Assessment of Coastal Erosion Along Kannur District, India using GIS

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***Abstract*—Coastal regions are major geographic features of our earth. The major part of the earth is covered by the oceans and various kinds of water bodies. The three parts of our country is surrounded by water. There are mainly 9 states in India which covered by large coastal area, and Kerala also keeps a position among them. This shows the importance of coastal region in the life of Keralites and Indians. Coastal region is exposed to continuous change due to natural causes and human inventions. The changes are very slow and complex, and not visible to us, but the impacts are more visible, mainly the erosion and accretion. Both will cause change of the shore line permanently. Geospatial technologies are the best methods to produce the coastline maps and for estimating the rate of changes. Observations made repeatedly on shoreline database, establish the shoreline changes over a period of time. Geographical Information System (GIS) enables to store the data in a digital form and also a provision to share between users over electronic networks and the models can make forecast about future shoreline patterns. GIS is also broadly employed in various coastal morphodynamical studies because they are cost effective, decrease manual error and are useful in the absence of field surveys. There was an analysis of shoreline of Kannur district in Kerala was carried out from the year 1983 to 2021 with a time period of 5 years using the satellite images of Landsat with the help of QGIS software. The main objective of the project was to analyze the sea shore line, determine the amount of coastal erosion, prediction of erosion rates in the future more energy than other connections when employing various vacancies**

Keywords*— *GIS, Costal erosion, Shoreline assessment, QGIS software, Landsat, Geospatial technology

I. INTRODUCTION

Coastal region is one of the important part in the earth surface, where always occur various changes. Erosion and Accretion are the common changes that would happen on the coastal regions caused either by natural force or Manmade. Shoreline is an imaginary line that coincides with the interface of water and land. Shoreline is continuous change with time because accretion and erosion of sediments occurs due to the tidal patterns. This whole process is known as shoreline change. Wind ,waves ,currents are the natural driving forces that easily move through the unconsolidated sand and soil in the coastal area, resulting rapid changes in the position of the shoreline .the coastal system have been also effected by the several aquaculture activities like ports, industries ,aquaculture farming and other human interventions in the form of coastal defense. The rising sea levels and global warming are very much focused topics for re-search work, because these problems may cause many natural disasters. In addition to that, due to greenhouse effect the icebergs in polar region melt and leads to sea level rise which consequently results in reduction of land. So, studying the shoreline changes is important for protecting the environment and coastal area. Geospatial technologies are the most efficient way to produce the coastline maps and to estimate the rate of changes of it. Observations made repeatedly on shoreline database, reveals the detailed shoreline changes over a period of time.

A shoreline movement can occur due to boost or drop in its sediments in a short span of time. For visualization and analyzing the coastal zone information, the geoinformatics approach could provide a better accuracy and time savings for its overall performance. Thus, RS and GIS are most adopted methods for coastline management and monitoring. This study access the shoreline changes in part Kannur district..

II. STUDY AREA

The present study area is Kannur district. Kannur is one of the 14 Districts along the west coast in the state of Kerala India. Kannur district is surrounded by Kasaragod district to the north, Kozhikode district to

the south to the southwest and Wayanad District to the southeast. To the east, the district is covered by the Western Ghats, which forms the boundary with the state of Karnataka (Kodagu district).

The Arabian Sea lies to the west. Paithalmala is the highest position in Kannur District (1,372m). Enclosed within the southern part of the district is the Mahi of the Union Territory of Puducherry. Kannur has an elevation of 1.02 meters or 3.3 feet along the coast of the Laccadive Sea, with a sandy coastal area

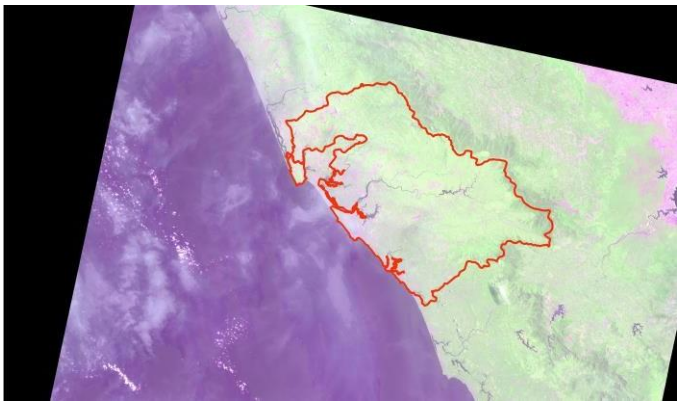

Fig1. Study area Kannur District

III. METHODOLOGY

Shoreline Change Analysis is analysed for Kannur district, Kerala, India using GIS software with the satellite image of Landsat 7 and Landsat 8 having wavelength ranging from 0.45 to 0.9 micrometers with a resolution of 30 meters. At first the band image from Landsat data is gathered from USGS earth explorer for various years as 1991,1996,2001,2006,2011, 2016 and 2021. After that band image is stacked and the necessary coordinates and processed to GIS software.

GIS is used for compiling geographic data, analyzing and managing mapped information in a database. Composite band is formed by processing the raster data (image) by using data management tools. The shapefile is created by converting the raster data to vector data by using line feature. By visual interpretation of satellite image, it was found that the objects are identified by different colour combination which helps to interpret the object such as blue colour represents water. The band composition are chosen to such an extent that the land and water are effectively distinguished. By visual interpretation, the long term shoreline change is examined by comparing the shapefile of different years and consequently the area susceptible to change is distinguished whether erosion or deposition has occurred.

Table 1. Landsat Mission and Sensor specifications

Satellite	Sensor	Launch Year	No. of MS bands [nominal resolution]	Panchromatic resolution (nominal) (m)	Thermal bands [resolution]	Altitude (km)
Landsat 1	MSS/RBV	1972	4 [80 m]	-	-	920
Landsat 2	MSS/RBV	1975	4 [80 m]	-	-	920
Landsat 3	MSS/RBV	1978	4 [80 m]	-	-	920
Landsat 4	MSS/TM	1982	6 [30 m]	-	1 [120 m]	705
Landsat 5	MSS/TM	1984	6 [30 m]	-	1 [120 m]	705
Landsat 6*	ETM+	1993	-	-	-	-
Landsat 7	ETM+	1999	6 [30 m]	1 [15 m]	1 [60 m]	705
Landsat 8	OLI/TIRS	2013	8[β] [30 m]	1 [15 m]	2 [100 m]	705

IV. SHORE LINE EXTRACTION

Shoreline is an active coastal region between the land and sea. In the coastal erosional studies, the shoreline only can show the changes in the coastal region. The satellite imageries with false color composition helps to find and extract the shoreline. The changes in infrared portion of electromagnetic spectrum expose low reflectance in water and high reflectance on sand. GIS Software used to describe the shoreline. Shorelines extracted from Multi-year satellite imageries were the latest trend which help us to identify and determine the changes. The net shoreline changes for the period 1991-1996, 1996-2001, 2001-2006, 2006-2011, 2011-2016, 2016-2021
determined.

Fig 2 Shoreline extraction of the year 1991

Fig 3 Shoreline extraction of the year 1996

Fig 4 shoreline extraction of the year 2001

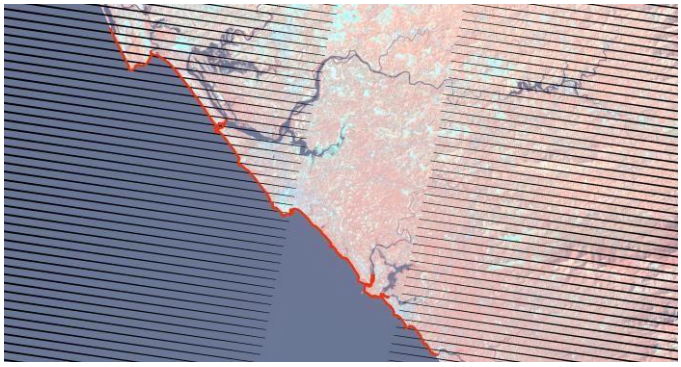

Fig 5 Shore line extraction of the year 2006

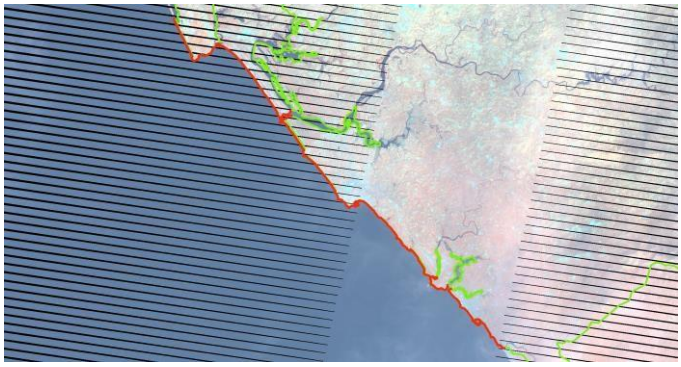

Fig 6 Shore line extraction of the year 2011

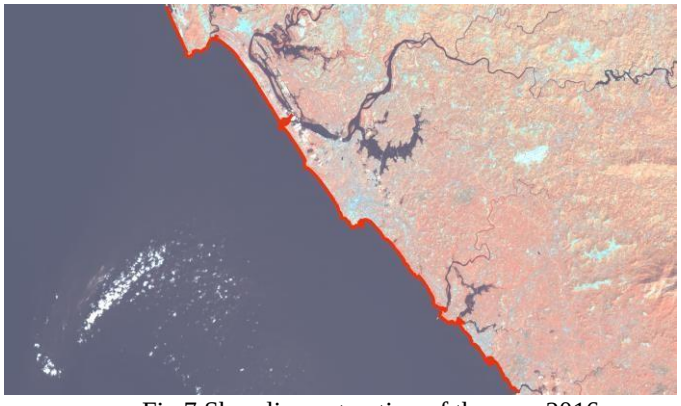

Fig 7 Shoreline extraction of the year 2016

Fig 8 Shore line extraction of the year 2021

RESULT

Coastline is most important dynamic landforms of coastal zone. Geomorphic process continuously changes the coastline. The assessment of coastline is therefore very important for planning measures. Coastline changes are measured in square meter with positive sign indicates accretion and negative sign indicates erosion.

The total shoreline changes is calculated for a period of 5 years from 1991-2021. In Kannur coast both erosion and accretion is noticed. Shoreline changes during each period was determined. It is observed that Kannur district had accreting pattern during 2001-2006&2016-2021 also erosion Ing pattern during 1991-1996, 1996-2001, 2006-2011 & 2011-2016.After

1991 erosion was increased. The study reveals that an area of 118,960,401.424m^2 was eroded during the last 30 years (1991- 2021). The rate of erosion is varies from site to site over the time due factors such as storm wave energy and duration, long shore current regime, erosion of beach material and it orientation, shore protection structures etc.

CONCLUSION

The Kannur coastline has various shoreline features such as viz, rocky, sandy, mudflats, riprap, sand dunes, deltas, estuaries etc. The Coastline maps for the time period from 1991 to 2021 using Landsat data were generated. The analysis is carried out for 5 periods 1991-1996, 1996-2001, 2001-2006,

2006-2011, 2011-2016, 2016-2021.Reasons of shoreline change are due to both artificial structures and due to natural processes acting together. It is necessary to study about each factor separately to determine their impacts on the coast. But the artificial structures are constructed mainly for development or protection purposes but, continuous monitoring is essential to study their impacts. This study mainly highlights the application of remote sensing and GIS to study and analyze the changes in coastal zone.

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