CHAPTER-II
A REVIEW OF LITERATURE
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2.1 INTRODUCTION

The location of the shoreline and the changing position of the Le Morne area boundary through time are of elemental importance to coastal scientists, engineers, and managers (Douglas and Crowell, 2000; National Research Council, 1990). An analysis of historical shoreline change studies along the beaches of Kauai, Oahu and Maui, Hawaii, as part of the U.S. Geological Survey, National Assessment of Shoreline Change Project (Fletcher et al., 2012; Romine et al., 2012; USGS, 2012). To understanding of coastal morphodynamics is crucial to evaluate current and predict future sea bed evolution under natural forcing and anthropogenic influence winter, C (2011). Both coastal management and engineering design require information about where the shoreline is, where it has been in the past, and where it is predicted to be in the future. For example, an analysis of shoreline information is required in the design of coastal protection (for example, Coastal Engineering Research Centre, 1984), to calibrate and verify numerical models (for example, Hanson, Gravens, and Kraus, 1988), to assess sea level rise (for example, Leatherman, 2001), to develop hazard zones (for example, Bellomo, Pajak, and Sparks, 1999; Douglas, Crowell, and Leatherman, 1998). The location of the shoreline can provide information in regard to shoreline reorientation adjacent to structures (for example, Komar, 1998) and beach width and volume (Smith and Jackson, 1992), and it is used to quantify historical rates of change (for example, Dolan, Fenster, and Holme, 1991; Moore, 2000).

2.1.1 Definition of ‘Shoreline’

The interactive relationship between shoreline changes and sea level rise and second was the applicability of multi-resolution satellite data along with statistical techniques in the prediction of shoreline changes and its dynamic nature which is very valuable in regards to coastal hazard assessment Chand P. and Acharya P. (2010). An idealized definition of shoreline is that it coincides with the physical interface of land and water (Dolan et al., 1980). Despite its apparent simplicity, this definition is in
practice a challenge to apply. The shoreline over a slightly longer time scale, such as a tidal cycle, where the horizontal/vertical position of the shoreline could vary anywhere between centimetres and tens of meters (or more), depending on the beach slope, tidal range, and prevailing wave/weather conditions. Over a longer, engineering time scale, such as 100 years, the position of the shoreline has the potential to vary by hundreds of meters or more (Komar, 1998).

2.1.2 Shoreline Indicators

Because of the dynamic nature of the idealized shoreline boundary, for practical purposes, coastal investigators have typically adopted the use of shoreline indicators. A shoreline indicator is a feature that is used as a proxy to represent the “true” shoreline position. In contrast, a tidal datum–based shoreline indicator is determined by the intersection of the coastal profile with a specific vertical elevation, defined by the tidal constituents of a particular area, for example, Mean High Water (MHW) or Mean Sea Level.

2.1.3 Historical Land-Based Photographs

Historical land-based photographs provide general background information to the coastal investigator, such as the presence of a specific morphological feature such as a sand spit or channel entrance. The shoreline change analysis is accomplished with the Shoreline Change Mapper, an application that works within the ArcGIS software from ESRI, and developed by Rutgers University for the purpose of the Protocol (Psuty et al., 2010). However, most land-based photos are by definition very oblique, with limited information available of scale or ground control points, and there are usually no information about the sea conditions (tide and waves), at that time the photograph were taken (Dolan, Hayden, And May, 1983). For these reasons, the majority of historical photographs are of limited value for application to quantitative mapping of past shorelines.

2.1.4 Coastal Maps and Charts

The sefton coast, a 36km along coastline located between the Mersey and the Ribble estuaries in northwest England Esteves, L.S. et.al. (2009). Although often rather striking to examine, a large proportion of early historical aerial photographs, result with table and charts focused as much on decoration as they did on content, with minimal information recorded as to the mapping methods used, the specific
shoreline feature selected, and assessments of accuracy (Carr, 1962). Potential errors associated with historical aerial photographs and charts include errors in scale; datum changes; distortions from uneven shrinkage, stretching, creases, tears, and folds; different surveying standards; different publication standards; projection errors; and partial revision (Anders and Byrnes, 1991; Carr, 1962, 1980; Crowell, Leatherman, and Buckley, 1991; Moore, 2000). However, their advantage is being able to provide a historic record that is not available from other data sources. By necessity, the “shoreline” that is obtained from historical maps and charts is determined by the surveyor and cartographer rather than the coastal investigator, and it is generally assumed to have been associated with some type of visibly discernible feature.

2.1.5 Aerial Photography

High resolution aerial photographs of the coastline began to be collected around the world in the 1920s (Anders and Byrnes, 1991; Crowell, Honeycutt, and Hatheway, 1999), but it was not until the late 1930s that reasonable-quality stereo-aerial photos became available (Anders and Byrnes, 1991). Aerial photographs provide good spatial coverage of the coast (Dolan, Hayden, and May, 1983), but temporal coverage is very site specific. Historical aerial photography may also be temporally biased toward post-storm “shorelines” (Douglas, Crowell, and Honeycutt, 2002). By definition, the “shoreline” obtained from aerial photography is based on a visually discernible feature. Accordingly, aerial photographs are distorted and must be corrected before they can be used to determine a shoreline.

2.1.6 Beach Surveys

Survey data can be an accurate source of shoreline information (Dolan, Hayden, and May, 1983; Goldsmith and Oertel, 1978). However, historical records tend to be limited both spatially (Morton, 1991) and temporally (Dolan, Hayden, and May, 1983; Goldsmith and Oertel, 1978; Smith and Jackson, 1992). A shoreline can be compiled by interpolating between a series of discrete shore-normal beach profiles. Often, the alongshore distance between adjacent profiles is relatively large, so alongshore accuracy of shoreline location is diminished, accordingly (Morton, 1991). If sufficient beach profiling data are available for a specific site, tidal datum-based shorelines, such as Mean High Water (MHW), are easily and accurately determined.
2.1.7 GPS Shorelines

A more recent method of mapping the shoreline is to use a kinematic differential GPS mounted on a four-wheel-drive vehicle, which is driven at a constant speed along the visibly discernible line of interest (Morton et al., 1993). The benefits of this method are that it is relatively rapid, low cost, and highly accurate (Morton and Speed, 1998). With modern GPS equipment, the greatest errors associated with this method are caused by the visual determination of the line of interest by the operator, rather than error from the GPS measurements. Pajak and Leatherman (2002) concluded that the GPS method was more accurate than aerial photography to identify specific shoreline features of interest.

2.1.8 Remote Sensing

Over the last decade, a range of airborne, satellite, and land-based remote sensing techniques have become more generally available to the coastal scientist, coastal engineer, and coastal manager. Depending on the specific platform that is used, derived shorelines may be based on the use of visually discernible coastal features, digital image-processing analysis, or a specified tidal datum.

2.1.9 Coastal Dynamics

Shoreline dynamic mapping is very valuable in regards to coastal hazard assessment Mark A.(2013). The shoreline mapping gives contribution to the morphological dynamic and their process in the coastal area. Historic rates of shoreline change provide valuable data on erosion and sedimentation trends and permit limited forecasting of shoreline movement. Multi sources spatial data analysis can be considered promising method regarding lack of homogeneous data sources in the long period of time. This research work is the first to report on shoreline changes throughout the Hawaii archipelago at high spatial and temporal resolution. This study provides important data on shoreline changes to U.S. coasts and on carbonate beach systems throughout the world.

According to winter, C., 2011, understanding of coastal morphodynamics is crucial to evaluate current and predict future sea bed evolution under natural forcing and anthropogenic influence. The analysis of coastal evolution commonly is based on bathymetric field data, remote sensing products, or modeling approaches. Method used for bathymetric data of the Southern German Bight (North Sea) as measured by
The relevant authorities (Federal Hydrographic and Maritime Agency - BSH, Waterways and Shipping Offices - WSÄ) in the years 1982-2008 were compiled.

The study of Chand P. and Acharya P. (2010) was to find out interactive relationship between shoreline changes and sea level rise and second was the applicability of multi-resolution satellite data along with statistical techniques in the prediction of shoreline changes and its dynamic nature which is very valuable in regards to coastal hazard assessment. The zone based analysis of shoreline changes shows that an extensive part of the shoreline is affected by the shore zone erosion during last 36 year. From the interactive relationship between sea level rise and shoreline changes this study can concluded that Mean Sea Level height was in an increasing trend during the period of 1990 to 2000 which in fact the same time span when shoreline also experience high magnitude of shifting from its earlier position.

Shoreline position relative to a common baseline is measured using Digital Shoreline Analysis System software, developed by USGS (Thieler et al., 2009), and the shoreline change analysis is accomplished with the Shoreline Change Mapper, an application that works within the ArcGIS software from ESRI, and developed by Rutgers University for the purpose of the Protocol (Psuty et al., 2010).

Esteves, L.S. et.al. (2009) studied the sefton coast, a 36km along coastline located between the Mersey and the Ribble estuaries in northwest England. It encompasses the longest coastal dune system in England and Wals, which has been rapidly eroding in the last century. In each case the spatial resolution, time frame and uncertainties are dependent on specific data sources and methods of collection and analysis. Both situations challenge coastal managers needing to provide long-term predictions of shoreline positions especially when incorporating the effects of sea-level rise.

Shoreline positions of the wave-exposed marsh shorelines were surveyed using Global Positioning System (GPS) techniques in 1993 and 1999. In both 1993 and 1999, the high tide position was surveyed. Additionally, the position of the entire 1986 shoreline was digitized from aerial photographs and maps by the Mississippi Office of Geology and National Oceanic and Atmospheric Administration (NOAA). The 1993 and 1999 GPS data cover the area from the west of Point aux Chenes to the interior of Point aux Chenes Bay, and along the southern shore of South Ringlets
Island. All of the data were added to a Geographical Information Systems (GIS) and analyzed to determine the erosion trends. Accuracies of both methods are better than 5 m (16 ft.). Erosion thresholds of more than 15 metres were used to highlight critical areas between 1993 and 1999 and 40 metres between 1986 and 1999. These values are significantly large to minimize the over-estimating critical erosion areas. With an estimation technique, which uses buffers created to highlight critical erosion, the total area loss from shoreline erosion has also been computed for the shoreline mapped in 1999.

To substantiate the change, wave pattern and its dynamics were also studied using IRS P2 May 1996 and IRS 1C May 2002 data. Image enhancement technique for infrared band of IRS P2 and IRS 1C were carried out using ERDAS IMAGINE image processing software. Coastal processes such as wave diffraction, wave refraction and shadow zone formation were identified. Because of wave action there is erosion at the tip of the Hare Island and the Vann Island during 1969 to 2002 (Selvavinayagam, 2002).

Analytical photogrammetry has always been a primary acquisition method of shoreline mapping for its reasonable cost and high accuracy. However, for shoreline change monitoring, mapping frequency has been an issue. With the advances in data acquisition techniques such as digital photogrammetric sensors, Global Positioning Systems (GPS), and other all-weather sensors, coastal researchers have been exploring the potential for more efficient and economic shoreline mapping methods (Li et al., 2001b). For example, the coastal mapping professionals have used land vehicles based mobile mapping technology in local shoreline mapping, utilizing GPS receivers and beach vehicles to trace watermarks along the shoreline (Shaw and Allen, 1995; Li, 1997).

Sources of shoreline mapping are simple photographs, which are processed through a method known in photogrammetry as the single photo resection in which stereo matching is not performed. This is the method used by the Ohio Department of Natural Resources (ODNR) to extract the 1973 and 1990 Ohio Lake Erie shorelines that are used in the study (ODNR 1996). Also, GPS has been used to provide precise ground control to enhance aerial photogrammetric triangulation, the process of estimating the object space from aerial photography (Merchant, 1994).
The shoreline erosion causes problems, when its development approaches (Li, 1997), for example, residential area. The vegetation line is a valuable additional indicator of shoreline position. By identifying the wet/dry line, one can use estimation of the low tide terrace (Dolan et al., 1980; Smith and Zarillo, 1990). Paine and Morton (1989) have compared multi-temporal shorelines (1974 and 1982) and vegetation lines mapped from aerial photographs. In combination with satellite images and high-resolution aerial photographs, many have successfully used to monitor long-term shoreline changes and morphological changes in the estuaries (Nayak and Sahai, 1985; Prabhakar Rao et al., 1985; Shaik et al., 1989; Vinodkumar et al., 1994).

Correspondingly, satellite data information by virtue of its repetitive (temporal), multi-spectral and synoptic nature, can provide images that will enable us to observe or study the measure of changes of shoreline and its associated features (Bartlett and Klemar, 1980). Moreover, to update the erosion data more frequently, high-resolution satellite imagery will be used in future for erosion monitoring (Li and Lia, 1998).

There have been dramatic changes to the delta shorelines during the 20th century, which are generally attributed to natural and man-made factors (UNDP/UNESCO, 1978). They are:

1. Reduction in the Nile discharge and sediment load to the Rosetta mouth due to the construction of water control structures along the Nile. Six barrages and 3 dams were built on the Main Nile and its two branches. Since the buildings of the High Aswan Dam in 1964, sediment discharge at the Nile promontories has reduced to near zero. Subsequently, the Niles’ promontories have been subjected to dramatic erosion.

2. A natural reduction of Nile floods resulting from climatic changes over East Africa.

3. Waves and currents continue to move sediment along shore, resulting in a major reorientation of the coastline as some beaches (<1 per cent), heavy minerals (1-90 per cent) and beach pebbles (1-3 per cent). The zone of coastal dunes along the eastern barrier is truncated by the shoreline, and occupies the backshore from 2 km east of the lagoon inlet for a length of about 19 km
eastward. The coastal dune of American coast has a maximum width of 1.5 km and reaches elevation up to 20 m. Yearly observations of an individual dune, 3.2 km of the inlet, indicate that encroaching of coastal zone 2 m/yr to 3 m/yr is noticed. These dunes are underlain by inactive older silty dunes (Frithy et al., 1988).

Application of satellite remote sensing for the shallow bathymetry has been done by Polcyn and Lyzennga (1979) in Bahamas, Hallada (1984) and Jupp et al. (1985) in Australia. Photogrammetric techniques have been developed for many years in order to measure rates and patterns of shoreline recession from inherently distorted aerial photographs (Avery and Berlin, 1985; Stafford and Langfelder, 1971).

Sahadevan et al. (1996) have reported the erosion potential experienced at the North Chennai Port, leading to a greater danger for Ennore Highway, north Chennai rail link, the industrial installation, fishermen and in total a disturbance to the area to normal life on assessing the coast during 1893 to 1955, particularly along the coastal region between Royapurm and Ennore, it has also been reported that an area of 260 hectares of land lost. About 30 hectares of land have been destroyed by the sea during 1980 and 1989. Overall loss has been estimated at 350 hectares during 1893 to 1989 (IHH Report, 2000). Kaliasundaram et al. (1991) have inferred about the coastal dynamics based on shoreline oscillations of selected locations during the period 1978 and 1988, and stand erosion has taken place at Royapuram at the rate of 6.6 m/year. Area of land lost is estimated at 215 hectares.

The various three dimensional models have been adopted to represent the spatial entity by Schoorl et al. (2001) who have highlighted the use of artificial digital elevation models for representation and also emphasized on quantifying the effect of changing spatial resolution upon modeling of landscape representation. Bonham-Carter et al. (1996) have discussed mineral potential modeling and generation of DEM surfaces for the mineral belt modeling at Central Nova coast. Lin et al. (1995), Nichols et al. (1995) and Power (1995) have developed 3D geological data models to analyze complex problems.

The various studies have been carried out on spatial data integration and decision supporting system (DSS) to evaluate mineral potential, Asis Bhattacharya et.al., (1993) have developed mathematical modeling for mineral exploration and
highlighted a number of ‘Favourability index maps’ based on unweighted, weighted and logical models. Likewise, Akhavi (2001) has developed a mineral potential model by means of integrated digital geological, geophysical and sediment data layers, used in GIS and image processing package. On the other hand, Webster (1997) has used radar sat data integration, interpretation and comparison of different geo-science datasets for mineral modeling at Central Nova coast.

More similarly, Toro and Mayerle (2000) have developed integrated Decision Support Systems (DSS). GIS has been integrated for in-situ data measurement and processing, managing, integrating, visualizing and statistical analysis of different spatial data. Yet another study by Barreto et al. (1994) has revealed the integration of mapping and database management systems of various spatial layers (shoreline change, geomorphology, grain size and heavy mineral) and beach morpho-dynamics. Mooree et al. (1996) have worked on conceptual outline of an expert system for coastal zone management. Allewijn (1994) has discussed about remote sensing data and GIS tools for coastal zone management. Stewart et al. (2001) have developed coastal zone databases through GIS mapping, visualization and erosional study of the Great Lakes. Spatial data mining has been considered as a promising field of data mining, which intends to extract implicit knowledge from spatial database.

Historical shoreline trend analysis has evolved over the last few decades based on earlier efforts to investigate shoreline change (described in Crowell et al., 2005). Since the early 1980s, computers-based Geographical Information Systems (GIS) software has been developed to digitally catalog shoreline data and facilitate the quantification of shoreline change rates (May et al., 1982; Leatherman, 1983; Thieler et al., 2005).

Historical records along Rosetta and Daimelta coast indicate that the shoreline has shifted southward since 1810 (UNDP/UNESCO, 1978). Aerial photographs taken in 1955 and again in 1983 indicate that the shoreline has advanced seaward along the western barrier. Accretion along the southern margin of the western barrier may be the result of wind action. According to Orlova and Zenkovich (1974), the Burullus headland is a remnant of the Sebennitic promontory. Subsurface studies of the region indicate that this promontory was developed in the Holocene 7500-3000 yrs B.P. (Arbouille and Stanley, 1991; Stanely et.al., 1992). The mouth of the old Sebennitic
distributary is located on what is now the inner to middle shelf off Baltim (Tousson, 1934; Arbouille and Stanely, 1991; Frithy and Lotfy, 1993).

Chandrasekar et al. (2001) have prepared the coastal landform mapping between Tuticorin and Vaippar coast using IRS 1C LISS III and PAN satellite data set. The coastline has been mapped (Harper et al., 1985) at 1:50,000 scale by using a combination of aerial photographs and video-photography with ground surveys and also classified using the scheme devised by Forbes and Fricker (1984). Additionally, Wagle (1982) has visually interpreted based on image element characteristics like the tone, texture, shape, size and pattern for delineation of different coastal landforms of Mahe Islands and Seychelles. Sukumar and Arunachalam (1997) have studied coastal dynamics in Azhikal Anchorage, Kerala using IRS 1C satellite data coupled with Naval Hydrographic Charts, inferred that heavy sediment discharge through Valapattanam and Kuppam rivers into the sea, leading to the formation of offshore bar about 3 km away from the mouth of the rivers, and to the progradation of coast by strandlines. The first coastal protection work has been taken up in North Chennai during the year 1950. The protection work has become vigorous after the construction of fishing harbour at Royapuram (Venugopal, 1996).

Remote sensing techniques utilizing space borne sensors had been used for coastal geomorphology and coastal hazard mapping in Egypt, India, Italy and Taiwan (Chen and Rau, 1998; Honne Gowda et al., 1995; Frithy et al., 1994; Ramana Murthy et al., 1993; Nayak and Sahai, 1985; Rao et al., 1985). Anand et al. (1987) have deliberated the coastal geomorphic processes along the Goa coast through remote sensing system. They have inferred that prograding shoreline has depositional environment and retrograding shorelines has erosional environment around Goa coast.

ArcView software and its customized programming Avenue Script Language (ESRI, 1997) is widely used for spatial database integration and application development. A majority of the papers relating to the use of GIS in the coastal zone describe its use for mapping erosion patterns and beach sediment responses of the coastal margins (Dong et al., 1999; Guillen et al., 1999; Livingstone et al., 1999). Juanes et al. (1995) have conducted research on beach erosion in Varadero Beach, Cuba, through shoreline measurements. They have found an erosion trend of 1.2 m/year and an estimated loss of sand of about 50,000 m$^3$/year, over a 14-year period
by monitoring elevation profiles along the 22 km stretch of the study area. Short and Hogan (1995) have studied the long-term beach change on the Narrabeen-Collaroy Beach, Australia, using beach profile data over the 19-year period from 1976 to 1995 and inferred that individual beach profiles fluctuate as much as 96 m in width and 24 m$^3$/m in volume in response to changing wave conditions. Daniel et al. (1998) have prepared GIS based coastal risk mapping for the Florida coast. The risk zones are the basis of parameters such as elevation, dune width, and distance from water and vegetation cover.

Mason et al. (1998) have developed a method to interpolate the spatio-temporal digital elevation model (DEM) of an intertidal zone from a set of elevated shorelines. He has also described the mode of construction of DEMs from combined shoreline and beach transects data using krigging. Olsen and Kjellesvig (1998) have recommended a 3D numerical model for sediment flow in a sand trap and estimations of maximum local scour depth. Schoorl et.al. (2001) have highlighted the use of artificial digital elevation models on landscape representation and also emphasized quantification of the effect of changing the spatial resolution upon modeling of landscape representation. Lin and Falconer (1996) have constructed a 3D numerical simulation for suspended sediment in estuarine and coastal waters. Florinsky (1996) has used a method based on the analysis of digital elevation models (DEMs) to demonstrate the fault morphology, tectonic motion on both horizontal and vertical motion.

2.2 BEACH SURFACE AND SHORELINE MODELLING

Beach surface modelling method is described by Nance and Fotheringham (1997) and Goddwins (1990) at Adelaide Coast. Accretion and erosion areas are coded using a gradational thin shading scheme representing increasing levels of beach surface change in meters. Calculation of volume changes has also been improved using that method (Nonce and Fotheringham, 1997). There is great potential for modelling software that integrates the benefits of GIS with the process analysis capabilities of modeling software (Abel et al., 1997; Bennett, 1997). The wave spectral model has been developed to estimate erosion (or) sedimentation of the shoreline. Rai (1982, 1985); Stanley et al. (1985) and Mazlan et al. (1989) have monitored the shoreline change on the coastal waters of Kuala Terenggana Company
with sequential aerial photographs, older maps and Landsat imagery.

Sommerfeld et al. (1993, 1994) have studied desktop computer simulation on cross-shore modelling for storm-induced beach erosion and for beach fill design at the U.S. Army Engineer Waterways Station. Larson and Kraus (1989) and Larson et al. (1990) have worked with numerical modeling, allied with the use of Beach Change Model (SBEACH) on beach morphology package in U.S. Coast, BMAP has been evolved as an integrated set of calculation, plotting and input/output procedures for analyzing beach profile morphology and shoreline change (for example, Larson and Kraus, 1992). Many authors have theoretically investigated different aspects of the coastal GIS, including data structures (Li, 1999; Lucas, 1999; Sherin and Edwardson, 1999; Zong, 1991). Some attempts have been made to provide direct mappings of spatio-temporal GIS models by event-based (Peuquet and Duan, 1995) or object-oriented data models (Worboys, 1992; Rapper and Livingstone, 1995).

The coastal dynamic study by Chandrasekar. N, 2002 was mainly focused on the application of Indian Remote Sensing Satellite (IRS) data for heavy mineral distribution and shoreline changes mapping along the coast between Kallar and Vembar coast. Both visual and digital techniques are used for preparing shoreline change maps. Control and accuracy assessment of the shoreline maps for understanding the heavy mineral distribution is needed. Automatic coastline detection from digital remote sensing data has been used for generating quantitative information on the shoreline change and heavy mineral variables in between Kallar and Vembar coast on Tamil Nadu coast. Heavy mineral change maps, prepared on 1:25,000 scale, to provide baseline information on the heavy mineral distribution and shoreline change. The careful scanning of literature reveals that no published information is obtained regarding relationships between shoreline changes and heavy mineral concentration.

Thumerer et al. (2000) have discussed about the Arc Info GIS packages. It is used to determine coastal vulnerability of England coast and the development of risk assessment model to estimate flood damage. Lamere Hennessee et al. (1998) have developed the Coastal Geological Information System (CGIS), which is valuable for assessing the effects of shoreline erosion, calculating sediment budget and setbacks. Parks (1993) has recognized the use of majority of recent GIS spatial modelling
research which has focused on environmental issues. Ereland (1999) has pointed out the detailed coastal morpho-dynamics model of Ameland coast in the Netherlands coast. Meentemeyer et al. (2000) have discussed computation and digital mapping of the topographic / betting plane intersection angle and also pointed out that the derivation of four spatially distributed variables such as topographic slope, slope aspect, bedding dip and dip azimuth. Slope and slope aspect surfaces are derived from a high resolution (10) digital elevation model (ESRI, 2000). Kellet et al. (2000) have employed the use of DTM in the calculation of highly accurate visual sunrise and sunset times that are required by the observant population in Israel.

Stringer et al. (1981) have studied morphology and hazards related to near-shore ice conditions in coastal areas of Beaufort, Chukchi and Bering Seas. Thieler et al. (1992) have scrutinized GIS, GPS and Remote Sensing techniques for beach morpho-dynamics and also the study has recognized an increase in erosion rates for beaches used in tourism and recreation, which have a profound effect on the economics of this area. Tarig (2001) has developed a coastal Terrain Change Detection modelled within the spatio-temporal GIS environment at Lake Erie coastal areas. From the model, he has described the coastal surface change and predicted the shoreline change.

The shoreline erosion causes problems when its development approaches (Li, 1997), for example, residential area. The vegetation line is a valuable additional indicator of shoreline position. By identifying the wet/dry line, one can use for the estimation of the low tide terrace (Dolan et al., 1980; Smith and Zarillo, 1990). Paine and Morton (1989) have compared multi-temporal shorelines (1974 and 1982) and vegetation lines mapped from aerial photography. In combination with Satellite images and high-resolution aerial photographs many have successfully used to monitor such long-term shoreline changes and morphological changes in the estuaries (Nayak and Sahai, 1985; Prabhakar Rao et al., 1985; Shaik et al., 1989; Vinodkumar et al., 1994). Correspondingly, satellite data information by virtue of its repetitive (temporal), multi-spectral and synoptic nature, can provide images that will enable us to observe or study the measure of changes of shoreline and its associated features (Bartlett and Klemar, 1980). Moreover, to update the erosion data more frequently, high-resolution satellite imagery will be used in future for erosion monitoring (Li and Lia, 1998).
The Remote Sensing and Geographic Information System techniques have been developed for monitoring and predicting shoreline changes, near-shore composition and structure identification in northern Brazilian coastline (Amaro et al., 2002a, b; Vital, 2003a, Vital et al., 2003b). Capobianco et al. (1999) have discussed the conceptual approaches of Remote Sensing and GIS integrated modeling of the long-term dynamics of coastal morphology. Likewise Meijerink (1971) has delineated the coastal land use and shoreline changes taking place in the Cauvery delta using remote sensing and discovered that the oldest beach ridge is located in Tiruthurai, nearly 35 km from Point Calimere on the east coast of India. In addition, Nayak and Sahai (1985) and Nayak (1999) have used multispectral, muti-temporal and synoptic nature satellite data to measure the changes of shoreline and its associated features.

The various authors have discussed the shoreline changes along the Indian coast. Chauhan and Nayak (1995) have studied the Tamil Nadu coast for the assessment of shoreline changes using remote sensing data of IRS LISS II (1998-1991) and LANDSAT MSS / TM for the period of 1975-1980 and 1985-1988 for the same season. Yet another study by Gangadharabhat (1995) has deliberated on the long-term shoreline changes of Mulki-Pavanje and Nethravathi - Gurupur estuaries; Karnataka and identified diverse coastal landform. Similarly, Paravath and James (1997) have studied the shoreline changes and sediment characteristics on Kerala coast. Subsequently, the investigations of the shore zone dynamics in Kerala by using IRS 1C data, collated with profiles made from hydrographic charts have been done.

Indian Remote Sensing satellite IRS 1C data, collated with profiles made from naval hydrographic charts, have been studied by Sukumar and Arunachalam (1997). In the same way, Ramasamy et al. (1998) have used remote sensing and GIS technology to study land accretional activity at Vedaranyam cape (Kodiakarai) and found it to be around 29 meters/year. Their study has projected that the Vedaranyam may be connected with Jaffna Peninsula (Sri Lanka). Very similar studies by Mitra et al. (2002) have calculated the shoreline changes and their impacts in Sagar Island, West Bengal, using LISS III and PAN data set. A most recent study conducted on shoreline change of Kakinada Port (Sharma, 1996; Ramkumar, 2000) have inferred that Bay mouth would be eventually silted and may lead to the closure of Kakinada Port. Loveson and Rajamanickam (1998) and Loveson et al. (1990) have described
the shoreline changes based on the deposition of landforms like the beach ridge patterns and occurrence of backwater zones.

Application of satellite remote sensing for the shallow bathymetry has been done by Polcyn and Lyzennga (1979) in Bahamas, Hallada (1984) and Jupp et al. (1985) in Australia. Photogrammetric techniques have been developed for many years in order to measure rates and patterns of shoreline recession from inherently distorted aerial photographs (Avery and Berlin, 1985; Stafford and Langfelder, 1971).

In addition, Tanaka (1995) has investigated the changes in the Japanese coastline by the comparison of different topographical maps: that is, maps of 1978 in the scale of 1:50,000. While James et al. (2001) have calculated annual rate of shoreline change based on linear regression model. From his analysis, the shoreline change caused by human alteration; that is, engineering modification and the change in the sediment budget at Avansas Pass Bay have been evaluated. Solan (2000) has discussed accretion and erosion process in Godavari delta using multi-date and source satellite images. Their findings have indicated that the deposition takes place at a very high rate: 15-20 ha/yr caused by heavy load of sediments from the Gautami Godavari River. Douglas and Crowell (2000) have come across a methodology for computing the shoreline predictions due to long-term trends of erosion. Mazlan et al. (1989) have monitored the shoreline change on the coastal water of Kuala Terengganu by comparing the sequential aerial photographs, from older maps and Landsat images selected on the basis of the same tidal data necessary for shoreline change detection study (Bendre et al., 2001). Wilson (1997) has discussed the shorter wavelength and the difficulties as to delineating the coastline. At the same time, a study on quantitative information can be generated on erosion / accretion scenario. Using Geographical Information System techniques, Chauhan and Nayak (1990) have brought forward the erosion level after using shorter wavelength method erosion level is more or less.

Komar et al. (2001) have analyzed short- and long-term beach erosion using setback equation to calculate setbacks on the Oregon coast. Thieler et al. (1994) have investigated shoreline digitization error problem and error accuracy matrix preparation for shoreline change detection. Moore (2000) has thrashed out several latest GIS strategies including an Automated Shoreline Analysis Program (ASAP)
which is used to quantify the changes of digitized shoreline mapping. Dewall and Richter (1977) have established the seasonal shoreline fluctuations at Jupiter shoreline and Florida, on the order of 15 m, whereas at Duck, North Carolina at the site of the CERC pier, Lee and Birkemeier (1993) have found that the shoreline fluctuations and erosional activity are low, although the offshore bar migrated more than 150 m by 50 m / year.

Ron Li (1999) has explored the modeling of the coastal dynamic segmentation of shoreline of Lake Erie and used End-Point-Rate (EPR) model for shoreline change prediction studies of the American coast. Cox et al. (2000) have developed calculation for shoreline recession rate and also developed integrated database for Wisconsin shoreline (that is, coastal geology, shoreline erosion, accretion and sediment transport) to determine present, past and future condition of shore. Crowell et al. (1991) have determined that error involved in locating relative positions of shorelines taken from aerial photographs to the tune of about 8 m. An investigation of shoreline change, using such high-resolution images, has made available greater spatial and temporal resolutions and has also promised high accuracy of shoreline-mapping (Zhou and Li 1999; Li et al., 2001). Comprehensive researches have been done by Rai (1982, 1985) and Stanley et al. (1985). Similarly, Mitra et al. (2002) have studied the shoreline changes and their impacts on Sagar Island, West Bengal using LISS III and PAN Datasets.

Gurugnanam et al. (2000) have studied the shoreline changes of the coastal districts of Nagapattinam and Thanjavur for the period 1930 and 1994, using the Survey of India topographical maps and remote sensing data of IRS 1B LISS II. Using overlay techniques, they have observed the erosion behaviour on the coast and depositional behaviour in the area. A recent study carried out by Surendran et al. (2000) on the erosion and accretion adjoining Chennai Port using GIS and remotely sensed data of IRS-1D LISS III of 1998 and Survey of India topographical maps for the year 1974, have shown that an area of about 98 hectares of land has been accreted on the southern side of Chennai Port (that is, Marina beach) and 114 hectares of land has been lost to the sea on the northern side of the Port within period of 24 years. GIS tools have improved both the accuracy and precision in the measurement of shoreline retreat (Montgomery et al., 1998; 1999).
Many authors (Dong, 1995; Guillen et al., 1995; Livingstone et al., 1999) have highlighted the use of GIS technology for modelling and predicting the beach erosion patterns and beach sediment responses to coastal dynamics for management purposes. Various studies have confirmed the capability of remotely sensed data for estimation of suspended sediments either qualitatively or quantitatively along the coastline (Nayak and Sahai, 1983; Khorram, 1981; Li et al., 2001). A Landsat and aircraft remote sensing system has been used in the appraisal of suspended solids in lakes and reservoirs (Lillesand and Kiefer, 1983; Ritchie and Cooper, 1991). Janos et al. (1999) have used grid data to model the crust, from which they have estimated the volume of sediment present in the mantle material and below the crust of Hungary.

School et al. (2000) have emphasized experimentally quantifying the effect of changing spatial resolutions upon modelling the process of erosion and sedimentation. The quantitative assessment of coastal sediment volume has been reported for the Indian coastline (Rajamanickam et al., 1986; Chandramohan, 1988; Chandramohan and Nayak, 1991; Angusamy et al., 1998; Bodapati, 2000; Chandrasekar, 1992, Chandrasekar et al., 2001; Cherian, 2003). Souza (1995) has explained about the sedimentological analysis applied for coastal zone management along the beaches of the state of Sao Paulo, Brazil. Trim et al. (2002) have developed a model for sediment transport process of a shingle beach under combined action of waves and tides. Bijker (1971) has developed a long-shore transport model based upon river-borne sediment transport. Sanil Kumar et al. (2000) have studied the long-shore currents and beach morpho-dynamics along Kannirajapuram coast, Tamil Nadu.

Arbogast and Brown (1999) have demonstrated GIS and remote sensing applications for quantifying coastal erosion in Michigan coast. Geographical Information Systems offer basic sustaining function for a modern GIS package. Within these categories, a special analysis with GIS enables end-users to have information for decision-making (Halla et al., 1996). The various data involved in studying shoreline changes, including spatial data, time series data, and social and economic data, and multimedia information are diverse (Li, 1997). Michale et al. (1993) have developed multispectral change vector analysis for the study of temporal change of coastal zone and coastal hazard assessment. Martinez et al. (1990) have studied the coastal erosion and accretion problems on the Las Canteras beach, Spain and they have used monthly beach profiles. Wright and Short (1983) have divided
into two morpho-dynamic sub-environments such as nearly dissipative beach and reflective beach. They have found that accretion process occurs in the summer and erosion takes place between autumn and spring seasons. The analytical or engineering methods for predicting beach profile changes are based on equilibrium profile concepts (Kriebel and Dean, 1985; Kobayashi, 1987; Kriebel and Dean 1993). The assessment of human intervention on shoreline change has been attempted by many such as Huang et al. (1999) and Sims et al. (1995). They have used the historical data to envisage future coastline changes.

Shaikh et al. (1989) have attempted coastal landform mapping around the Gulf of Kambhat using the Landsat TM data. They classified the estuaries and mudflats based on tidal currents and compositions. Geomorphologists have classified different types of landforms and landform developments in various morpho-climatic regions (for example, Tricart and Cailleux, 1972; Budel, 1982). Furthermore, Subramanyan et al. (1988) have attempted coastal geomorphological and sediment distribution mapping of the Orissa coastal zone using digital image processing of Landsat TM data. In the same way, Tripathy et al. (1996) have argued coastal geological and geomorphological mapping in part of Ganjam district, Orissa using remote sensing techniques. Madhavan et al. (1999) have studied the coastal geomorphology of Godavari river delta using optical LISS II data and airborne SAR data. A geomorphic highs or ‘morpho-structures’ are identified in Godavari delta from the satellite imageries (Vaidhyanathan and Pradhan, 1991).

Livingstone et al. (1999) have investigated the assimilation of airborne imagery with terrain to interpret micro-geomorphological features of the area. In recent times, Tony Moore et al. (1997) have described the use of an expert system for extraction of coastal landforms from a DEM on stereo aerial photographs at the Marine Laboratory, University of Plymouth. Kaufman et al. (1991) have successfully recognized remote sensing techniques for the identification of minerals and rocks such as bauxite, kaolinite and hydrothermally altered areas. The heavy minerals in different parts of the world have been reported (Rajamanickam, 1983; Komar and Wang, 1984; Pirkle et al., 1984; Reid and Frostick, 1985; Boon and Berquist, 1991; Fletcher et al., 1991; Li and Komar, 1992; Chandrasekar, 2001; Muthukrishnan, 1993; Udayaganesan, 1993; Loveson, 1994; Angusamy, 1995; Rajasekar, 1995; Mohan, 1995; Gujar, 1996; Mohan and Rajamanickam, 2000). The well-known occurrences
of beach placer deposits are reported in Visakhapatnam, Andhra Pradesh by Sastry et al. (1987a) and Ram Mohana Rao et al. (1982). Chandrasekar (1992) has reported the occurrence of heavy mineral placers from central Tamil Nadu coast in the stretch from Nagore to Tirumullaiivasal as a zone rich in zircon, garnet and kyanite.

Broadley et al. (2002) have explained about the transport and distribution of heavy minerals along the wasteland beaches of New Zealand with implications for accumulation of other high-density minerals. Gujar (1996) has made an exhaustive study on near-shore placer of Konkan coast and estimated the reserve of ilmenite and magnetite to the tune of 1 MT and 2 MT, respectively.

Loveson (1994) and Loveson et al. (1996) have identified many strike slip faults formed by neo-tectonic activities along the coast between Kanyakumari-Kuttankuli and Sippikulam. This has acted as controlling factors for the segregation of heavy minerals. Donald (1985) has demonstrated geomorphological controls on the distribution of placer deposits. Many geologists in India have also attempted to know the tectonic settings for beach placer mineral exploration (Radahakrishna, 1984; Banerjee, 1993; Sarkar, 1985; Mahadevan and Fernandes, 1987, Loveson et al., 1996). Prabakara Rao (1968) has made an attempt to explain heavy minerals concentration along the Kerala coast based on geomorphology. Parthasarathi et al. (1985) have attempted an aero-magnetic survey and used Landsat data to identify the subsurface configurations and delineation of litho units of South India and also the buried mineral deposits. Ahmed (1986) has studied in detail the relationship between the lineaments and mineral occurrence through Landsat imagery interpretation. Ravi et al. (2001) and Gajapathi Rao et al. (2001) have established that the formation of heavy mineral deposits of varied dimensions and concentration are mainly controlled by geomorphic, geological, climatic and hydrodynamic conditions.

In the last two decades, the role of remote sensing in coastal studies has been well initiated in the Indian coast (Subramaniyan et al., 1986; Nayak et al., 1989). Nair (1987) has done coastal geomorphological mapping for Kerala using Landsat satellite imagery and aerial photographs. Several endeavours have been made in the use of satellite data and they have proved their efficacy in coastal landforms and action (Nayak, 1994; Johannessen et al., 1993; Hill et al., 1994; Ahmad and Neil, 1994). Consequently, Gupta et al. (1988) have worked with integrated remotely sensed data,
namely, Landsat 1 MSS imagery, Salyut 7, KATE space borne photograph and aerial photographs for extraction of coastal geology and geomorphic landforms in South Kannada district of Karnataka. Moreover, the recognition of different objects on the imageries is based on tone, texture, location, size and association while the key has been developed at SAC (Nayak, 1991). In addition, the various remote sensing sensors are used in the interpretation of coastal landforms like the numerous cut-off tanks, meander bars and creeks through radar images (Lewis and Macdonald, 1970; Koopmans, 1973; Madhavan et al., 1994).

At the same time, thorough review and critique of the procedures that are employed to make these estimates have been conducted (Dolan et al., 1991; Crowell et al., 1997; Douglas et al., 1998; Douglas and Crowell, 2000; Honeycutt et al., 2001; Fenster et al., 2001; Ruggiero et al., 2003; Moore et al., 2006; Genz et al., 2007).

Recently, the U.S. Geological Survey (USGS) has used this approach to evaluate the potential vulnerability of the U.S. coastline on a national scale (Thieler and Hammar-Klose, 1999) and on a more detailed scale for the U.S. National Park Service (Thieler et al., 2002). The USGS approach has reduced the index to include six variables (geomorphology, shoreline change, coastal slope, relative sea level change, significant wave height, and tidal range) which were considered to be the most important in determining a shoreline’s susceptibility to sea level rise (Thieler and Hammar-Klose, 1999). Simultaneous and continuous monitoring of coastal changes is necessary for the proper assessment of impact of these changes and to design viable land use and protection strategies.