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Shoreline Changes Using Remotesensing Andgisenvironment: A Case Study of Valinokkam to Thoothukudi Area, Tamilnadu, India

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***Abstract:** Coastal erosion is a worldwide difficulty distressing almost every country throughout the world having a shoreline. This complexity is probable due to the global warming, sea-level rise and the impact is the global problem. An attempt is made to study the erosion and accretion along the Valinokkam and Thoothukudi coast. Landsat ETM 1992, ETM 2000, ETM SLC OFF 2005, ETM SLC OFF 2010 and ETM SLC OFF 2012 data is utilized and comparison with toposheet no NC44-3 and NC44-13(1920) as baseline data. It is estimated that erosion during the period 1992 to2000 was 369m, 2000 to 2005 was573m, 2005to2010was 172m and 2010 to2012 with 305m respectively. The accretion during the period 1992 to 2000 was1258m, 2000 to 2005 was 120m. 2005 to 2010 were 531m, and 2010 to2012 were 366m correspondingly. Simultaneous erosion and accretion were also observed in specific geographical areas in Hare Island as sand spits below southern harbour breaker water and urban coast. In these areas the accretion dominates, suggesting the coast as a pro-grading coast. To verify the change, wave pattern and its dynamics were also studied using land sat image 2012.*

***Key words** – Remote sensing & GIS, Landsat and ETM, shoreline erosion, deposition, Valinokkam, Thoothukudi*

I. INTRODUCTION

Coastal erosion is a global problem affecting almost every country around the world having a coastline. This problem is expected to accelerate in the future due to the global warming, which most likely will cause a sea-level rise and increase the number of storm events across the globe. Shoreline or coastline, the boundary between land and sea keeps changing its shape and position continuously due to dynamic environmental conditions. The change in shoreline is mainly associated with waves, tides, winds, periodic storms, and sea level change, the geomorphic processes of erosion and accretion and human activities. The beach profile is important, so it can be viewed as a valuable natural mechanism, which causes waves to break and bowl away their energy (K.Selvavinayagam2008).

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By constructing breakwaters the natural equilibrium linking the sources of seashore sediment and the littoral drift pattern is not satisfied. In an area where several groins are constructed, which may modify the hydrodynamics in the area. This alteration overturns and accelerates erosion than proposed or shifts the erosion problem to nearby areas. Other behaviors such as dynamite fishing, sand mining, collecting of mangroves and mining of the coral reef are likely to accelerate the erosion problems (VedastMakota et. al. 2004, Ramesh and Ramachandran 2001). Many researchers have successfully investigated long term shoreline changes and morphological changes in the coastal landforms by utilizing remote sensing and GIS techniques (Meijerink1971, Nayak and Sahai1985, PrabharRao et.al 1985, Shaikh et.al 1989, Vinodkumar et.al 1994, Capobianco et.al.1999, Loveson et. al 1990, Chandrasekar et.al.2000, 2000a, 2000b, 2002a, Amaro et. al. 2002ab, Vital 2003a, Vital et.al. 2003b, Charatkar 2004, Rajamanikam2006,Griffiths,c.j.(1988).

The constant shoreline variation examination facilitates recognizing thenature and processes that caused these changes in any areas to assess the human impact and to plan management strategies. Remote-sensing data could be used effectively to observe the changes along the coastal zone, including shoreline with reasonable accuracy. Remote sensing helps to replace the conservative survey data by its rhythmic and fewer cost-effectiveness. Hence, an attempt is put forwarded from Thoothukudi to Valinokkam in order to study the coastal processes; the shoreline change, wave action, bathymetry and coastal geomorphology were analyzed using Remote Sensing and GIS tools.

II. STUDY AREA

The study area covered in the Latitudinal and Longitudinal extensions of 9° 10’ - 8° 40’ N and 78° 50’ 30 - 78° 50’ E on the Tamil Nadu, East Coast of India (Fig. 1). Along stretch of study area a chain of islands is aligned parallel to the shore line. In these two groups of coral islands falls in between the study points, one is Valinokkam group of island, and another is Thoothukudi group of the island. The Geology of the area falls under six different types of sedimentary deposits CzlQm, Qfm, Qf, N_1cs, and Amh. The area is self-possessed by Gondwana formation, which is exposed at Thoothukudi and Ramanathapuram district (Fig.2). Thoothukudi was a centre of maritime trade and pearl fishery for more than 2000 years .

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Thoothukudiports in the study are constructed on 11-7-1974, by its tremendous growth now this harbour is declared as the tenth major port for its potential economic activities. Another important socioeconomic potential which sustains the livelihood of the local communities includes fishing, farming, and sand mining and scrub harvest.

III. MATERIALS AND METHODS

The base map was prepared by Topo sheet Nos. NC44-9 and NC44-13. The quantification data on the shoreline changes in the Valinokkam and Thoothukudi area was exported using landsat image from 1992,2000,2005,2010 and 2012. Erosion and deposition environment data is prepared from the Landsat for multiple years (Fig.3).

IV. FIELD WORK AND DATA COLLECTION

Ground accuracy data was collected within the study area for ten days. The aim was to collected more data and information from the field area. The people interviewed were asked about the status of the shoreline in relation to historic events and the present-day information. The collected information is interpreted and incorporated with our GIS analytical findings. The present shore line changes were captured, which shows stunning examples of shoreline erosion and deposition. Beach profiling and sampling are done along the study area at constant intervals of 500m, at each station sediment's samples were collected at water level, slope, berm, dune, etc., and river confluence data were also gathered. The data for determining gradient, beach width, berm shape index and surf parameter were collected from each sampling station to classify the morphodynamic condition of the study area.

V. RESULTS AND DISCUSSION

1920-1992: The analysis on the shoreline changes between1919 and1992 is shown in (Fig.3). Landsat images and graph rate of erosion shown disclose that an average of 447 meters of landward is eroded from the shore in the Veppalodai, Taruvaikulam, Pattanamarudur, Thoothukudi, Valinokkam, Melmundal, Madathurani near Tamilnadu salt pans, Panayur, Terknaripayur, are highly eroded and in Veppalodai, small amount deposition is noticed in the western side.

1992-2000: The shoreline changes between 1992 and 2000, and the rate of the erosion graph prepared by Arc Gis software, which highlights that the average erosion is 578 meters of landward erosion from the shore at Thoothukudi, Mukkaiyur, Melmundal, Ayyanapuram, Taruvaikulam, Veppolodai, Kilvaippar, Naduppaduminvadi, Panaiyur.

2000-2005: Nearly about 573m of land eroded from the southern part of Valinokkam projection between 2000 and 2005 and shown in the erosion environment graph figure.4. The projections at Valinokkam of the study area have evidenced critical erosional features. In the northern side of area, the construction of groins to prevent coastal erosion has been fully eroded and immersed during high tide level. As well as Palathar river mouth in the northern side is eroded and mixed with sea. In Terukunarippaiyur and Thoothukudi salt factory in the southern side of Valinokkam is evidenced with erosional features. In Western side of Thoothukudi harbour area landward erosion is noticed, and it is said that it may be due to change in direction or diffraction of wave due to the construction of harbor on the sea, and change is wave direction by the coral islands. In KilVaipparRiver, inward erosion occurred in found at Oplian and landward erosion noticed; it is influenced by Gundar River.

2005-2010: It is noted that during 2005 and 2010, nearly 172meter of landward erosion is recorded in the erosion environment graph. The erosional features identified in Madarsupuram, Melmundal, Davispuram, Thoothukudiharbor, Chettimariyur, Vadakkukalmadu, and Vembar area in the study area.

2010-2012: There were extensive shoreline changes in this area from 2010 and 2012. The average shoreline erosion estimated nearly about 305 meter land inward erosion from the shoreline. The high level of erosion in this region is found between Koneri, Markkayarpattanam and Valinokkam. The curved projection in Valinokkam is due to diffracted of wave direction due to the prevailing wind direction during northeast and southwest season. Erosional features are evidenced more during the northeast monsoon. The extensive of erosional features are also noticed in Kilmundal, Naduppuminvadi, Thoothukudiharbor, Kilvaibar, Pachayapuram, Vembar east, Duraiswamipuram, MappilaiUrani, TerkuMukkaiyur. (Fig.4).

After the detailed field work and satellite data analysis, it is found that preceding effects for controlling coastal erosion through the construction of groins does not seem to have been effective measures to control erosion, some of the groins have been washed away, and others stand from the current shoreline showing that erosion is still actively taking place. The aggressiveness of the erosion process is conversely alive withValinokkam and Thoothukudi area. It is noted that erosion is significant in the north and deposition in south of the present study. It is clearly identified that some parts south of the Valinokkam area that have been affected by erosion, as evidenced by collapsed and removed properties along the shorelines.

From the Landsat image's interpretation, it noticed that severe shoreline erosion occurred at the river mouth and every bay between 1992 and 2012. Landsat images of 2012 exhibits that, at Valinokkam, Terkumukkaiyur, Thoothukudiharbor, Kilvaibar, Pachayapuram, Vembar, Duraiswamipuram area widened towards land ward. It is difficult to determine the extent of these depositional features from the satellite image, there is no contrast between the tone of beach and sand deposits, nevertheless, possible to determine shoreline erosion based on the pattern and texture of the land and water areas in relation to the river passage. The fisherman interviewed also helped to identify the features from the Landsat images during field work. In northern part of Konnerai, Marakkayarpattinam, Valinokkam nose and Vaippar accretion is evidenced in every bay. According to measurements using the GIS software graph wizard during 1992 -2012, an average of 305 meters from the land is covered with vegetation, such as tree and vegetation and the sand dune developed is fully washed away along the coastal zone. The present study using remote sensing and GIS to quantify shoreline change between Valinokkam and Thoothukudi area, has shown that shoreline change is accelerated in the study area as a result of both erosional and accretion processes.

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It is exposed that during 1992-2012, more erosion took place in the northern part and southern part within the study area landward in meter, during 1920-1992(449 m), 1992-2000(369m), 2005-2010(172m) 2010-2012(305m), sand dune eroded and agriculture land is also affected.

Constant monitoring of shoreline changes is vital to our sympathetic changes taken place at Valinokkam and Thoothukudi area, further a detailed study and data on land-use patterns, hydrological data, human activities and other process taking place should be integrated with other datasets with GIS in order to monitor the changes in futures. It is also important that these result should be shared with relevant stake holders, together with coastal manager's investors, the municipal, strategy makers, researchers and other scientist, for making decision creation on such issues as land-use planning, development of set-back lines and identifications of low cost methods, which could be used as the content of integrated coastal management.

It is said that the present study using remote sensing, and GIS tools have given approach for monitoring the coastal environment and the resource in Valinokkam and Thoothukudi. The study has revealed that during 1992-2012 more erosion evidenced in Valinokkam, Terkumukkaiyur, Thoothukudi harbour, Kilvaibar, Pachayapuram, Vembar, Duraiswamipuram, while deposition took place in Vembar west, Valinokkam west, and western of Thoothukudi harbor.

VI. CONCLUSIONS

The recent systematic tools of Remote Sensing, GIS and GPS are exceptionally important for coastal environmental studies. Accessibility of monotonous, synoptic and multi-spectral data from a mixture of satellite platforms, contain helped to produce in sequence on a variety of aspects of the coastal and marine environment (Nayak2002). In the present study, an attempted is made to monitor shoreline changes from Valinokkam to Thoothukudi, and to distinguish the places mostly affected by erosion inValinokkam, and Valinokam west, Terkumukkaiyur, Thoothukudi harbour, Kilvaibar, Pachayapuram, Vembar, Duraiswamipuram, while deposition took place in Vembar west, near Thoothukudi harbor west.

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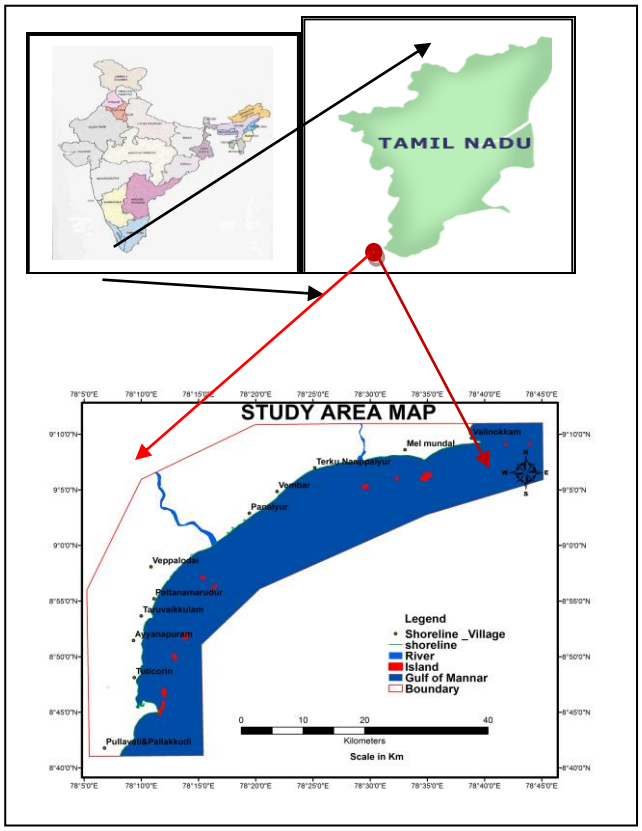


Figure.1 Study area Map

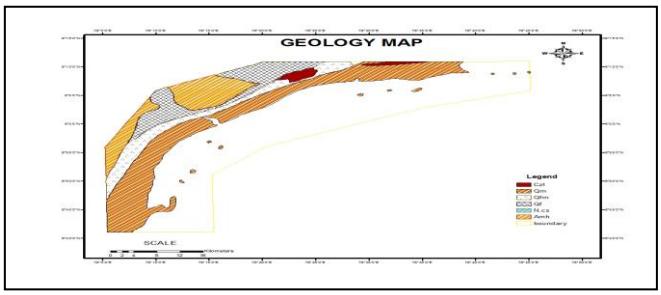


Figure.2 Geology Map

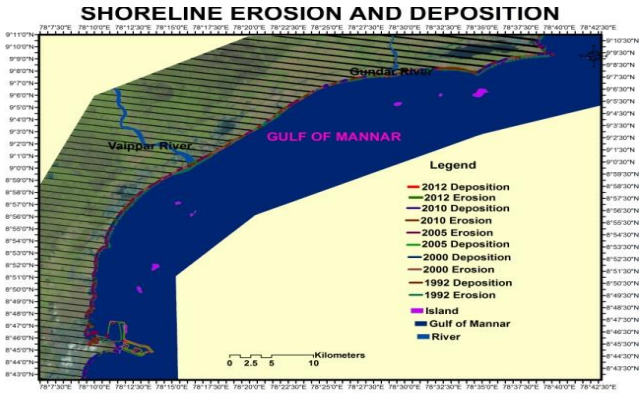
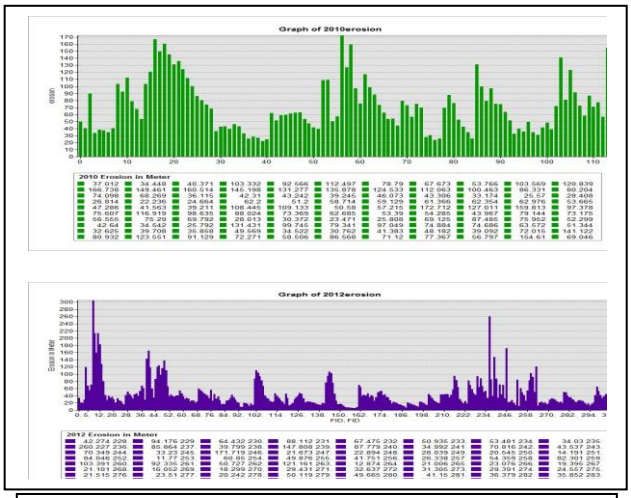


Figure.3 Shoreline Erosion and Deposition Map



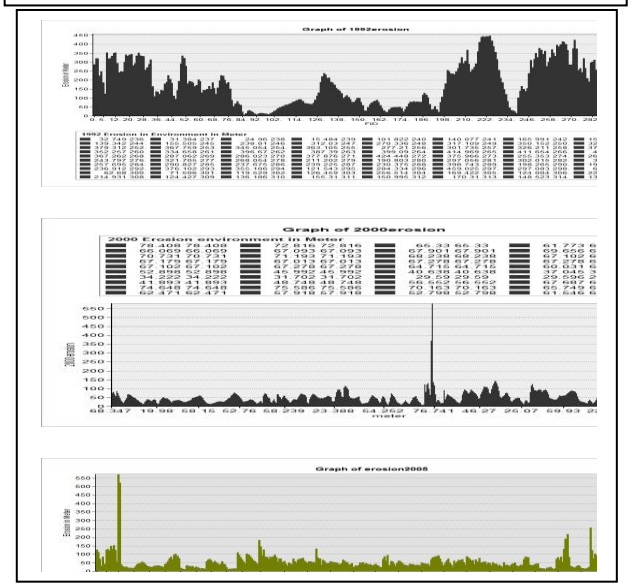
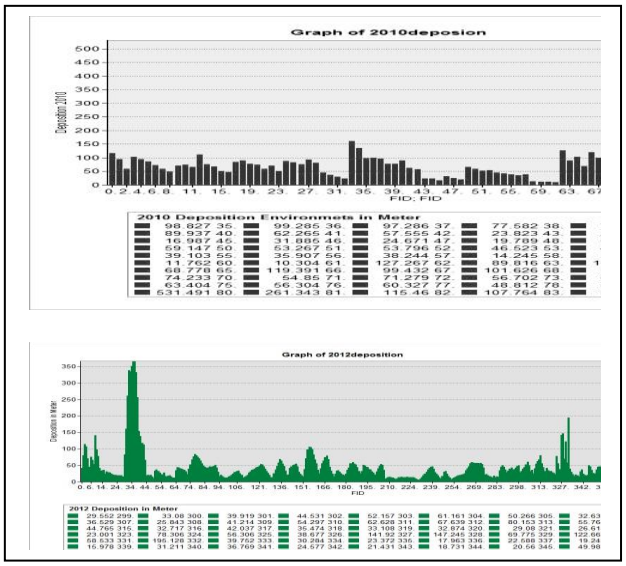


Figure.4 Erosion Environment Valinokkam to Thoothukudi -1992 to 2012



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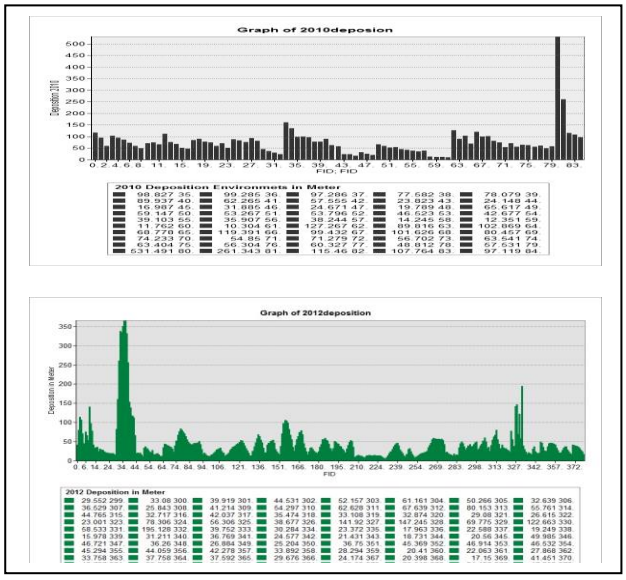

Figure.5 Deposition Environment to Valinokkam to Thoothukudi-1992 to 2012

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