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A Study on Coastal Erosion Modeling using GIS and Remote Sensing Technologies Case Study: Andhra Pradesh Coast

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**Abstract:** The aim of the study is to analyze the change in the Coastal Morphology using modern technologies such as Remote Sensing and Geographic Information System (GIS) along the Coastline of Visakhapatnam City (Vizag), Andhra Pradesh state, India. The objective of this study also emphasizes on the land use/land cover, landforms, shoreline and coastal regulation zone (CRZ) changes of the Visakhapatnam beach waters using LISS III and LISS IV satellite data of NRSC and Toposheets from Survey of India. Salient changes have been seen amid the past three decades through the analysis of land change which distinctly explains that the regulatory zones in the coastal region underwent significant revisions in both natural and evolutionary activities. The field work results were very productive and confirmed several geomorphic units. The latest shoreline map evidently shows some significant changes, which indicate that the area of shoreline produced by erosion is fairly large and seem important in effect than the stable prone shoreline and natural growth. The high resolution data heavily helped in preparing large-scale maps for the execution of CRZ numbers. Ultimately, the results were extremely good and propose the usage of modern geo-spatial information and technological tools to direct the course of coastal morphological studies.

**Keywords:** Coastal Erosion, Geographic Information System and Remote Sensing

## 1. Introduction

Located on the southeast shoreline of Indian Peninsula, the Andhra Pradesh coastline structures a part of the Coromandel Coast, with waters of Bay of Bengal. With 974 km, the AP coastline is regarded as the second longest coastline in the country. The coastal passageway comprises of a few ports, harbors, unlimited extend of sandy shorelines, and wildlife and feathered creature asylums, new water lakes, Eustaries and so forth. The coastal stretch reaches out from Ichchapuram of Srikakulam locale to Sullurpeta of Nellore area, which geologically exists in the middle of the banks of Orissa and Tamil Nadu. Beachfront wetlands are spread over a territory of 1,138.7 km<sup>2</sup>. There are 9 areas that have coastline and every one of them fall under Coastal Andhra region of Andhra Pradesh. They are Srikakulam, vizianagaram, Visakhapatnam, East Godavari, West Godavari, Krishna, Guntur, Prakasam and Nellore. Each region has famous beach waters to encourage tourism in the state, for example, Rushikonda Beach, Ramakrishna Mission Beach, Vodarevu Beach, Suryalanka Beach and so forth with Visakhapatnam area having many other beaches. [2]

## 2. Study Area

The study zone reaches out from Gangavaram Port bearing Longitude 16.734708°n and Latitude 82.047572°e to Mangamarripeta bearing Longitude 17

50 28.6°n and Latitude 83 24 36.9 °e of AP Coast. The region involves four Case Studies i.e. Gangavaram Port, R K Beach, Thinneti Park and Mangamarripeta.

## 3. Objectives

Preparation of map and analysis of the shoreline Morphology and shore line changes that have occurred along this coast from 2000-2014 using LISS-III & LISS-IV data.

### 3.1. Data Used

Indian Remote Sensing Satellite Data:

IRS IC – 2000, 2001, 2002

IRS P6 – 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011

IRS RS2 - 2012, 2013, 2014

LISS – IV Data: 2011

Survey of India Toposheets: 65O5 SE, 65O5 SW, 65O NE, 65ONW – 1:50,000 Scale

### 3.2. Software Used

Arc GIS 9.3

ERDAS 9.1

AutoCAD 2011

**Table 1: Satellite Image Resolution**

S. No	Features	LISS IV	LISS III
1	Spatial resolution	5.8 m at Nadir	23.5 m at Nadir
2	Spectral bands (µm)	Band 2 0.52 - 0.59 Band 3 0.62 - 0.68 Band 4 0.77 - 0.86	Band 2 0.52 - 0.59 Band 3 0.62 - 0.68 Band 4 0.77 - 0.86 Band 5 1.55 - 1.70

**4. Methodology**

Spatial Modeling and Analysis for Shoreline Change Detection and Coastal Erosion Monitoring, is likewise alluded as dynamic system for shore line division[4]. The technique usually utilized particularly by coastal land organizers and administrators to foresee future shoreline-changes is an extrapolation of a consistent rate-of-progress (Owens 1985). This system makes utilization of progressive shoreline information accessible over the long run, which gives the capacity to survey future shoreline changes by checking on the Spatio-fleeting changes of the shoreline. The preference of this model is that, it safeguards the topological connections between the shoreline and beachfront characteristics, which are crucial for spatial examination. Utilizing this direct information demonstrate, the shoreline is partitioned into variable portion lengths.[1]



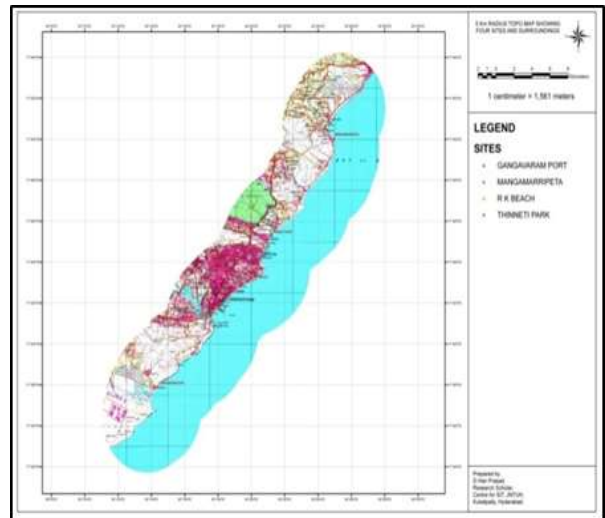
*Figure 2: Showing Thinneti Park Site*



*Figure 3: Beach Erosion in RK Beach*



*Figure 1: Showing Annavaram Site*



*Figure 4: Showing the Study Area-Gangavaram Port, RK Beach, Thinneti Park & Mangamarripeta*

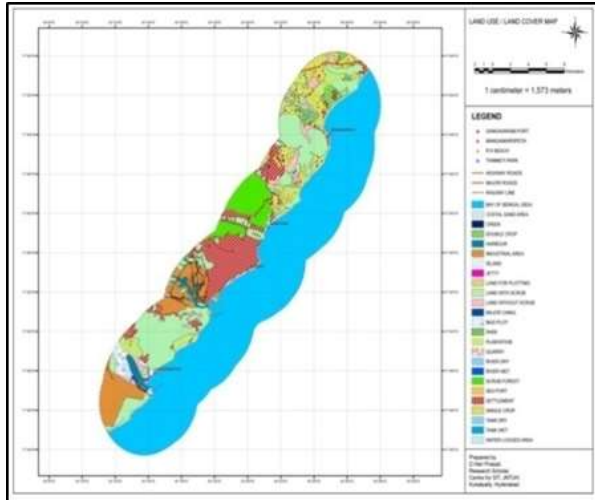


Figure 5: Landuse Land Cover Map

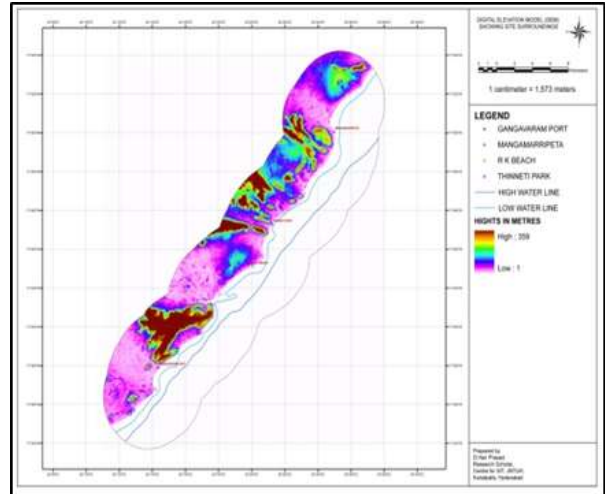


Figure 8: Map Showing DEM

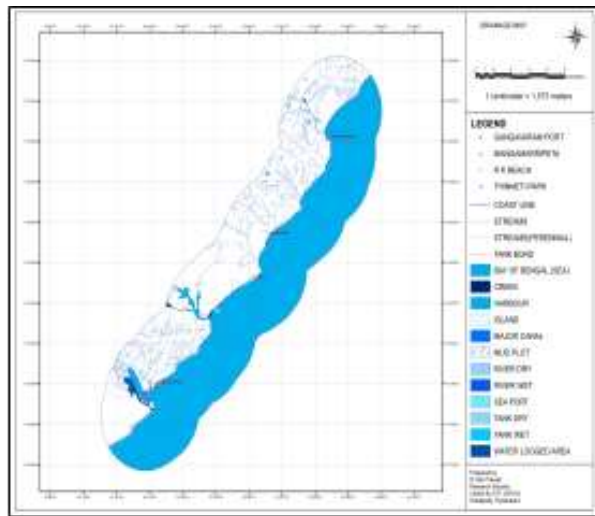


Figure 6: Drainage Map

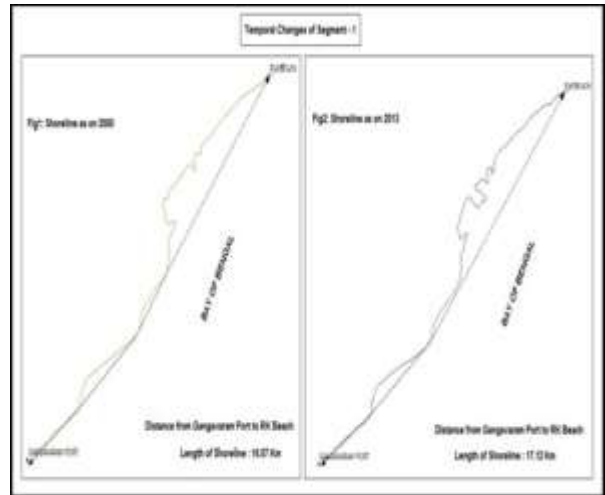


Figure 9: Map Showing Segment – 1 Variation in Length & Area

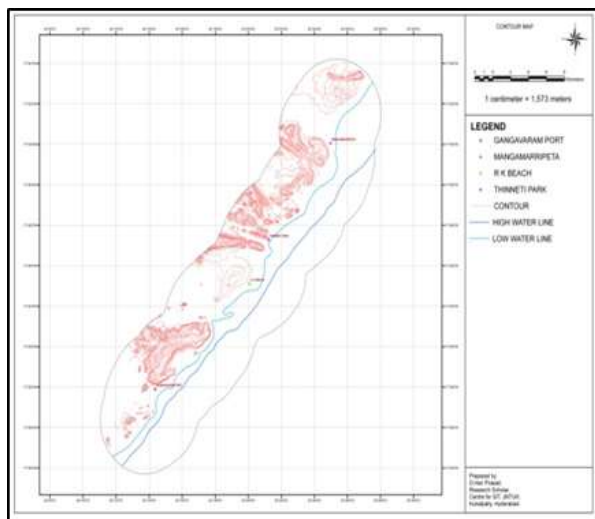


Figure 7: Slope Map

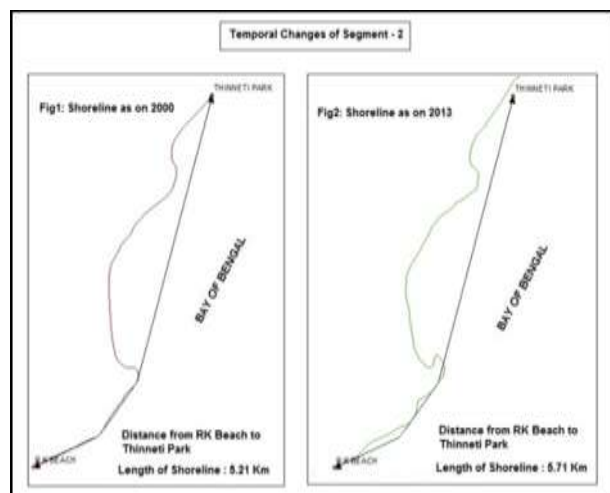


Figure 10: Map Showing Segment – 2 Variation in Length & Area

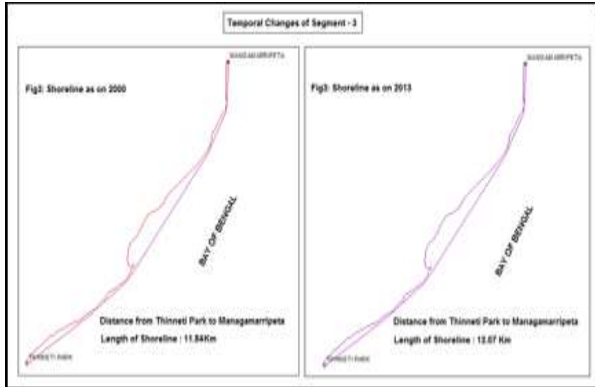


Figure 11: Map Showing Segment – 3 Variation in Length & Area

Table 2: Segment Length

Segment Name	Village Name	Length(KM)
Segment-1	Gangavaram Port to RK Beach	14.16
Segment-2	RK Beach to Thinneti Park	4.88
Segment-3	Thinneti Park to Mangamaripeta	11.74
Total		29.88

### 5. Results

Shoreline changes were observed using satellite data and topomaps. Based on the methodology adopted by li et.al (2001a) the coast line is divided into three segments from Gangavaram Port to Mangamaripeta.

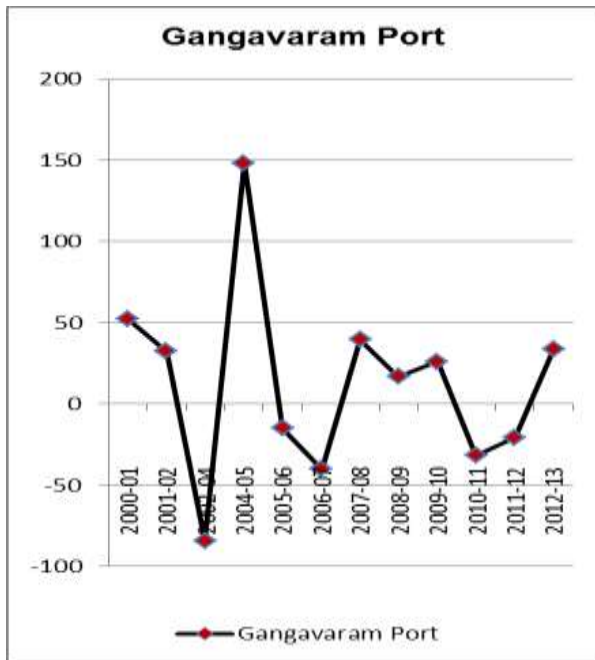


Figure 12: Map Showing Erosion and Accretion in Gangavaram Port

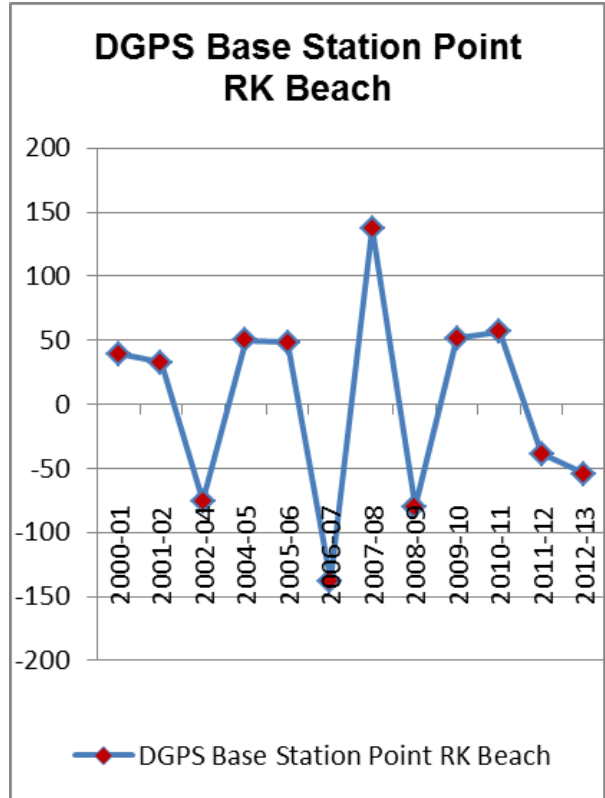


Figure 13: Map Showing Erosion and Accretion in RK Beach

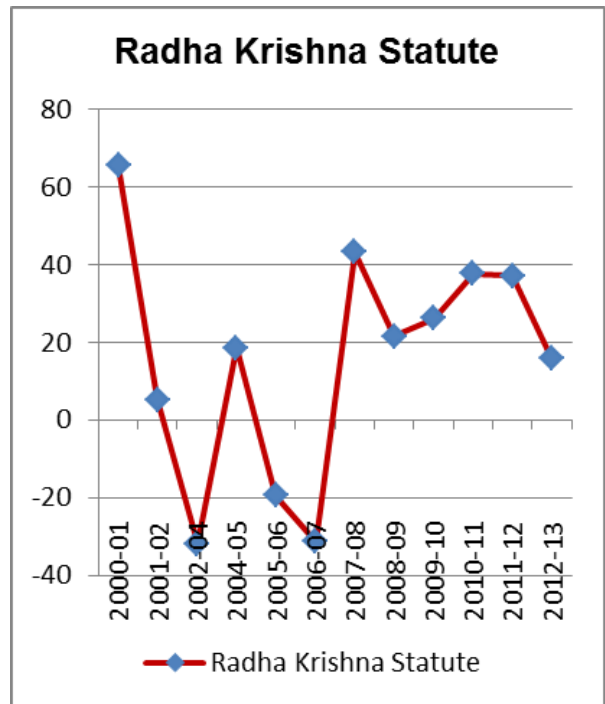


Figure 14: Map Showing Erosion and Accretion in Gangavaram Port

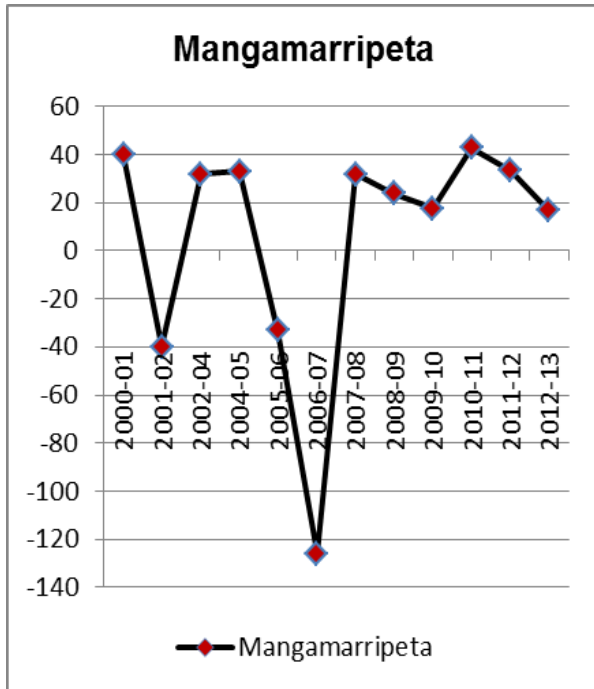


Figure 15: Map Showing Erosion and Accretion in Mangamarripeta

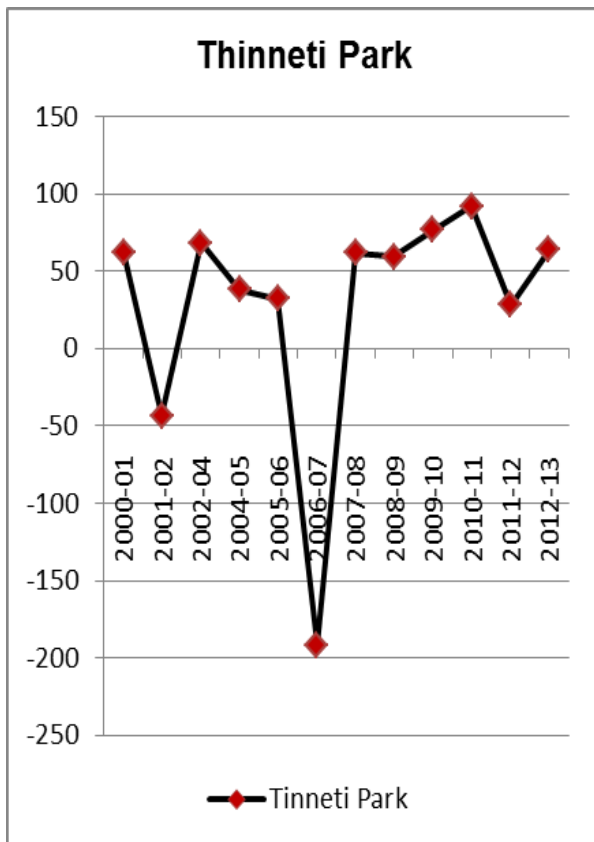


Figure 16: Map Showing Erosion and Accretion in Thinneti Park

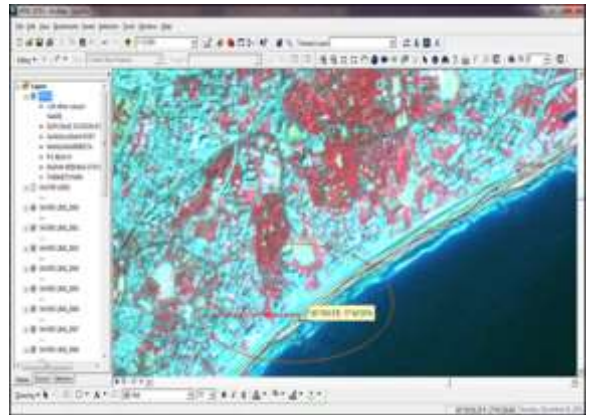


Figure 17: Map Showing Erosion and Accretion in Arc GIS 9.3[5]

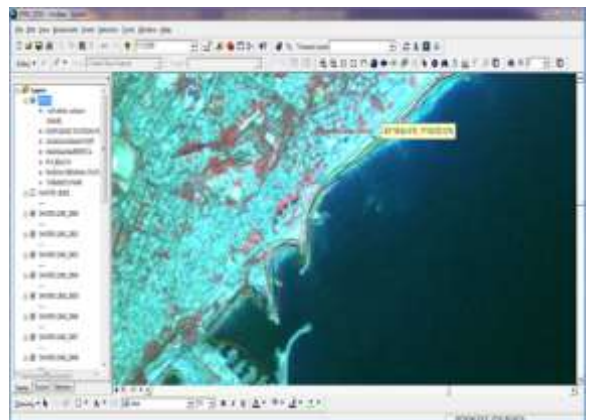


Figure 18: Map Showing Shoreline Morphology for the Past 13 Years 2000-2014

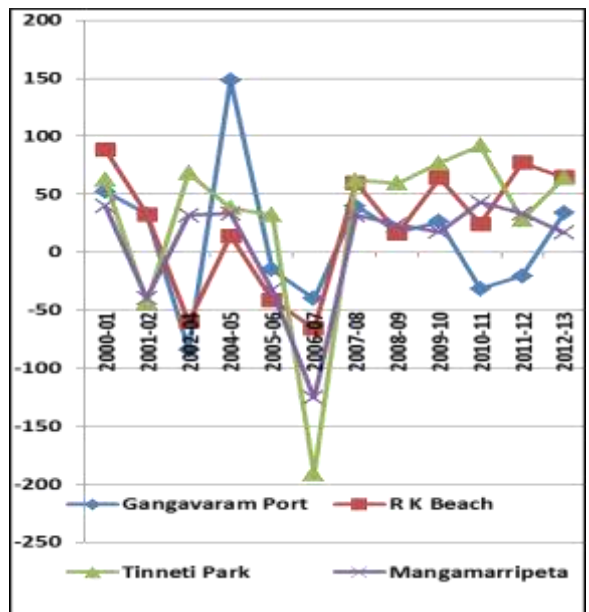


Figure 19: Before Cyclone image along RK Beach near Sub Marine

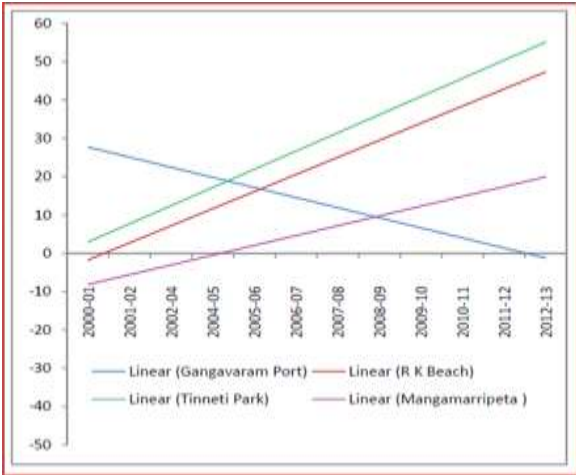


Figure 20: Fig. showing the Linear Trending line of Erosion and Accretion



Figure 23: Before Cyclone Showing RK Beach



Figure 21: Before Cyclone image along RK Beach near Sub Marine



Figure 24: After Cyclone Showing RK Beach



Figure 22: After Cyclone image along RK Beach near Sub Marine



Figure 25: Beach Erosion along the RK Beach



**Figure 26:** Beach Erosion along the RK Beach

Using the Arc GIS 9.3 software, Year 2000 is the Base for Erosion and Accretion level[1]. In the graph at Gangavaram Port Based on the methodology adopted by Li et.al (2001a) the coast line is divided into into three segments and he Temporal Changes were observed for each segment from 2000 to 2013. Table-1 data shows that these shoreline segments that have been eroded. In Gangavaram Port there is continuous Accretion for the past 13 Years. Erosion is happening for these years. In the graph year 2004 there is Erosion at Gangavaram Port (150m). In the Year 2006-07 Accretion of 200m occurred at Thinneti Park. For the past 13 Years in RK Beach there is no Accretion. In the fourth Site Managamarripeta Erosion occurred i.e. 48m. [9]

## 6. Conclusions

The lengths of each shore line segment are given in Km. The length of AP coast is 973 Km and as per the interpretation from satellite image mosaics, it is found that the length of the coast is varying which is evident from temporal changes charts. It is found that from the past 8 years RK Beach is eroding continuously.

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