Studies on Remotesensing and Geographical Information System Applications on Coastal Geomorphological Landforms from Portonova to Coleroon River Mouth, South Arcot, Tamilnadu, East coast of India

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ABSTRACT

Now days, the world scientific community is focusing their attention towards coastal area due to warming provided by the scientists involved in global warming studies, much research works are emerging in this aspect mainly to protect coastal environment and to mitigate coastal hazards. Coastal area is facing serious threats from both manmade and natural disturbances. coastal erosion, sea level variation and cyclones are the major factors that alert the coastal geomorphology the impact of the natural disturbance can be reduced by the protecting the coastal vegetation. The aim of this study is to bring out coastal geomorphological landforms from Portonova to Coleroon river mouth, using remote sensing, GIS and field information. It is in the survey of India Toposheet No.58M/15. The study area contains three types of coastal geomorphological landforms; they are depositional, erosional and other features. The depositional features like, beach, beach ridges, cheniers, paleo - barres, paleo – tidal flats, mudflats. The erosional features like Sea cliffs and other features like back waters and mangroves, creeks and deltas. A GIS database was developed and updated in order to provide access for future use and computer analysis.

Keywords: Coastal Geomorphology, Remotesensing, GIS, Satellite data, Toposheet

1. Introduction

The extensive littoral low land of coastal area of Tamilnadu, East Coast of India is an excellent area for fundamental and strategic research on Coastal Geomorphology. The scientific study of the coast in India is only three decades old. The Holocene marine processes in particular have favored the growth and decline of many cities and ports along the Tamilnadu coastal belt. Hence, landform studies are essentially warranted for understanding the possible changes in geomorphic processes during the recent past and their human response. Remote sensing as the words imply is the method of observation of earth scope by a device some distance away from it. According, to the physics of remote sensing, different surface objects return different amount of energy in different wavelength of the electromagnetic spectrum. Detection and measurement of these spectral signatures enable identification of surface objects both from the airborne and space borne platforms. A Geographical Information System (GIS) is a system of hardware, software and procedures to facilitate the management, manipulation, analysis, modeling, representation and display of georeferenced data to solve complex problems regarding planning and management of resources. Functions of GIS include data entry, data display, data management, information retrieval and analysis. The applications of GIS include mapping locations, quantities and densities, finding distances and mapping and monitoring change. The world scientific community is focusing their attention towards the coastal areas of their settlements. About > 60% of the populations are found to occupy the coastal areas in the developed nations
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(Rajamanickam and Loveson, 1998). Karikalan et al., (2001), have attempted the coastal geomorphology of Portonova region. In India within the establishment of NRSA and ISRO, Coastal geomorphological studies have clearly shown the existence of difference the east and west coast in our country. The study area enjoys the humid-tropical climate. The average temperatures of summer and winter are 32°C and 25°C respectively. It receives maximum rainfall, during the north-east monsoon which lasts between October and December, whereas scanty rainfall occurs during the south-west monsoon between June and September. During the north east monsoon, seasonal depressions are common in the Bay of Bengal which brings heavy rain to this region. Hence the Bay of Bengal is one of the influencing factors in the climate and rainfall of the area. The east-flowing rivers like Vellar, Uppanar, Karungalar and Coleroon draining the area discharge into the Bay of Bengal (Coleroon is one of the distributaries of the Cauvery through which major portion of discharge of Cauvery water takes place). All the rivers are seasonal in nature, water flows through them only during the monsoon period.

2. Study area

The area of study located between latitude 11°20' to 11°30' north and longitudes 79°45' to 79°55' east extends from Coleroon River mouth to Portonova. The coastline of Portonova is characterized by long sandy barrier beaches throughout its length, where the coastline is formed by low cliffs cut into marine terraces. These barriers are bordered in the west by coastal sand dunes, lagoons and deltaic plain in the east by the Bay of Bengal. This complex coastal area is bordered in the west by greatly. The Survey of India’s topographical map (1975 edition, 1:50000 scale. No.58M/15) and geo-coded satellite image of IRS 1C imagery in scale of 1:50000 were used in the present study. The all data have been digitised by using the Arc GIS 9.3 Software and the areal coverage of different landforms computed. Satellite data were Geo-referenced to a common projection by using the ERDAS Software. The variation in the image characteristic like tone, texture, pattern, etc. It was used to identify by various landforms. Interpreted results have been verified by ground truth/field checks.

![Figure 1: Study area](image-url)
3. Methodology

3.1 Visual Interpretation Techniques

Visual interpretation of remote sensing images for extracting desired information could be achieved in an efficient and effective manner by using several basic interpretation keys (or) elements (Floyd F. Sabins Jr. 1987). The basic interpretation keys are i) Tone ii) texture iii) pattern iv) shape v) size and vi) location or association. All these interpretation elements are qualitative attributes and they are subjective depends on the experience and personal bias of an interpreter.

3.2 Image Interpretation and Analysis

The satellite data products are available in various scales, digital data stored in the form of Computer Compatible Tape (CCT) cartridges, floppies and C.D ROMs. The desired information can be extracted from the above data products through visual interpretation and digital image processing techniques. Both visual and digital image analysis techniques are complementary to each other. For large areas and spectrally homogenous scenes digital image processing techniques may provide a quick and cost effective means of image analysis. Smaller areas and spectrally heterogeneous scenes visual interpretation method is more suitable. However in order to bring out the subtle variation and quantitative measurements it is essential to perform the digital image processing techniques since classification of digital data can be done through computers with help of image processing software.

3.3 Digital Image Processing

Remotely sensed data compounds to different earth features collected by the satellite sensors and stored in computer compatible tape, cartridge CD-ROM, floppy in regular line and columns. The pixel represents brightness value having a specific Digital Number (DN) value depends on the reflected energy from the earth surface in a specific wavelength or band or channel. Therefore, each one of the earth features is sensed by the sensors simultaneously and provides a set of DN values. The DN values of each pixel are ranging from zero for black to some higher value (255) for white, based on the radiometric resolution. The availability of remote sensed data in digital form helps in carrying out digital image processing with aid of ERDAS-imagine image processing software. The digital image processing techniques provide flexibility in data handling due to the fact that the digital data can be numerically manipulated by using an equation (or) set of equations to get the desired details in the graphic display (or) pictorial form for further analysis (Lillesand TM and Kiefer RW, 1987) There are many procedures/methods available for image data manipulation they can be broadly grouped into 3 categories viz. 1) Image rectification and restoration also called preprocessing 2) Image enhancement and 3) Image classification.

3.4 Image rectification and restoration

Preprocessing operations are intended to eliminate or correct the distortions or errors caused due to geometric distortions, radiometric distortion presence of noise in the data, etc. This standard products made available to the interpreters are preprocessed therefore generally data can be used directly for image enhancement and classification.
3.5 Image enhancement

Operations are being implemented to image data to get the enhanced output for subsequent visual interpretations. The enhancement techniques provide better feature exhibition to increase the visual distinction between features contained in a scene. The enhanced output can be seen in the display or can be recorded in the pictorial form as Black and White (or) colour composite images.

3.6 Image classification

Image classification operations are essentially meant to substitute visual analysis of remotely sensed data with quantitative analysis. The classification of the remotely sensed satellite digital data can be carried out either without a prior knowledge about the features present in the scene is called unsupervised classification and with a prior knowledge about the terrain features interactive classification method is called supervised classification i.e. The user can define the class beforehand the supervised classification is the setting representative pixel values for each class and classifying another pixel values based on this standard set. In this present study preprocessed satellite were used for Coastal Geomorphology mapping and also supervised classification method were performed using ERDAS Imagine image processing software package.

4. Results and discussion

4.1. Depositional Features:
The eroded materials are deposited in a particular place. Due to deposition the places are emerging to a specific size. This type of features is called as depositional features. The present study area having beach, beach ridges, mudflats/saltpans and bay mouth bars/spits.

4.1.1 Beach
The landform that occurs throughout the study area without any break is sandy beach. The dominant wave actions with large amount of input of sediments derived through longshore littoral currents make the beaches as the most dynamic landforms of the area and because of this reason the area is considered to be the best for the study of processes. Though the beach accretion is found in its entire length, the causes of erosion vary from natural to man. The beach is very thinly and developed. These don't have much vegetation except some scrubs at places.

Figure 2: Beach
4.1.2 Beach ridge

Beach ridges are the long, linear and parallel to the coast, it’s continuously or discontinuously. These beach ridges formed due to the littoral current waves. These seaward beach ridges gradually become wider in the south. The beach ridges mostly used for Agricultural practices, buildup land and also casuarina plantation are here. A maximum beach ridges are found around the Vellar and Coleroon river region. However the ages of the beach ridges are until now unknown, the extension of these beach ridges in the southern Tamil Nadu area has been dated to 4000-6000years BP (Brueckner, 1989) and marine terraces in line with beach ridges 140 to 5440 years BP (Rajamanickam & Loveson, 1990).

![Figure 3: Beach ridges](image)

4.1.3 Mudflats

The mudflats form under the grip of the tidal activities, the mudflats are developed to a wider spread. These mudflats/saltpans are also found directly exposed to shoreline. Most of the mudflats covered with mangrove vegetation. Some of the mudflats are reclaimed and converted into aquaculture farms.

![Figure 4: Mudflats](image)
4.1.4 Baymouth bars/spits

The baymouth bars/spits form due to the littoral currents to dump the sediments and build the sandbars at their mouths. In the study area two rivers having namely, Vellar and Coleroon.

![Figure 5: Baymouth bars/spits](image)

4.1.5 Swales

Swales are the depression located normally between the beach ridges. Most of the swales formed during the last stage of regression, are of water inlets so as to get developed backwaters in due course of time. These swales are having 100m to 200m width and at places even more. These swales have permanent connection with the sea either through the creeks or the streams. The floor and the banks of the swales are characterized by black clays and mudflats.

![Figure 6: Swales](image)

4.2 Erosional Features

Due to severe wind and waves the material from the surface are eroded from one place and it deposited to the other place. The features formed due to the erosion are called erosional features.

4.2.1 Sea Cliff

On the basis of composition and nature of shoreline, the sea cliffs are classified into coralline cliffs and rocky cliffs. In the study area sea cliff range is height from 0.5 m to 1.5 m is significantly observed between shore zone and back shore zone. Beaches have a width of a
maximum of 0.5 km near Vellar and a minimum of 20 m near Coleroon. The cliff is
developed in the sandy beach as indicated in the second type of beach profile also modify the
form and height of the beach cliffs. Nevertheless, the beach cliffs exist throughout the year.

![Figure 7: Sea cliff](image)

4.3 Other features

Other Features Rivers, streams, tanks, backwater, Saltpan and mangroves are comes under in
the other features.

4.3.1 Back water

The Bay of Bengal has broadening nature of the river mouth before entering into the sea. The
backwater zone extends up to a kilometer in the river mouth. Consequently, due to the
development of wide estuarine mouth near the sea, a lot of seawater encroaches through them
during the high tide. The Pitchavaram backwater located south of Porto Nova.

![Figure 8: Back water](image)

4.3.2 Delta

When a river ultimately meets the sea or a lake, the flowing water lose sits velocity and
dropdown the balance of its load right at its point of emergence. The mouth of the river, such
deposition naturally initiates, under favorable conditions, the formation of a new land mass which is approximately triangular in shape. Such fluvial deposits are known as delta. In the study area delta was formed in between the landward beach ridges and palaeo swales. These palaeo swales are completely overprinted by the vast spread of deltaic sediments. A Vellar river delta extends to an area of 650 sq.km. As the river flows in large section through areas of sedimentary rocks, the sediment load is expected to be higher.

Figure 9: Coastal Geomorphology Map

Figure 10: Supervised Classification (Minimum Distance)
5. Conclusion

Therefore, the present study clearly reveals that varies geomorphic features like beach, beach ridges, mudflats, bay mouth bar, spit, swales, sea cliff, backwater, delta and mangrove swamps are observed in the coastal region from the Portonoa to Coleroon river mouth. It appears that sea level changes of the Holocene period have exerted great influence on the
evolution of coastal landforms in this region. Coastal processes such as erosion, deposition and other oceanographic processes have constantly modified the shoreline. Temporal data derived from topographical maps and satellite images revealed significant changes in the configuration and extent of shoreline and land use and land cover. Two series of beach ridges are noticed in the study area with intervening swale system. After the interglacial transgressed phase, regression has occurred delta procreation around Coleroon and vellar river regions.

6. References


