Isodata Classification Technique to Assess the Shoreline Changes of Kolachel to Kayalpattanam Coast

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Abstract **-The Landsat Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+) sensor images, Toposheet and Google Earth Images at unequal intervals spanning 60 years period between 1953 and 2013, were analyzed to quantify the Transgression and Regression along the coast between Kolachel and Kayalpattanam. Visual interpretation and ISODATA classification techniques were used to extract the shorelines. The proposed method estimates the shoreline changes between 1953 and 1992, 1992 and 2006, 2006 and 2013 and the overall period change between 1953 and 2013.The outcome of this proposed method identifies the transgression and regression area of our study area. In this research article, all the process were carried out using ArcGIS 9.3.1, Erdas Imagine 9.1 and Elshyal smart web online software.**

Keywords - ISODATA classification; visual interpretation; shoreline changes; transgression and regression.

I. INTRODUCTION

In environment protection, coastal zone monitoring is an important mission, in which extraction of shorelines should be regarded as fundamental research of requirements [1]. The international Geographic Data Committee recognized shorelines as of the 27 most important features. [2]. Shoreline represents the dynamic boundary separating beaches from the continual impact of waves, winds surge and tides [3]. Shoreline regarded as one of the most dynamic process in coastal area, due to with much physical process such as tidal inundation, sea level rise, transgression and regression [4]. Transgression and regression pattern was locally disrupted by the construction of productive engineering structures (eg. Seawall) [5]. Remote sensed data were used to make for analysis the shoreline change in coastal and deltaic environments in many researchers. For example Sabyasachi Maiti and Amit K. Bhattacharya (2009) analyzed shoreline change by using remote sensing and statistical approach [6], Tancay Kulelli et al. (2011) were detected the shoreline change on coastal Ramsar wetlands of Turkey [1], Usha Netasan et al. (2012) were analyzed the shoreline change for vedaranyam coast, Tamil Nadu, India [7] and Aliakbar Asuly et al. were monitored the Caspian sea coastline changes using Object oriented techniques [8], N. Chandrasekar et al. (2013) were classified the vulnerability zones and shoreline changes for southern tip of India using Remote Sensing and GIS approaches [9], M. M. Yagoub and Gridhar Reddy Kolan (2006) monitored the coastal zone land use and land cover changes of Abu Dhabi [10]. The demarcation of shoreline is an important task useful for various fields such as coastline change detection, coastal zone management and flood prediction. Khalid M. Dewidar and Omran E. Frihy (2010) in their study threshold method was used to extract the shorelines form band 4 for MSS and band 7 for ETM+ / TM sensor images [5], Pritnam Chand and Prasenjit Acharya (2010) were extracted shorelines from band 4 for MSS and band 5 for ETM+ / TM sensor images by histogram/ grey level threshold method [11], A new water index method was used to map the shorelines by Yashon O. Ouma (2006) [12], sobel edge detection method have been used to extract the shoreline form SAR image by Y. wang and T.R Allen (2008) [13]. In this present study ISODATA Classification and visual interpretation techniques were used to extract the shorelines and matrix method was used to detect the changes. Shoreline change identification is more essential because it is and input data for coastal hazard assessment.

II. STUDY AREA

The study area Kayalpattanam to Kolachel is fall in the Kanyakumari, Tirunelveli and Tuticorin Districts, in the south and south eastern part of the Tamil Nadu. It’s geographically located in between $77^{0}20'0''$ E to $78^{0}10'0''$ E and $8^{0}0'0''$ N to $8^{0}30'0''$ N. The study area shoreline length is around 155 kms. Fig . 1 shows the study area. The southern part of the study area was covered by Indian Ocean and south eastern part covered by Bay of Bengal Sea. It was covered by sandy coast and cliff coast.

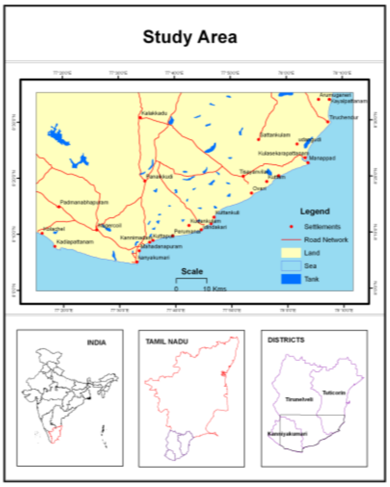

Fig . 1

III. DATA AND METHODS

Landsat Multi Spectral Scanner (MSS), Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM+) data have been widely used in coastal research and environmental studies because this satellite provides historical data for all area in the world. It is suitable for monitoring water quality, glacier recession, sea ice movement, invasive species encroachment, coral reef health, land use change, deforestation rates and coastline change [1].

In this present study, toposheet, multi spectral and multi temporal satellite images were used. Each data was acquired in different dates and unequal intervals. In 1953 Digital topographic maps scale of 1: 2, 50,000 acquired from Texas university website (URL - 1), Landsat TM image in 1992 and Landsat ETM+ image in 2006 with resolution 30m, downloaded from Global Land Cover Facility (GLCF) website (URL - 2) and updated 2013 Google Earth image were used

All data were in the world reference system (WGS 84) with GeoTiff format and were projected using the Universal Traverse Mercator (zone UTM 43 N). In the previous studies various techniques have been used for shoreline extraction and change detection and most of the earlier works have analyzed and identified the shoreline mapping and changes in the vector based analysis but in the present study different image processing techniques are employed for mapping the shoreline and raster based analysis for identifying the shoreline changes.

In this study visual interpretation method was used to differentiate the land and sea features from toposheet and Google Earth images and then converted to raster formats. ISODATA classification technique was used to classify into 50 classes. Besides, classified image was regroup into two classes (land and sea).This process was carried out by TM image and ETM+ image.

Change detection involves pixel by pixel comparison to detect changes. An important aspect in the change detection is to determine which feature is automatically changing to which feature, for example how much area of land is changing to sea is possible in matrix method in Erdas Imagine software. This method was used to detect the changes between 1953 and 1992, 1992 and 2006, 2006 and 2013 and the overall period changes 1953 to 2013 were calculated. Transgression and Regression area was identified very easily in this method. A flowchart of the proposed methods is shown in Fig. 2.

A. Flow Chart

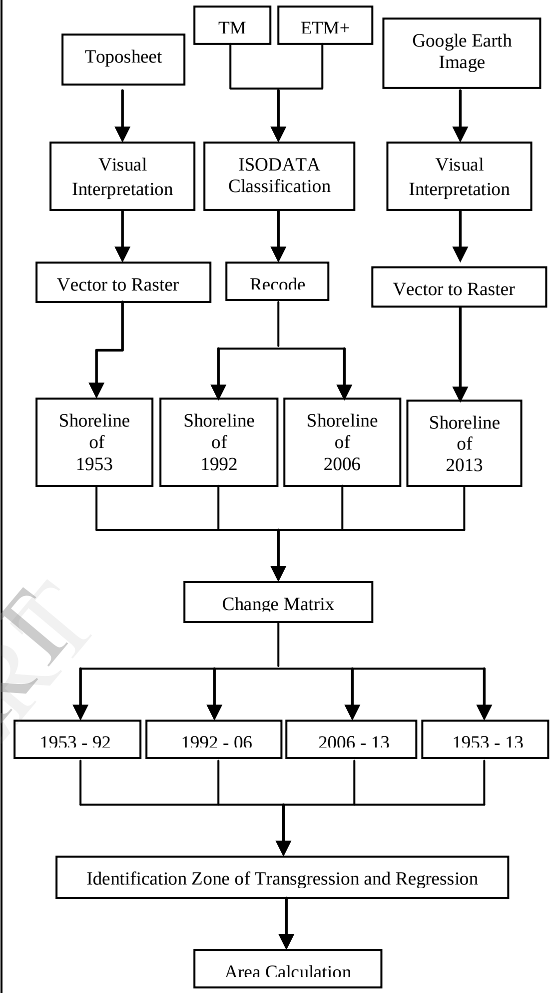

Fig . 2

IV. RESULTS AND DISCUSSION

In this research, shoreline was extracted from toposheet and satellite images for 1953, 1992, 2006 and 2013 by visual interpretation and ISODATA classification methods. The shoreline changes were calculated by change matrix method. From the analysis it is clear that the major area under change were observed. In all periods of shoreline changes the transgression concentration was higher than regression. It was clearly shows in the table 1. The result of the present study, the coastal morphological changes has caused the transgression and regression.

Fig. 3 shows the shoreline changes between 1953 and 1992. In this period the changes have been observed in the southwestern part of the study area and a few areas in the southeastern parts such as Kuttapuli, Perumanal, Idindakarai and Manappad area were affected by regression and the remaining part of the study area was concerned by transgression.

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Fig. 4 portrays the shoreline changes between 1992 and 2006. In this period the head land areas like Muttam, Manappad and Tiruchendur were changed by regression and the left over area was distressed by transgression.

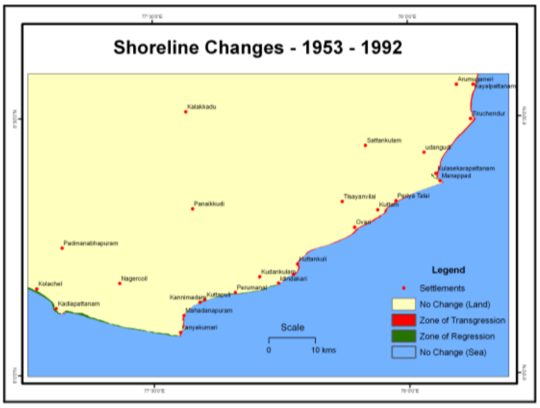

Fig . 3

Fig . 4

Fig. 5 represents the seven year shoreline changes from 2006 to 2013. In this period the shoreline changes were identified in less area compared with other periods of changes.

Fig. 6 explains the overall period of shoreline changes from 1953 to 2013. The changes considered the transgression concentration was higher than regression.

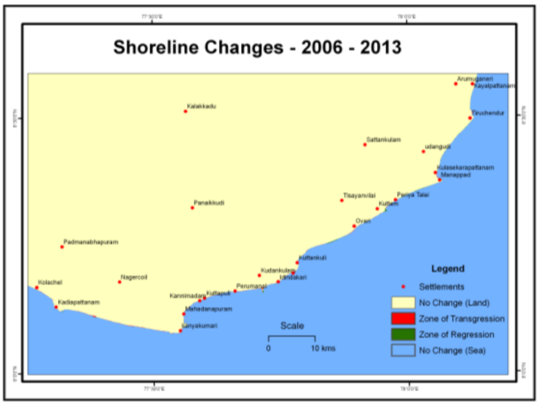

Fig . 5

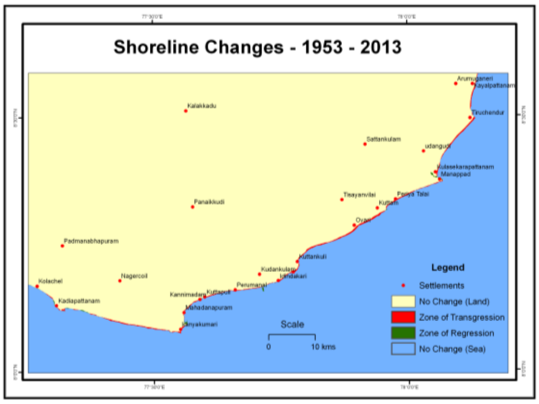

Fig . 6

TABLE I. SHORELINE CHANGES

Shorelines	1953 - 92	1992 – 06	2006 – 13	1953 – 13
No Change (Land)	400847.5	400114.0	400218.3	400210.0
Transgression	1368.90	1893.15	245.88	2006.28
Regression	1159.65	350.10	176.76	184.86
No Change (Sea)	274701.8	276032.4	277437.06	275677

Table I describes the affected area by transgression and regression for 1953 to 2013. It clearly shows the transgression was higher than regression in all periods of shoreline changes.

V. CONCLUSION

The coastal area is very important for economically and ecologically in all country. For that coastal area was continuously affected by shoreline changes. The shoreline changes are due to both natural and anthropogenic activities. The primary natural causes of shoreline changes are sea level rise, storms and geomorphic process of erosion and accretion. Human activities are the main reason for rising the global temperature, sand mining, urban development and over exploitation of natural resources in the coastal area. Toposheet and temporal satellite images are the most important data sources for the shoreline change detection. In 1992 – 2006, the affected area by transgression was 1893.15 hec. and the overall periods of shoreline changes affected by transgression was 2006.28 hec. It is almost near for two periods of transgression. In between the 1992 and 2006 the Tsunami was affected coastal area the impact of Tsunami was clearly shows Fig – 4. At the same time the regression 350.10 hec. was higher than the overall period of shoreline changes. Coastal Changes and their negative impacts have to reach the people. So that they will be aware and anthropogenic activities for coastal change can be minimized.

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