

# Evaluation of Hazards along Calicut - Kasaragod Coast, Kerala – a Geoenvironmental Approach.

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## Abstract

*The Calicut - Kasaragod coast of northern Kerala trending NNW-SSE, is a very dynamic and young coast. This densely populated coast exhibits geomorphic features such as spit, narrow active beach, beach ridges, tidal flats/swale plains, mudflats, sea-cliffs/rocky promontories and wave cut benches. The coastal area consists of pre-Cambrian gneisses overlain by Warkala sediments comprising sandstone and clay followed by laterites. The Quaternary formations represented by sand, black clay and silt occupy a major part of the coastal tract. The foliation of gneisses trends NNW-SSE and NW-SE. The IRS 1D LISS III satellite imagery reveals a set of fractures and lineaments extending on to the younger sediments which might indicate neo-tectonic activity and reactivation of basement faults, in this coastal region.*

*The analysis of imagery and field data reveals that the coast is tectonically active and has a history of earthquakes and tremors in the past. The area falls in the zone III of seismic zonation map of India. The other natural/anthropological hazards include intense beach erosion, tidal incursion and salt water contamination of fresh ground water aquifers, illicit sand mining and quarrying, siltation of estuaries and destruction of mangrove vegetation. Based on the field studies, suitable remedial measures have been suggested for mitigation of various hazards affecting the coastal zone.*

## Introduction

The coastal areas may be seen as impregnable, but they actually constitute one of the most fragile and changing land forms on our planet and two thirds of world population lives along the coast (Donald R Coates). The Kerala state endowed with 560Km long coast line trending NNW-SSE has the unique and dynamic coast where natural as well as anthropological factors have contributed to coastal hazards which bear a direct impact on the day to day life of the local population. This paper attempts to give a brief account of some the hazards affecting the coastal region of Kerala in general and the northern coastal belt of Calicut- Kasaragod, in particular.

## Geology

The coastal area consists of Precambrian gneisses trending NNW-SSE and NW-SE.

The gneisses are overlain by Warkala sediments comprising sandstone and clay followed by laterites. Both the crystallines as well as sedimentaries are extensively lateritised. The Quaternary formations which occupy a major part of the coastal tract are represented by sand, black clay, and silt. The geomorphic units of the area are active beach, beach ridges, tidal flats, mudflats, swales, spits and bars, lagoons, marine terraces and rocky promontories. The fluvial landforms are flood plains and active channel deposits, including point bars and channel bars.

## Structure and evolution of coast

The coastline of Kerala has been remarkably straight controlled by NNW-SSE lineaments, offset by ENE-WSW lineaments (Nair M.M). These lineaments are affected by neo-tectonic activity as evidenced by break-in-slope, knick points of rivers and acute bends

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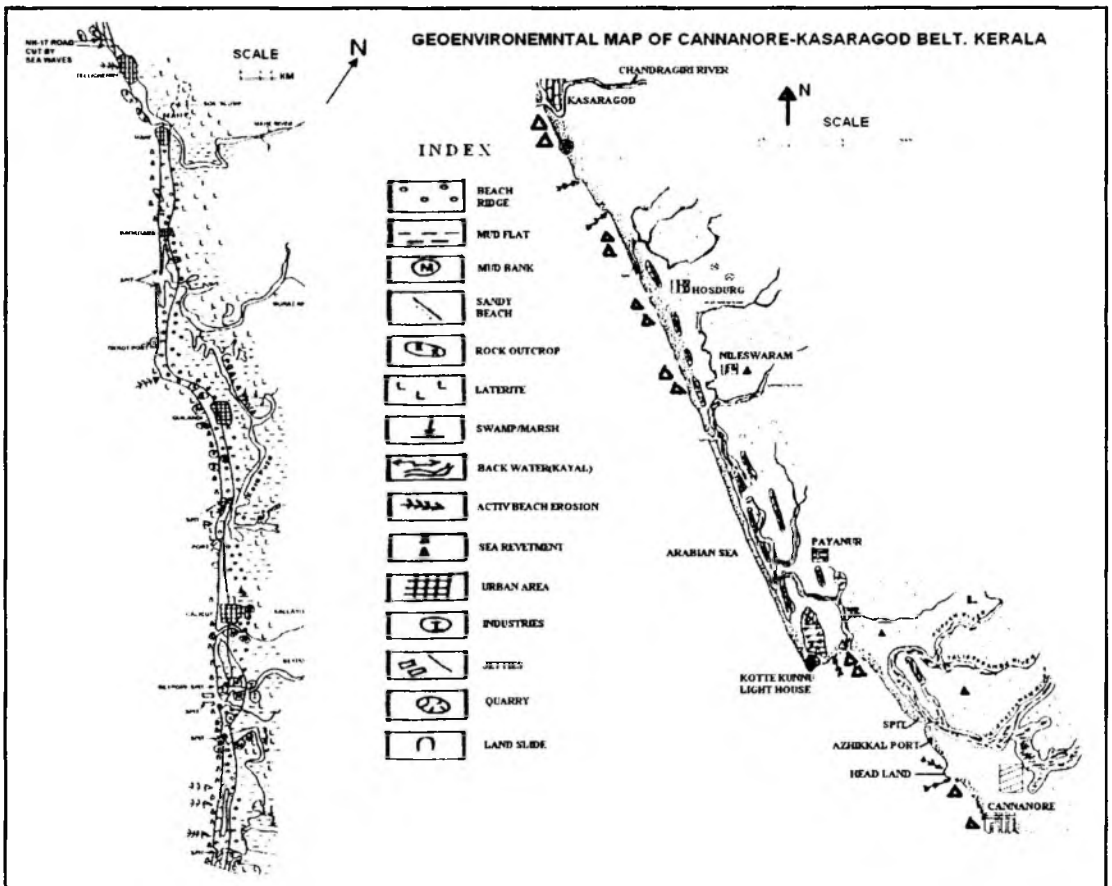
of streams/lagoonal mouths. The Kerala coast shows double shore line features, where inner shore line is represented by rocky coast with wave cut benches, cliffs, mud flats showing submergence and the outer coast line showing emerging coast with sandy beaches, barrier ridges, spits and bars.(Ramasamy S.M)

**Environmental Hazards**

The hazards degrading the coastal environment are mainly 1. intense beach erosion, 2. illicit sand mining and quarrying 3.Tidal incursion and storm surge (Tsunami), 4. Back swamp reclamation, 5. Soil slump/ slides, 6. Coastal pollution 7. Siltation of estuaries 8. Destruction of mangroves and 9. Seismic hazards (Fig. 1).

**Beach erosion :**

Kerala is one of the most densely populated maritime states in the country experiencing intense beach erosion along certain stretches of the coast. Nearly 75% of the 560 Km long Kerala coast is being affected by erosion. It has been estimated that the state had lost 22 Sq.Km, of land by erosion during the period from 1910 to 1965 (Thrivikramjee 1983). As per the computation of Kerala Engineering Research Institute (KERI), approximately 600 mts wide land had been devoured by sea over a period of 120 years from 1850 to 1970. The erosion is all the more severe during the South West monsoon season. The wave climate along Kerala coast during SW monsoon is marked by strong westerly and south westerly winds(with



(Plate - 1)

maximum velocities of the order of 75 to 100 Km/hr) causing highest wave crests which erode the coast, very rapidly.(Nair.KPP.)

In the study area, beach erosion is severe in a few segments along the cliffed coasts at Tellicherry, Cannanore and Azhikod. These cliffed shores made up of easily erodable laterites and other soft sedimentary formations are more susceptible to erosion by wave attack than the hard resistant rocky promontory coasts elsewhere in the area. Moreover, the lack of protective sandy beaches at the base of these cliffs renders the shore line very fragile, as the entire wave energy is impinged on these cliffs. Thus, a steady state of erosion takes place leading to retreat of shore line landward, year after year. At Tellicherry, coastal erosion due to under cutting by sea waves has been posing a threat to the safety of the National Highway No. 17, nearby. In the sandy beaches too, erosion has taken place along Mattul-Pudhiyangadi, Kadalundi - Puraparamba and Elathur – Puthiappa stretches. These beaches, devoid of any preventive sea walls or protective coastal vegetation like casuarina or mangroves bear the brunt of erosion at places.

The natural processes of erosion are at times accelerated by human activities along the shore region. Construction of marine engineering structures like break waters, jetties, groins etc., projecting into the sea often intercept the littoral or long shore movement of sediments leading to down drift erosion. Improper land use and indiscriminate design of sea walls/revetments too have aggravated the beach erosion along this coastal belt.

**Illicit sand mining:** Beach sand mining is carried on illegally along the coast near Kalnad, Shiriya, Manjeswar, Kappad, Puraparamba and other localities, where large quantities of sand are being removed for construction purposes and filling low lying areas. Constant removal of sand material from beach has a detrimental effect on the near shore environment, in terms of reduced

sediment supply, which is the basic cause for most beach erosion problems in the world (Snead R.E,1982)

**Tidal incursion and storm surge(Tsunami):**The coastal area representing a zone of fresh water-salt water interface is prone to salinity hazard due to sea water intrusion into fresh water aquifers, as and when ground water is extracted over draft especially during summer months. At Calicut and Tellicherry towns, over exploitation has led to saline water ingress into fresh water zones. Studies by the Centre for Water Resources Development and Management (CWRDM), Calicut, have proved different levels of contamination by sea water. The intense aquaculture activity in the northern coastal belt near Manjeswar has affected the ground water quality in the surroundings. Salinity is present not only in ground water but also in surface water along streams and river channels of the area up to 10 to 12 Km inland from sea (Valapatnam river) due to tidal incursion. The Kerala coastal segments affected by 26<sup>th</sup> December 2004 Tsunami are Tottapalli-Pallana, Paravuru, Chirayinkil, Punnapara, Alappadu and Dharmadam areas.

**Back swamp reclamation:** Due to increasing population pressures along the coastal zone, land has become a scarce and limited resource in many coastal towns of Kerala. In the pretext of development, coastal wet lands such as backwater swamps, mud flats and marshy (Water-logged) lands are reclaimed for habitation and other constructional activities, leading to ecological imbalances. The mud flats, marshes and backwater (lagoonal) swamps around Calicut, Mahe, Tellicherry, Quilandi and south of Payyanur are under reclamation due to rapid urbanization, resulting in water logging problems.

**Soil slump/slides:** Indiscriminate removal of soil at the base of lateritic scarps along road cuttings near Cheruvathur, Manjampoti in northern Kasaragod coastal belt has been endangering the stability of these scarps by

activating soil slumps and slides during monsoon. Landslides have occurred on the Mahe-Pallur road and Quilandi in the southern Calicut coastal sector. Soil erosion also takes place by gully on these quarried lateritic scarps.

**6. Coastal pollution:** Coastal zones, the world over, are subjected to a wide range of pollution arising out of disorderly disposal of chemicals and industrial effluent discharges, domestic/organic wastes and oil spills from ships. In the present study area, though there are no major polluting industrial units, still the impact of small industries is clearly noticed. A number of textile mills and ply-wood industries around Calicut and Cannanore, sea food processing and drug manufacturing units in the Calicut-Farook area, besides domestic wastes/ municipal sewage from coastal urban centres are causing considerable pollution. The Kerala State Pollution control board at Payyanur is monitoring the levels of pollution in and around Cannanore, Tellicherry and other coastal towns of northern Kerala.

**7. Siltation of estuaries:** It is yet another problem confronting the coastal region especially at the river mouths (estuaries) and along the entrance channels at the port and harbour sites. The seaward flow of river water and landward flow of sea water have resulted in the accumulation of silt/sediments at the river mouths, hindering the free flow of river channels. At Mopla bay harbour Cannanore, construction/design of two breakwaters obstructing the movement of littoral sediments has led to siltation problem along the entrance channel. Periodical dredging is being done to maintain the required water depth favourable for navigation inside the harbour.

**8. Destruction of mangroves:** The mangrove swamps fringing the tidal rivers at Valapatnam and backwaters west of Payyanur are under threat of destruction, due to human interference and large scale reclamation of mudflats, back swamps and marshy lands. The existing natural mangrove

vegetation forming part of the coastal ecosystem has been cleared off indiscriminately along the northern coastal tract of Kasaragod for developmental activities. Until and unless effective steps are taken to protect the mangrove species from further damage, these plantations may disappear for ever from the coastal area, in the near future (Nair K.K).

**9. Seismic hazards:** The Kerala State has a history of 23 earth quakes since 1341 (Tilak N.B.G.). The Calicut area had experienced earth quakes/tremors many times in the past. Since the area is tectonically active, especially along the ENE-WSW lineaments and also there are strong evidences of neotectonism, further tremors/shocks cannot be ruled out in the near future from this coastal region. The Reservoir Induced Seismic (RIS) tremors from Idukki reservoir area were also reported covering parts of Calicut coastal area. An Earth quake of 5.5 magnitude has been recorded with the epicenter located at 125 Km away from Calicut. The area falls in zone III of seismic zonation map of India (ISI, CIS 1983-1978, ISI 1971).

## Conclusions

The studies carried out along the Calicut-Kasaragod coastal belt of Kerala have brought into focus certain environmental issues arising out of human interferences with the natural coastal eco-systems of the area, which need to be addressed judiciously for protection and preservation of this fragile coastal environment. Though natural processes, at large, are responsible for some of the coastal hazards enumerated above, anthropogenic causes have further aggravated these problems. In the context of coastal zone environmental management, human settlements in the near shore region must be avoided. The mangroves and casuarina vegetation should not be destroyed any more for developmental purposes. Illegal mining of beach sand and over exploitation of ground water from coastal aquifers should be checked. Sea walls to contain beach erosion

should be suitably executed with proper revetments to avoid under cutting of sand (Reddy.D.V) The impact of erosion can be further minimised by raising well designed wave breaker structures beyond the surf zone parallel to the shore to dissipate the wave energy (Nair K.P.P).

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