

COASTAL EROSION AND FLOODING: CAUSES AND CONSEQUENCES

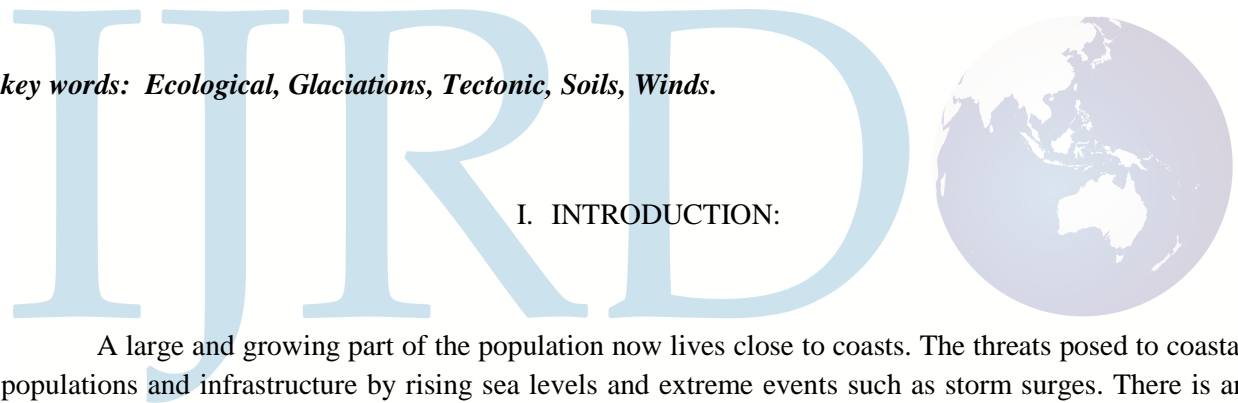
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Abstract

Shoreline changes induced by erosion and accretion are natural processes that take place over a range of time scales. They may occur in response to smaller-scale (short-term) events, such as storms, regular wave action, tides and winds, or in response to large-scale (long-term) events such as glaciations or organic cycles that may significantly alter sea levels (rise/fall) and tectonic Activities that cause coastal land subsidence or emergence. Hence, most coastlines are naturally dynamic, and cycles of erosion are often an important feature of their ecological character. Wind, Waves and currents are natural forces that easily move the unconsolidated sand and soils in the Coastal area, resulting in rapid changes in the position of the shoreline along Andhra coast present we discuss about coastal erosion causes and consequences among Andhra coast fully depend upon on secondary data study.

key words: Ecological, Glaciations, Tectonic, Soils, Winds.



I. INTRODUCTION:

A large and growing part of the population now lives close to coasts. The threats posed to coastal populations and infrastructure by rising sea levels and extreme events such as storm surges. There is an urgent need for action now in order to limit the adverse effects of climate change upon ecosystems and human society. Coastal erosion happens primarily as a result of sea level rise, intense storm action, and changed or more intensive wave action. In the upland areas, the increased intensity of rains leads to the Erosion of forest land. In the coastal areas, there is less evidence for sea level rise, but intense Storms and increased wave action have certainly accelerated the rate of erosion in several coastal areas. This is especially significant in districts where major rivers open into the Bay of Bengal – e.g., East & West Godavari, Krishna and Guntur. The natural processes of erosion are aggravated by the human-induced changes to the Environment. Several coastal villages experience an increase in the intensity of erosion which leads to loss of long stretches of coastline and damage to properties annually. Erosion of the shoreline has reduced space for living and for fisheries, Stalinized freshwater sources, and increased population pressure in the hinterland. In this study coastal district s providing the most severe of the impacts of erosion Andhra Pradesh.

II. OBJECTIVES OF THE PRESENT STUDY

1. Ecological and environmental factors of the sea erosion.
2. Process of coastal erosion
3. Effects on living hoods
4. Suggestions and remedial methods.

III. DESCRIPTION OF THE STUDY:

Coastal erosion and accretion are natural processes; however, they have become anomalous and widespread in the coastal zone of Asia and other countries in the Indian Ocean owing to combinations of various natural forces, population growth and unmanaged economic development along the coast, within river catchments and offshore. This type of erosion has been reported in China, Japan, India, Indonesia, Viet Nam, Sri Lanka, Thailand, Bangladesh and Malaysia. Bilan (1993) reported that the erosion rate in the northern part of Jiangsu Province in China is serious and as high as 85 metres/year; in Hangzhou Bay the rate is 40 metres/year, while in Tianjin it is 16–56 metres/year. Erosion persists even where preventive measures such as sea dykes are constructed. Beach scour has been found along coasts with sea-dyke protection. This erosion is attributable to many factors such as river damming and diversion, that leads to less sediment supply to the coast, and the clearing of mangrove forests, which makes coastal areas more

Susceptible to the hazard. Juxtaposing these phenomena, the intensification of typhoons and storm surges during the 42-year period between 1949 and 1990 has meant that storm surges with increasing tidal levels exceeding one and two metres have occurred 260 and 48 times respectively, thus exacerbating the erosion problem. Most of the sediment taken offshore by the storm waves has been returned in minimal quantities to the coast during normal conditions owing to the frequent storm intensity.

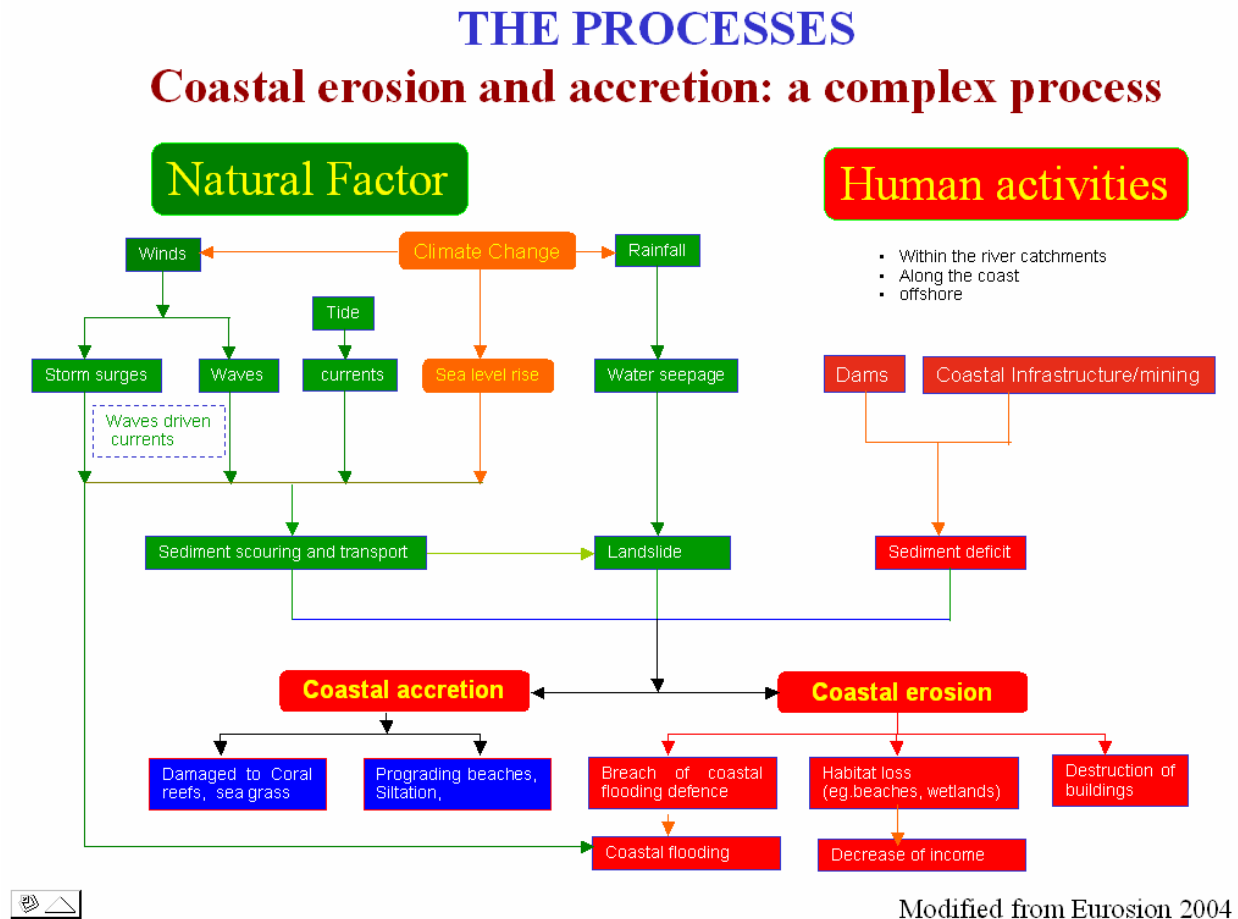
In Viet Nam, most of the coastline in the south that is located in a wide and flat alluvial fan and bordered by tidal rivers fringed by wide mangrove swamps, has been eroded continuously at a rate of approximately 50 metres/year since the early twentieth century (Mazda *et al.*, 1997; Cat *et al.*, 2006). This massive erosion — mostly due to wave and current action — and vanishing mangrove vegetation is attributable to the long-term impacts of human activities since the late nineteenth century and also human-induced change within watersheds (dam construction that has reduced the sediment supply to the shore). Erosion still occurs in the central coastal zone of Viet Nam and preventive measures such as sea dykes, revetments, and tree plantations have been implemented in many coastal areas; however, in the southern coastal zone, mangrove plantations have mitigated wave action and prevented further erosion (Cat *et al.*, 2006).

IV. PROCESS OF EROSION:

The rapid erosion of the Coast of Sagar Island in West Bengal, India, is caused by several processes That act in concert; these are natural processes that occur frequently (cyclones, waves and tides that can reach six metres in height) and anthropogenic activities such as human settlement and aquaculture that remove mangroves and other coastal vegetation. The erosion rate from 1996 to 1999 was calculated to be 5.47 square kilometres/year (Gopinath and Seralathan, 2005). The areas that are severely affected by

erosion are the northeastern, southwestern and southeastern faces of the island. Malini and Rao (2004) reported coastal erosion and habitat loss along the Godavari Delta front owing to the combination of the dam construction across the Godavari and its tributaries that diminish sediment supply to the coast and continued coastal land subsidence.

Fig: No: 1



V. THE CAUSES OF COASTAL EROSION:

Coastal erosion and accretion are complex processes that need to be investigated from the angles of Sediment motion under wind, wave and tidal current action; beach dynamics within a Sediment/littoral cell; and human activities along the coast, within river catchments and watersheds and offshore, both at spatial and temporal scales. In terms of temporal scales, the issue of sea-level rise is complex and produces a range of environmental problems. As the sea level rises, the water Depth increases and the wave base becomes deeper; waves reaching the coast have more energy And therefore can erode and transport greater quantities of sediment. Thus, the coast starts to adjust to the new sea level to maintain a dynamic equilibrium. Figure 1 lists the processes of coastal Erosion and accretion, as well as natural factors and human activities.

The key physical parameters that need to be understood to identify coastal erosion as a problem in the coastal zone is:

- Coastal geomorphology: Coastline type and sensitivity to coastal processes.
- Wind: The main force in wave generation; under the right environmental conditions, wind may transfer sediment from the beach environment landward on all open coastlines.
- Waves: They are the most important forces for sediment erosion and transport to the coastal zone. They introduce energy to the coast and also a series of currents that move sediment along the shore (long shore drift) and normal to the shore (cross-shore transport). It is important to understand the movement of wave forms as well as water particles and their interaction with seabed material; also how the waves determine whether the coasts are erosive or accretion.
- Tides: They are influential in beach morph dynamics. They modulate wave action, controlling energy arriving on the coast and drive groundwater fluctuation and tidal currents. understanding why coastal forest clearance causes intensive coastal erosion in particular environments.
- Vegetation: Important for improving slope stability, consolidating sediments and providing some shoreline protection. Equally significant human activities that must be considered over the range of spatial and time scales are:
 - Activities along the coast: Building houses via land reclamation or within sand dune areas and port/harbor development has a long-term impact on shoreline change; protective seawalls lead to erosion at the end of the structures, generate beach scouring at the toe of seawall and shorten the beach face. This can occur in the short term (less than five years) or the long term (more than five years). Other structures such as groynes and jetties typically cause erosion down-drift of the structure within a short period of time (between five and ten years). Removal of dune vegetation and mangroves will expose low energy shorelines to increased energy and reduced sediment stability, causing erosion within five to ten years.
 - Activities within river catchments/watersheds: Dam construction and river diversion cause reduction of sediment supply to the coast that contributes to coastal erosion. The effects of dam and river diversion in terms of coastal erosion are not straightforward, but there are mid to long-term impacts (20 to 100 years) with spatial scales approximately from one to 100 kilometers.
 - Onshore and offshore activities: Sand and coral mining and dredging may affect coastal processes in various ways such as contributing to sediment deficit in the coastal system and modifying water depth that leads to altered wave refraction and long shore drift. The impact of these activities will be obvious within a short period of time (one to ten years).

VI. RELEVANT STUDIES:

ⁱAndhra Pradesh with a coastline of around 974 km has frequently been affected by cyclones and inundated by storm surges. Sea erosion is noticed at Visakhapatnam, Bhimunipatnam and in the East and West Godavari districts. Vishakhapatnam coast is facing erosion since long specially at Ramakrishna Beach. In 2013 and 2014, the cyclones 'Phailin' and 'Hudhud' further hastened erosion of the Ramakrishna Beach, severely damaging the adjacent protection wall and road. Uppada village which is 22 kilometers away from Kakinada also faces severe erosion. The Kakinada-Uppada road is gradually disappearing due to shoreline erosion. In the event of submersion of the road in sea water, the residents of 20 seashore villages will have to face many difficulties to reach Kakinada. Many buildings, temples and coconut groves in the village also face the threat of incursion by the sea. Peddamylavani Lanka of West Godavari district is another fishing village which is affected by sea erosion. Many coconut trees have got uprooted and roads damaged with the sea extending more inland. Environmentalists attribute beach erosion which has been severe in the recent times to urbanization, anthropogenic activities, construction of jetties and lack of mangrove plantation along the beaches. An annual feature since the construction of the Outer Harbour in 1970s, the Visakhapatnam Port Trust takes up the responsibility of beach nourishment by removing sediments collected in the Sand Trap built near the Dolphin's Nose and breakwater area. Dredging is being carried out for restoration of beach and for sand deposition at shore. Coconut trees damaged by sea erosion at Peddamylavani Lanka Sea erosion at Ramakrishna Beach Beach restoration process by dredging.

ⁱⁱThe global coastal changes are concerned with the rock formation and the structures seen in cliffs, shore out crops, and the sediment have been deposited on the coastal region. (*Eric Bird, 2007*). Coastal geomorphology provides vital knowledge for the active work of preserving of costal landmarks and communities. The formation and development of beaches, cliffs, sand dunes, salt marshes, reefs and other coastal landforms reflect the pressures and forces acting upon a coastline, both natural and manmade. Coastal geomorphology focuses on explaining landforms in the coastal zone by examining the form, sediments and the depositional history at the modern shoreline (*Wood roffe, 2002*). There is an urgent need for action now in order to limit the adverse effects of climate change upon ecosystems and human society. Coastal erosion happens primarily as a result of sea level rise, intense storm action, and changed or more intensive wave action. In the upland areas, the increased intensity of rains leads to the Erosion of forest land. In the coastal areas, there is less evidence for sea level rise, but intense Storms and increased wave action have certainly accelerated the rate of erosion in several coastal areas. Erosion of the shoreline has reduced space for living and for fisheries, Stalinized.

ⁱⁱⁱAnalysis of multi-date satellite sensor data and maps indicated loss of 1836 ha of land during 1976–2001 along the Godavari deltaic coast resulting in displacement of coastal communities and mangrove destruction. Decrease in sediment loads from an annual average of 145.26 million tons in 1971–79 to 56.76 million tons during 1990–98, apparently due to construction of dams, largely diminished vertical accretion at the delta, while continued coastal subsidence that might have been accentuated by possible neotectonic activity and consequent relative sea level rise led to shoreline retreat. The extant conditions indicate that the problem may compound in future causing irreparable damage to this important deltaic ecosystem.

^{iv}Coast erosion is the process of wearing away material from a coastal profile due to imbalance in the supply and export of material from a certain section. It takes place in the form of scouring in the foot of the cliffs or dunes or at the subtidal foreshore. Coastal erosion takes place mainly during strong winds, high waves and high tides and storm surge conditions, and results in coastline retreat and loss of land. The rate of erosion is correctly expressed in volume/ length/time, e.g. in m³/m/year, but erosion rate is often used synonymously with coastline retreat, and thus expressed in m/year

^v The coastal environment is a unique because mangroves forest, coral reefs, sea beaches, sea weeds, tidal flats and daily tide, waves etc. are found only at the coast. The terrestrial and marine process such as wind actions, tide, wave, currents, erosion /accretion etc continuously influence the coastal zone and make it dynamic and fragile. It contains a wide range of natural resources, productive and valuable habitat of the biosphere such as mangroves, coral reefs, saltpans, salt-marsh, creeks, estuary, beach, sand dune estuary, lagoons, coastal wetlands and mud-flat etc. It also provides important services such protecting shoreline and absorbing flood water as filtering of pollution, retaining nutrients, maintaining water quality. Due to its unique location benefited environment, fertile lowland, abundant marine resources, water transportation, aesthetic beauty etc., people are attracted to live, to commerce, to military and to a variety of industries from ancient time to the present. It is an area of high economic significance due to faster economic development. Two-thirds of the worlds cities occur on the coast . But the coastal zones are facing a lot of problems. They are landfill, dredging, and pollution caused by urban, industrial and agricultural development, coastal erosion, loss of coastal habitat, storm surge, tsunami and the global warming induced sea level rise etc. Coastal erosion is caused due to both natural processes and anthropogenic interventions. The unceasing act of winds, waves, tides and currents leads to shore movement or littoral drift along certain coastal stretches. The imbalance created or the lack of littoral material supply thus makes the land lose by erosion, which, at places will be permanent. The concentration of wave energy due to wave refraction further accelerates erosion. These effects will also impact severely upon human society.

^{vi}The Kakinada Bay is about 11 km wide and shallow. During the spring tidal days at low tide time the bay is exposed. The Coringa and the Gaderu Estuaries join in the south of the study area, originate from Godavari River, drain huge quantity of fresh water during July and October. Kakinada town is situated on the western side of this bay. An irrigation canal joins the bay in the western side of Kakinada town. To the north of this study area, i.e. nearer to Uppada, a river called Pedda river and a Upputeru join the Bay of Bengal. The present study has been taken up in between the Pedda River in the north-east and the Kakinada canal in the south west.

^{vii}The costs of installing hard structures for coastal protection are very high; strong negative public reaction to rock emplacements along the coast often aggravates the problem (Bray *et al.*, 1995; Black, 1999; Clark, 1995; van der Weide, 2001). This has led to uncertainty among managers and local government authorities on how to treat shoreline erosion. It has become an issue for serious debate for politicians, coastal managers, land- and property owners, lawyers, bankers, insurers and fisherfolk, especially in areas of intensive use and rapidly rising coastal land value. Many of these stakeholders are resorting to planned retreat where houses or hotels are simply removed and the coast is left to erode. However, planned retreat can be expensive, unnecessary and sometimes impossible, especially in highly modified environments.

VII. CONCLUSIONS

Coastal erosion and accretion are natural processes; however, they may become a problem when exacerbated by human activities or natural disasters. They are widespread in the coastal zone of Asia and other countries in the Indian Ocean owing to a combination of various natural forces, Population growth and unmanaged economic development along the coast, within river catchments and offshore. This has led to major efforts to manage the situation and to restore the ability of the coast to accommodate short- and long-term changes induced by

human activities, extreme events and sea-level rise. Understanding the key processes of coastal dynamics and how coasts are Functioning both in spatial and temporal time scales (short and long term), in juxtaposition with Human activities along the coast, within river watersheds and offshore is crucial for managing Coastal erosion problems. Three main conclusions can be drawn on the roles that coastal forest and Trees can play in combating coastal erosion.

- 1) There is evidence that they provide some coastal protection and their clearance has increased the vulnerability of coasts to erosion. Based on scientific findings, the presence of vegetation in coastal areas will improve slope stability, consolidate sediment and diminish the amount of wave energy moving onshore, therefore protecting the shoreline from erosion.
- 2) Increased interest in soft options (in this case the use of coastal forest and trees) for coastal protection is becoming predominant and is in line with advanced knowledge on coastal processes and the natural protective function of the coastal system. This is because hard options are mostly satisfactory in the short term, while soft options are effective in medium to long-term perspectives (five to ten years).
- 3) A combination of hard and soft solutions is sometimes necessary to improve the efficiency of the options and to provide an environmentally and economically acceptable coastal protection system.



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