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Shoreline Transformation Study of Visakhapatnam Coast, Andhra Pradesh State: Geospatial Approach

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Abstract: *Quantitative and Qualitative studies on change of Coastline of Visakhapatnam, Andhra Pradesh State, India have been carried out using toposheets from Survey of India and Satellite Imageries (IRS-P6 LISS III, LISS IV and CARTOSAT-1). Changes during 20 years period are studied at each station. Significant morphological changes along the coastline are observed in the study. The study indicates that gradual erosion is observed at Museum North and South, R K Beach, Rushikonda and Mangamaripeta.*
Keywords: *Coastal Erosion, GIS and Remote Sensing*

I. Introduction

Coastal zone is the transition area between land and ocean and is an area of complex, dynamic and delicate environment. External factors influencing the coastal zone are the sediment supply by the rivers and coastal processes. Shoreline is one of the most rapidly changing landforms of the coastal zone. The accurate mapping of shoreline is therefore very important for planning conservation measures such as protection of human life, property and natural environment. The coastal zone is receiving an increasing attention because of the pressure of increase population and industrial developments. Protection of natural resources, the loss of habitats, severe coastal erosion, sedimentation in ports and harbours and municipal and industrial pollution are major concerns for coastal zone managers.Remote Sensing technology had been used commonly to map the shoreline and offers the potential updating maps frequently. Satellite Remote Sensing technique has proved its utility in all fields of earth science studies including the study of coastal processes, because of the repetitive, synoptic and multispectral coverage's of the satellite. Satellite imageries are useful tools for detecting the coastal morphology changes. Remote Sensing data can be used to evaluate the coastal processes like erosion/accretion and shoreline changes. Geographic Information System (GIS) is designed to work with data referenced by spatial/geographical coordinates. The major advantage of GIS is that it allows identifying the spatial relationships between features and temporal changes within an area over a time. Remote Sensing satellite images have been effectively used for monitoring shoreline changes of different locations i.e. R K Beach, Fishing Harbour, Light Hose, Rushikonda, Mangamaripeta and Bheemunipatnam. In this paper an attempt has been made to study the shoreline changes in terms of erosion and accretion using LISS III, LISS IV, 3D stereo data, toposheets, field data and GIS technique along Visakhapatnam Coast, East Coast of India.

II. Study Area

Visakhapatnam Coastline extends over a length of 68 km intercepted with a number of rivers joining the Bay of Bengal. The present study is focused at one 4km stretch RK Beach. RK Beach is one of the major tourism points along the Visakhapatnam Coast. It starts with Fishing Harbour North, Hotel Novotel, Kaali Temple, YMCA and Light House.

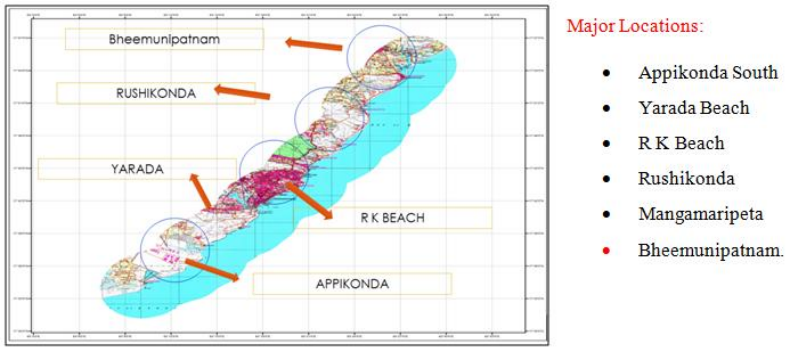


Fig: Study Area

III. Data And Methods

3.1 Data Source

Satellite Data Imagery LISS III (cloud free) for the past 20 years i.e. 1997 to 2016 are procured from NRSC (National Remote Sensing Centre) with path 104, row 60 and CARTOSAT -1 Satellite Stereo Imagery for the past 10 years with path 570, row 314 are used for the study. Characteristics of IRS-1D (LISS –III), IRS – 1P6 (LISS IV) and CARTOSAT-1 are presented in the table below –

Table 1: Satellite Data Characteristics

Satellite	Sensors	Spectral Bands (Micron)	Resolution (m)
	PAN	0.50 – 0.75	5.2 to 5.8
IRS-1D	**LISS-III**	0.52 – 0.59 (B2)	
		0.62 – 0.68 (B3)	21.2 to 23.5
		0.77 – 0.86 (B4)	(V & IR)
		1.55 – 1.70 (B5)	
	WiFS	0.62 – 0.68 (Visible)	169 to 188
		0.52 – 0.59 (Green Band 2)	
	LISS-IV	0.62 – 0.68 (Red Band 3)	5.8
		0.76 – 0.86 (NIR Band 4)	
		0.52 – 0.59 (B2)	
IRS-P6	**LISS-III**	0.62 – 0.68 (B3)	23.5
		0.77 – 0.86 (B4)	(V & IR)
		1.55 – 1.70 (B5)	
		0.52 – 0.59	
		0.62 – 0.68	
	AWiFS	0.77 – 0.86	58
		1.55 – 1.70	
	CARTOSAT-1	0.5 – 0.85	2.5

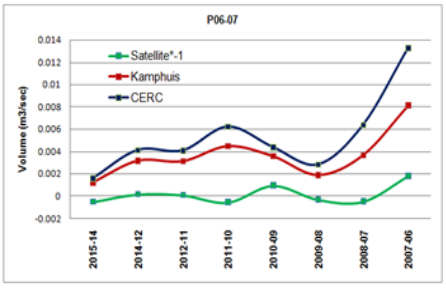
Type of Data	Source of Data
Topo sheets (1:50,000 Scale) 65 O 5 SE, 65 O 5 SW, 65 O NE, 65 O NW	SOI (Survey of India), Hyderabad
Satellite Data (LISS-III. LISS-IV, CARTOSAT-1 Stereo Pair	NRSC (National Remote Sensing Centre)
Wave Data (Ocean sat)	INCOIS, Hyderabad
Bathymetry Data	NIOT, Chennai & National Hydrographic Charts
Land use / Land cover map	Satellite data analysis
Drainage Map	Satellite Data and Topo sheet analysis

3.2 Data Processing

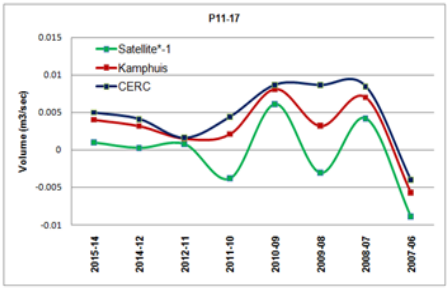
Top maps are scanned and opened in ERDAS IMAGINE 9.1 environment. Base maps are generated based on the Survey of India topographical maps surveyed in the year of 2011, registered by giving corner points after projecting into geographic projection WGS 1984. LISS III, LISS IV imageries from 1997 to 2016 are Geo-registered with the base map using more than 25 corresponding Ground Control Points (GCPs) like road crossing, bridges and other permanent significant features, using survey of India toposheets. Geo-registration is a process of stabilizing the relationship between map and the known real coordinates. Re-sampling in each case is performed using cubic interpolation technique to keep the spatial distortions at minimum. Accuracy of the geo-correction is tested by swiping one image above the other and confirmed by field data. The geo-corrected data is imported into Arc GIS environment for digitization of Shoreline. Shorelines representing different years of a same station are presented by overlaying together. Quantification of erosion/accretion rate is carried out from the stereo pair imagery.

IV. Analysis & Results

Sediment Transport Volumes are calculated from Stereo Satellite Imagery, Kamphuis and CERC.

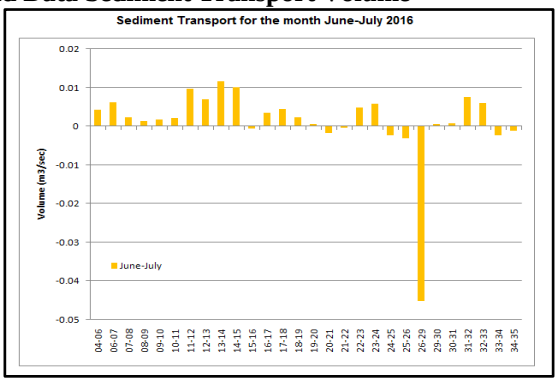


Location: Fishing Harbour, Novotel, And Kaali Temple

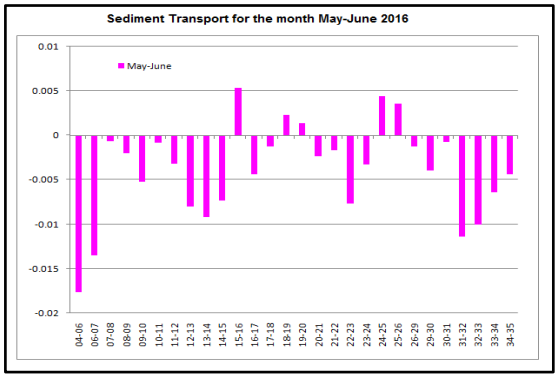


Location: R K Beach

Field Data Sediment Transport Volume



Location: R K Beach (June-July-2016)



Location: R K Beach (May-June-2016)

V. Conclusions

This study investigates the coastal erosion and deposition at the RK Beach (Point -04 -34) covering a period of 20 years along the Visakhapatnam Coast, East Coast of India. Both erosion and deposition are observed at all the locations in RK Beach. Severe erosion is spotted at North, South of Museum and Rushikonda Beach.

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