SSRG International Journal of Civil Engineering
ISSN: 2348 – 8352 /doi:10.14445/23488352/IJCE-V7I11P101

Volume 7 Issue 11, 1-4, November 2020

Analysis Of Shoreline From Cuddalore To Nagapattinam Using Gis And Remote Sensing

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Received Date: 29 October 2020
Revised Date: 03 December 2020
Accepted Date: 09 December 2020

ABSTRACT

The coast is a unique environment that contacts the atmosphere, hydrosphere, and lithosphere. The coastline is a major linear characteristic on the surface of the earth with a vibrant nature. Coastal zone and their environmental management require coastal lines of information and changes. To update shoreline change charts and natural resource management, a shoreline change study is needed. Only changes in the coast are often monitored. The shoreline is the most important coastal GIS element and offers the most information on coastal changes. This paper discusses current methods of satellite detection of shoreline changes. This paper investigates the shoreline changes in Cuddalore district, Tamil Nadu, using geospatial techniques (GIS).

I. INTRODUCTION

A. GENERAL

The contact line is defined as the coastline between land and water. In other words, the intersection of a specified water plane with the coast or beach is defined. However, the coastline approximates the average coastal high-water line and nautical charts and surveys from the Geodetic Survey. The term is considered to be synonymous with the shoreline in coastal surveys. (Shalowitz, 1962). The shoreline charts and surveys on the National Ocean Service's Nautical charts approximate the high water line.

Table 1: Coastal geomorphic features of India

Sl. No	State	Landforms and features
East coast of India		
1	Tamil Nadu	Deltas, long narrow beaches, spits, tidal flats, mangroves, coral reefs, sand dunes, Ridge swale complex etc.
2	Andhra Pradesh	Deltas, long narrow beaches, spits, mangroves, Cliffs, long sand dunes, Ridge swale complex etc.
3	Odisha	Deltas, long beaches, spits, tidal flats, long sand dunes, Ridges etc.
4	West Bengal	Large delta, very thick mangroves, tidal channels, islands, dunes, tidal flat, beaches etc
West Coast of India		
5	Kerala	Estuaries, lagoons, barriers, spits, dunes, Tombolo, cliff, beaches etc
6	Karnataka & Goa	Estuaries, spits, sand dunes, Tombolo, cliff, wave cut platforms, beaches etc
7	Maharashtra	Estuaries, cliffs, small sand dunes, Tombolo, cliff, wave cut platforms, pocket beaches etc
8	Gujarat	Marshy land, tidal flats, estuaries, cliffs, mud flats, mangroves wave cut platforms, beaches etc.

B. PROBLEM STATEMENT

The shoreline is constantly affected by variations in sea level, climate, and ecosystems over various time scales. The combination of nature and activity often exacerbates coastal change and increases the coastal community's risk factors. Coastal change is one of three environmental issues identified for development activities, including ports, ports, fishing jetties, and reclamation facilities. A long-term systemic study on coastal change can provide information about the coastal change, structures, and changes in beach widths, land losses, land gain, and historic change rate.

C. OBJECTIVES

- The delineation of geological, structural, and geomorphological elements.
- To produce shoreline change and LULC maps that can be used efficiently by coastal managers to devise an effective coastal zone management plan.
- The determination of the causes of shoreline changes and coastal erosion and the coast's long-term evolution.

II. COLLECTION OF LITERATURES

1. P. PrabhakaraRao, M. M. Nair & D. V. Raju – 2007 stated that the NNRMS (National Natural Resources Management System), an effort has been made to estimate the use of LANDSAT images and air photos in assessing and monitoring coastal shift using the Kerala coast as a case study.

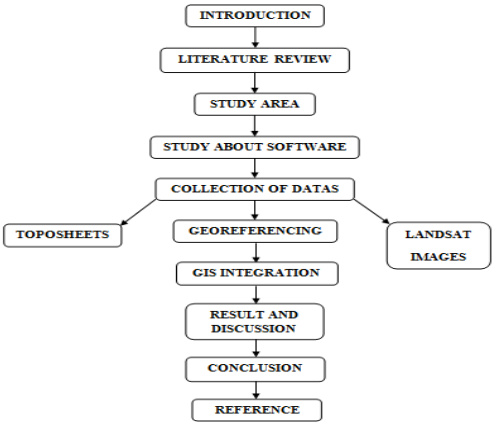
2. SemihEkercin - 2007 studied the shoreline changes were investigated using satellite data collected between 1975 and 2001 from Landsat MSS, TM, and ETM. In the picture processing step, coastal changing assessment was carried out using registrations, ISODATA classification, and temporal picture ratio techniques. At the end of the

study, important shorelines (in some parts over 200 m) were detected for 26 years.

3. A. A. Alesheikh et al., - 2007 – discussed current coastline change detection methods with satellite pictures. A new procedure was developed based on the advantages and disadvantages of the methods. The procedure proposed is based on a combination of histogram and band ratio techniques. The procedure is proposed. Urmia Lake; 20th is the study area of the project. The world's second-largest hyper-saline lake. They were compared with ground truth observations to assess the accuracy of the results.

4. R. S. Kankaraet.al., - 2015 - Predicted, a "shoreline proxy" has been attempted for the past 22 years to monitor changes on the coast of Andhra Pradesh (1990-2012). Satellite data such as Landsat TM, Landsat ETM+, IRS-P5 (Cartosat-1), and IRS- P6 (LISS-III and LISSIV) were used for assessing short-term and longer-term shoreline shifts. The Standard Operating Protocols have been followed for image correction, shoreline extraction, and map accuracy in accordance with the NNRMS standards.

III. METHODOLOGY



A. STUDY AREA

The Cuddalore district is bounded in Latitude 11°11," and 12° 5" N Longitude78° 38" and 80° 00" E covered in an area of 3678 Sq.kms. The District of Viluppuram borders it to the north, the Bay of Bengal to the east, Nagapattinam to the south, and Perambalur to the west. Cuddalena (11°44' 45" N and 79°45'56" E is the head office for the Cuddalore District), a large industrial village that has been rapidly expanding its coastline.

Fig.1 Cuddalore District map

Fig.2 Location map of Cuddalore district

IV. ABOUT REMOTE SENSING

Remote Sensing means to collect information without contacting an object, area, or phenomenon. If we take the term remote sensing, then there would be a number of things in the remote sensor, for example. Seismic, fathometer, and so on. Without direct contact with earthquake focus, the intensity of the earthquake can be measured. Without contacting the ocean floor, the fathometer can also measure its depth. But modern, remote Sensing means the acquisition of knowledge on soil and water surfaces by using reflected or emitted electromagnetic energy.

V. GEOGRAPHICAL INFORMATION SYSTEM (GIS)

The expansion of GIS is a Geographic Information System which consists of three words, viz. Geographic, Information, and System. The word 'Geographic' here covers spatial objects or features that may be referenced on the earth's surface or related to a specific location. The object can be natural or cultural/human-made. It can be a natural object. Likewise, the word 'Information' deals with the large volume of data about a particular object on the earth's surface. The data includes a set of qualitative and quantitative aspects that the real-world objects acquire. The term 'System' represents a systems approach where the complex environment (consists of many objects/features on the earth's surface and their complex characteristics) is broken down into their parts for easy understanding and handling. Still, an integrated whole for decision-making and management is considered.

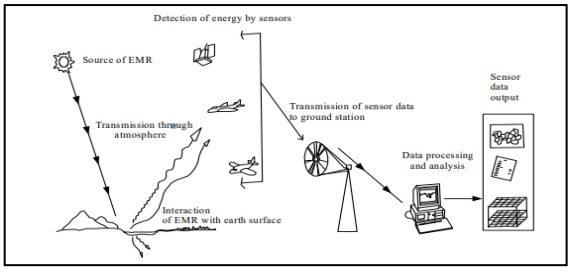


Fig.3 Stages of remote sensing

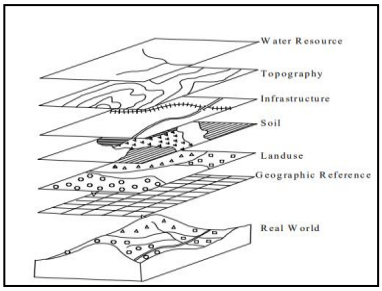


Fig.4 GIS data- Thematic layers of spatial features

VI. ANALYSIS RESULTS

A. DATA SOURCES

In this study, the shoreline modifications along Tamilnadu were separated by ortho-rectified Landsat MSS (Multi-spectral scanner), TM (Thematic Mapper), and ETM+ (Enhanced thematic Mapor Plus). The data sources used to detect a change on the shoreline are shown in Table 2. Datasets were mainly obtained for cloud-free images from February to June.

Table 2: Data Sources used for the study

S.No.	Satellite Data and its Sensor	Acquisition Date
1	LANDSAT MSS	23/06/1978
2	LANDSAT ETM+	04/09/2001
3	LANDSAT ETM+	03/03/2010

From 1978 to 2010 multi-date satellite data, Shoreline datasets were extracted using Arc GIS 10.2.2 software. The high water line was regarded as a proxy on the shoreline.

B. EROSION/ACCRETION ANALYSIS

The erosion/accretion schemes for 500 m of orthogonal transects along the coastline were calculated using the baseline and the shoreline. The erosion and accretion rates obtained on Tamil Nadu's coast were subdivided into seven categories (Table 3).

Table 3: Shoreline Classification based on EPR and LRR

S.No.	Rate of Shoreline Change (m/yr)	Shoreline Classification
1	>-2	Very High Erosion
2	>-1 to <-2	High Erosion
3	>-1 to<0	Moderate Erosion
4	0	Stable
5	>0 to <1	Moderate Accretion
6	>1 to <2	High Accretion
7	>2	Very High Accretion

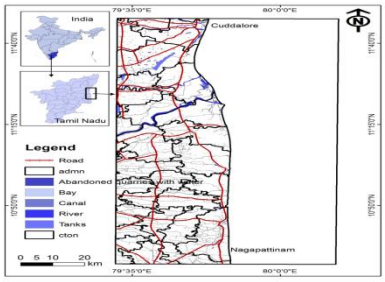


Fig.5 Coastal area – From Cuddalore to Nagapattinam

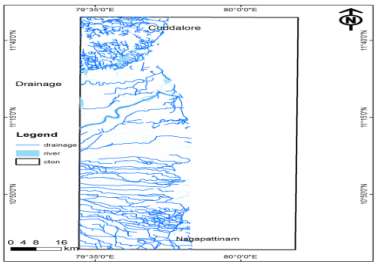


Fig.6 Drainage pattern

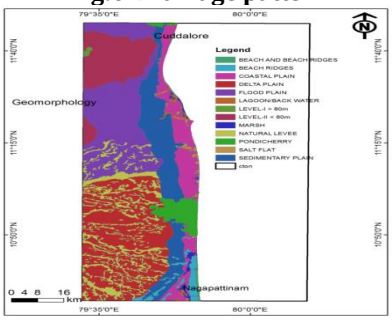


Fig.7 Geomorphology map

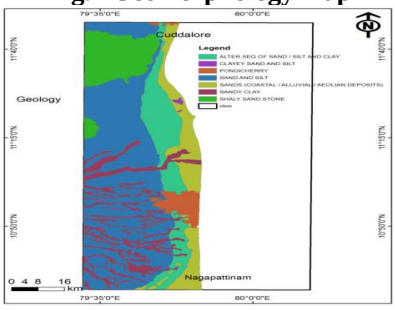


Fig.8 Geology map

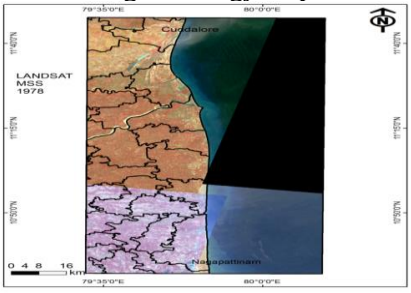


Fig.9 Landsat MSS – 1978

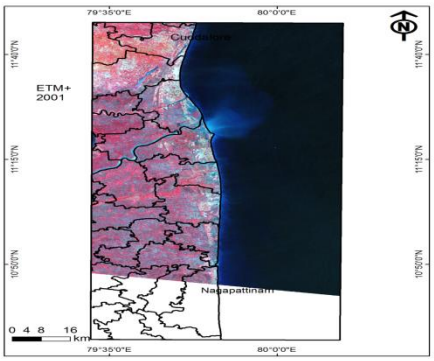


Fig.10 ETM + 2001

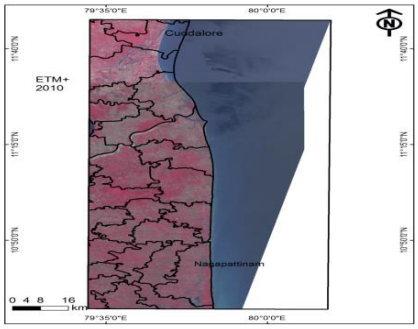


Fig.11 ETM + 2010

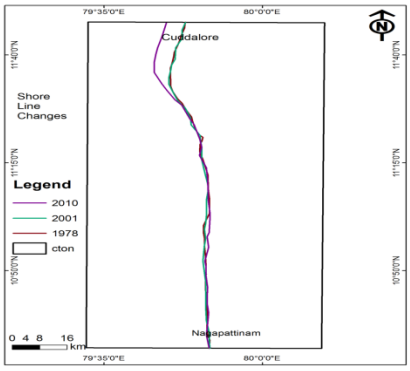


Fig.12 Shoreline changes in the study area

The erosion, accretion, sedimentation, wind, wave, and sea-level rises were responsible for changes on the shores. In nature, the shoreline is always dynamic. Erosion and accretion processes are also connected to changes on the shoreline.

The shoreline change analysis shows both erosion and accretion trend, but erosion is significant. Fig.12 shows the shoreline changes in the study area.

VII. CONCLUSION

The long-term surveillance of shoreline changes and the complete view of the economically important coastal areas' erosion and accretion patterns will help remote sensing and Geospace techniques coupled with DSAS (Digital Shoreline Analysis System). Shoreline dynamics have been mainly linked to waves, tides, wind, regular storms, sea-level changes, geomorphic erosion and accretion, and human activity. The coastal geomorphic studies can improve and protect the coastal zone in vulnerable areas. The present study has brought out recently and full information on coastal region vulnerability, coastal geomorphology, geology, and drainage and shoreline change between 1978, 2001, and 2010. It is used for knowing the shoreline change rate in terms of accretion and erosion. From the analysis, a high erosion zone was noticed towards the west side in the Cuddalore coastal zone in 2010. The remaining shoreline of our study area has only little changes, and some remain unchanged.

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