SECTION II – THE PROJECT

A. [STATE]'s Vision and Strategy for ICZM

The State has a coastline of around 476.40 Km. & coastal ecosystem is home to a significant and unique array of biological and ecological diversity i.e. sand dunes, beaches, wetlands, mangroves, estuaries, backwater lagoons and coral reefs. The people in coastal areas mainly depend on coastal resources and the sea for their survival. Several activities such as unregulated tourism, polluting industries, infrastructure, aquaculture, sand mining & rapid urbanization pose serious threats to the health of these ecosystems and to lives and livelihoods of coastal communities.

Climate change and changing patterns and behavior of sea and human interference with biological and ecological diversity of the coastal ecosystem for sustenance and livelihood are the key issues. These issues justify the necessity of an integrated coastal zone management plan for Orissa.

People in coastal zone depend mostly on coastal resources and agriculture for their livelihood. Over the years due to other effects the behavior of the sea is changing rapidly which threatens the livelihood of coastal people.

To safeguard the coastal ecosystem especially to arrest the coastal erosion

B. Strategy

To ensure sustainable and optimal use of coastal areas and their resources in the future by making sound coastal planning and management with participatory approach

C. Coastal Protection as part of ICZM

Erosion of coast and destruction of mangrove forest at a very faster rate in recent years is very alarming.

Orissa coast in general and the Paradeep-Dhamra stretch in particular has been ravaged by storm surge twice in the last forty years. Coastal protection integrated with other components to provide access to the area, to support the lives and livelihood of the people of the area and protecting and expanding the mangrove forest without interfering with the existing ecosystem is aimed at through ICZM in Orissa. The approach is in line with that followed in other participating states.

D. Project area Background

Pentha (20°- 32'-5"N) (86°-47'-5"E) is an agriculture village in Kendrapara District (Fig.1). It is a peculiar location, as almost till the tip of beachfront from the land, agriculture is being practicised. The coast is also known for sporadic nesting by Olive Ridley Turtles. The beach is separated by an embankment having a height of approx. 3 meters and a length of about 1.5km. Out of this, about 400 m long is most vulnerable for seawater intrusion, due to the fact that the coastal is prone to erosion (Fig.2). The site is flanked by Hukitola bay on the east and on Mahanadi river on the south. The beach length of about 1.5km is subjected erosion, out of which, the most vulnerable zone is 400 m. Observations made by the State Water Resources Department (WRD) indicate that this part of the coastal stretch is constantly subjected to erosion for the past 5 years and the beach width of about 340m was already lost to the sea.

Fig.1 Location of Pentha and its environs

As a result the wave activity has increased close to the shore posing a threat to the existence of the embankment. During monsoon, the wave action is severe and state Water Resources Department (WRD), Government of Orissa has undertaken temporary

restoration work to tackle the erosion problem at this location. The probable causes of erosion at this site might be the physical setting of the coastline, the bathymetry of the adjacent nearshore that affecting the wave climate of the area, the variability in sediment input from the Mahanadi and the alongshore littoral drift. The drift which used to previously nourish the beach has been interrupted or diverted due to presence of the Hukitola spit and the orientation of the coastline in a bay form. It is necessary to study the coastal circulation pattern around the coast of Pentha to delinear the forces responsible to cause erosion and develop an appropriate coastal protection strategy for Pentha.

Fig.2 Erosion in the seaward side of Embankment at Pentha (Photo taken on 15th November 2007)

Fig.3 Erosion in the seaward side of Embankment at Pentha (Photo taken on 20th June 2009)

E. Project Objectives and Key Indicators

Project Objectives

(i) It is a pilot project proposed to develop structural system to face wave action creating threat to the existing embankment.

(ii) As the traditional counter wave embankment strategy is not found feasible, the special pilot design is intended for long term protection.

(iii) It is intended to protect the immediate cultivable land, habitation of a village of Pentha and life and property of the habitants of near by villages also. Experience of 1971 and 1999 are still fresh in the memory.

(iv) It is expected to extend protection to the life & property of 6 Gram Panchayats consisting of 58 villages covering an area of 6883 Ha & Population of 41222.

Key Indicators:

(i) Immediate dissertation of the Pentha village by the people will not going to be happening.

(ii) Protection of the cultivable land which is the prime livelihood resource of the region

(iii) Ingress of saline water will not affect the fresh water resources of the surrounding area.

(iv) It will be an indicator of protection against soil erosion is most vulnerable areas of coastal stage.

(v) Natural habitat and ecosystem will be maintained in its perpetuation.

(vi) Land mass will be protected from erosion.

Village Pentha region is a flood plain region, around 7 thousand hectors of cultivable land & 58 villages under 6 G.P's of Rajnagar Tahasil is prone to flood and saline ingression. By protecting the Pentha embankment the entire region will be saved from saline ingression and the local communities will be benefited.

F. Project's Guiding Principles and Key Design Features

Project's Guiding Principles

(i) The project is designed in one of the most vulnerable areas along Orissa coast which has threatened life and property of Pentha village in the district of Kendrapara. It has caused severe damage to the built up embankment indicating immediate erosion of cultivable land.

Water Resources Department has taken following steps to protect the embankment and save the villages since last 6 years.

(ii) Traditional sand bagging supported by wooden poles piling and brush wood protection in repeated years found un-successful in protecting the existing embankment from severe wave action. In spite of the action initiated, erosion has helped to reach the L.T.L only 5mtrs from the embankment in June 2009. In recent years during high tide time the tidal waves over top the existing embankment creating severe damage.

Departmental discussion with I.I.T Madras brought following alternatives to check the erosion at pentha

(i) Concrete wall protecting the embankment.

(ii) Masonry wall protecting the embankment.

(iii) Embankment protected by rock rip-rap.

(iv) Embankment protected by Geo tubes covered.

(v) With Gabion mattress and Gabion bonat the toe on the sea side.

Protection strategies against storm sea wave adopted else where like stone dumping, stone wall in the country may not be successful here due to following reasons.

(a) The area contain loose soil base with black cotton soil.

(b) The up shore land side area do not contain mangroves or any type of vegetation to save the sever wave action.

(c) Immediate land mass beyond the embankment is the cultivable area which provide no protection to the embankment.

(d) Rock is not available in the locality.

Proposed protection measure under item 4 was found to be suitable considering following aspects

- Geotubes are more stable hydraulically and geo technically because they are hearier units with larger width to height ration and have better boundary contact with adjacent units.
- Rock is available at around 100 kms. It is difficult to carry rock to site. Finer materials available site could be used as filling material.
- Underwater application is easier in case of geo tubes.
- The gabions used as surface protective.

Gabions will absorb the lesser wave forces and dissipate the wave energy in a better way due to void spaces in between the stones and larger surface area of the small stones used in the gabions.

Key Design features

The Department of Ocean Engineering, IIT Madras has submitted a preliminary cross section drawing based on the site visit (Annexure-). The estimate has been framed as per the cross section supplied by IIT Madras. In the estimate Geo tubes 3 m dia with flexible Gabions and woven geo textile filter with sand filling and gabion materials filled with stone has been adopted.

Technical consultancy will be sought for from I.I.T.Madras at the time of execution.

G. Project Area Description

The project area has been identified in the earmarked coastal stretches namely: Paradeep-Dhamara. Paradeep is now emerging as a major investment site in India with several upcoming steel plant by POSCO, oil Refinery, Thermal Power Plant and Petrochemical Complex. Thus Paradeep is expected to become one of the six major special economic and investment region planned in India. Especially at Pentha (Kendrapara district) the erosion effect is so high that the LTL is only 20 m from the embankment and during cyclonic event the sea water overtopped the embankment

causing threat to the village. Village Pentha is located near the sea shore in the same flood plain with 58 villages under 6 nos G.P's of Rajnagar Tahasil covering an area of 6883 Ha & 41222 of population. The main production of the locality is Paddy and they are depending upon catching fish. The location map of the project site is enclosed.

Population & Area effected due to Pentha Project.

Sl No	Name of G.P	Name of village	Area in Ha	Population
1	Rajnagar G.P	Rajnagar	278	4171
		Mahisasura	329	1371
		Tarapada	113	486
		Mangarajpur	156	625
		Dhaneswarpur	87	353
		Guludia	142	1003
		Sanaora	48	343
		Maliabuda	125	468
		Baghua	155	689
2	Kurunti G.P	Kurunti	329	1489
		Balarampur	204	1114
		Chakradharapur	147	818
		Tiara	39	274
		Dhagua	71	108
		Kanhua	56	542
		Paschimabeda	38	558
		Nathapur	79	472
		Jhinkiria	93	282
3	Bramanasahi G.P	Bramanasahi	234	1419
		Bada Naukana	104	949
		Bindha naukana	56	377
		Praharajpur	153	756
		Gobardhanpur	173	1136
		Khandamara	89	743
		Pentha	192	370
		Endulpur	103	960
		Sundirapala	90	252
		Lunia	39	46
		Jayapur	169	384
4	Dera G.P	Hatina	222	1547
		Kaitha	195	833
		Dera	75	749
		Gamasikhara	61	267
		Kathuaganda	60	207
		Chinchiri	121	255
		Nuagawn	74	705

		Gokhani	84	911
		Junupangara	55	452
		Paripangara	129	571
		Mugakani	42	362
5	Mahulia G.P	Mahulia	147	858
		Manapada	109	829
		Pokharia	115	529
		Rajagada	198	1267
		Baghataiala	72	884
		Kani	165	714
		Jharapada	75	246
6	Gupti G.P	Gupti	184	972
		Gopalpur	50	414
		Krushanpriyapur	75	492
		Rajeragaswarpur	125	528
		Banabihiri pur	226	895
		Nachipada	69	560
		Dhobaigada	64	312
		Hariharapur	29	292
		Debendranarayanpur	171	2013
		Total	**6883**	**41222**

H. Earlier studies on Pentha

Earlier, ICMAM-Project Directorate had made a beach morphodynamics survey during 2004-06 for the Gahirmatha (Satbhaya village to the Dhamara River mouth about ~20km) coastline, 18km north of Pentha. The results clearly indicate that the entire coast is experiencing erosion at the rate of nearly 80 to 100m per year at certain stretches and the high water line (HTL) is shifting landward. A comparative analysis of 1972 toposheet and the recent satellite image indicates that nearly 200 – 300m of the coastline has receded landward, which is also in conformity with the available records and the local villagers statements. This long term trend of erosion could be mainly due to the predominance of high wave activity as most of the time the cyclone crosses the coast at this segment, lower quantity of fluvial sand supply from the Mahanadi and tributaries rivers and entrapment or diversion of northerly littoral drift after the construction of Paradeep port. The impacts have been felt since the inception and functioning of the Hirakud dam (1956) and the Paradeep port (1964) in the late part of 1960's and in successive decades.

As per the inputs and observations provided by the local villagers and the Water resources department of Government of Orissa, that the stretch of the coast adjacent to Pentha village is under continuous erosion for the last few years and in July 2007, the erosion was severe and the saline embankment was at stake. One of the basic reasons is that during 2007 southwest monsoon months, the Orissa coast experienced frequent depressions and stormy conditions within a short span of time. The physiography of the surrounding area of Pentha indicates that the growth of long sand spit extending northwards diverts sediment supply towards offshore and so the shore of Pentha is undernourished. The available bathymetry data indicates that the Hukitola bay is quite shallow.

H.1. Environmental conditions

The surface atmospheric and oceanographic features that influence a coast are primarily wind, waves, currents and the bathymetry, apart from other features such as orientation of the coast. Details and relevance of these forces to the erosion problem of Pentha are described below:

H.2. Wind and wave:

Geologically speaking, the level of the sea surface determines the relative position of a region's shoreline. The local climate, through its wind regimes, and the wave set up generated by those regimes at regional to local scales are of fundamental importance in the understanding of the processes that drive coastal erosion.

Wind blowing over the water surfaces triggers various oceanographic processes at the edge of the ocean. Wind direction, particularly long-shore wind initiate near-shore currents and thereby the littoral drift along the coast. Wind velocity intensifies all its impact, and strong onshore and offshore winds contribute to sub-aqueous sediment transport through down-welling and upwelling currents.

The other important variable involved modifying the coast is the waves. The waves change in their characteristics such as wave height, frequency and energy daily, seasonally and spatially. Importantly, the coast responds relatively slow to their attack except during period of storm waves. This is one of the crucial parameters that determine the general

character of the coast at a particular time. Coasts exposed to waves from a variety of directions, heights and frequencies are much more complex in both plan and profile than those are affected by less variable wave regimes.

The waves most commonly impinging on a shoreline are those generated either by local winds or by storms at a relatively great distance from the shoreline. Locally generated waves are known as “seas” and waves generated by a distant storm are referred as “swells”. The two types of waves (seas and swells) exist simultaneously at any time in open water. However, the local wind waves or seas obscure the swell, except near shore where the swell peaks up to a greater height. The swell generally contains much more energy than the local wind waves. Consequently, it is the important sediment-moving factor when the energy is released by ‘breaking’ at a shoreline. The relationships between the type of wind generating and the characteristics of waves are fairly well established and the wave characteristics (height, period and direction) from known wind conditions can be fairly estimated from empirical relations either using a model or graphical methods.

H.3. Waves near the coast

When waves approach a coast with crests parallel with the shore, important transformation in the wave characteristics occur. While the period remains the same, the wave velocity and the wavelength decrease; and the total energy slightly reduced by bottom friction. The height first decreases by a small amount as the waves move into shallow water and then increases up to the point of breaking. A maximum wave height occurs at this point. The breaking action is accompanied by relatively high accelerations and velocities of the water particles, resulting in a highly turbulent condition that is capable of placing large amounts of sediments into suspension.

When these waves break at an angle to the coast, the momentum of the breaking wave generates onshore currents that flow in the direction of propagation of the breaking wave and its bore. The pile up of water along the shore causes longshore currents flow parallel to the beach inside the breaker zone. The water in the longshore current returns seaward as rip currents. The near coast bathymetry plays a significant role in altering the direction and velocity of wave induced currents.

Waves approaching a shoreline at an angle not only undergo the transformations but they also bent or refracted because the inshore portion of the wave front travels at a lower velocity than does the portion in deeper water. Consequently, the waves swing around and conform to the bottom contours. The characteristics of the bottom topography, the wave period, and the wave direction in deep water, determine the pattern of the wave crests in shallow water. The result of refraction is a change in height and direction of the waves. The magnitude of these changes can be estimated by refraction pattern. The convergence zones are the regions of high concentration of wave energy that trigger erosion.

H.4. Tides and Sea level Variations

Water level variations in the coastal areas to prominent levels are caused by oceanographic, meteorological, hydrologic, geologic, seismologic and geostatic factors. The first three factors are important for the seasonal variations whereas, the other three are important for long-term variations of seawater level. The coastal geomorphology is partly affected by variations of these levels. The variations can be short-term or long-term. The short-term regular variations are affected by the semi-diurnal and also associated with phenomena of tsunamis and storm surges.

Sea level due to anticipated global warming is said to be rising currently at the rate of 1-2 mm per year, though this rate may not necessarily same throughout the region. Although, the impact of sea level rise on a regional or local scale may be difficult to differentiate from the contributions of other factors, but the possible effects of sea level rise should be incorporated in the long-term forecasts of shoreline changes and for undertaking any shore protective measures.

H.5. Geomorphology and beach morph dynamics

The beach is a dynamic environment as its loose granular sediment continuously responds to the ever-changing waves and currents imposed from the adjacent body of water. The appropriate method of evaluation of this dynamic environment is by determining its profiles. The cycles of beach profiles show that offshore shift of sand from the berm to the bars takes place during storm conditions of large wave activity. Alternately, during smaller swell wave conditions, sand shifts back onshore and the

berm grows. The beach profiles developed in the two cases of large storm activity and smaller swell activity are termed as 'Storm Profile' and 'Swell Profile' respectively.

'Summer' and 'Winter' profiles usually characterize respectively the depositional and erosional trends of the beaches above the low water level. A beach profile resulting from prolonged attack by uniform waves is referred to as an 'equilibrium profile'. In addition to long period changes, the beaches also undergo seasonal fluctuations due to the changing wave conditions. The nature of seasonal fluctuations at any place depends on various factors such as the degree of wave exposure, the slope of the foreshore and the type and characteristics of the sediment and the nearshore bathymetry. The seasonal beach changes are magnified due to near protruding coast, river mouths or obstruction by sand spit on the lee side. Further, short-term beach changes may also occur due to offshore-onshore movement of the beach material especially during and after the cyclone periods. Sediment deposition is intimately associated with the availability of sediment (source) and longshore sediment transport. The sediments move onshore offshore and along shore as either bed load or suspended load under the action of waves and currents. Sediment movement perpendicular to shoreline (onshore-offshore) is responsible for short-term coastal changes whereas the along shore movement is important in causing major long-term changes of the coastal zone.

H.6. Long-shore Sediment Transport

The long-shore transport of sediment is caused mainly by the action of waves and currents in the surf zone. The material transported along the shore in the littoral zone by waves and currents is known as the littoral drift. The waves breaking at an angle to a shoreline generates long-shore or littoral currents. It is this current, combined with agitating action of the breaking waves, is the primary factor in causing a movement of sand along coastline. This movement takes place in two manners in suspension and by rolling in a zigzag motion along the beach face. As much as 80 per cent of the material moved by wave action is moved in the area shoreward of the breaking point. The direction of littoral drift at a particular time is dictated by the direction of the along-shore component of wave velocity at the breaking point. Along Orissa coast, important reversals in the direction of littoral drift occur because of the seasonal variation of the

direction of wave attack. So, it is necessary to know both the direction of littoral transport at any one time and the predominant direction of littoral transport over a normal climatic cycle. The predominant direction is difficult to determine and may involve locating the position of natural and man-made littoral barriers and those areas are called nodal zones in which the net littoral transport changes direction. In these zones, the net littoral drift is zero or, in other words, the down drift components of littoral drift are equal to the up drift components.

I. Immediate measures suggested by Sate government

The State WRD had initiated temporary measures by packing large size sand bags along the sea face side of the embankment for dissipating the wave energy and to protect the embankment. As an immediate measure, it has proved to be working. For long term measures, the WRD has made a proposal to strengthen the embankment and another supporting parallel embankment behind the present embankment. It also had an idea of construction of an appropriately designed seawall off the coast of Pentha to prevent the erosion. However, after discussion with ICMAM Project Directorate, Ministry of Earth Sciences and the State Wild Life wing, the WRD has agreed to adopt an ecologically and environmentally friendly anti-erosion measure such as deploying sand filled geosynthetic tubes. Accordingly, the present proposal has been suggested.

J. Numerical modeling of waves along Orissa coast.

For developing a permanent solution, the cause of erosion needs to be investigated. In order to understand the basic processes along Pentha and to asses the feasibility of developing protection structure, numerical modelling studies were conducted using MIKE 21 Spectral Wave Model. Wave transformation on shelf scale and near coast was studied using finite volume spectral wave model (SW) with unstructured mesh, which allows describing the accurate coastline. Fully spectral formulation of the model is based on the wave conservation equation Komen (1994) where the directional frequency wave action spectrum is the dependent variable. The model can simulate simultaneously swells and sea state for the given area. The description of model domain, sources of data and wind forcing used for simulation is given below.

The model area extent is 60^{o} to 98^{o} (E-W) and 6s to 25 N, which covers both the Bay of Bengal, the Arabian sea and portion of the north Indian ocean to account for swells originating in Indian ocean. Since, the area considered for the model is large, four different mesh sizes were employed to obtain fine resolution data at coast. The area of mesh employed is 1.5 sq.km, 0.5sq.km, 0.018sq.km and 0.0010275 sq.km. The bathymetry data from CMAP, GEBCO and 6 transects surveyed in Deep Ocean was merged to make a unified data set for discritization. The bathymetry of the regional grid is shown in Figure. The figure indicting model size and bathymetry for the entire domain and Pentha is shown in figure. All the data was specified in polar coordinate and model was implemented in spherical coordinate system.

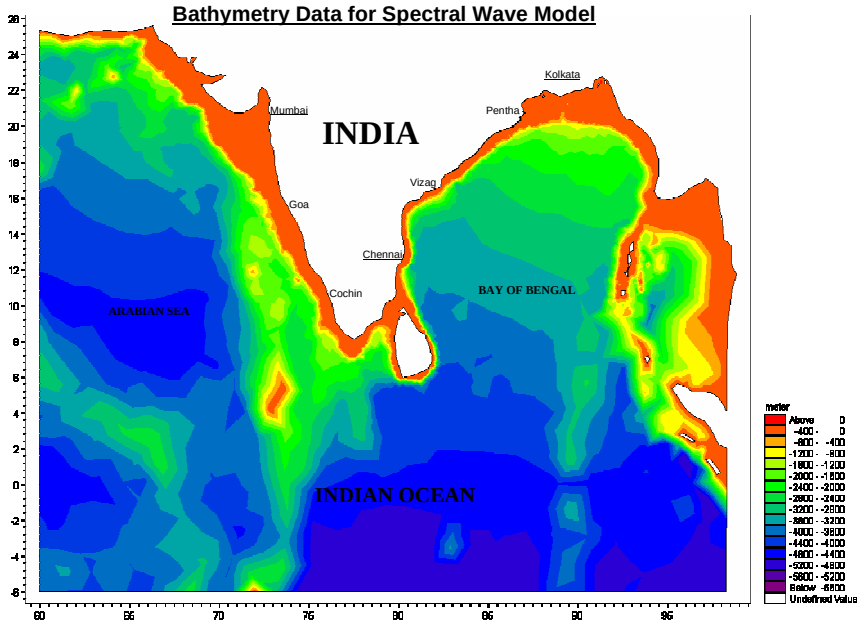
K. Wind Forcing

The major forcing for the wave model is wind and earlier studies have considered the wave atlas developed by National Institute of Oceanography, Goa based on ship observed data for design of coastal structures. Recent developments in instrumentation, satellite based weather data and modeling techniques have improved the wind information in the entire globe.

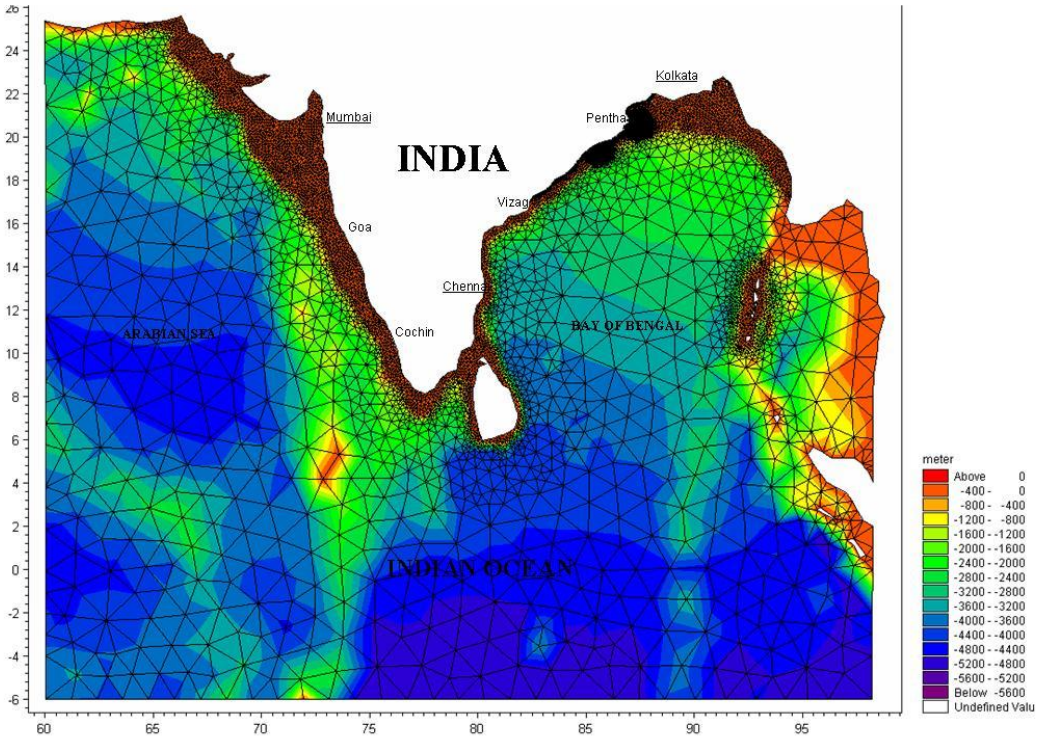
Global 6-hourly maps of ocean surface winds are derived from blending of high-resolution space and time blend of QSCAT-DIRTH scatterometer satellite data (Sea winds instrument on the Quick SCAT satellite - QSCAT) observations and global weather center re-analyses (NCEP). This blending method creates global fields of high temporal and spatial resolution datasets (6-hourly, and 0.5 x 0.5 degree) of wind vector components (U and V) and wind stress curl by retaining QSCAT wind retrievals in swath regions, and in the unsampled regions (between swaths and in data gaps) augmenting the low-wave number NCEP fields with a high-wave number component that is derived from monthly regional QSCAT statistics. The blended data set includes files for 10m surface wind-components U and V, as well as for windstress curl. **bln**: The global coverage datasets begin in July 1999 and are updated periodically as long as the QSCAT mission continues. Surface wind component and wind stress curl fields are available in three forms. The "bln" product is the blended wind field output. This blended wind product was developed for general circulation scale analyses in spite of some limitations. The output

grid has a resolution of 0.5° x 0.5°, and spans from 88S to 88N. Land points are not set to some missing values, but instead the technique is applied everywhere: the NCEP analyses include wind values over land and the blending adds statistical high-wave number variability to this background field wherever there are no satellite observations. This way, the dataset can be used to force any ocean model, regardless of its particular configuration of the land/ ocean mask. Caution is to be used, however, when using near-coastal values, as these grid points may be contaminated by land-values from QSCAT and NCEP. This blended wind product was developed for general circulation scale analyses. It should not be used when meso scale or ultra-high resolution is required. Moreover, each 6-hourly surface wind field is derived from the latest 12-hours of QSCAT observations (centered in time on the analysis time). This means that alternating halves of the globe retains the same QSCAT obs in each blended field output. Therefore, the blended winds are not suited for point-by-point, temporal comparisons (i.e. with buoy data), or when true 6-hourly resolution is needed.

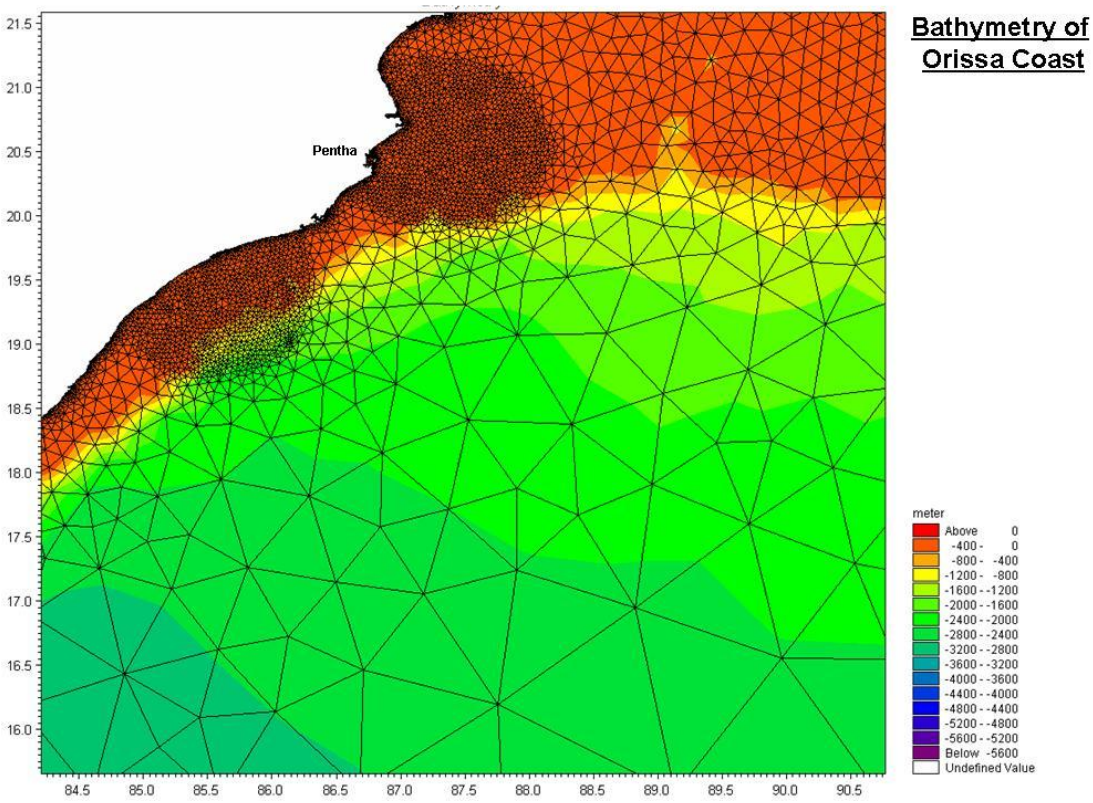
As it was observed from the field data that severe erosion was reported following the months of July and August 2007, wind data region of interest was extracted for the months of July, August, December and January for the year 2007 and compared with normal wave activity corresponding to similar months during July August for 2004. Wave simulations were conducted with 4 months during 2007 and 2 months during 2004. A comparative analysis of hind cast wave climate of Pentha from the model for moths of July and August for the years 2004 and 2007 are shown in figure. In order to assess the distribution of wave height during SW and NE monsoons, wave rose for July, August, December and January 2007 is shown in figure The above results clearly indicate that high wave activity is noticed during July and August 2007, the first being larger, which is possible reason for sever coastal erosion along Orissa coast. Comparison of wave height distribution for SW and NE monsoons shows that later being less severe during 2007.



Bathymetry considered for Spectral wave Model

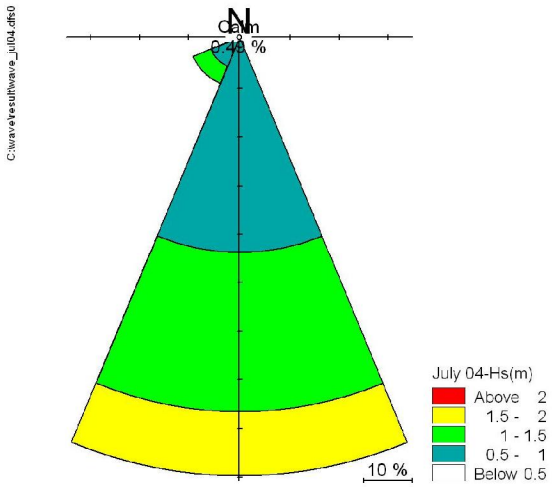


Coarse grids for entire North Indian ocean

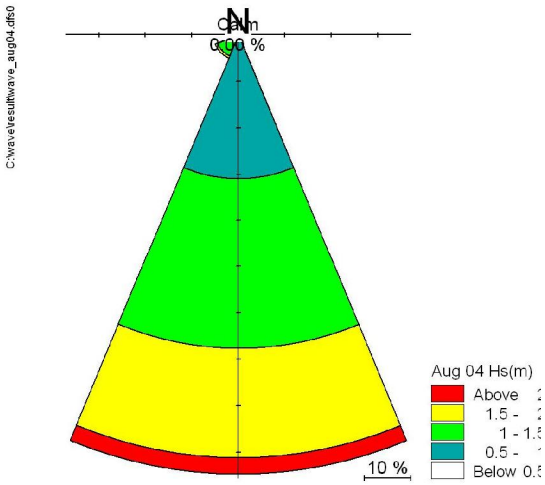


Fine grid at Pentha

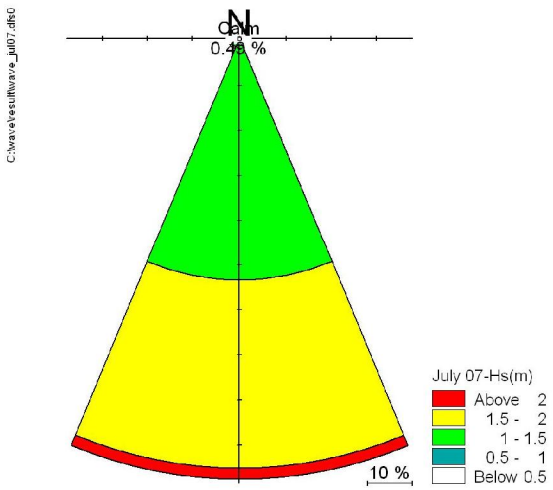
Model domain and discretization of grids for wave model



(a) July 04



(b) Aug 04



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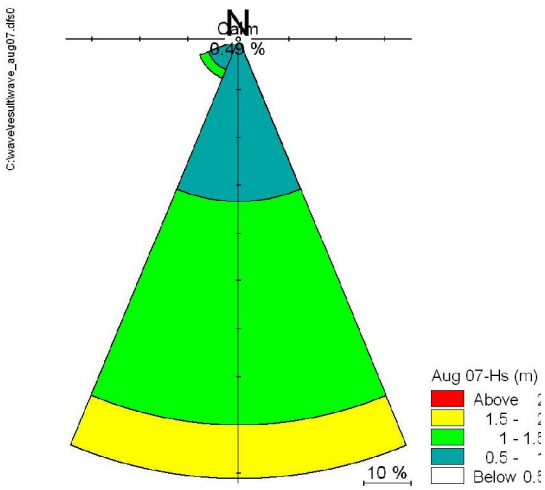
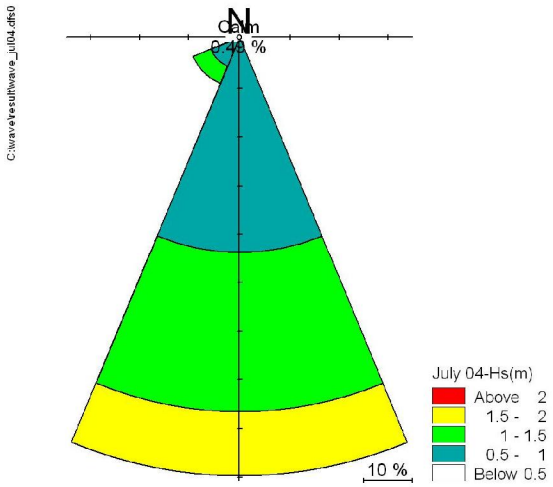


(d) Aug 07

Comparison of wave climate for monsoon months of 2004 and 2007



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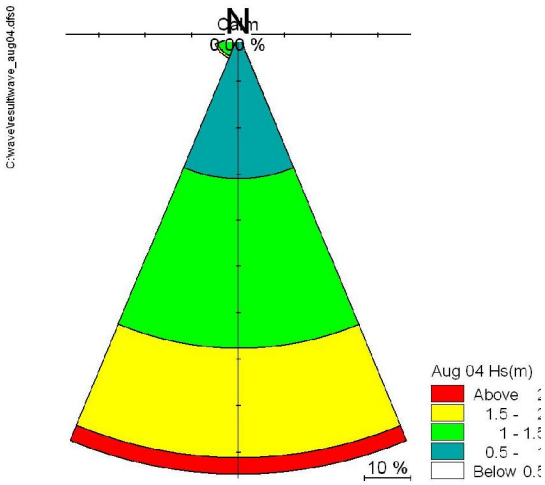

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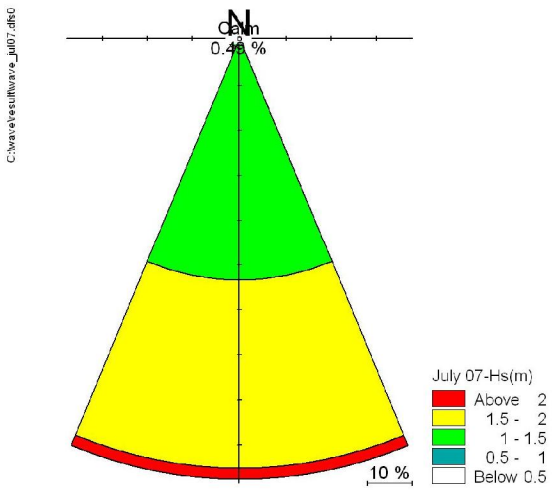

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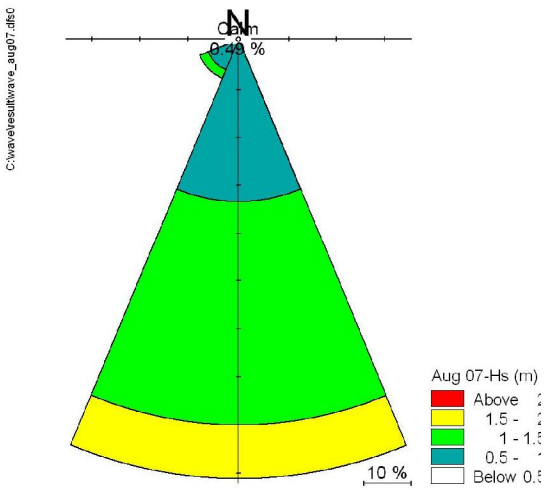
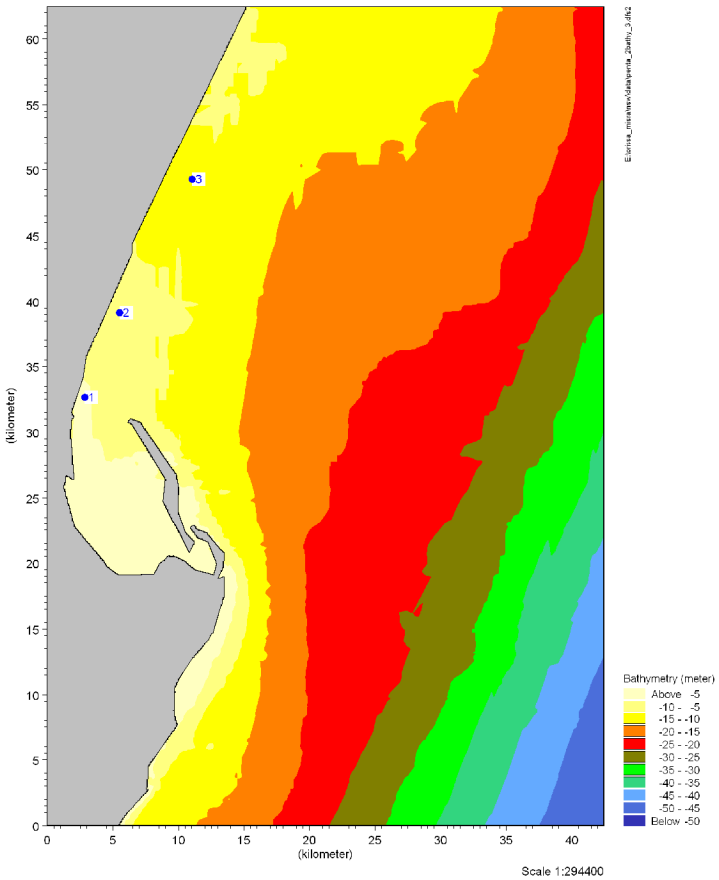


(d) Aug 07

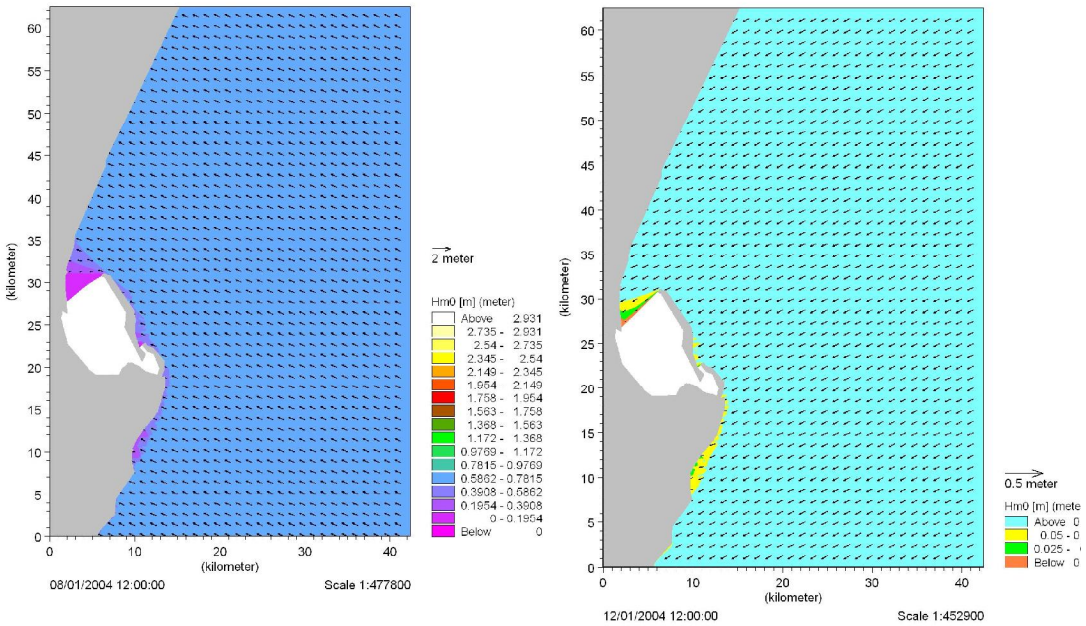
Comparison of wave climate for SW and NE monsoon months of 2007

In order to understand the near-shore transformation of waves along Pentha and to assess the feasibility of developing protection structure, near-shore spectral wave

model was constructed. The bathymetry derived from CMAP was used. The output from this regional spectral wave model was used as boundary condition for near-shore spectral wave model to study near-shore wave transformation. The wave transformation for two typical wave regimes at Pentha i.e SE and NE waves is shown in figure. The results indicate the circulation at Pentha is complex and shoreline changes at the site are not only governed waves but also by interaction of coastal currents and sediment inputs from the Mahanadi river. Hence, a field experiment is required to asses the influence of each forcing function and resultant changes on the coast.



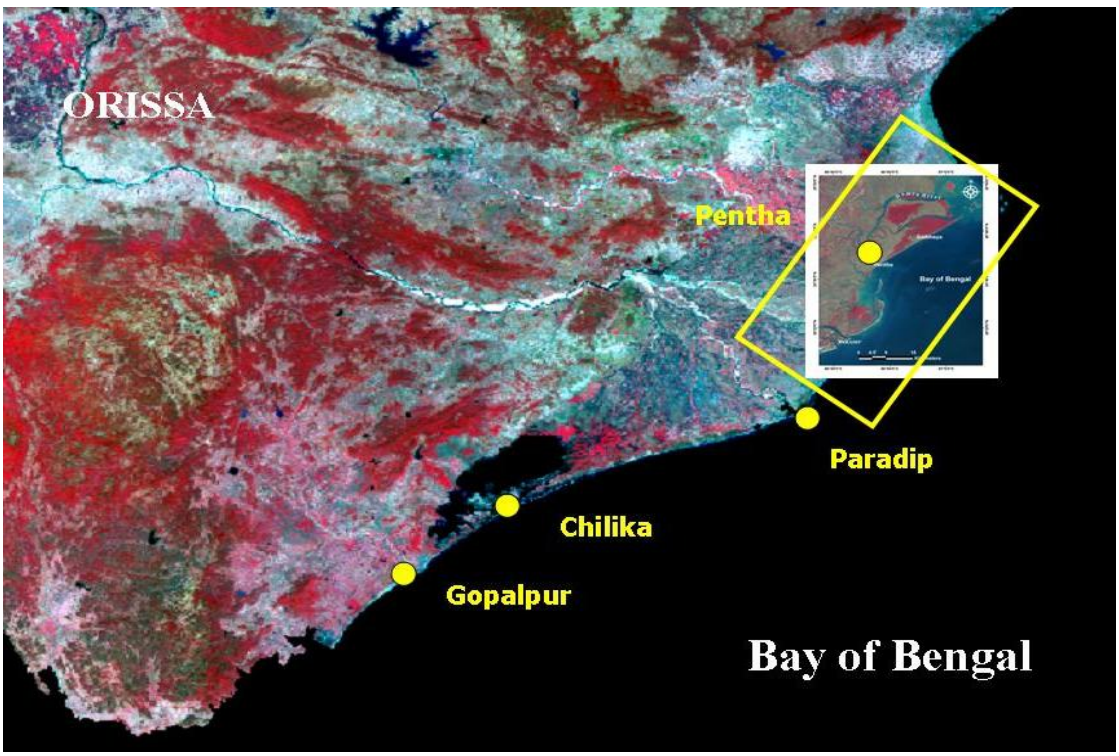
Bathymetry considered for near-shore spectral wave model



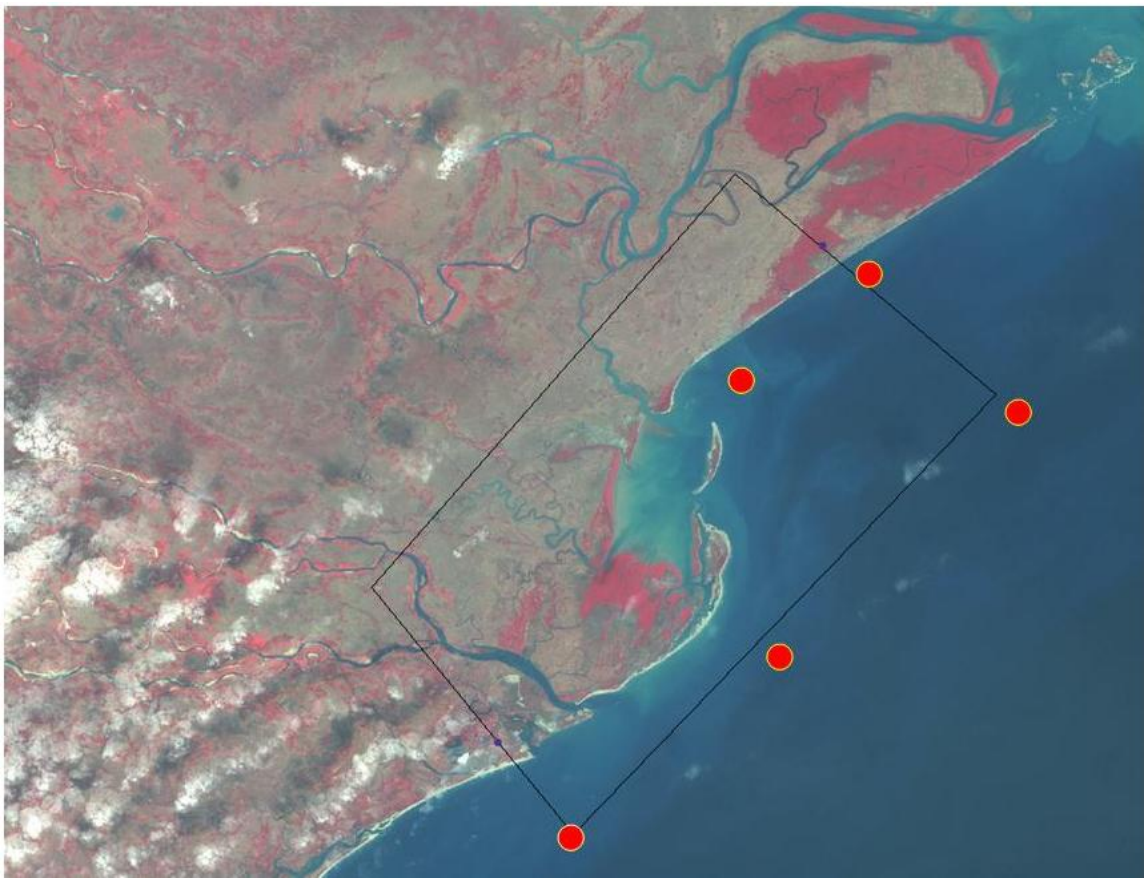
Wave transformation for SE and NE waves at Pentha

Development of coastal protection strategies for Pentha

The site to be protected from erosion is located in ecologically sensitive area where massive turtle nesting takes place. Hence, it is necessary to adopt a soft solution, for e.g., "Multipurpose reef/ submerged geo-tube" for coastal protection which do not cause any adverse impact to the geomorphic and sub-bottom features of ecologically



sensitive areas.



L. Project Description & Scope

Project Description

L.1 Necessity of the Project:

Shore line has advanced more than 1.50 Km from 1999 super cyclone. Sea waves have already damaged the existing embankment. Traditional method of protection using wooden piles, sand bags and brushwood every year proved to be unsuccessful. Other protection strategic such as dumping stones, concrete or masonry wall in the country side seems to be unworkable as, foundation soil found to be loose and black cotton. Country sides do not have mangroves. Immediate lands are cultivable lands. No permanent approach to the area. Carriage of construction materials to the site are difficult. Keeping top level 7.4 m above msl with top width of 5.0 m filling with compacted earth fill, gabion box filled with stone and compacted sand fill and gabion

box filled with stones towards sea side to protect the severe wave action, as per suggestion of I.I.T, Madras,

L.2 Present Proposal

For a long term and workable solution Technical advice from Ocean Engineering Department of IIT, Madras was taken. They suggested a retard saline embankment, i.e. under construction at present funded by Special Relief Commissioner, Orissa. (the designs are annexed). The bottom layer of geo-tube to be placed above HTL and top level of embankment will be kept at 3.5 m above observed HTL. The Plantation shall be carried out towards the Sea side of the embankment which will be the first line of defense. Geo-tubes and geo-textiles are preferred because they are more stable hydraulically and geo-technically, are heavier units with larger width with respecting to height ratio & easy to handle on dry land and in-water. These are available in various sizes and length to suit the design as well as economical as compared to traditional masonry or concrete and stone works, if construction materials are to be carried from a long distance. The dredged material at site can be used as filler materials. Geo-textiles are permeable to arrest soil erosion, chemically inert and strong. The length of the proposed embankment is about 700 m by utilizing the geo-synthetic tube. The coastal afforestation will be taken up over a length of 2200 m along the coast line with a width of 3.5 m in between sea and geo-tube embankment.

L.3 Scope

The proposed construction of embankment taken as pilot project to face the strong sea wave which the traditional practices are unable to protect the embankment. Construction of the compacted earthen embankment keeping top level at 7.4 m above MSL with top width of 5.0 m, sea side protected by geo tubes filled with sand, stone and muck etc. Seaside faces to be covered with geo gabion mattress. Sea side area to be covered with plantation. Length of the embankment with geo tube 700 m and the length of afforestation will be 2200 m.

If it will be successful it will be reproduce in other vulnerable area of the coast which will go a long way to save the coastal erosion including land, property and life. Besides it will protect the coast during natural calamity.

Attempts will be made to take up afforestation works with suitable plant species within the proposed embankment and the high tide line to prevent further coastal erosion in the project site.

The present proposal for construction of sea wall is expected to cause no substantial negative environmental impact. The project is targeted at involving public participation and hence expected not to bring any negative social impact. Besides, the successful implementation of the project will bring benefit in following;

i) Annual loss to the tune of Rs.3.00 crores will be prevented.

ii) The village Pentha will be protected. So habitants will not desert the village.

iii) The cost benefit ratio is 2.397

In addition the Detailed Project Report will be a case study for the Regional Coastal Process studies proposed in this project.

M. Project Components and Component Description

M.1 Construction of sea wall (Geo-tubes) near village Pentha

Construction of the embankment, keeping top level 7.4 m above msl with top width of 5.0 m filling with compacted earth fill, at toe trench the gabion box will be filled with stone up to msl and the geo-tubes shall be placed (6 meters) filled with sand dredged from the sea and sand compaction will done covering the geo-tubes. Top gabions will be filled with stones towards sea side which will reduce the wave action resulting in protection of the coast (as per suggestion of I.I.T, Chennai).

The installation of Geo-tubes shall be done by technically qualified bidders. The contractor/ bidder shall be responsible for collection of sand from the sea as per specified environmental guidelines suggested in the project and by IIT Chennai.

The stones shall be procured from licensed queries. This will be mentioned specifically in the Bid documents for procurement through the supplier/ contractor.

Installation of structure in field

Variety of coastal protection measures are adopted worldwide, which includes hard and soft solutions such as groins, breakwaters, sea-walls and artificial nourishment. The interest in adopting "soft" remedial measures like beach nourishment, submerged reefs, sand bypassing and offshore sand mounds has also increased significantly. Once the cause of beach erosion is identified which may be either due to a natural process or due to manmade activities, careful selection of type of protective measure to be adopted carries importance. Though the existence of natural wave barriers such as, Great Barriers Reef in Australia, long sandpits, coral reefs and atolls in numerous island states have taught the mankind on the methodology for coastal protection, these techniques have not found a place in the present day coastal management strategies. The experiences of hard structures such as seawalls, groins etc., implemented in India showed that they could not provide fruitful solutions and problem of erosion have rather shifted from one location to other.

The soft structure with geo-textile material after design has to be installed in a suitable water depth. The installation steps should include;

1) Survey of Installation point

2) Deployment of apron mat (filter layer)

3) Placement of geo-tube

4) Fixing of nozzles/ ports and pipe line to geo-tube openings

5) Dredging of sand and filling geo-tube

6) Checking of the geo-tube for its completion.

Since, the proposed site experiences two active monsoons viz. SW monsoon (June - September) and NE monsoon with possible cyclones (October - November), the period left for installation of the structure will be 4 months (December- March). Therefore, the entire construction need to be planned for 4 months in fair weather (December - March). The preparatory activities such as procurement of material, installation equipment has to be mobilized at the site before November. The site has no proper roads and equipment, tractors etc., need to be moved through paddy fields,

when no cultivation takes place. The engineering aspects of the project report submitted by consultant should includes

- Volumes of multipurpose reef/geo-tube
- Geotextile mega-container designs
- precise methods of construction
- sand base stability
- sources of material
- vessels
- procurement, manufacture and transport of geotextiles
- harboring of construction vessels
- access to the site
- sand pumping methods

Summary of the tasks expected in implementing the project by consultant are:

- Assess existing knowledge of the site and region in relation to beach processes and ecological sensitivity
- Choose a precise location and depth for a multi-purpose reef/geo-tube
- Design the reef/ geo-tube to have multi-purpose use
- Evaluate the beach sediment dynamics with the reef present, including long shore transport, cross-shore transport, formation of a salient, short to long term impacts on the beach system and equilibrium beach conditions.
- Undertake numerical modeling of the wave transitions, with particular emphasis on the wave penetration into the beach, dynamics of waves on the reef and effects on downstream regions, for a broad range of wave conditions (periods, heights, tidal state)
- Evaluate the wave breaking characteristics for surfing
- Undertake numerical modeling of the currents around the reef with emphasis on rip currents and any unfavorable currents that may be identified

- Undertake numerical modeling of the sediment dynamics around the reef with particular emphasis on the formation of salient, tombolos, scour areas,effects on hot spots or passage of littoral drift past the reef.
- Undertake physical laboratory modeling of the wave breaking characteristics e.g. tube shape, peel angle, breaking intensity.
- Identify local materials and resources for construction, using geotextile structures
- Identify capabilities in India and association with R & D institutes (ICMAM / CDA)
- Produce a reef design and construction report, including environmental impact assessment
- Provide input into the environmental consent process, at the discretion of the Wild life Department
- Attend meetings with the client (WR Department)
- Present the results of the construction details to the stakeholders.
- Work collaboratively with government agencies and their advisors, as required

M.2 Coastal aforestation

Coastal afforestration will be taken up near a length of 2200 m along the coat line with a width of 3.5 m in between sea and geo tube embankment. The purpose of plantation is to further break the wave energy and to increase the stability and functioning of the geo tube and protective embankment at this vulnerable area. As it is a sandy area following spices have been identified by the Forest and Wild Life Department, Government of Orissa for their sustainability. The plantation work will be executed by the department of Water Resource directly involving local community. All the construction work and plantation will be done on government land (refer annexed map). Therefore there is no need of land acquisition and land donation from the community.

Plant Species:

Costal a forestation will be taken up over a length of 2200 m along with coast line having width of 3.5 m in between Sea & Geo tube embankment. The purpose of plantation is further to break the wave energy and to increase the stability and functioning of the Geo tube. As this vulnerable area is a sandy zone, as per the

discussion with the forest department & village community the following species has been identified for the sustainability of the project;

1. Casurina
2. Prosppis
3. Neem (Azhadiracta indica)
4. Pandanas
5. Bobul

Plant Density and Spacing:

A spacing of 2 m will be adopted for the plantation and about 2500 seedling will be planted per ha.

Nursing Planting and Post Planting Care:

Nursing will be raised near the site i.e. in village Pentha and one year old tall seedlings will be planted. Pits will be dug out with one cft. Dimensions and imported soil and fertilizer will be added to the pits before plantation. Plantation will be carried out in the site during monsoon month. Watering will be done in the post-monsoon and summer month because the area is saline. Soil carrying and weeding will be done after plantation. Watch and ward facilities will be provided. Two watchers will be engaged for the purpose. Brush wood fencing will be provided in the village side for necessary protection. The plantation will be maintained for 3 years.

M.3 Approach road construction:

In addition, it is also proposed to construct an approach road from the ODR (other district road) to the proposed site. The approach road shall be constructed from village Luniya to Pentha (Rajnagar-Gopalpur Saline Embankment) approximately 3.00 kms in length. The road shall be constructed with Concrete (M30) with proper surface drainage. The approach road shall be constructed encompassing the village Lunia, Khandamara & Prasanapur on government land. Hence no land will be acquired from the community/ private owner. The work is detailed in annexed bid document sheet.

M.4 Construction of office cum Store:

It is also proposed to construct an onsite monitoring office cum storage go-down at Pentha. The office cum storage go-down will be approximately 1500 sqft plinth area comprising of two office rooms and a large go-down hall.

N. Project Costs

The year wise breakup of the project cost of the following components has been furnished as detailed Cost Table.

N.1 Estimates-by component, by year

The detailed estimate for year 1 activity is annexed.

a) Geo-tube wall
b) Approach Road
c) Godown
d) Aforestration

N.2 Estimate by Year

The detail project activity time line is annexed.

N.3 Fund Flow:

The entire proposed project cost will be made from the indicated amount of Rs.18.91 cores by World Bank through MOEF, Govt. of India and Department of Forest & Environment, Govt. of Orissa. The payment will be made to the Executive Engineer, Aul embankment Division, Aul from State Project Management Unit, ICZM Project. A separate Bank account for implementing agency i.e. in favour of Executive Engineer, Aul Embankment Division will be opened. The utilization certificate will be submitted by Executive Engineer, Aul Embankment Division to state management unit, ICZM project with copy to head of Department. The budget shall be operated through a separate account to be meant for the project.

PROGRAM AND IMPLEMENTATION SCHEDULE

Department of Water Resource: Setting up Geo-Tube Saline Embankment
PERT CHART

Activity	Year - 1												Year - 2				Year - 3			
	1	2	3	4	5	6	7	8	9	10	11	12	Q-1	Q-2	Q-3	Q-4	Q-1	Q-2	Q-3	Q-4
Setting up field office																				
Procurement of office accessories																				
Call for tender and invitation of Bids (Geo-Tube, Road & Building)																				
Award of Contract																				
Earth work and leveling (Road)																				
Procurement of road construction materials																				
Road Concrete work																				
Construction of Office cum Store Building																				
Procurement																				
Woven Geotextile Filter (GWF 26-130)																				
Flexible Gabions of Size 2m x 1m x 1m with 150mm mesh																				
Flexible Gabions of Size 1m x 1m x 1m with 150 mm mesh																				
Flexible Gabions of Size 4m x 1m x 0.5m with 150 mm mesh																				
Geotubes of 3m dia (GWF 80-350)																				
Installation																				
Laying of Geotextile Filter Fabric																				
Packing of Stones in Gabions and placing them in position																				
Filling of Geotubes 3m dia																				
Trenching																				
Supply of Stones (aprx)																				
Sectioning																				
Sand Filling & Compaction (aprx)																				
Plantation																				

SECTION – III
PROJECT IMPLEMENTATION ARRANGEMENT

A. Institutional Arrangement

A1. Institutional Arrangement

Water Resources Department is a fully established engineering organization with specialized wings such as construction wing, Planning wing, Design wing, Quality Control wing, Monitoring wing. To look after the different aspects of the work, the construction wing is responsible for smooth and proper execution of the work. The Planning wing prepares the DPR of the work after making detail survey and investigation. The Design wing is responsible for Design and research work. Quality Control Division check the quality of the work which as monitoring wing monitoring the physical structural program of the work. The Higher authority visit field to inspect the work and provides necessary technical guidance to the field engineers.

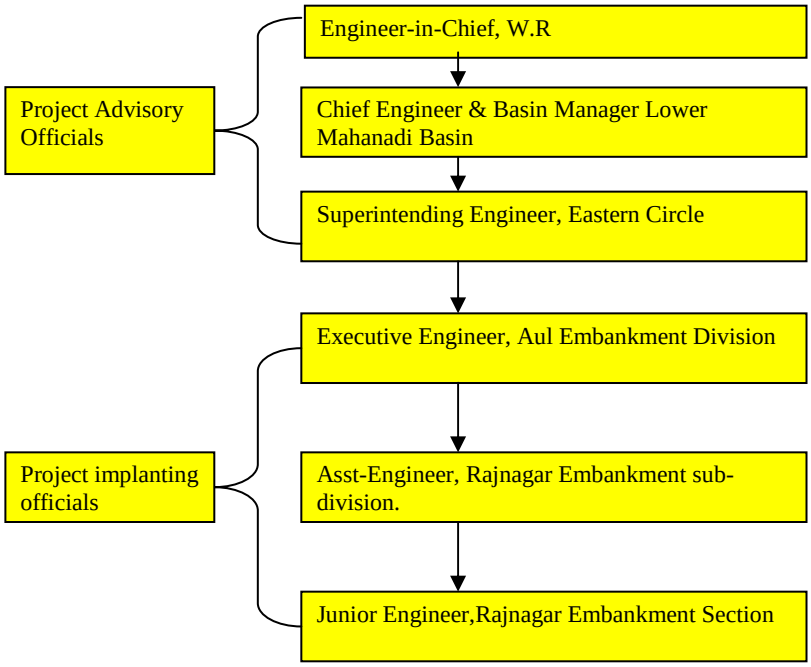
For this work the overall institutional model (and rationale), Executive Engineer, Aul Irrigation Division has existing infrastructures like Sub-Divisional Office, Section Office to look after the work.

A2. Implementing Agencies – roles & responsibilities

The project will be monitored by Engineer-in-Chief (WR), Chief Engineer & Basin Manager, Lower Mahanadi Basin and Superintending Engineer, Eastern Circle and shall be implemented as well as supervised by Executive Engineer Aul Embankment Division, Aul, and Assistant Engineer Rajnagar Embankment Sub-division and Junior Engineer Rajnagar Embankment Section, Rajnagar.

A3.Staffing plan.

The existing staff will take up the work



B. Financial Management Arrangement

B1. Financial Management Framework

The Financial Management at Head Office level is handled by Financial Advisor of Orissa Financial Service. At the Division the Executive Engineer will the Drawing and Disbursing Officer (DDO) supported by Divisional Accounts officer deputed by Deputy Accountant General (Works Puri), Government of Orissa and Divisional Cashier to assist the DDO.

B2. Fund Flow and Disbursement Arrangement

The entire proposed project cost will be made from the indicated amount of Rs.18.91 crores by World Bank through MOEF, Govt. of India and (Department of Forest & Environment, Govt. of Orissa). The payment will be made to the Executive Engineer, AUL Embankment Division, Aul from the Project Management Unit of ICZM Project of the state.

B3. Accounting Policies and Procedures

State Public Works Department has formulated the accounting policies and procedure in line with Central Public Works Department this will be followed for all financial transaction of the project.

B4. Staffing and Capacity Building

Existing Staffs can handle the work. Capacity building of existing staffs is available for construction of sea wall near village Pentha. During the filed work depending upon the requirement the technical persons are also available to execute the work smoothly

B5. Financial reporting

Monthly financial accounts shall be prepared by divisional accountant and shall be submitted to D.A.G. (W&A) for verification and submission to Project Management Unit, ICZM Project Orissa. Further, the financial program will also be reported to Head Office and other administrative office for monitoring the program of the work.

B6. Internal Control Mechanism

The overall internal control mechanism of finance is maintained by Director, Monitoring office of the Engineer-in-Chief, WR and also check the financial transaction by financial advisor O/o the EIC, WR

B7. Audit Arrangements

Annual Audit to the Financial Transaction is being done by Accountant General, Orissa in addition to Internal Audit mechanism of the State Government.

B8. Retroactive Financing

Usually Water Resources Department has retroactive financial arrangement for verifying the financial position.

B9. User Cost Sharing Principles

Is not followed at present

C. Procurement Arrangements

C1. Procurement Responsibility

The Engineer-in-Chief office has a procurement cell headed by Deputy Director on the rank of Executive Engineer. The Cell is guiding the field divisions in all procurement matters.

C2. Procurement Methods

Procurements are being done through calling the tender NCB, ICB, LCB as requirement as per OPWD code of Govt. of Orissa.

C3. Procurement Thresholds

Director Monitoring will monitor the physical and financial progress each and every month with the Chairmanship of E.I.C (W.R.).

Chief Wildlife will look after the aforestation work and also will look after procurement cell and DFO, Rajnagar will guiding the fieldwork in all procurement matters.

C4. Overall Procurement Plan

Overall Procurement Plan are being finalized taken into account the previous rules and regulation after finalizing usually tender procedure.

C5. Procurement Manual

As per Govt. Manual the procurement of the material are made.

C6. Annual Procurement Plan

For long term projects Annual Procurement is made in advance to facilitate smooth and timely completion of the projects. However, it will grow through calling tender after allocation of funds in each year.

C7. Procurement of Works

Normally standards procedure of the works department Govt. of Orissa is followed for procurement of item of works.

C8. Procurement of community level

As in practice priorities are given to local parties to procure the available items for the local community.

C9. Key Procurement Guidelines

Establish procurement guideline of State Government is followed.

D. Environmental and Social Safeguards

D1. Current Regulatory Framework

As C.R.I. Act is operating in the State in the coastal Region of the Country WR Department will abide by it during implementation of the proposed project. The project includes new construction of embankment with Geo Tubes and hence does require any environment clearance. It also does not require land acquisition and as it is not affecting adversely ECO system. The will be donated by the beneficiaries without taking any financial benefits. Therefore, no environment clearance is required to implement the project and also the project is situated adjacent the villages.

D2. Baseline Environment Situation

The environmental management at the proposed sites is coming under the direct control of the Department of Forest and Environment Govt. of Orissa no server environmental degradation, Saline ingress server wave action has been reported the proposed site.

D.2.1. Physical Settings-

Pentha (20^0-32'5" lat) (86^0-47'-5" long) is an agriculture village in Kendrapara district situated along Dhamara-Paradeep stretch. It is a peculiar location, as all most till the tip of beach front from the land, agriculture is being practiced. The beach is separated by an earthen embankment having a height of approximately 3meters and a length of about 1.50kms, out of which, the most vulnerable zone is about 400m.In the year 1960, the LTL was about 4kms away from the embankment, but it was reduced at the rate of of 85m/year and in June 2009, the LT L was only 5m from the embankment. During cyclonic events the Sea waters over tops the embankment causing severe threat to it.

The very location is part of the Hukitola Bey, where Sea is shallow and it is facing directly to the Bay of Bengal between Hukitola spit and another offshore spit. It might have caused increased wave action along with concentration of wave forces on the coast of Pentha. As the wave action is high during the monsoons, along with lack of sediment supply might have eroded beaches over the year leading to present condition.

D.2.2. Biological Settings

The agricultural land is extended almost till the tip of beach front. Hence agriculture is in practiced all through the extended flat flood plain of the region, paddy being the principal crop. The beach front of the village do not have Casuarinas plantation rather found extended sandy beach. However following plant species are found in the village;

1. Coconut - Cocos mucifera
2. Karanja - Pongamia Coronaria
3. Khajuri - Phoenix Sylvesthis
4. Tangara - Ervataima Coronaria
5. Betel nut - Areca Catechu
6. Jack fruit - Artocarpus Integrifolia
7. Neem - Azadirachata Indica
8. Bamboo - Bambusa Tulda
9. Tala - Borassus Flabellifera
10. Arakha - Calotropis Species
11. Papaya - Carica Papaya
12. Chakhunda - Cassia Species
13. Bara - Ficus Bengalensis
14. Peepal - Ficus Religiosa
15. Chinarose - Hibiscus Rosasinesis
16. Kia - Pandanus Tectorius
17. Mango - Mangifera Indica
18. Indian Plum - Zizyphus Jujuba
19. Shami - Prosopsis Species

20. Babul - Acacia Species

21. Suisa - Albizzia Species

The beach is considered to be one of the important areas for nesting ground of pacific Olive Ridley turtle. However the number of the animal coming to the beach for nesting is inconsistent. Presently the wildlife division of the Forest Department, Govt of Orissa setting temporary camps for production and collection of eggs during nesting period. Besides the beach is experiencing habitation of red crabs which are seen in large numbers collecting their food along the L.T.L.

Although the sandy beach do not form the habitat for wild animals but occasionally wild animals like Jackle, Wild Bores, Wolf and Deer's visit the beach as well as nearby crop fields from near Barunai frest area, situated about 3km's away from the village near the mouth of Hansua river.

D.2.3. Socio economic settings

The total population of village Pentha is 370 (2001 census) and the Grampanchayat's total population is 7392 (2001 census). Agriculture is the predominant livelihood source except few people are engaged in fishing activity. Economically the people are poor with very few people at marginal level. The inhabitants by caste wise are mostly general caste with very few schedule caste.

D.3. Policy, Legal and Administrative Frame works

Pentha is agricultural village mostly carryout paddy cultivation in the field extended from the beach front along the extended flood plain. The village lies in the Rajnagar Tahasil belonging to Kendrapara district. All administrative as well as revenue laws of the state are applicable to the area.

As regards to Environmental Impact Assessment following legal policy and administrative frame work is applicable to the village area including the beach front.

The Environment (Protection) Act-1986

The act focuses on the protection of the Environment which includes water, air and land as well as inter relationship them. The act provides power to the authority

declared under the Act to take necessary measures for the purpose of protecting and improving the quality of environment. It lays down standards for the quality of environment and various emissions or discharges. Environmental Impacts Assessment Notification 2006 forms part of the regulations under this legislation. However in present context natural condition affects the beach through erosion. However during project operation the appropriate measures will be taken care.

Water (Prevention & control of pollution) Act 1974 & 1981

Air (Prevention & control of pollution) Act 1974 & 1981

Both these acts have been enacted to implement measures devised for effective prevention and control of water pollution & air pollution respectively. Small village Pentha (Population 370 according to 2001 census), do not cause any breach of either water or air pollution emission standard specified in the Act. The present situation of severe breach erosion at Pentha is the part of dynamic coastal phenomenon. The proposed pilot project is designed to check the progressive land ward erosion as well as stabilization of the beach. However, during the construction of the proposed embankment, all possible mitigation steps will be taken to prevent water as well as air pollution.

The coastal Regulation zone (CRZ) Notification, 1991 Amended 2002)

The act has been issued under Environment (Protection) Act 1986 for Environment Management of Coastal stretches. The beach front of Pentha will fall in the category of CRZ-III, which designates coastal area that are, relating undisturbed and those which do not belong to either CRZ-I or CRZ-II. These will include coastal zone in the rural area (Developed or undeveloped) and also areas with in Municipal limit or in other legally designated urban areas which are not substantially built up.All required formalities will be under taken during the operation of proposed Geo-tube embankment for coastal protection at Pentha.

2.0 Environmental & Social Impact:

Impact Assessment Index

Impact Identification Matrix

	Air	Noise	Surface Water	Ground Water	Climate	Land & Soil	Ecology	Health	Socioeconomic

Land acquisition	No land will be acquired, embankment will be done on revenue/ government land. Hence no impact								
Construction Phase									
Transportation of construction materials	√	√				√		√	√
Construction	√	√						√	√
Operation Phase									
Generation of solid waste						√		√	
Operation of DG set	√	√						√	

Impact Prediction Matrix

Activity	Environmental Attributes	Causes	Impact Characteristics			
			Nature	**Duration**	**Reversibility**	**Significance**
Construction Phase						
Transportation of construction materials	Air	Transportation of construction materials in trucks & exhaust emission from vehicles	Direct negative	Short term	Reversible	Low
	Noise	Noise generation from vehicles	Direct negative	Short term	Reversible	Low
	Land & Soil	Dumping of materials and excavated earth	Direct negative	Short term	Reversible	Low
	Health	Inhalation	Direct negative	Short term	Reversible	Low
	Socio economic	Employment	Direct positive	Short term	Irreversible	Low
	Risk	Risk of accidents during	Direct negative	Short term	Irreversible	Low, if safety measures are taken to prevent accidents
Construction activity	Air	Operation of construction machinery	Direct negative	Short term	Reversible	Low
	Noise	Noise generation from vehicles & machinery	Direct negative	Short term	Reversible	Low
	Health	Inhalation	Direct negative	Short term	Reversible	Low
	Socioeconomic	Employment	Direct positive	Short term	Irreversible	Medium
	Risk	Risk of accidents during transit	Direct negative	Long term	Irreversible	Low, if safety measures are taken to prevent accidents

Legal frame work:

The legislative tools for the management of Coastal environment (including Pentha) are outlined in the Environment (protection) Act 1986, water (Prevention & control of Pollution) Act 1974 and air (Prevention & control of Pollution) Act 1981 and the Coastal Regulation Zone (CRZ) Notification, 1991 Amended 2002). In spite of the obvious strength of these regulations, there exists some gap in the institutional Coordination. It is very much essential in enforcement of the low.

Institutional frame work:

The operational unit (OU) of the state project Management unit (PMU) will have overall responsibility for enforcement of the Environmental law during project implementation. The O.U will be assisted by Environmental Expert and other technical and managerial staff both from the PM U & implementing agency for the assessment of the impact and formulating mitigation plan. The implementing agency will provide regular report in this regard to the PMU and intern PMU will be responsible for preparing consolidated environmental Monitoring report as part of the regular project monitoring and will undertake Evaluation, during which suitable external Expert may be included in the process.

2.1. Positive and Negative impact:

ENVIRONMENTAL AND SOCIAL ASSESSMENT OF ICZM PROJECT

ENVIRONMENTAL AND SOCIAL ASSESSMENT CHECKLIST

Features likely to be affected	Positive impact		Negative Impact		No Impact	Mitigation measures required or not
	Yes	Likely	Yes	Likely		
Forestry/Vegetation	√					
Birds		√				
Fisheries		√				
Other wildlife/animals		√				
Air quality				√		√
Noise environment				√		√
Water quality				√		√
Water availability	√					
Soil quality				√		√
Landuse and topography		√				
Drainage patterns					√	

Sedimentation/erosion	√					
Agriculture	√					
Food production	√					
Climate					√	
Groundwater table					√	
Industrialization					√	
Housing (involuntary resettlement)					√	
Employment/training	√					
Income and livelihood	√					
Other socio-economic activities	√					
Health and safety	√					
Communications					√	
Historical/cultural monuments					√	
Scenic views and vistas		√				
Tourism		√				

3.0. Public consultation

Public consultation is very much necessary for implementation of any developmental project. It is intended not to develop any adverse social concerns during the construction as well as operation of the project.

During the month of April 2009 inhabitant of Pentha have been consulted for the Coastal protection project under ICZM project at Pentha. The Environmental Consultant, from SPPC, ICZM Project, Orissa assisted in the process.

The inhabitants were briefed about different aspects of the project including both positive and negative impact of it. As project is aimed at protection of the village and their crop field, they promised all possible support for the project.

The coastal afforestration part the project was also decided through public consultation to carry out by community participation and filling local species will be mainly planted for the social afforestration program.

4.0 Analysis of Alternatives

To safeguard the coastal environment in harmony with development, it is necessary to monitor the environmental components regularly. Besides, it is also necessary to evaluate i.e. to analyse the impact of such development activities at regular interval to protect the environment. To fulfill this objective, there is no other alternative

except to carry on regular monitoring and evaluation of the proposed activities under ICZM Project both during construction and operation phases of the project.

5.0 Environmental Management Plan

5.1 Mitigation:

Primary objective of this EMS and monitoring program is to control the environmental impacts to bring down to the level of acceptable level. It will help to minimize possible negative impact on the community & the environment as well as on the work force of foreseeable risks during construction & subsequent operation phases of the project. These mitigation measures shall be used inconjuction with good management practices and good engineering design, construction & operation practices.

5.2 Mitigation measures

Mitigation measures during construction and operation;

The following section contains instruction to the contractors, which should be adhered to while carrying out the construction activity. This section will be appended into the relevant bid document	
Tree falling during site development	No tree will be cut in the project activity area. Rather there is plantation activity covering an area of 2200 m X 3.5 m stretch (0.77 ha)
To soil erosion	Deploy silt fences to avoid/ reduce soil erosion and run off. Temporary and permanent drainage systems will be designed to minimize soil erosion
Air pollution due to dust during construction and transportation	Locally available materials should be used as much as possible so as to avoid long distance transportation, especially that of sand and stone, i.e. sand will be collected from sea and the stones will be procured from nearest licensed queries. Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on road. All dusty materials shall be sprayed with water prior to any loading, unloading for transfer operation so as to maintain the dusty materials wet. All vehicles, equipments and machinery used for construction shall be regularly maintained to ensure that the pollution emission levels conform to the CPCB norms. Mixing equipments should be well sealed, and vibrating equipment should be equipped with dust removal device.

	Residents should be 500 meters from downwind direction of asphalt mixing sites. The random ambient air quality monitoring shall be done to ensure that the significant impacts are being mitigated adequately.
Noise pollution	Noise emission level from all construction equipment shall actively conform to the MoEF/ CPCB noise standards. On site power gensets shall be covered with an acoustic enclosure and fitted with muffler and shall conform to the noise emission standards. Ambient noise level monitoring shall be conducted at suitable locations at periodic intervals during construction phase to conform to the stipulated standards both during day and night time.
Water logging and creation of mosquito breeding site	Careful attention to be given on design and maintenance of earthworks and drainage systems during construction to avoid creation of significant habitat areas for mosquito larvae. Spray larvicide in silt traps to prevent the mosquito breeding
Surface water pollution	Use water resources without conflict. Solid/ liquid/ construction/ domestic waste should not be disposed in surface water bodies.
Ground water pollution	Requirement of water for the whole construction period will be met from tanker supply and ground water. Necessary precautions will be taken to minimize the wastage of water in the construction process
Land pollution	The project will take prior permission from the competent authority for disposal of construction waste on landfill site in suitable area. It will be ensured that no construction spoils of any unsuitable material are disposed off on roadside or any other place in the project area. Construction debris will be collected and suitably used on site as per construction waste management plan.

Environmental Issues			**Social Issues**		
Issues	**Exists or not**	**Measures to be taken**	**Issues**	**Exists or not**	**Measures to be taken**
Close proximity of any critical habitat	No	NA	Future claims on land donated	No	NA (no private land will be acquired for

					project activity
Collection of sand for filling bags: impact on coastal geomorphology	Yes	Sand will be collected from sea after detailed assessment	Loss of income/ livelihood sources	No	NA
Collection of stones	Yes	To be collected from licensed quarries	Loss of access to sea coast – local community	No	NA
Adverse environmental impacts on land/ air/ water during construction phase	Yes (the approach road is planned to constructed outside the village settlement on Govt. land)	Materials to be transported in covered trucks. New approach road will be constructed. Environmental sanitation facilities for workers to be provided	Social acceptance of the structure and species selected for afforestration	Yes	Stakeholder consultation has already been done and local communities have given their consent

5.3 Monitoring

Monitoring is necessary for both during construction phase as well as operation phase. It will be a continuous program to analyze and ensure the effectiveness of the mitigation measures for potentiality adverse environmental impacts arising from construction & operation of the project. It will also help to suggest any additional mitigation measures to avoid and significant detoriation of environmental quality.

Monthly reporting will be done by the agency to PMU for preparation consolidated report and to facilitate periodic monitoring and evaluation both during construction & operation phase of the project.

5.4 Capacity Development & Training

The routine reporting of environmental monitoring is the responsibility of the implementing agency. However, technically competent persons are not available in our unit. However, manpower training in the field of environment management, waste management, and environmental audit is required to meet the mandate. Infact PMU has formulated capacity building plan for all implementing agencies by conducting training need assessment, involving Xavier Institute of Management, Bhubaneswar.

PMU will carry out such capacity Development and Training during the implementation of ICZM Project.

5.5 Environment Management Framework

For the protection of costal environment following organization are involved and develop an environment management framework.

1. Director, Environment
2. State Pollution Control Board
3. Department of Forest
4. Department of Wild Life.

The District Civil Authorities are also responsible to look after the immediate environment degradation in their Jurisdiction. But Director of Environment has over all control of the environment of the State.

5.6 Environmental Monitoring Plan

The protection and conservation of the plan for construction of sea-wall at Pentha is not expected to degreed the equilibrium of the environment even then steps will be taken to monitor the environment during and after completion of the project to ensure social safeguard and decision will be made in association local habitants.

5.7 Institutional Arrangement for Environmental Management

At present departmental engineers are responsible for environmental safety planning during project operation, If required experts in the filled will be engaged for environmental and social safeguard.

5.8 Capacity Building

To meet the requirement of environmental norms the department is interested to provide training in environmental laws and to develop experience exposure to various ongoing project else where.

5.9 Implementation Schedule & Cost Estimates

Implementation Schedule:

During outset of the project implementation the baseline study of the beach profile and socioeconomic study, of the project site will be undertaken by the implementing unit of the department, taking support from PMU, OSPCB and technically

competent persons from Institute/ University. A similar study will also be undertaken at the end of the project to generate output data of the project.

5.10 Budget

The budget has been allocated separately for environmental and social safeguard. The arrangement will be made through nodal agencies from World Bank to ICZM projects for protection of the village Pentha and environmental safety.

SECTION – IV

MONITORING AND EVALUATION

Project Evaluation and Monitoring

The WRD will constitute a Project Evaluation and Monitoring Committee composed of experts in the field, technical representatives of respective Central and State Government Departments and Institutions. The ICMAM Project Directorate will also be associated in the committee. The committee will be involved in the evaluation of the Terms of References prepared by the WRD for the selection of the International Consultant and in the evaluation of technical and financial bids to recommend a suitably technically qualified consultant to carry out the tasks described as above. The committee will evaluate the work plan, design of structure proposed and advise the WRD in all aspects relating to the construction of the proposed anti-erosion structure. Periodically it will evaluate the progress made under the project.

A. Objective

(i) It is a pilot project proposed to develop structural system to face wave action creating threat to the existing embankment.

(ii) As the traditional counter wave embankment strategy is not found feasible, the special pilot design is intended for long term protection.

(iii) It is intended to protect the immediate cultivable land, habitation of a village of Pentha and life and property of the habitants.

(iv) It is expected to extend protection to the life & property of 58 villages under 6no G.P's covering an area of 6883 Ha & Population of 41222 Vide pate 8 of this report

B. Components of Monitoring

Field visit will be done by E.E., Aul Embankment Division, SDO, Rajnagar and concerned Junior Engineers and for aforestation work will be done by DFO, Rajnagar and the field officers of Forest Department.

Desk Review will be done by E.I.C, WR and CE & Basin Manager, LMB. **Evaluation** of the project will be evaluated by Director of Monitoring, O/o E.I.C (WR) and for aforestation work, Chief Conservator, Wildlife and DFO, Rajnagar will review the field work and evaluation work.

Preparation of Status report Status report will be prepared by E.E., Aul Embankment Division and will be scrutinize by S.E., Eastern Circle and C.E & B.M, LMB. For aforestation work status report will be prepared by DFO, Rajnagar and will be scrutinized by the conservator Chief Wildlife, Bhubaneswar.

C. Results Framework

In the mid time and final completion will be available from E.E., Aul Embankment Division.

For aforestation work mid time and final composition will be available from DFO, Rajnagar Division.

D. Implementation Arrangement

D1. Arrangement for Results Monitoring: By the monitoring cell, O/o the E.I.C (WR).

D2. Programme Management Reports: After completion of the project will be available.

D3. Programme Operations Management Information System: This will be provided with monitoring cell with collaboration of Department of Forest and Environment, Govt. of Orissa and State Project Preparation Cell (Nodal Agency) (CDA).

D4. Data Collection Tools: The data collection will be done using tools like digital/ still/ video camera/ CD/ Photo Copy / P.C. and Laptop will be used to store the data in digital form.

E. Monitoring and Evaluation Indicators

- People not migrating away from the coast
- Stabilized beach
- Protection of crop fields
- Increased productivity due to reduction of salinity ingress

SECTION V - FEASIBILITY REPORT

A. Physical (Hydrological Features):

Planning for coastal protection is a challenge worldwide. Coastal erosion occurs due to several natural events like cyclone storm surges, floods etc. Human induced events also are responsible for coastal erosion. One of the major requirements of planning coastal protection is to understand the erosion process. A cost is said to be eroding when the loss of material exceed the material supplied/ deposited near the coast.

Orissa has a coastline of around 476.40 km. various areas of the Orissa coast experience sever erosion. The region south of Dhamra in Paradeep in Paradeep-Dhamara stretch is one such critical area. The proposed proposal for coastal protection near village Pentha is situated south of Dhamara. The main reason for coastal erosion near Pentha is high waves accompanied by strong wind during monsoon. Further shallow water effect is also responsible for sediment transportation of literal drift causing instability of shoreline at Pentha.

During 2005 the low tide line of the sea was around 200 meters away from the embankment. During 2006 it was observed that the shore line came further closer and was at around 130 m. away. During 2008 it was observed that the share line has further receded and low the distance is around 10 m.

Though temporary protective measures have been adopted erosion has not controlled. IIT, Madras took up as study and the preliminary findings suggested for construction of saline embankment with geo-tubes so that reemission of the embankment can be stopped.

B. Economic features:

At the feasibility stage, the proposed is economic viable. The benefit cost ratio at feasibility stage comes to 2.524

If the wall would not be constructed the erosion will take place at a faster rate thereby destroying the habitats etc

C. Existing Service status:

The temporary protective measures for embankments are protecting the human life and property against high tides. A permanent solution is aimed at.

D. Planning Aspects:

Feasible alternative plans

During the course of study by IIT, Chennai, following feasible alternative plans for protection were studied.

(I)Concrete wall protecting the embankment.

(II)Masonry wall protecting the embankment.

(III)Embankment protected by rock rip-rap.

(IV)Embankment protected by Geo-tubes covered.

(V)With Gabion mattresses and Gabion bonat the toe on the sea side.

The proposed arrangement under (IV) was found to be suitable considering the followings.

- Geo-tubes are more stable hydraulically and geo-technically because they are heavier units with larger width to height ration and have better boundary contact with adjacent units.
- Rock is available at around 100 kms. It is difficult to carry rock to site. Finer materials available site could be used as filling material.
- Underwater application is easier in case of geo-tubes.
- The gabions used as surface protective.

Gabions will absorb the lesser wave forces and dissipate the wave energy in a better way due to void spaces in between the stones and larger surface area of the small stones used in the gabions.

- Broad economic analysis and financial impact

The economic analysis shows that Benefit cost ration is 2.397. The expenditure is capital expenditure as the cost is being created. Operation and maintenance will be taken up out of the normal provision.

- Social Screening outcome, R&R Requirement.
- Social survey and screening was made by the DOWR along with the officers of Revenue Department. The project was highly appreciated by the local people as their life and property are going to be served.
- Environmental Screening Outcome,
- This is no negative environmental impact of the project. The project will help in processing the marine habitats in the coast which would have been destroyed due to coastal erosion.
- Overview of the Institutional issues
- Required Earth work, Mangrove plantation and other ancillary activities can be taken up by the DOWR with the existing experienced staff. Capacity building is necessary for taking up the geo-tube works etc.

E. Environmental & Social Assessments

As per the present norm under Environmental Impact Assessment Notification, September'06, the proposed project does not require environmental assessments.

Social assessment will be done pre and post project and recorded. Now, the residents of the area are living with uncertainty of life and property and they are very much in agreement for the project. Recently the Collector & DM, Kendrapara and the DOWR Officials had visited the area. During the visit consultations were made.

F. Implementation Arrangements and Schedules

Present implementation arrangement is as follows.

- The entire proposed project cost will be met from the indicated amount of Rs. 18.91 crorer. by World Bank through MoEF Govt. of India (Department of Forest

and Environment Govt. of Orissa) the payment will be made to the Chief Engineer & Basin Manager, Lower Mahanadi Basin from the project, Project Implementation Cell of ICZM project of the State. Implementation of the projects "Construction of Sea-wall at Pentha" will be done by the Executive Engineer, Aul Embankment Division who will reimburse the expenditure.

- Work will be taken up by DOWR through the experienced staff concerned with handling of World Bank assigned projects.
- The local gram Panchayats will be involved during the detailed design and implementation process.
- Additional capacities may not be required as the present staff will be implementing the work.
- The project will be covered under the purview of the State Quality Monitoring Cell (SQMC) under DOWR. SQMC envisages quality control and assurance to be ensured by the agency who is executing the work and the principal employer, i.e. DOWR. Also third party quality monitors will be engaged.
- Procurement will be made WB procedures/Govt. of Orissa (OPWD) procedures as agreed.
- Implementation plan has been prepared and enclosed.

G. O&M Planning

Investment is of "Capital" in nature. O&M will be taken up through the normal O&M grant of Govt. of Orissa. However, for geo-tubes etc O&M during the period of warranty will be provided by the executant's depending on the provisions of the contract.

H. Service Level Monitoring

A. The effectiveness and serviceability of the project will be monitored every three year.