# Coastal problems in Sagar Island: The overview

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*Abstract:* ***Delta is considered as the most significant depositional feature develops at the confluence of fluvial- marine condition. It is the combination of huge number of Sediments coming from both the rivers and ocean and deposited at the mouth of the river by the interaction of both fluvial-marine activities. According to Morgan (1970), 'river regime, coastal structure, process, wave, currents, climatic regime are dominant geomorphic variables which in simple and complex combination produce a great variety of deltaic morphology'. It is the result of both erosion and depositional activities of the river and ocean. Bengal delta is considered as the largest and most active delta in the world. But now days it faces severe rate of Erosion than deposition. As a result deltaic portion of Bengal basin are erode at a faster rate.***

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**Introduction:**

This differential erosion and wave action helps to change the shape of delta and this change may have a long term or short term impact on both the hydrodynamics of the river system and on the human being. There can be found no alternatives in case of Sagar Island. Every land mass on Earth has miles of Coast at the interface between the hydrosphere and the lithosphere. Natural forces such as wind, waves and currents are constantly shaping the coastal regions. The landward displacement of the shoreline caused by the forces of waves and currents is termed as coastal erosion. It is the loss of sub-aerial landmass into area or lake due to natural processes such as waves, winds and tides, and due to human interference. The effects of waves, currents, tides and wind are primary natural factors that influence the coast. Coastal erosion can be defined as the removal of material from the coast by wave action, tidal currents and the activities of man, typically causing a landward retreat of the coastline.

Plate: Coastal landforms are created by a wide variety of coastal processes, which vary depending on the process, the wave climate, beach morphology, geology, and human activity. This results in the two processes of erosion and accretion.

Coastal erosion is defined as "the group of processes whereby debris or rock material is loosened or dissolved" (Thomas & Goudie, 2000).

Accretion is "the gradual increase in the area of land as a result of sedimentation" (Thomas & Goudie, 2000).

Geomorphologic factors are including topography, the composition and structure of the geological formations exposed at the coast the state of man-made coastal defenses local currents and tidal range, wave climate which are characterized by wave height, period, direction , fetch and groundwater sediment supply. The effects of waves, currents, tides and wind are primary natural factors which influence the coast. The other aspects eroding the coastline include the sand sources and sinks, changes in relative sea level, characteristics of the shore and sand, etc. Beach material can vary in size from very fine sand (0.005 cm) to small pebbles (1.5 cm). Sand is brought to the shore from the continental shelf, rivers and eroding cliffs, sand dunes, as well as from other beaches through the action of long shore currents. Sinks for the sand include continental shelf accumulations of sand that are in water at depths greater than 30 meters (100 feet) and sand that is carried into deep ocean canyons. This sand is below the "reach" of the waves and cannot be moved and returned to the beach. In addition, sand that is blown inland is also lost from the beach. The changes in sea level, scientists have developed methods to interpret the geologic record left by prehistoric events. Size of polar ice caps and valley glaciers which change the amount of water available for oceans and seas. Expansion and contraction of ocean volume due to changes resulting from plate tectonics. Rising and sinking of coasts due to plate tectonic changes. Warming of ocean water which leads to increased volume for the same amount of water. Increase in total water available in the ocean due to human activities which release groundwater and make it part of the surface water system. Anthropological effects that trigger beach erosion are construction of artificial Structures, mining of beach sand, offshore dredging, or building of dams or Rivers.

Some Beach Erosion Factors: loss of sediment offshore, onshore, alongshore and by attrition, Reduction in sediment supply due to deceleration cliff erosion, reduction in sediment supply from the sea floor, increased storminess in coastal areas or changes in angle of wave approach and Increase in beach saturation due to a higher water table or increased precipitation. First waves start by attacking the main points of weakness in the rock such as the joints and any fault that there may be in the rock. The point of weakness is increased until it becomes a cave. The waves

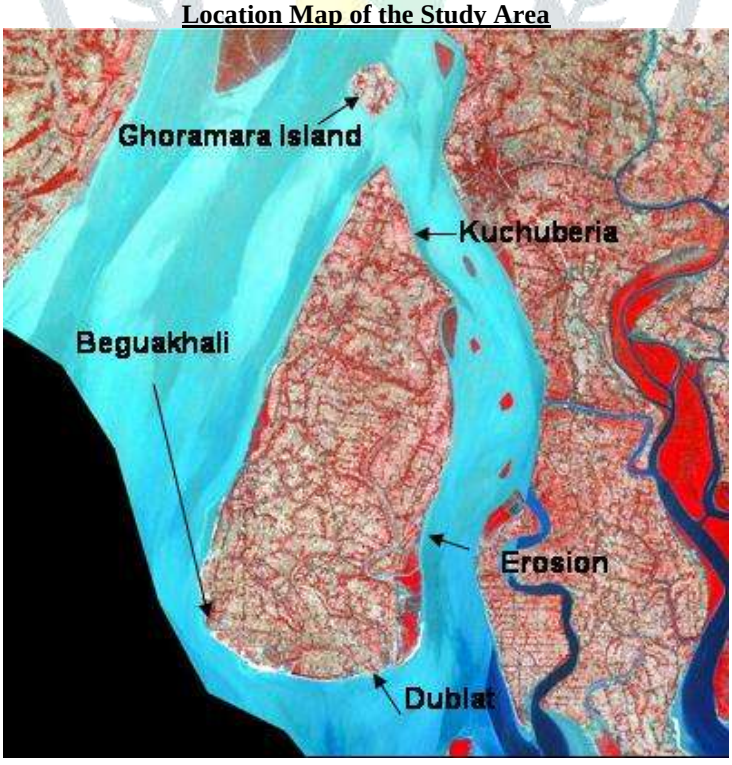
continue to attack the cave, which finally results in an arch being formed through the headland. The arch is then attacked by both coastal and sub - aerial erosion and finally the roof of the arch falls into the sea. This then leaves behind a stack, which is then slowly eroded down to become a stump. Low out crop of rock formed by the erosion of a coastal stack. Unlike a stack, which is exposed at all times, a stump is exposed only at low tide.

The easiest way of describing the overall effect of coastal erosion is that, if left unchecked, all the coastlines would be, low wave cut platforms. Most erosion takes place around high tide and will be carried out in one of three ways. The first is Hydraulic erosion which has an effect of a small explosive charge. The sudden impact of a wave on to the cliff face forces air into any cracks that they might be or along the bedding planes, compressing the air briefly then releasing the pressure. The changes in pressure causes the cracks to widen and go further into the cliff, material breaks away and washed out of the cliff by following waves. The material washed away becomes means for further erosion. The debris is washed against the base of the cliff in a process known as corrosion and acts in a grinding motion. In this process, not only does erosion take place at the foot of the cliff but the sediment itself is worn down and rounded in a process known as attrition. The third type of erosion is chemical, particularly in limestone and chalk cliffs where chemicals within the sea water attack the rocks eroding the weaker sections and gradually causing the cliff to collapse. Coastal lands may experience long-term erosion under some conditions. For instance, if sea level is rising, the beach may eventually migrate landward or drown.

This causes coastal land behind the beach to erode. Also, if the amount of sand from the seaward side is reduced, a beach will erode the land behind it to maintain a constant sand supply. This creates a condition called coastal erosion. Beaches on eroding coasts undergo seasonal profile adjustments, but they slowly shift their position landward as the land erodes.

Sagar Island situated in the Southern part of West Bengal especially on South 24 paraganas district and 150 km away from Kolkata. It has an elevation of 6.5 metre from the mean sea level, lying between 21◦37’21″ - 21◦52’28″ n to 88◦2’17″ - 88◦10’25″ e. (Mukharjee, 1983). It is bounded by Hugli River in the North-West, Muri Ganga in the East and Bay of Bengal in the South. The maximum width and length of this Island are 12km and 30 km respectively and it basically stretched from the North to South direction. In 1951 the Sagar Island covers an area of 285.40 sq. Km but in 2015, due to extensive rate of erosion it goes down into 235 sq. Km.

**Location Map of the Study Area**



Major Causes of Coastal Erosion are like: Waves are generated by offshore and near shore winds, which blow over the sea surface and transfer their energy to the water surface. When it move towards the shore, waves break and the turbulent energy released stirs up and moves the sediments deposited on the seabed. The wave energy is a function of the wave heights and the wave periods. Winds acts not just as a generator of waves but also as a factor of the landwards move of dunes (aeolian erosion). Tides results in water elevation to the attraction of water masses by the moon and the sun. During high tides, the energy of the breaking waves is released higher on the foreshore or the cliff base. Sediments scoured from the seabed are transported away from their original location by currents. In turn the transport of coarse sediments defines the boundary of coastal sediment cells, i.e. relatively self contained system within which coarse sediments stay. Currents are generated by the action of tides (ebb and flood currents), waves breaking at an oblique angle with the shore (long-shore currents), and the backwash of waves on the fore shore (rip currents). All these currents contribute to coastal erosion processes.Storms result in raised water levels and highly energetic waves induced by extreme winds (cyclones). Combined with high tides, storms may result in catastrophic damages such as along the east coast of India (Orissa super cyclone, 1999). Beside damages to coastal infrastructure, storms cause beaches and dunes to retreat of tenths of meters in a few hours, and it may considerably undermine cliff stability.The daily, slow sculpting of the coast, other events like tsunamis which result in major coastal changes over very short time periods. These are referred to as catastrophic events because of the extensive damage that is caused and the unpredictable nature of the event. The term "slope processes" encompasses a wide range of land-sea interactions which eventually result in the collapse, slippage, or topple of coastal cliff blocks. These processes involve on the one hand terrestrial processes such as rainfall and water. Vertical land movement including Isostatic rebound, tectonic movement, or sediment settlement it may have either a positive or negative impact on coastline evolution. Sea level has risen about 40 cm in the past century and is projected to rise another 60 cm in the next century. Sea level has risen nearly 110 meters since the last ice age. Due to global warming, average rise of sea level is of the order of 1.5 to 10 mm per year. It has been observed that sea level rise of 1 mm per year could human influence, particularly urbanization and economic activities, in the coastal zone has turned coastal erosion from a natural phenomenon into a problem of growing intensity. Human intervention can alter these natural processes through the following actions: Dredging Of Tidal Entrances, Construction Of Harbors' In Near Shore, Construction Of Groins And Jetties, River Water Regulation Works, Hardening Of Shorelines With Seawalls Or Revetments, Construction Of Sediment-Trapping Upland Dams, Beach Nourishment, Destruction Of Mangroves And Other Natural Buffers and Mining or Water Extraction. Erosion rates vary over time and space. These variations occur in response to many factors. Among them are: soil slope and composition like Erodibility of material, Near shore seabed shoals and slopes, Storm wave energy and duration, Precipitation, Ground water and soil conditions, Ice cover, Shoreline orientation, Beach composition, width and slope and Shore protection structures. It has been observed that sea level rise of 1 mm per year could cause a recession of shoreline in the order of about 0.5 m per year. **Coastal** erosion occurs when wind, waves and long shore currents move sand from the shore and deposits it somewhere else. The sand can be moved to another beach, to the deeper ocean bottom, into an ocean trench or onto the landside of a dune. The removal of sand from the sand-sharing system results in permanent changes in beach shape and structure. The impact of the event is not seen immediately as in the case of tsunami or storm surge. But it is equally important when we consider loss of property. It generally takes months or years to Note the impact of erosion; therefore, this is generally classified as a "long term coastal Hazard"

Tidal water enters into the inland at higher speed and during ebb tide this water fails to go back seaward and the sediments which they entrain deposited into the channel. As a result the channel become filled up and going to decrease in depth. So siltation is the main problem in coastal area. Tidal influence plays an important role to increase the salinity. Tidal water enters into the island and the severe destructive wave action increases the salinity which has an adverse effect on socioeconomic conditions of this island, especially on the crop production. Only the plants which have a good salt tolerance can grow in this area. This type of water is not fit for irrigation and agriculture purposes. The problems of ground water is the another important sign of coastal erosion on Sagar Island. This is mainly due to the ingression of sea water during high tide time. Several parts of the Island become submerged under the sea water during high tide conditions which helps to percolate the saline sea water under the ground and contaminate the ground water. Besides construction of deep tube well for the irrigation purpose also help to pollute the ground water in this region. Due to destructive wave action and tidal effect most of the areas are going to submerge under the sea. As a result of which people have to loss their property as well as land. Though the state govt. has taken the initiation to construct the embankment, but built up embankment is not a permanent solution to protect the Island from landless. Continuous erosion and land loss change the characteristics of the land and decrease the productivity in this area. Salinity remains increases rapidly, mangroves are degraded and sand deposited in the south eastern part of the island. Most of wetlands are affected by salinity during cyclone and embankment breaching. Besides these immense growth of settlement also helps to change the shape of map of this Island. In order to provide a comprehensive guide to the options available for the Management of coastal erosion all principle coast protection and erosion management techniques are covered. It must be recognized, however, that finely all of these can be damaging to the natural environment, to a greater or lesser degree, in inappropriate situations. The inclusion of any particular approach herein does not, therefore, indicate that it is, necessarily, environmentally Sensitive, nor are universally appropriate as a means of managing erosion. Rather, the summaries highlight and encourage the pursuit of good practice, from an environmental perspective, which ever approach is deemed necessary by the circumstances concerned.

Structural measures used for Coastal Erosion prevention are as follows: there is no permanent solution to protect any land from severe coastal erosion. Several measures can be taken to prevent the loss of land, life and property, but it will not be succeed until people will become aware about the significance of such natural resources. Govt. should also take some initiatives to prevent the unscientific construction on active delta region and for this purpose implementation of environmental protection acts or follows the rules of crz is very important.

TJHere are some measures have been mentioned here : Seawall may be useful in case of protection of specific area from erosion and storm surges. Adverse effect is experienced on downstream side. Groynes may be adopted to stop or decrease shoreline recession and for beach formation. However, extremely adverse effects are observed on downstream side and groynes should be avoided unless their main purpose is to keep a beach at one particular position at the cost of adjoining areas. These may be adopted for shore protection and beach formation. Severe downstream erosion may result due to littoral barrier effect. It is an expensive option and needs regular maintenance to avoid rapid breakdown of breakwater. Soft-structural measures generally adopted to reduce/prevent coastal erosion are: Beach nourishment may be adopted for protection

and beach development. Combination of nourishment of beaches with seawall/groynes will create beach in front of protected area and eliminate leeside erosion. Vegetation covers such as mangrove and palm plantation can restrict sand movement and erosion.

Severe erosion problem has been experienced due to construction of jetties and/or dredged channels. This problem cans be solved by bypassing of material from the up drift side of inlet to the down drift side. Out of these measures, the techno-economically viable and site-specific suitable measure should be adopted. Combination of the above measures may give optimum results with least adverse effect on down drift.
Human intervention can through the following actions: dredging of tidal entrances, construction of harbours in near shore, construction of groins and jetties, river water regulation works, hardening of shorelines with seawalls or revetments, construction of sediment-trapping upland dams**,** beach nourishment**,** destruction of mangroves and other natural buffers and mining or water extraction.

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