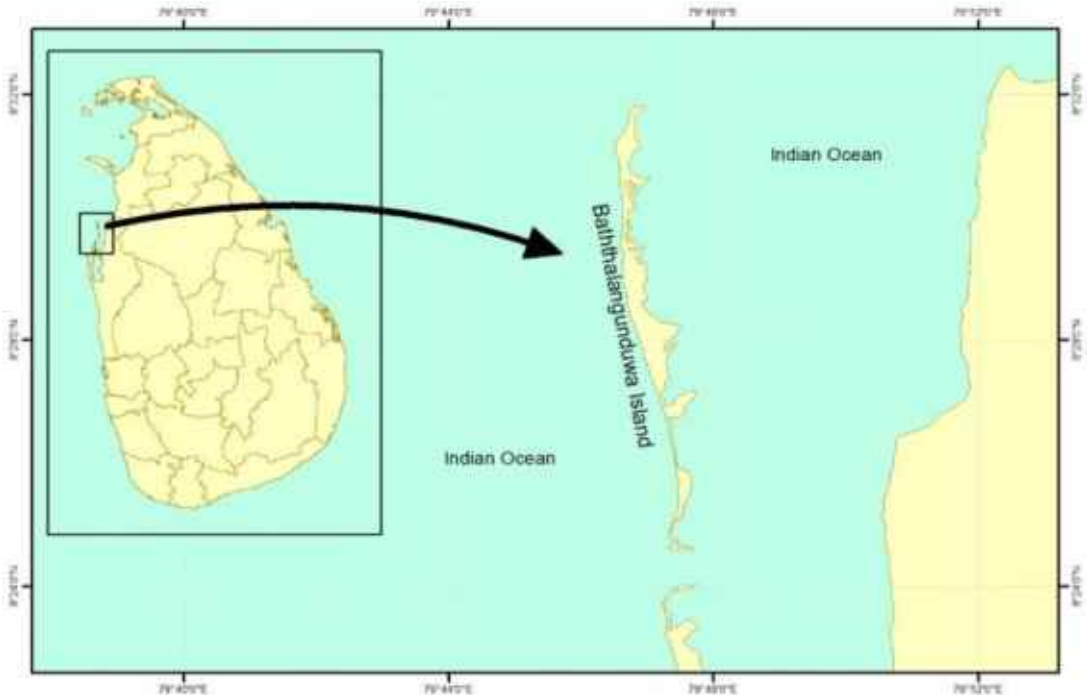

Figure 1. Location of the Baththalangunduwa Island, Sri Lanka

The climate in Sri Lanka is defined primarily by rainfall. Temperature in the lowlands is largely homogenous and increases rapidly with elevation. Four climatic seasons can be identified in Sri Lanka as (i) First intermonsoonal period (March to April), (ii) Southwest monsoon (May to September), (iii) Second intermonsoonal period (October to November) and (iv) Northeast monsoon (December to February). But this sequence is not possible to see the Baththalangunduwa Island, and area includes periods of low rainfall, intense sunlight and strong seasonal winds. The average rainfall should be 750-1,125 mm per year, but heavy rainfall can be distinguished in April to May, and October to December.

The average temperature is 28.2 C^{o} and the warmest months are from March to September with a peak in May (29.7 C^{o}). Lower temperatures are experienced from October until February, with the lowest in January (21.7 C^{o}). The average monthly maximum temperature is 31.0 C^{o} with a peak in April or May as well as in October or November (33.8 C^{o}). The average monthly minimum temperature is 25.5 C^{o} in January. The wind climate of the island is characterized mainly by two monsoons, the northeast monsoon and the southeast monsoon. Of these, two monsoons, the southwest monsoon has the strongest winds (Figure 2). The southwest monsoon begins in May and intensifies during June; from July to the end of September, strong southwesterly winds blow across the inland, and weaker northeasterly winds prevail from December to February. During the inter monsoonal periods, there are moderate winds from different directions. The whole island appears as flat terrain, and soil can identify as Regosols on Recent beach and sand dunes.

3. METHODOLOGY

Coastal Processes mainly erosion, transportation and deposition of the Baththalangunduwa island has been calculated from the period from 1985 to 2017. Remote sensing technology such as aerial photographs, satellite imageries and topographic maps used as secondary data for identifying the physical changes. Rectificatin of satellite imageries to image interpretation, and scanned and geo-referenced topographic maps to digitize and identify the coastal boundary and field surveyed database used to identify the results. Temporal analysis technique used to identify the physical change of the island. Field survey in November, 2016 was undertaken with GPSs used for verification and to identify some prominent and permanent locations of the island. Information on changing of the Baththalanguduwa Island Chain, due to the erosion and accretion, during the past 5-6 decades, based on PRA (Participatory Rapid Assesment) procedure. We collected the evidence from the Officials of the Sri Lankan Navy Camp and the general public of the Baththalangunduwa Island.

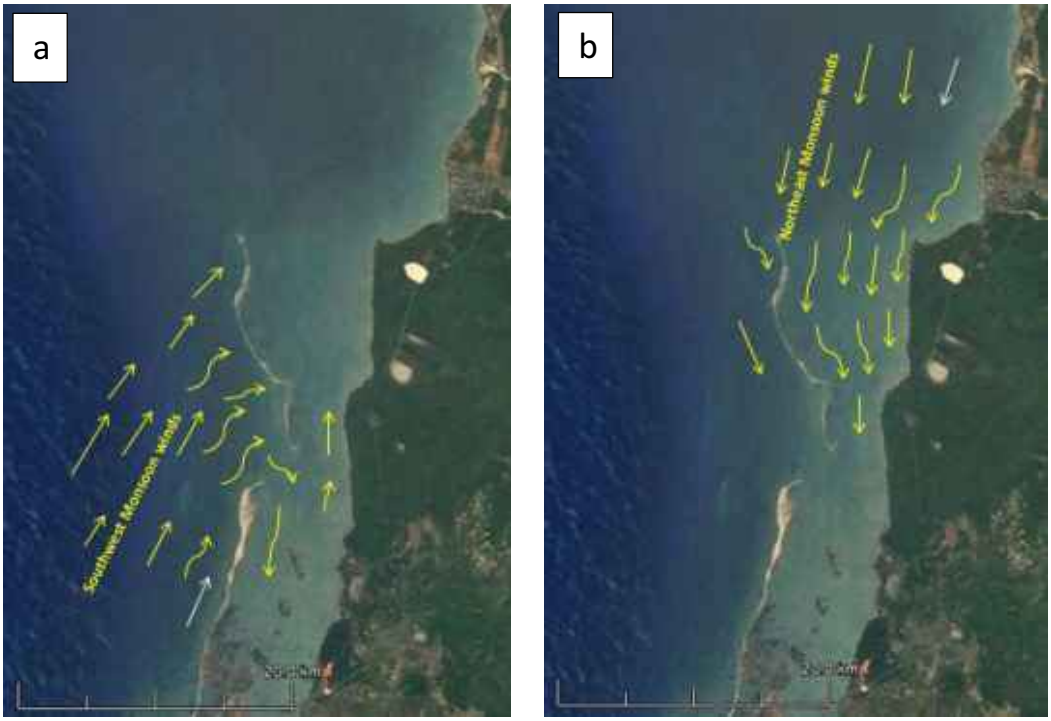

Figure 2. (a) The Southwest Monsoon has the Strongest Winds and
(b) Weaker Northeasterly Winds Prevail Across the Baththalagunduwa Island.

4. CAUSES AND CONSEQUENCES OF COASTAL PROCESSES

Coastal landforms are created by a wide variety of coastal processes, which vary depending on the process, the wave climate, beach morphology, geology, and human activity. This results in the two main actions of erosion and accretion. Coastal erosion is defined as: the group of processes whereby debris or rock material is loosened or dissolved and accretion is defined as: the gradual increase in the area of land as a result of sedimentation. Both processes cover a number of sub-processes, some of which cause both erosion and accretion. Thus the coastal processes include the effect of rising and falling tides associated tidal current, and are influenced by oceanographic factors such as sea temperature and salinity, determined by climate and the patterns of ocean currents (Balabathina et al, 2015; Bird, 2007).

Erosion and Accretion at Baththalangunduwa Island: After analyzing data spatially, erosion can be seen especially in the western flank of the island. The area is faced with waves, swells, storm winds and tides of the Palk Strait during the southwest monsoon period (Figure 2-a) and *vice versa* accretion can be seen especially in the northern and eastern flanks and along the southern corner during the northeast monsoon period (2-b). The waves, wind pattern and tide of the Portugal Bay are responsible for the transportation and deposition (accretion) in the area.

Due to these processes, along the eastern and southern flanks of the island, there form micro landforms such as sandy lobes and hooks, mud flats, sea grass beds, mangrove patches, incomplete small bays and lagoon features. Most of these features are temporal, and limited to a week or a month or a season (Figure 3). According to the results, about 1 km erosion measured from the farthest point to the present coastal line, and total land extent change from 226 ha to 501 ha (Chart 1). Sea waves, especially high tides and wind speed as well as wind directions are reasons to change the shape of the sand deposited island daily.

5. RESULTS AND FINDINGS

The extension of the Baththangunduwa Island Chain is changing due to the erosion and accretion, and it is evident that the land is reducing the width annually. During our survey, we corroborated this situation with evidence through the PRA procedure held with the officials of Sri Lankan Navy Camp and the general public at the Baththalanguduwa. The elders of the Island revealed that the erosion is greater than the accretion. But we found that the eastern margin of the island has eroded as pockets by diurnal tidal prism, waves, long shore currents etc (Photopraphs A-F). In some years, severe erosion can be seen along the western coast and public property washed to the sea. The people

mentioned, as an example the severe coastal erosion, which occurred during the southwest monsoon storms in 2016 year (Photographs G-L). Google images also reveal that the extending the island northwards and developing eastwards the island (Figures 4 & 5).

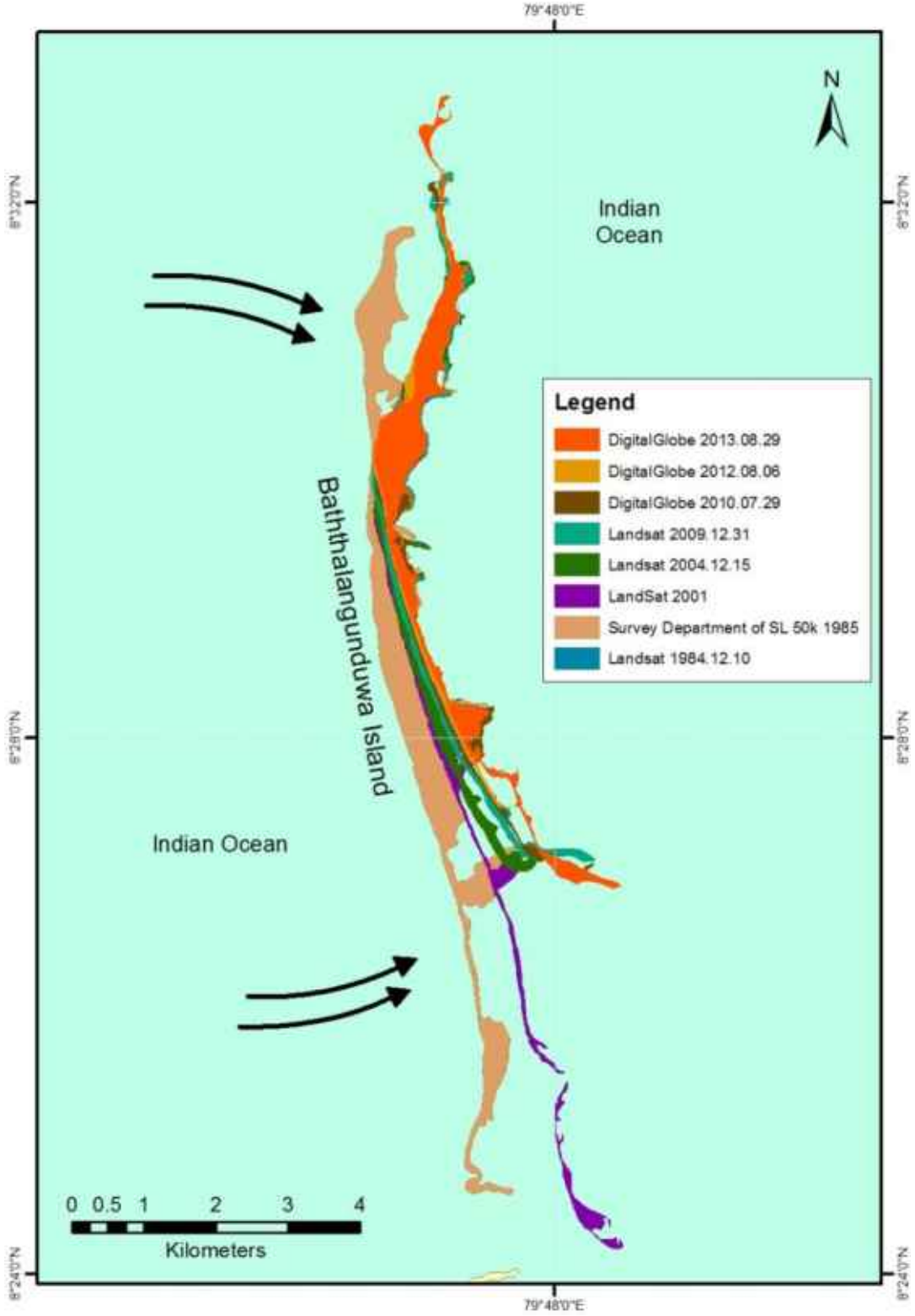

Figure 3. Temporal Movements Occured Daily, Weekly, Monthly and Seasonally at the Baththlangunduwa Island Chain from 1984 to 2013.

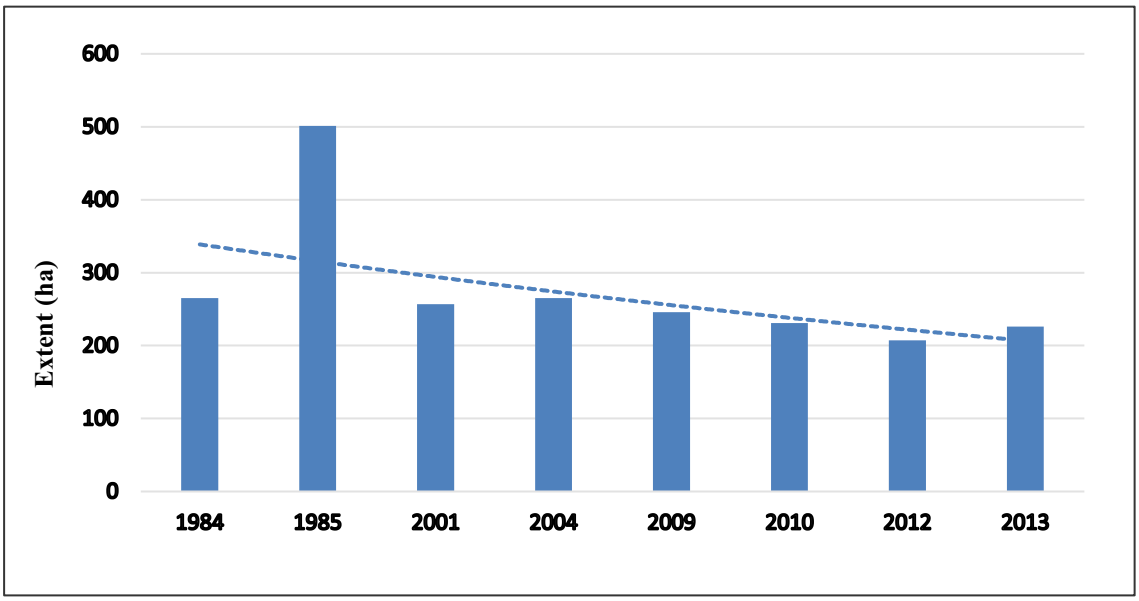

Chart 1. Sequence of Land Extent by Year from 1984 to 2013 of the Baththalagunduwa Island.

The depicted photographs clearly show this destructive activity. By this mean, fishing huts and semi permanent building were damaged and displace the hundreds of inhabitants. Likewise, we found that some changes have occurred northern part of the island (Figure 4).

Figure 4. Development of Northern Tip of the Baththalangunduwa Island (Source: Google Earth).

Figure 5. Changes of the Southern Tip of the Baththalangunduwa Island (Source: Google Earth).

Coastal erosion along the eastern flank of the Baththalangunduwa island (Photographs A-F).

Photographs A – F: Eastern Margin of the Island has Eroded as Pockets by Diurnal Tidal Prism, Waves and Long Shore Currents.

Coastal erosion along the western flank of the Baththalangunduwa island (Photographs G-L).

Photographs G – L: Severe Erosion Along the Western Coastal Flank of the Baththalangunduwa Island by Storm Surges in 2016.

6. CONCLUSION

Along the continental shelf of Sri Lanka, a large number of islands can be seen, and most of them are formed by sand and coral mainly in northwestern and northern coastal areas. West to northeast, the rocky islands have been evolved due to the submergence surrounding lowlands of the main island, Sri Lanka. The northwestern sandy islands, north of Puttlam Lagoon formed after to the Flandrian Transgression, and can be correlated with the Mid and Late Holocene Periods, which were followed the palaeo climatic and sea level changes.During the past 50 – 60 year period, the Baththlangunduwa and surrounding islands are gradually changing by erosion and accretion and islands' inhabitants will suffer as a result of future climate change.

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8. REFERENCES

Balabathina, V., Ravikumar, K., Ramesh, T., Venkateswararao, M., & Sridhar, PN., 2015. Areal Extent of Erosion and Accretion in and around the Gahirmatha Coast, NW of Bay of Bengal by Remote Sensing and GIS Analysis of Multi-Temporal Satellite Imagery. International Journal of Geosciences, 2015, 6, 705-719 Published Online July 2015 in SciRes.

Bird, E., 2007. Coastal Geomorphology – An introduction. Hichester: John Wiley and Sons.

Cooray, P.G., and Katupotha, J., 1991. Geological evolution of the coastal zone of Sri Lanka. Proceedings: Seminar on Causes of Coastal Erosion in Sri Lanka.

Deraniyagala, P.E.P., 1958. The Pleistocene of Ceylon. National Museum Publication, Colombo.

Katupotha, J., 2013 Palaeoclimate change during Glacial Period: Evidence from Sri Lanka. Journal of Tropical Forestry and Environment Vol. 3. No. 01 (2013) 42-34.