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Geospatial Technology Based Shoreline Change Studies In Parts of Cuddalore District, Tamilnadu, India

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ABSTRACT

Application of Geographic Information Technology with satellite imageries have a vital role in shoreline studies. The Present paper highlights the application of this technology to explore the changes in the coastal tract. The prime aim of the paper is to locate the major changes in terms of erosion and deposition during a period of Four decades. A comparative study had gone using shorelines those extracted from toposheet and satellite imageries between (1972 to 2013). From the extracted Shorelines, changes have identified, Further DSAS employed for getting the Linear Regression Rate(LRR) for the area. The shoreline taken as a length of 9.3 km and it buffered 3 km it having 19.1 km^2 of land and 22.62 km^2 of sea for the given study. There found a drastic erosional changes. And the studies examine the area is under the threat of erosion with an average of –4.13 m/year

Keywords: Shoreline, Accretion and Erosion, Arc GIS, DSAS,LRR, Cuddalore, India.

I. INTRODUCTION

Erosion and Accretion are some sort of changes that would happen on the coastal regions caused either by natural or Manmade. [1]. The coastal part of Tamil Nadu is a victim region by the hazardous impact of 2004 Sumatra Tsunami, large part of coast is low lying and gentle slope, resulting high inundation that make it a vulnerable [2]. Due to the Abundance of resources in coastal region population got raised, artificial constructions also increase. After Tsunami, the region is characterized by dominated erosion than deposition [3]. Shoreline monitoring is a dynamic input for coastal zone management. It is necessary to identify the changes over the past years to compare it with the present situation to estimate the rate and reason for these changes. Present study accesses the shoreline changes in part of cuddalore, Uppalvada, Kandakkadu, Devanampatinam,Sonangakuppamand Singarattoppu.

The study is to find out the Accretion and erosion rate and to classify the area into High, Medium and Low Erosion or Accretion Zones. Through the statistical LRR values between the years of 1971 and 2013, using DSAS tool added in Arc GIS Software. The remote sensing data as well as the data from field observation from recent past can provide the information. The combination of these innovative modern techniques can be suitably used to assess the shoreline changes.

II. STUDY AREA

The study area is shown in (Fig. 1) was carried out in part coastal belts of Cuddalore District, Tamil Nadu, India. It is bounded on the north by Pondicherry Union Territory, south by cuddalore district, east by Bay of Bengal and west by Panruti and Virudhachalam Taluks of Cuddalore district. It was located between 11°30'57" and 11°48'03" N latitudes, and 79°38'11" and 79°51'08" E longitudes. The total length of shoreline taken as 9.5 km and it buffered 3 km which contains 19.1 km^2 of land and 22.62 km^2 of sea for the given study. The cuddalore area during the past two decades, industrial development has increased three times with many large and small industries being established in this coastal region. The coastal zone of cuddalore includes production of

fertilizers, dyes, chemicals and mineral processing plants, metal based industries, etc. The area is well drained by two major rivers namely Ponnaiyar, and Gadilam, The river Ponnaiar flows in the northern part of the study area. Gadilam River flows through the town and separates the Cuddalore Old town from the new one. Studies based on remotesensing and GIS point out the severe erosional change of this coastal area [4]. The area is also attractive to the tourists. And above all, one-third of the human population is living in and around the coastal areas, making this region an economically important one.

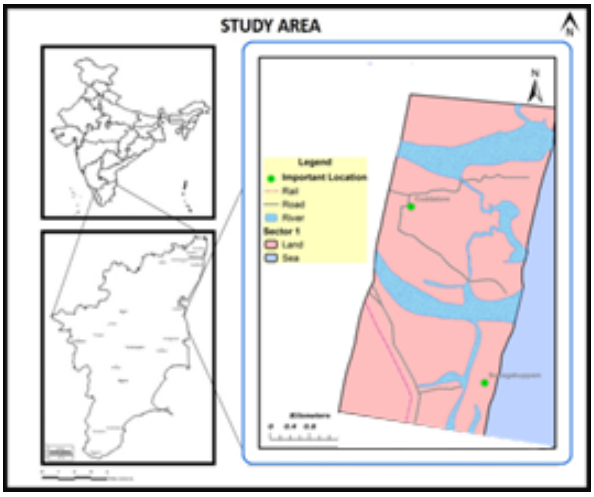

Figure 1. Study Area

III. MONITORING SHORELINE CHANGES

The present study is to investigate as well as quantify the shoreline changes along the coast in the parts of cuddalore district, east coast of Tamil Nadu. Natural and manmade processes alter the shorelines continuously. Shoreline is one of the exceptional features of the earth's surface. It is easy to define but difficult to capture, because of the demarcation is always changing by the action of wind, waves, periodic storm, sea-level changes and other human activities [5]. Recent days Satellite Remote sensing data are widely active to analyze the shoreline changes and provide more information within a short span of time and it is a unique tool for research and monitoring coastal area.

IV. MATERIALS AND METHODS

For the present study, base map is prepared from the Survey of India Toposheet (SOI) map and satellite data of Landsat 1991, 1999, resourcesat 2008 and IRS P6 LISS 4MX, Landsat TM and ETM were used for the study. The input satellite imageries from the various data sources, had gone through Image preprocessing includes the detection and restoration of band lines, geometric rectification, image registration, radiometric calibration, atmospheric correction and topographic correction were processed using ERDAS 9.3, Image processing software. The satellite imageries with false color composition used to extract the shoreline [6] .The reflectance of a satellite sensors in water surface is low and high reflectance on bare sand because of the difference in infrared portion of electromagnetic spectrum[7]. so, it is easy to identify and delineate the shoreline through vector lines created on Arc GIS Software.

4.1. Shoreline Extraction

Shoreline is the relevant active coastal feature helps to identify where the land and sea meets. In the coastal erosional and depositional studies, the shoreline only can expose the changes in the coast. Various shoreline from the year (1971 – 2013) were extracted from the satellite imageries explain in (Table 1). using Arc GIS 10.2 Software.

4.2 Erosion and accretion analysis

The shoreline transects analysis was carried out to calculate the horizontal displacement. The rate of shoreline change was performed using digital shoreline analysis system (DSAS) developed by USGS. The pre-defined statistical algorithm of this software allows the user to measure the shoreline change rate using geo-rectified multiple time series shorelines in each transects at user defined interval [8]

Table 1. List of spatial data products used

Name of the Satellite	Landsat	Landsat	IRS	IRS P6
Date of Acquisition	1991/08/25	2000/10/28, 2006/10/12	2008/02/06, 2009/12/06	2013/05/24
Sensor	TM USGS	ETM+ USGS	LISS III	LISS IV
Path & Row No	142/052	142/052	102-65	102-65

For the study 142 transects were plotted with a gap of 10 m interval from the baseline towards offshore. Linear regression rate of change statistics is commonly used for this statistical calculation. Shoreline movement and estimating rates of change calculations are estimated by this method [9].

V. RESULTS AND DISCUSSION

Identification of erosion and accretion

The study deals with the shoreline changes in part of cuddalore stretch, the coastline 9.3.km which having a buffered area of 19.1 km^2 toward land and 22.62 km^2 to sea. Topographical maps and satellite imageries provide the shorelines of each year for this comparative study. The net shoreline changes for the time span of (1971-1991, 1991-2000, 2000-2006, 2006-2008 as well 2008-09, 2009-2011 and 2011-2013) have got delineate through the software. Accordingly, Net accretion and erosion rate were calculated for the coastal region namely Uppalavadi, Kandakkadu, Devanampatanam, Sonagakuppam and Singarattoppu. From the period of 1971-1991 the area experiences an accretion on the northern part of the cuddalore, from uppalavadi to singarattopu (Fig .2). An area of 1.52 km^2 extended from the 1971 shoreline towards sea, the changes are graphically represented in (Chart.1). The same attempt done to access the changes for the year upto 2013. (Fig .3) Shows the changes of accretion and erosion of region Sonangakuppam and Devampatinam part of cuddalore in the year between 1991-2000. It was about 0.07 km^2 area of accretion found along the coast. (Chart.2) shows the rate of Changes in the specified year. While compared with the previous year the rate of accretion is less but erosion occurred in the surrounding part of sonangakuppam coast with an amount of 0.07 km^2. (Fig .4) shows the erosion and deposition during the year 2000 to 2006 have an accretion rate of 0.05 km^2 and 0.1 km^2 of erosion the changes graphically plotted in (chart.3) the erosional rate emerging towards the northern side of Devanampattinam coast. (Fig .5) shows the changes During The year 2006 to 2008 it exposes the beginning of a drastic erosional change along the whole coastal track. Less than 0.01 Km^2 of accretion had found and the erosional rate is quite increased from the previous year, up to 0.17km^2 of region eroded from the coastal track was plotted in (chart.5). In 2008 and 2009 (Fig.6) there was no accretion but the erosional changes occurred up to 0.35 km^2 area, changes mentioned in (chart.5). Also, the following year 2009 to 2011 (Fig.7) moderate accretion along the whole coast as an area of 0.24 km^2 (chart.6) but there was no erosion. Finally, the accretion and erosion changes had calculated for the year 2011 to 2013 data (Fig.8) there was no net accretion but a total amount of 0.86 km^2, (2.02%) of area was eroded towards sea from the 19.1 km^2. of total land area.

5.1 Rate of shoreline change

The Linear Regression Rate for the year (1971-2013) for the study area is given in the (Table.2). The values show in negative which means entire study area was under erosion with an average rate of –4.13 m/year. The comparison of minimum and maximum values of LRR shows relatively high erosion along the Bay of

Bengal coast. it confirms the coastline have high erosion along the villages Uppalvada, Kandakkadu, Devanampatinam, Sonangakuppam and Singarattoppu. The shoreline is classified as Very High, High and Moderate based on the LRR shown in the Figure 10.

Table 2. Rate of shoreline change (m/year)

Rate 1971 - 2013(m/year)	LRR
Average	-4.13
Minimum	-5.72
Maximum	-1.47

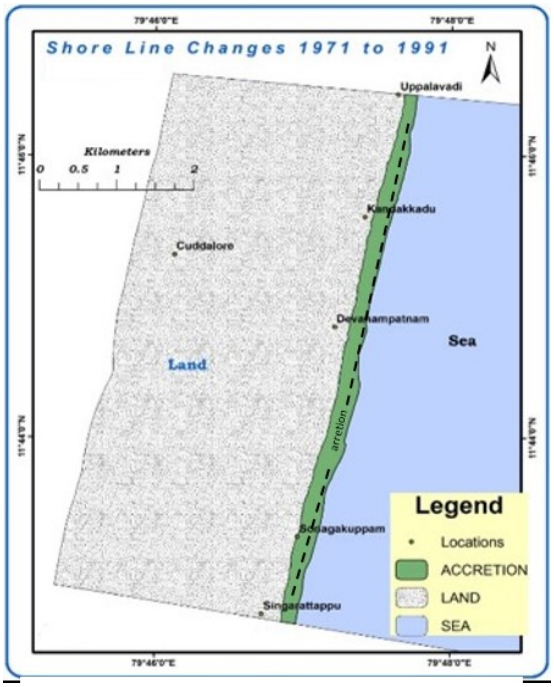

Figure 2. Shore Line Changes 1971-1991

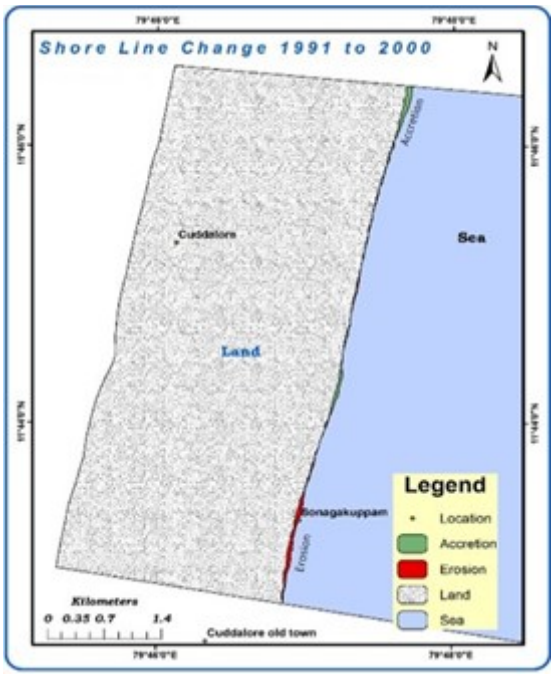

Figure 3. Shore Line Changes 1991-2000

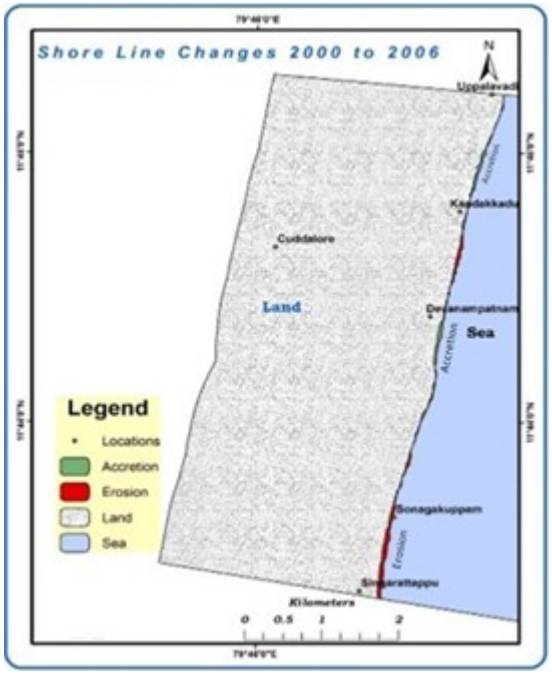

Figure 4. Shore Line Changes 2000-2006

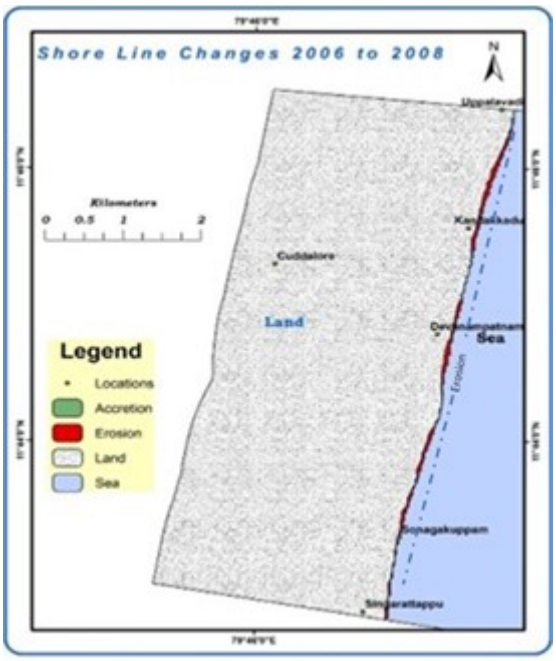

Figure 5. Shore Line Changes 2006-2008

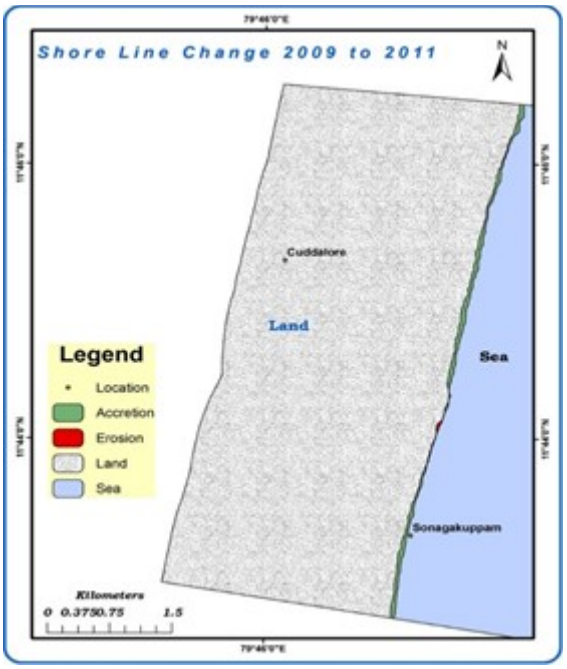

Figure 7. Shore Line Changes 2009-2011

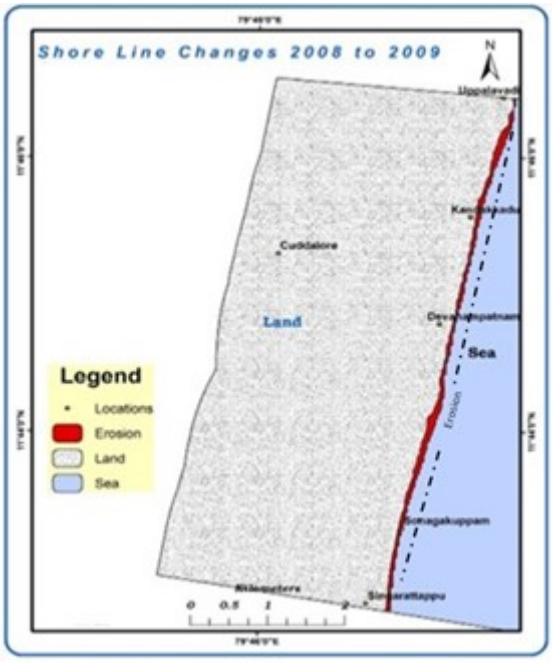

Figure 6. Shore Line Changes 2008-2009

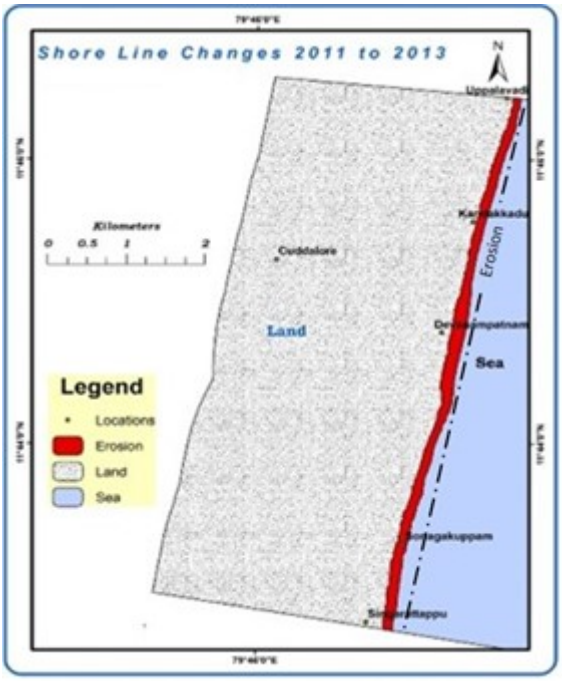

Figure 8. Shore Line Changes 2011-2013

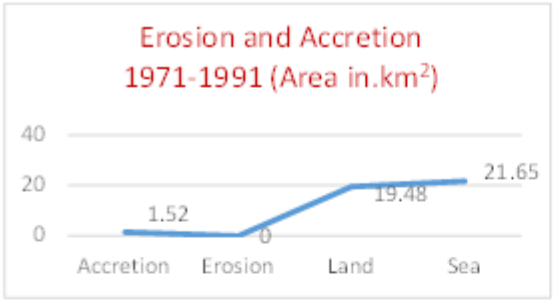

Chart: 1 Erosion and Accretion 1971-1991

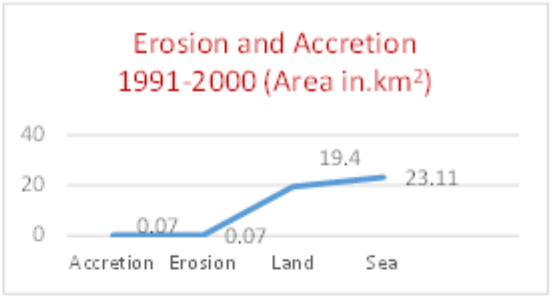

Chart: 2 Erosion and Accretion 1991-2000

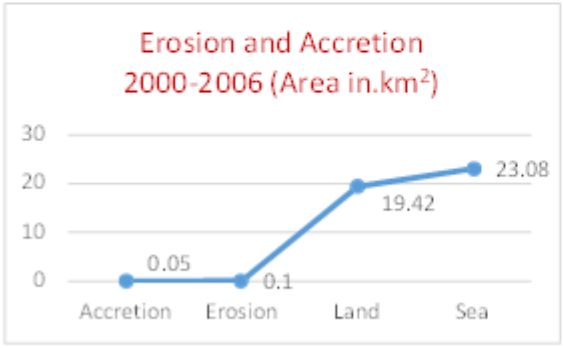

Chart: 3 Erosion and Accretion 2000-2006

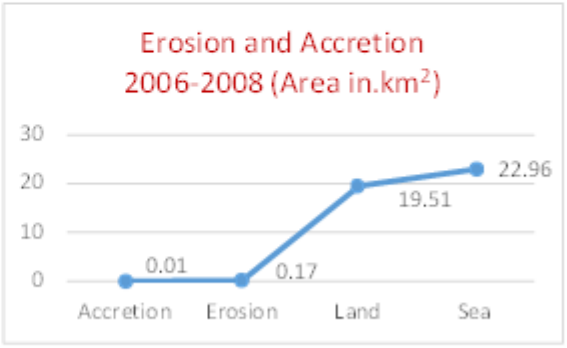

Chart: 4 Erosion and Accretion 20006-2008

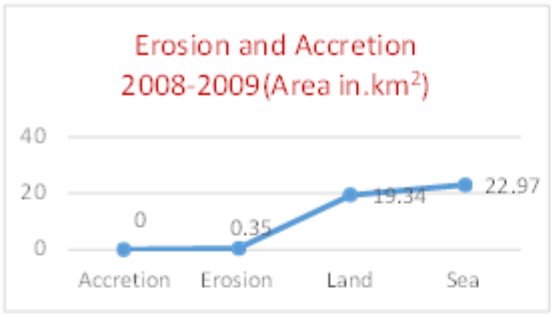

Chart: 5 Erosion and Accretion 2008-2009

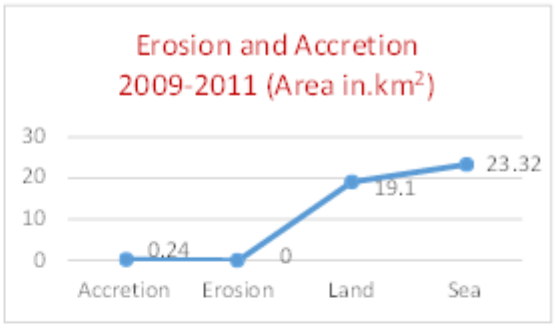

Chart: 6 Erosion and Accretion 2009-2011

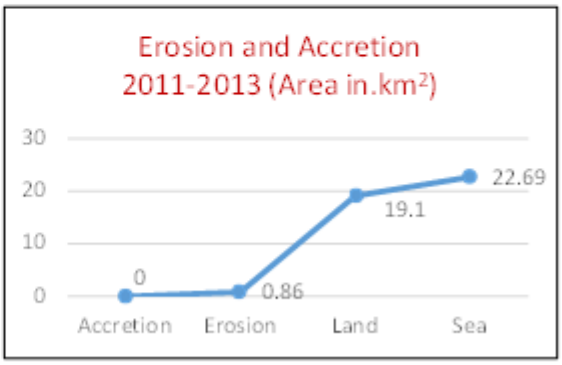

Chart: 7 Erosion and Accretion 20011-2013

Chart 1-7. Erosion accretion changes of 1971-2013

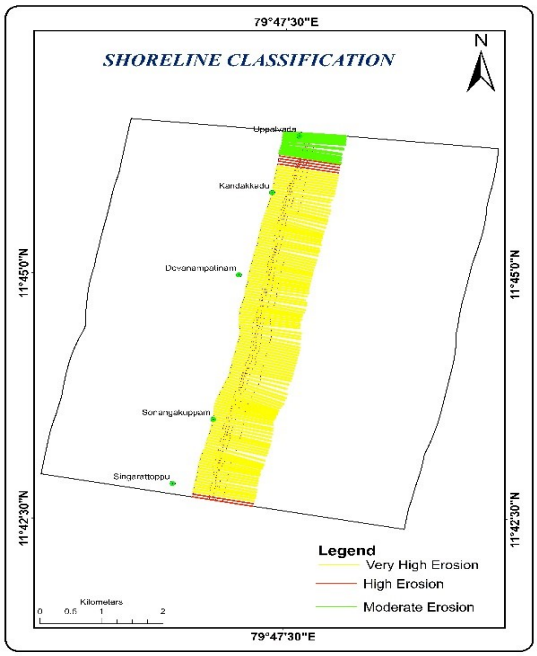

Figure 10. LRR Based Shoreline Classification Map

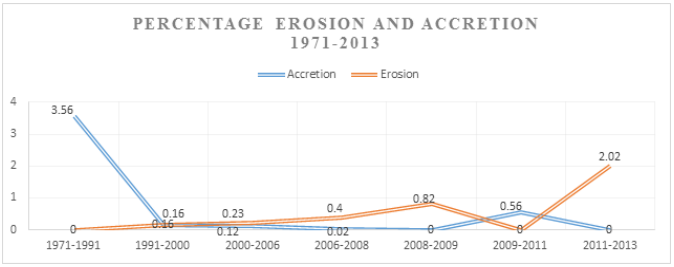

Chart 8. Erosion and Accretion 1971-2013

VI. CONCLUSION

The studies for the shoreline changes in part of cuddalore coastal from the year 1971-2013 for an area of 19.1 km^2 of land and 22.62 km^2 of sea. There were enormous changes got found. The region was been in accretional during past decades, but gradually changes occurs as erosion from the beginning of the year 2000. Percentages of yearwise changes plotted in Chart (8). The erosion reaches unnatural during 2013. An area of 2.02 % was eroded as a Maximum of 0.86 km^2 of areas displaced towards the sea got observed. And it was noted along northern to southern part including Uppalvadi, Kandakkadu, Devanampatinam, Sonangakuppam, and Singarattopu. The major reason behind the coastal erosion was the natural causes include wave action, wind, tidal actions, those triggered after catastrophic event Tsunami. Along with the anthropogenic activities like Construction of artificial structures like Jetties, River water regulatory works, Dredging of tidal entrances and other urbanization. The above-mentioned causes were identified from the ground field study undergone timely to ensure the accuracy of the erosion rate. Remedial measures have to be taken includes, Beach nourishment and Dune grass planting to reduce the intensity of the erosion

VII. REFERENCES

[1]. Usha Natesan, Anitha Parthasarathy, R. Vishnunath, G. Edwin Jeba Kumar and Vincent A. Ferrer.,2015. Monitoring longterm shoreline changes along Tamil Nadu, India using geospatial techniques, international conference on water resources, coastal and ocean engineering (icwrcoe 2015).

[2]. Saxena.S, puvraja. R, Mary divya Suganya.G, Ramesh.R, Coastal hazard mapping in the Cuddalore region, South India, Nat Hazards (2013) 66:1519–1536

[3]. Kumaravel.S, Ramkumar.T, Gurunanam.B, Suresh.M,Dharanirajan.k,An Application of Remote Sensing and GIS Based Shoreline Change Studies-A Case Study in the Cuddalore District, East Coast of Tamilnadu, South India, International Journal of Innovative Technology and Exploring Engineering (IJITEE)ISSN: 2278-3075, Volume-2, Issue-4, March 2013

[4]. Kumaravel.S, Ramkumar.T, Gurunanam.B, Suresh.M, Quantitative estimation of shoreline changes using remote sensing and GIS: A case study in the parts of Cuddalore district, East coast of Tamil Nadu, India, International Journal Of Environmental Sciences Volume 2, No 4, 2012.

[5]. Adarsa Jana, Sabyasachi.Maiti, Arkoprovo Biswas., Analysis of short-term shoreline oscillations along Midnapur-Balasore Coast, Bay of Bengal, India: a study based on geospatial technology., Model.

Earth Syst. Environ. (2016) 2:64,DOI 10.1007/s40808-016-0117-7

[6]. Mageswaran T, Ram Mohan v. Chenthamil selvan S ,Arumugam T,Tune Usha, and Kankara R.S . Assessment of Shoreline changes along Nagapattinam Coast using Geospatial techniques, international journal of geomatics and geosciences volume 5, no 4, 2015.

[7]. Ateeth,Shetty,Jayappa.K.S,.Mitra.D, Shoreline Change Analysis of Mangalore Coast and Morphometric Analysis of Netravathi-Gurupur and Mulky-Pavanje Spits,2015,Aquatic Procedia

[8]. Sheik Mujabar, Chandrasekar, A Shoreline Change Analysis Along the Coast Between Kanyakumari and Tuticorin, India, Using Digital Shoreline Analysis System, Geo-spatial Information Science 14(4):282-293 ,Volume 14, Issue 4,

[9]. Ram Anand Bheeroo, Chandrasekar.N,. Kaliraj.S,Magesh.N.S, Shoreline change rate and erosion risk assessment along the Trou Aux Biches–Mont Choisy beach on the northwest coast of Mauritius using GIS-DSAS technique, Environ Earth Sci (2016) 75:444,DOI 10.1007/s12665-016-5311-4