

Assessing the Rate of Shoreline Changes of Rameswaram Island, Tamilnadu, India, using MATLAB Component Runtime Utility & Digital Shoreline Analysis System

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Abstract: The Present study highlights the changes in the coastal tract of Rameswaram island located between the geometric location, latitude 9° 10' to 9° 20' N and the longitude 79° 12' to 79° 30' E. Using Geospatial Technology, Long-term changes have noticed from digitized shorelines taken from Landsat imageries and SOI toposheet for the years 1968, 1978, 1988, 1999, 2009 and 2018. Digital Shoreline Analysis System (DSAS) an extension provided by USGS for ArcGIS used to cast transects perpendicular from the baseline, towards the shorelines. High water Line (HTL) has taken as shoreline in this study. The distance between the shorelines has taken from the cast transects plotted from the baseline. For the rate of change calculation, MATLAB component runtime utility for ArcGIS has used. Based on the Linear Regression Rate (LRR) the shore has classified into High Erosion, Low Erosion, Stable and Low Accretion, High Accretion zones. The island has a shoreline length of 78.4 km, and the studies found that 27.83 km (35.41%) of shoreline is accreting nature, 37.90 km (48.21%) of shoreline is stable, and 12.86 km (16.36 %) of shoreline tends to erode. During the field investigation identified that High amount of erosion occurred in the locations near Pamban, Tharavaithopu and Dhanushkodi. Also, Accretion identified over the locations Ayyanthopu, Natarajapuram and Arichumanai tip. Wind action is one of the physical parameters that induced the erosion in some location of this study area.

Keywords: EPR.LRR, DSAS, MATLAB, Erosion, Accretion

I. INTRODUCTION

The coastal region is unique on earth surface, where always occur long and short-term changes [1], Erosion and Accretion are the frequent changes that would happen on the coastal regions caused either by natural force or Manmade. [2]Abundance of resources in sea makes peoples settle in near coastal. As a result, artificial constructions also increase. The shoreline is an active coastal feature between the land and sea [3]. In the coastal erosional and depositional studies, the shoreline only can expose the changes in the coast.

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The satellite imageries with false-colour composition help to identify and extract the shoreline [4]. Arc GIS Software used to delineate the shoreline. Shorelines extracted from Multi-year satellite imageries was the recent trend which helps to identify and assess the changes [5].

A. Study Area

The study area is in Rameswaram district, Tamilnadu and study aim to find the erosional and depositional changes of the study area (Fig-1) over a time of five decades (1968-2019). The region is located between a latitude of 9° 09' to 9° 20' N and the longitude of 79° 11' to 79° 31' E. Northern side of the study area is pak bay shore, and the southern side is Gulf of Mannar. During 1964 a powerfull cyclone which hit over there and vanishes most of the livelihood of this region. The study area has one of the famous pilgrimage centre, the Rameswaram temple, where tourism has a significant role in the economy of this region. Peoples mainly depends on sea and sea resources. Hence the constructional activities become increased over the island for making transportation and tourism spots. The littoral current during the northeast monsoon alters the coastal region over the island[6].The study Highlights the coastal locations which are under High erosion, Low Erosion. High Accretion, Less Accretion and Stable.

II. MATERIALS AND METHODS

A. Shoreline Extraction

The study was done using ArcGIS software and the multi-date satellite data. Baseline has taken from the Survey of India toposheets acquired in 1968. Accordingly, Landsat satellite data which freely available in USGS -Earth Explorer has taken for demarcating multiyear shorelines for the period 1978 – 2018. Geometric errors have rectified by register using Ground Control Points (GCP's) acquired on field. The list of data mentioned in (Table:1)

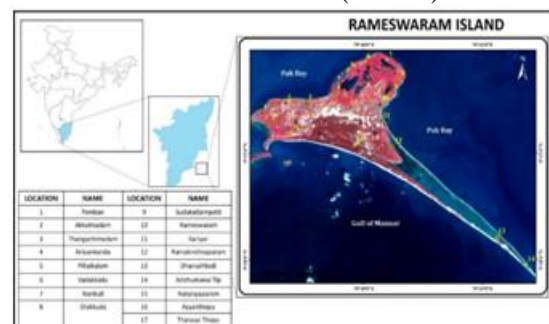


Fig – 1 Study Area

B. Shoreline change analysis

The shoreline change study was carried out by digitising the shorelines in the ArcGIS software. Digital Shoreline Analysis System (DSAS) is an extension tool that freely provided by USGS, works with ArcGIS platform[7]. DSAS will operate to construct the transects from the baseline and this will used to calculate the horizontal movement of shoreline[8]. In the study area there are 697 transects with 100-meter interval that constructed from the baseline is used for the Statistical calculation LRR and EPR has shown in (Fig-2). The MATLAB runtime monitor along with this DSAS which calculating the End Point Rate (EPR) by dividing the total distance between oldest and youngest shoreline by the total time and the Linear Square regression (LRR) has calculated by the position of shoreline on the transect with the time. The calculated output will give the rate of changes in meters. The Negative (-) values show rate of erosion and Positive (+) values shows the rate of accretion. Based on the output the shoreline has classified as High Erosion, Low Erosion, High Accretion, Low Accretion and Stable listed in (Table:2).

Table: 1 List of spatial data products

Sl. No	Data Products	Year of acquisition
1	SOI Toposheet (1:50000)	1968
2	Landsat (MSS)	1978
3	Landsat (MSS)	1988
4	Landsat -7	1999
5	Landsat -7	2009
6	Landsat 8 OLI	2018

III. RESULTS AND DISCUSSION

A. Identification of Erosion and Accretion of the study area

Around the Rameswaram island has been occurring dynamic coastline changes over the period. There are various factors such as wind, Littoral wave and another anthropogenic parameter which influence in the coastline. The shoreline is 78.4 .km length and the island is having 88.9 km2 area. The coastal region of the island which is mainly silt and sand deposits[9].The sandy seashores were exposed higher for the erosion, and accretion activities by wind and waves[10].,The Northern region of the island is Pak bay, and the southern region is Gulf of Mannar. The LRR and EPR for the five decades (1968-2018) have calculated for important island locations are given in (Table:3 and Fig-4). The LRR values along Pillaikulam, Ariyankundu, Pamban, Dhanushkodi, Tharavai Thopu shows negative (-) values implies the erosion over that region. EPR for this region shows > -3.39 m/yr that indicates relatively high erosion. The highest rate of erosion that occurs in pamban region where anthropogenic activities are more shown in (Fig-3) In the Island locations Ayyanthope, Natarajapuram, sudukattampatti, olakkuda, Karaiyur and arichumunai tip the LRR values are Positive (+) that indicates the shore fed with sediment deposition over the location and the EPR values comes up to 9.78 m/yr .The highest rate of accretion which occurs in arichumanai tip where the sandspit elongates toward the Sri Lankan coastal through the gulf of Mannar with an annual rate of 9.78m/yr. The Graphical representation of the statistical values are given in (Fig- 5)

Table: 2 classifications based on EPR and LRR

Sl. No	Shoreline classification	EPR and LRR rate(m/yr.)
1	High Erosion	>- 2
2	Low Erosion	-1 to -2
3	Stable	-1 to 1
4	Low Accretion	1 to 2
5	High Accretion	> 2



Fig – 2 Transect construction

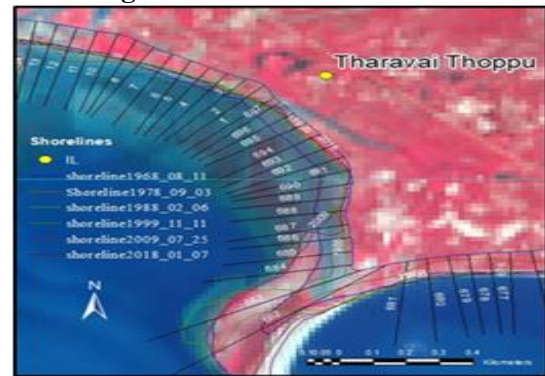


Fig – 3 Anthropogenic activities near Pamban Bridge

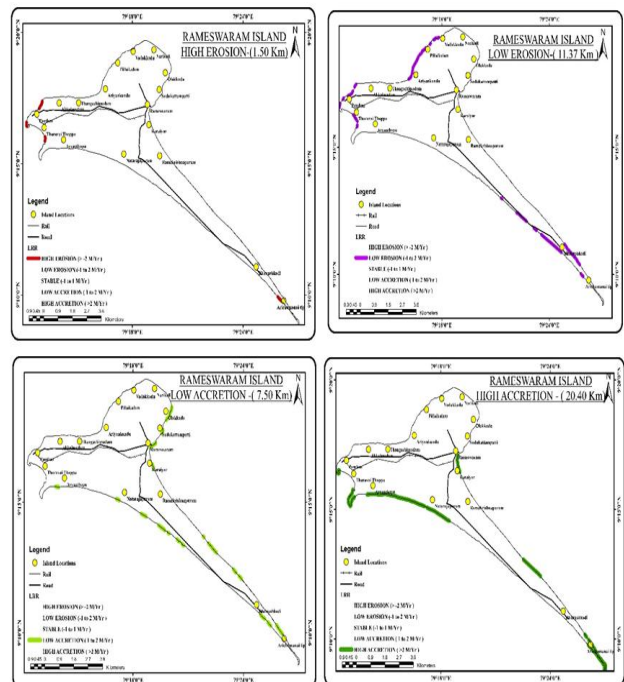


Fig – 4 shoreline classification based on End point Rate and Linear regression rate

IV. CONCLUSION

The coastal changes of the island have been predicted based on End Point rate and Linear Regression rate for Five decades (1968 - 2018) using the Digital Shoreline Analysis System. The study based on EPR and LRR have shown that erosion undertakes in the locations, Pillaikulam, Ariyankundu, Pamban, Dhanushkodi, Tharavai Thopu and Accretion mainly happens in Ayyanthope, Natarajapuram, sudukattampatti, olakkuda Karaiyur moreover in arichumanai Tip. The wind action over the region and Littoral current which influencing the morphological

changes over the region. Human activities such as trenching and construction activities near the pamban bridge also making High erosional changes.

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Table :3 Statistical calculation of EPR and LRR

Location	EPR (m/yr)	LRR(m/yr)
Pamban	-3.39	-2.47
Akkalmadam	-0.98	-0.37
Thangachimadam	-0.85	-0.26
Ariyankundu	-2.88	-2.89
Pillaikulam	-2.1	-1.81
Vadakkadu	-0.15	-0.06
Narikull	-0.41	-0.59
Olakkuda	2.34	2.74

sudukattampatti	2.32	1.46
Rameswaram	1.54	0.73
Kariyur	2.84	3.01
Ramakrishnapuram	-0.66	-0.89
Dhanushkodi	-1.17	-0.68
Arichumanai Tip	9.78	10.77
Natarajapuram	4.13	3.96
Ayyanthopu	4.99	4.96
Tharavai Thopu	-2.21	-1.92

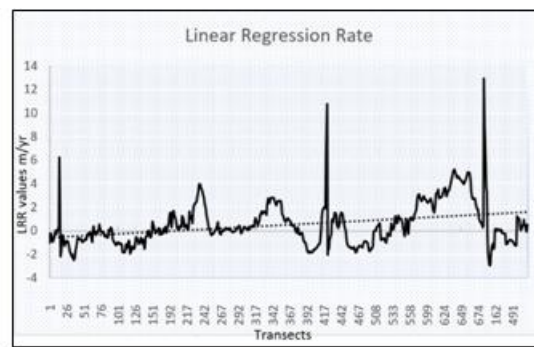
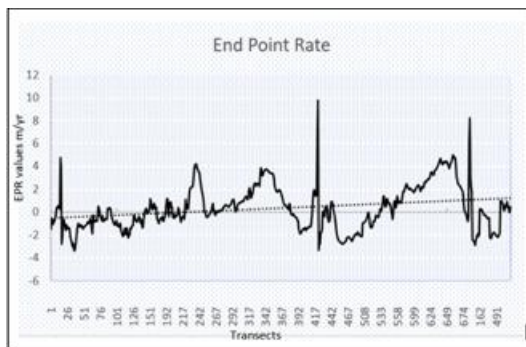


Fig -5. Graphical Representation of End point Rate and Linear regression rate of the study area

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