

Chapter 4

**Sustainability of coastal development
under vulnerability**

4.1 Concept

Coastal Zone is a region of diverse activities, both complementary and conflicting to each other. Accelerated and unscientific development activities have induced catastrophic consequences. In order to optimally & reap the benefits, without hampering the fragile balance, it is necessary to adopt coastal management strategies based on solid scientific foundation that allow for multiple use of the resources without causing serious damage to the environment (Sawale, et.al, 2011). The “carryingcapacity” of a coast means the finite resources of the coastal zone which can only support a certain amount of activities before its limitations are realized (Beevi, et. al., 2015). Social and environmental indicators research is experiencing a renaissance at present, especially in the arena of sustainability science, i.e. UNDP, 2000.

Sustainable coastal management requires us to consciously integrate social, cultural, ecological and economical productive dimensions of the coast. This approach gives us the opportunity to give us the way of living on the coasts that are synergistic and constructive, rather than destructive. While an understanding of the ecological model is clearly fundamental to the task of managing coasts sustainably, it is equally important to understand people and their unique cultures and economies that are connected to the coasts because management depends ultimately on the behaviours of people who use and have an impact on the coast. Human activities and aspirations are now primary drivers of coastal ecosystems, and we have therefore to accept and manage humans as part of the ecosystem, not as a superior or even separate sphere of moral concern.

This research work being an applied work depends on the most controversial word sustainability. But as the study area is already well developed as rising tourist recreation area so this research work cannot discard the already existing tourism area which has grown double its area in not more than 10 years. The total built up area has increased from 0.40 sq km to 0.82 sq km from 2009 to 2018. In order to suggest a sustainable coastal development we have dealt with 3 consecutive CRZ notifications of 2001, 2011 and 2018. These regulations have drawn our attention towards the legality of the development of the tourism sector and how it is creating excessive pressure on the morphogenetic regions of the selected area. The detailed research on Integrated Coastal Zone Management (ICZM) put forward by UNEP showcases various methods, plans and implications of the principles of ICZM. Few places of West Bengal coast have already adopted this concept of Integration, this chapter justifies whether the selected region is apt for this kind of applications.

All these assimilation and consideration of management strategies may not work if we won't consider the vulnerabilities of this coastal stretch. The cyclones and deep depressions which had a landfall in and around this Kathi Coastal Belt created episodic changes (Table 4.1) not only over the morphogenetic regions but also on the tourism sector and livelihood diversity. The tidal breach points also shows the zones of flood prone regions mainly areas having elevation lesser than 3m from mean sea level.

Table 4.1: Data of cyclone hitting the coastal West Bengal

YEAR	CYCLONE NAME	MAGNITUDE	EFFECTS ON STUDY AREA
2020	Amphan	260 km/hr wind speed considered as Super cyclonic storm over the deep sea, but it made a downfall as Very severe cyclonic storm with 155km/hr wind speed at Bakkhali, West Bengal.	West Bengal, the epicenter of the cyclone's landfall, saw the most widespread damage from Amphan. The storm was considered the strongest to hit the region in over a decade. It leads to huge loss of economy and ecology as coastal flooding with 5m storm surge, saline intrusion, uprooting of trees, dune degeneration etc. are the immediate effects. Storm surge and coastal flooding
2019	Fani,	215km/hr	
	Bulbul	145km/hr	
2018	Titli	wind speed reaching 55 to 65 km per hour(kmph), gusting to 75 kmph is likely over deep sea areas of central and adjoining north Bay of Bengal and gradually increase to 80 to 90 kmph, gusting to 100 kmph.	Coastal flooding and saline water intrusion.
2017	Mora	150km/hr	Sand encroachment over back dune area
2016	Roanu	65-70 km/hr (Eastern Winds)	Salt water encroachment in the low lying area and small scale destruction of hotel buildings of the sea front position
2015	Komen	75 kmph. Heavy Rainfall	Flood situation in the southern part of West Bengal. 2.14 people have been shelter.
2014	Hudhud	185 km/hr	Though worst hit region is coastal Odisha but it also hit the study region and Salt water encroachment in the low lying areas of Jaldah and Pichhaboni are noticeable
2013	Phailin	Maximum wind 115 knots (215 kmph)	maximum storm surge of 2-2.5 meters above the astronomical tide
2009	Aila	172km/hr	Salt water flooding in the low lying area, Shoreline erosion on villages, Destruction of hotels on the sea face of villages.

Source: *IMD* and verified by field survey

4.2. Analysis

Considering the outcomes of previous three chapters a classification has been done according to Environmental zoning approach. In between two tidal channels i.e. Jaldha tidal inlet and Pichaboni River lies the Mandarmani tidal system. Under this system there are four subsystems – Beach, Dune, Barrier and Wetland. Further subsystems are seen within Wetlands – Channel, Mangrove and Tidal Flats. These subsystems interact with each other and within themselves creating a morphodynamic setup of the whole tidal system. This interaction between system and subsystem made by hydrodynamic and two aerodynamic statistics leads to the landscape evolution. Moreover the system – subsystem setup are again influenced by external forces or the entropy i.e. the storm, sea level rise, fluvial influence (i.e. from the Hugli estuarine system or Subarnarekha Fluvial influence), geology and tectonics and also anthropogenic effects.

All these characteristics together constitute a balance between all the morphodynamic variables. Each entropy force influences each subsystem individually and collectively which distorts the equilibrium condition. The recovery phase taken for adjustment of this equilibrium setup if took a longer period calling a positive feedback system, may take years or decades for balancing this imbalance. But if there occur a negative feedback system among the entropy then the recovery phase will be smaller and equilibrium can be easily reinstated ([Masselink, et. al., 2014](#)).

This research work encircles the shaping and mutual co-adjustments of coastal landforms and examines the dynamics taking place in response to varieties of coastal process. An understanding of coastal evolution is always necessary for coastal management and this analytical planning and its implementation in coastal areas are subject to continuing change. The paramount aim of coastal management is devising a framework within which “Man” may live harmoniously with nature or, in current jargon, providing sustainable coastal resource utilization. Thus; the administrators, researchers and planners should know the balancing act between cause and effect, being alert of the external and internal changes and adjust henceforth.

The relationship between man and coast is pretty uneasy. We have successfully enough tried to tame it, adjust to it and even to ignore it. Collectively all these activities may be mentioned as coastal management. Mitchell (1982) had suggested that 1970 is the initiation age to the age of coastal management. As for now 40% of the world’s population reside within 100 km of the sea ([Marc Leoy, Columbia University, N.Y.](#)). Even many

countries have above average concentration of coastal population. The US has almost 50 % of its population in the coast, which is 80% for that of Australia (Carter, 1991) and 43.75% of the Indian population resides in the coastal states and the Union Territories (Iomervis.nic.in; CCZM & CSB). The reasons for this agglomeration have grown through historical settlement, trade and commerce, political linkage, hospitable climate, availability of even and fertile alluvium, proximity to fish stocks, or more recently due to aesthetics and recreation. Besides, the spectacular boom of population in the coast exhibit allometric growth (Carter, 1991). So this faster expansion of coastal people more than that of the national growth rate concentrating over a less than 10m elevation zone may be a leading cause for increased level of country's vulnerability.

As it has been already discussed in Chapter 3 about Ketchum's (1972) six types of human activities which are also estimated by LDIs (SI, HHI, OI, SEI) that these options vary with time and space inferring into a complementary or conflicting result. So considering various issues of coastal management involve politics, economy, environment, coastal hazards and also carrying capacity with space & time. According to Carter, Organizational Framework is the first and foremost thing to think upon.

Complex and ill integrated systems encourage poor decisions making and unnecessary bureaucratic disputes. Besides, if several administrative agencies join and imply a "one window" approach by designating a lead agency, then the Coastal Zone Management (CZM) initiative would be a better option. The best way to manage is to consider the coastal zone as a defined unit with variations of when and where the demand arises. Thus Coastal Zone is the whole area starting from the water and seabed of territorial waters (upto 12 nautical miles for LTL), covering the adjacent coastal land, inland channels influenced by tide, even including the local authority abutting sea and also ecologically, physically and culturally sensitive areas (EPA, 1986) Theoretically CZM programs can be negative or positive (Carter, 1991). In the negative programme, the control work is done through restrain, means, one must prove one's need in order to get the permission for development whereas positive system mainly encourages coastal development with strategic standards of management. British approach of management is a negative systems based on only substantive changes and that of Sri Lanka is a perfect is a positive approach generating foreign exchange from coastal tourism (Mitchell, 1982). But in the present scenario most of the countries have become aware of the fact of conservation and following a model of "positive within negative". This means some sensitive zones are set aside for negative policy and remaining zones are enriched with controlled developments.

To implement the declaration of Stockholm (Sweden, 1972) Conference by United Nations on the Human Environment, the Government of India enacted the Environment Protection Act (EPA) in 1986 under Article 253 of the Indian Constitution. The Ministry of Environment and Forest (MoEF) of Indian Government, issued a notification in 19th February 1991 for the regulation of the activities of coastal area. This notification was published in the Gazette of India vide no S.O. LI4 (E) with many more amendments (1994, 1997, 2001, 2003, 2011, 2018) done till date. According to the notification the main zoning is more or less same for each year i.e., the coastal land upto 500m from the High Tide Line (HTL) and upto 100m along tidal channels and rivers with tidal fluctuations is called Coastal Regulation Zone (CRZ). As per Section 3(1) and Section 3(2)(d) of the Environment (Protection) Rules, declares that the zone can be classified into four categories. From the 1991 notification only CRZ-I is for the areas that are ecologically sensitive and inter-tidal (LTL to HTL); CRZ-II is designated for developed sea side or urban area, CRZ-III has the relatively undisturbed or the rural areas and finally CRZ –IV for the other coastal areas coined as CRZ-I,II,III or small islands and Andaman & Nicobar and Lakshadweep. From the year 2011 the zoning approach has been changed for CRZ-IV consisting of the water area i.e. the territorial waters from LTL to 12 nautical miles and water area within the tide influenced channels including its bed (having salinity 5 parts per thousand). This sort of change has happened due to continuous objections from different coastal states, Union Territories and other stake holders and a separate draft for Island Protection Zone Notification has been issued. The ecologically sensitive area viz. national parks/ marine parks, sanctuaries wildlife habitats, reserve forests, mangroves, coral reefs, breeding and spawning ground of fish and marine life, areas of natural beauty, historic significance and heritage presence and other areas with rich genetic diversity fall under CRZ-I from the beginning of the notification. But in 2011 notification some geomorphological features are also included like Sand Dunes, Mudflats, Salt Marshes and also more ecologically important areas like Turtle nesting grounds, Horse shoe crabs habitat, Sea grass bed, Birds nesting ground and if mangroves have a coverage of more than 1000 sq.m. then a 50m buffer of No-Development Zone (NDZ) should be left for their growth and stability. The change in CRZ-II area can be seen in the draft of 2018 where the meaning of developed area is more specific with a built-up ratio (built-up plots to the total plots) being more than 50%. In case of CRZ-III, the relatively undisturbed area (viz. rural) which does not fall under CRZ-I & II are further classified in the draft of 2018. It mentions two classifications on the basis of population density CRZ-III A having population density more than 2161 person per sq km and CRZ-III B with less than 2161 person per sq km. For

CRZ-III A, NDZ is up to 50 m from HTL (which is proven by the environmentalist as not considerable because of the development of more resorts/ hotels very near to the HTL) and for CRZ-III B, NDZ is 200m from HTL landward.

All these are the regulatory measures and NDZ rules has to be abiding by strict steps. But always there is a gap in each rules made by the government. If the businessmen or administrators or hoteliers plea for construction of concrete new or extension of buildings or resort area, they are given permission to do so. This creates a chaotic situation. In the present study area most of the hotels are facing legal notice for curtailing the CRZ rules and were asked to move their farther landward. They were even offered substitute land to move away. But their persistence is not only creating an alarming situation but also leading towards a perfect imbalance among 3 E's – economy, ecology and environment. The only remedy to cope with this frantic behaviour of human is sustainable tourism development and even eco-tourism.

Sustainable Tourism Development means optimal use of environmental resources, maintaining essential ecological processes, helping to conserve natural heritage and biodiversity, giving respect to the socio-cultural authenticity of local communities, preserving their built, existing with the cultural heritage and traditional values and make own contribution to inter-cultural understanding and tolerance. Ensure viable long-term economic operations, providing socio-economic benefits to all stakeholders, including stable employment and income-earning opportunities and social services to host community and contributing to poverty alleviation. Sustainable Tourism Development requires the informed participation of all relevant stakeholders as well as strong political leadership to ensure strong participation and consensus building. Achieving sustainable tourism is a continuous process and it requires a constant monitoring of impact, introducing necessary preventive or corrective measures whenever necessary. Sustainable tourism should also maintain a high level of tourist satisfaction and ensure meaningful experience to the tourist, raising their awareness about sustainability issues and promoting sustainable tourism practices amongst them. (UNWTO, 2004)

The importance of Sustainable Tourism Management are good coastal management practices, clean water, air and healthy coastal ecosystems, maintaining a safe and secure recreational environment through the management of coastal hazards, beach maintenance, controlling noise pollution for wildlife and habitat protection (Hall, 2001).

In West Bengal there is still very few tourism sites which are converted into eco-tourism parks like some tourist spot of hilly regions and western plateau areas. Only for coastal area a few spots of Sagar Island in the Hugli estuary have been proposed to be an eco-tourism site. But except that all coastal tourism regions are of mass tourism type. So if any researcher or administrator proposed to convert any particular site of the study area to be an eco-tourism site then it has to be the eastern part of the coastal stretch. The western part is already under mass tourism flourishing and also there is noticeable beach lowering or coastal erosion. This kind of situation can be coped up with the help of the local inhabitants and only through Integrated Coastal Zone Management.

According to ICZM Principles by UNEP 2009, the coastal area is a unique resource system which requires special management and planning approaches. Water is the main integrating force in coastal resource system. It is essential that land and sea uses be planned and managed in combination. The edge of the sea is the focal point of coastal management programs. Coastal management limitations should be problem based and adaptive. A major emphasis of coastal resources management is to conserve common property resources. Avoidance of destruction from natural hazards and conservation of resources should be combined in ICZM programs. All the levels of government within the country must be involved in coastal management and planning. The nature-synchronous approach to development is especially appropriate for the coast. Special forms of economic and social benefit evaluation and public participation are used in coastal management programmes. Conservation of sustainable use is a major goal of coastal resources management. Multiple-use management is appropriate for most coastal resources systems. Multiple-sector participation is mandatory for sustainable utilisation of coastal resources. Traditional resource management should be respected. The environment impact assessment approach is essential to effective coastal management (Clark, 1992).

The integrated management approach should not only be applied for general coastal zone management but also for special sectors such as coastal tourism. The importance of tourism in ICZM process is much greater in tourism dependent region. Tourism is one of the principal economic activities strongly identifying the economy of the region. The need to develop tourism directly affects the development of agriculture, trade and traffic, infrastructure and communication. In ecologically sensitive areas development of all other activities has a strong impact on the development of tourism. Therefore it's necessary to harmonise the overall development planning, even in areas where tourism is not much significant. Beach management a new discipline developed within ICZM deal with all safety

factors, but also with landscape quality and management. At a certain region, as a whole, risks becoming less competitive in the tourist market due to the excessive degradation of the environment, environmentally sound coastal area planning and management emerges as a basic prerequisite for the further development of tourism.

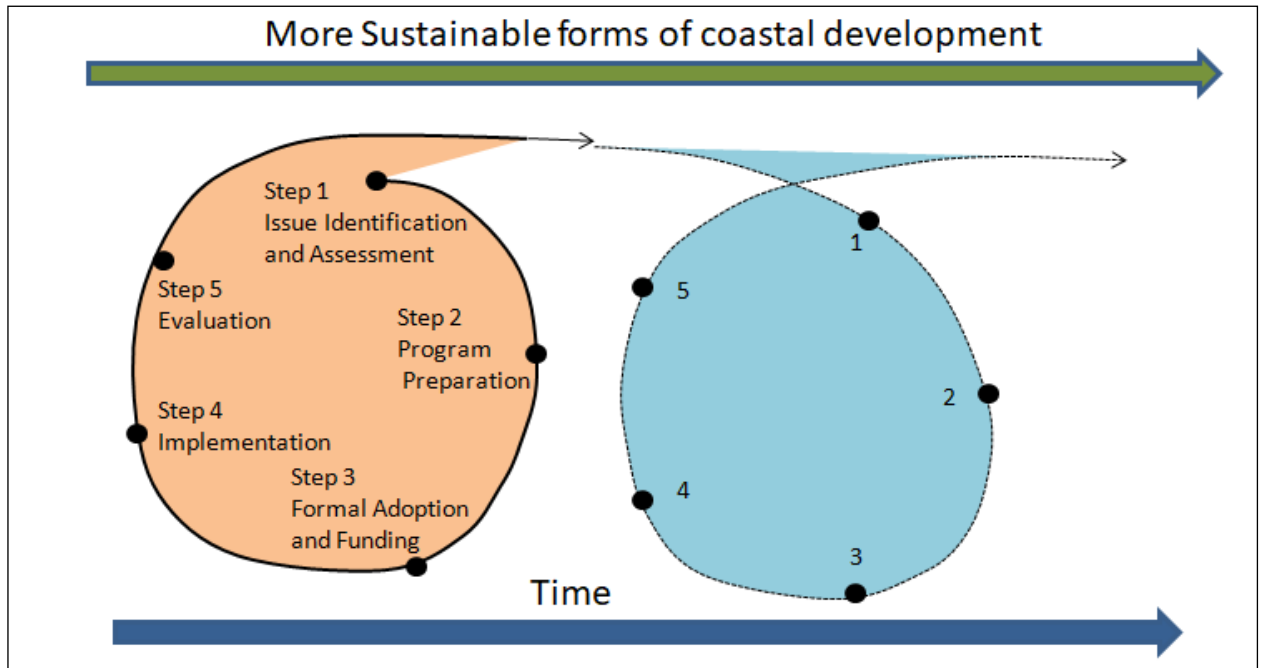


Figure 4.1: Stages of ICZM cycle (GESAMP, 1996)

ICZM West Bengal, Principles and Key Design Features are recognition and acknowledgment of cross-sectoral issues, protecting ecosystem for sustainable livelihood generation, ensuring habitat protection for sustaining bio-diversity, respecting the rights of coastal communities over coastal resources, protecting the environment adequately, promoting sustainable and rational use of coastal space. In the Belabhumi project by Integrated Coastal Zone Management Program, West Bengal (ICZMPWB) implemented at Sagar Island the main motives behind this arrangement are Capacity Building, Construction of Micro Coastal Infrastructures as part of Entry Point Activities and Promotion of various trade specific livelihoods through Income Generation Activities (IGA). According to the stages of ICZM cycle (Figure 4.1) there must be a constant identification, implementation and evaluation process going on to keep up with the input and output of a system working on. There is a deliberate infrastructure development, community building, solid waste disposal and various co-operative works being implemented on the Sagar Island. ICZMPWB along with Digha-Sankarpur Development Authority is undertaking varieties of project works including construction of storm water drainage system, development of beach beautification like watchtower and gardens and waste management facilities. As has been considered by the

State Government that Digha-Sankarpur Development Authority are extending their development works to Mandarmani and Tajpur also. As the study area is in very sensitive stage so environmental zoning approach is suggested for further management work.

The geo-environmental zoning depicts an important approach in the territorial management. However it requires a logical and structured procedure. Therefore, an approach using physiographic compartmentalization is proposed and applied as case study in a region covered by topographic maps of Mandarmani coastal tract. This region has great geomorphological and ecological peculiarities, beyond being a place with large human interventions because of its quick economic growth.

4.3.Outcome

The repetitive downfall of cyclonic storms or deep depressions each year in the coastal stretch is posing a serious threat to the social, economic and environmental setup of the region.

Following the UNEP principles of ICZM, West Bengal Government has been pursuing some of its visions but taking into consideration the dynamic coastline of Bengal. But the exception is again for the coast of Mandarmani. The ICZM regulations have been implemented in the adjacent coastal tract of Digha.

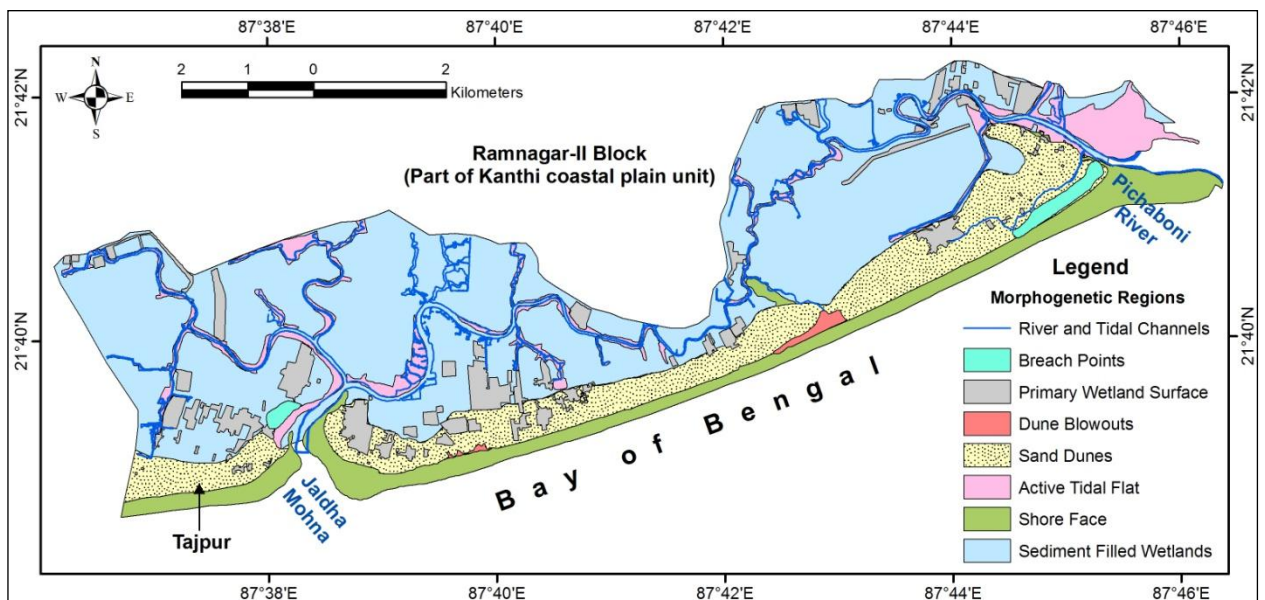


Figure 4.2: Morphogenetic regions of study area

The CRZ amendment is taking a direction towards the society and their habitat. So the human encroachment towards the mangrove forest, beach-dune complex, tidal creeks, near shore regions are considered as much more sensitive and need more concern. A CRZ map (Figure 4.3) for the study area has been generated to point out the do's and don'ts of the region which is primarily based upon the morphogenetic regions (Figure 4.2) demarcated from past study.

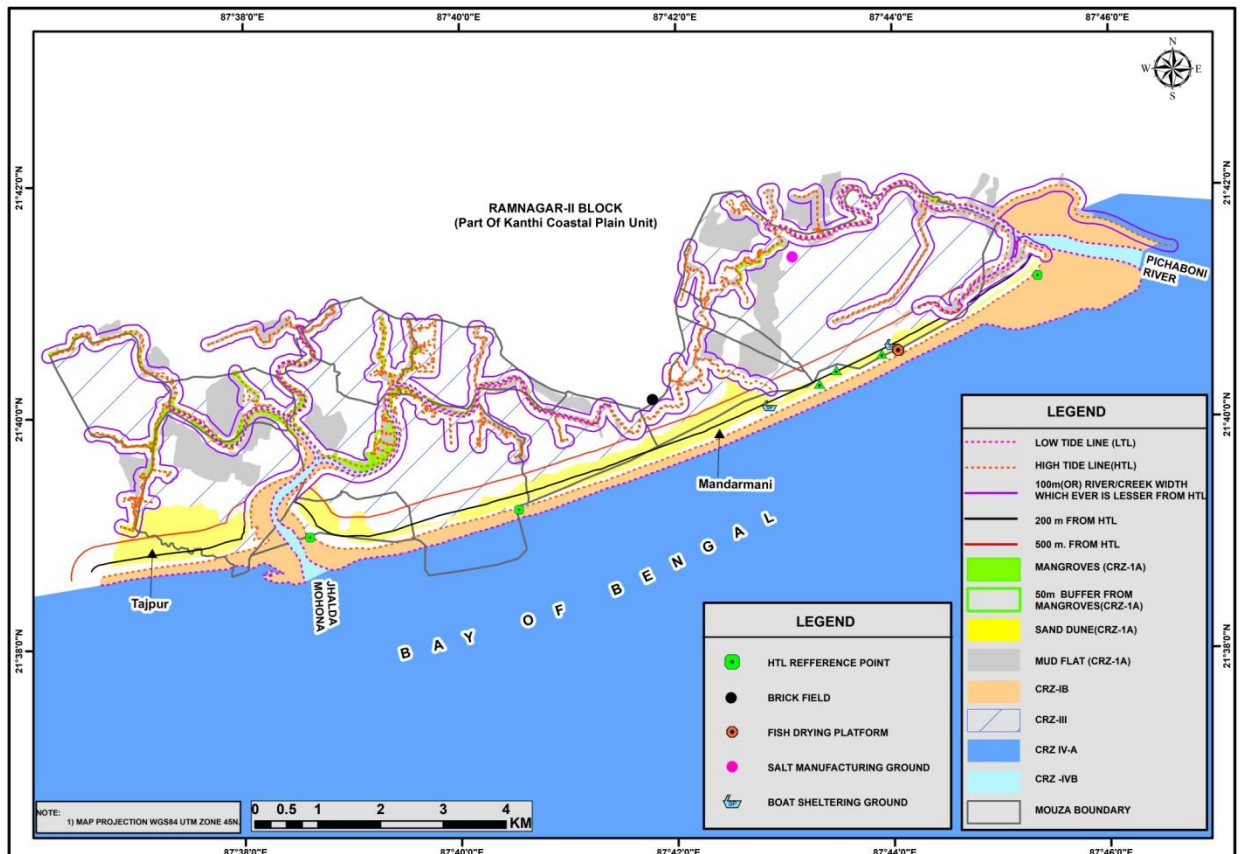


Figure 4.3: CRZ map of study area

The CRZ map is not the solution for every region. Actually the problem must be solved region specifically. The environmental Zoning approach (Figure 4.4) is the solution for most of the above mentioned problems. Each zone will take into consideration particular problems in the backdrop of a topographic setting. In this Environment Zones no relaxations are to be given for Permanent Preservation Zone (PPZ). All the other zones can be permitted according to priority and preservation. Different regulations have to be set for different zones. The areas where the CRZ rule allows big businessmen to extend their hotels and resorts seaward, there this environment zones can bind them to act according to priority basis and also following the rules. Always the local inhabitants must be given more priority. They

have to be given permission to start home stay business in their own one-storey homes so that the economy of the area remains stable as well as the ecology won't be hampered due to excessive mass tourism. So home-stay tourism can be a part of eco-tourism initiative mainly in the eastern part of the study area in order to reinstate the balance of the area.

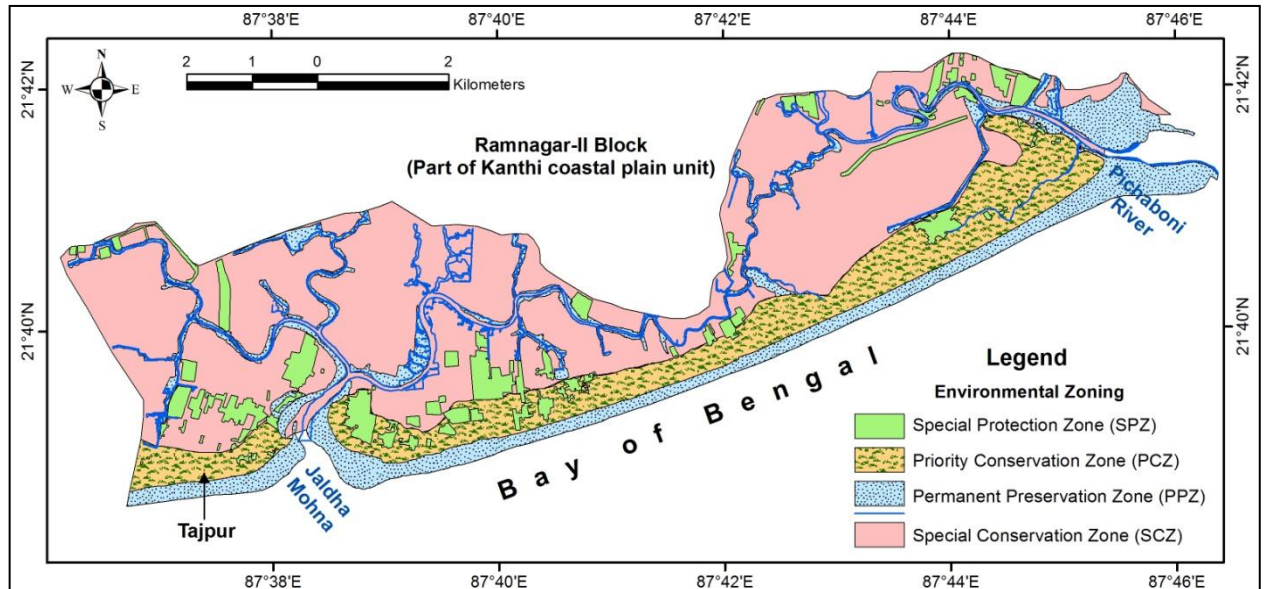


Figure 4.4: Environment zoning of study area

4.4. Discussion

Based on coastal zoning approach to coastal management in the part of Kanthi coastal plain the entire study area may be grouped into following zoning classes.

- 1) Buffer Zone, the area demarcated just adjacent to the PPZ and SPZ (Figure 4.4) is a necessary requirement. The buffer zone areal extent can vary between 50 to 100m depending in the item its preserving under adjacent PPZ. There must be an entry and exit barrier on human interference. But relaxation has to be maintained in case of livelihood protection.
- 2) Habitat protection zone is a very important zone for ecological diversity. As this is a land famous for red crabs and the dune creepers and scrubs community have to be given freedom to thrive without meddling around them or trying to destruct their ecological pyramid.
- 3) General use zone falls under SCZ where a sustainable development projects can be allowed with proper guidance from the local government. The stakeholders must act cooperatively to develop not devastate the zone.

- 4) No structure subzone is a part of the PPZ mainly at the intertidal zone, 200m from HTL of beach area and 100m from tidal channel area. The traditional activities with no permanent structures can only be allowed to flourish.
- 5) Wetland conservation park or zone are the areas undertaken by the government at the back dune area and these are the lowest elevation zone of the study area, even few are under mean sea level (MSL). It should be under constant watch that no encroachment of land use can enter its premises.
- 6) Tourism recreation zone is a zone for the economy of the region. But in order to develop the economy the ecology must not be vested. So no further extension of resorts and hotels are allowed both seaward and skyward. There must be a capping of entry and exit of tourist mainly during peak season. This can transfer a mass tourism site into a sustainable tourist site.
- 7) Traditional fishing zone is one of the main livelihood options among the locals. The sweet water ponds are where the people may engage for subsistence as well as commercial fishing and supply local farmed products to the nearest tourist area.
- 8) Vegetables and Rice Paddy cultivation zone have to be given a proper scope to maintain the whole lot of people residing and visiting this region. The sandy soil with a thin layer of salt blown with the wind helps various kinds of vegetables to grow. The flat and muddy soils of the regions beside tidal inlets are the best place for paddy farming (of course with an artificial embankment).
- 9) Salt manufacturing zone, or the Bengal Salt Factory of Mania mouza has its no existence at all. This factory has to be preserved and invested upon as it can give us a natural salt and also help the locals to get employed and retard out-migration.
- 10) Commercial Fish Farm zone is a very sensitive zone because it happens mainly in mass scale and also over the waters of near-shore region or Continental Shelf. There must be limit according to weight of fish catch and also size of them to make a scrutiny over the fishermen community. This can not only feed the local inhabitants and tourist but also it can be marketed in the outskirts of the study area.

Activities in zones may be allowed, allowed with permission, and can be applied in economic development, tourism or conservation situation of the region. This is a useful technique to manage the available resources and accelerate development activities in the sensitive coast.

4.4 Major Findings of the Research

From the Beach Stage Model it is evident that the Mandarmani beach is in a dissipative stage but with seasonal fluctuation the character of the beach shifts from dissipative to reflective.

Dune stability is interlinked with the beach status and the progradation and advancement of dune solely depends upon the moisture condition and the floral community.

People either depend upon the tourism industry or fishing or paddy cultivation and very few market gardening and livestock rearing option. Mostly the common people are migrating interstate or intrastate in search of other jobs. 187 hotels of Mandarmani coastal tract are mostly unscientifically constructed and exerted a negative impact upon the underground water table and which accelerates the intrusion of saline water table into the sweet one.

Moreover, the present study shows that there is the ample of livelihood options in the coastal belt dominated by wetlands (9 diverse types). Currently people have selected only 3 standard measures against the global environmental variability and local hazards and introduction of tourism development in the coastal belt since 2007.

Soil salinity, salt water flooding, shoreline change hazards has been rapidly increasing due to the over exploitation of land water and vegetation of the coastal belts. Salinity level is slowly increasing over time and causing serious threats to traditional agricultural practices, modern farming, vegetable gardening and mangrove ecosystem.

There is constant conflict between villagers and tourism sectors in terms of resource use of the low lying coasts. Some of the previous coastal disasters remind us what can happen if the landfall of the repeated cyclones produces salt water flooding, erosion and soil salinity in the coastal belt. Such hazards have long-term impact on socio and economic functions of the coastal environment. So we have to take some decisions which will improve the coastal resilience capacity with restoration of mangrove ecosystem, dune ecosystem and wide sea beaches.

The methodology of the study though has been tried to be framed as scientifically as possible, due to some data constraints there may be some lacking between the accuracy and approach of the research.

The major prospect of this study is to carry out an extensive total station survey, quantifying the morphological features through GIS techniques, depicting the socio-economic

picture of the area and implementing the physical model for the betterment of the human society and the Mother Nature.

4.5.Recommendations

The study on beach stage and dune stage models represent the nature of morphodynamics and surface instability over such low lying dune fringed coast. The development and expansion of tourism recreation activities should be concentrated in a specific region under environmental regulations.

The partially degraded wetlands of salt marshes and mangroves of the embayments and backshores should be restricted for conservation uses in environmental zoning approach.

The livelihood diversity is getting reduced under the stress of climatic hazards, geomorphic hazards and hydrologic hazards. The encroaching saltwater flooding sand movement and salinity of aquifers are directly hindering the possibility of multiple options for selecting livelihood practices by the local people in the coastal belt.

The sets of data from morphometric measurements of forms on the shore and near shore allow us to provide information of basic importance to forecasts erosion/accretion processes and to take necessary measures henceforth. A detailed study on the land use pattern, hydrological parameter, human activities and other processes taking place has been integrated with GIS in order to monitor the dynamic nature of the sea and the adjacent coastline.

The well managed market gardening in the villages of the sea shores and environment friendly aquaculture practices by the local people can support the demand of tourists and tourism area as supply of marine foods and vegetables. The sea shells gathered by the local people on the sea shores can be utilised as raw materials to produce handicrafts and edible lime in this area to support the tourism demand.

Finally, the tourism process should be directed towards eco-tourism expansion to reduce the impact of mass tourism on local environment and to restrict the use of available natural resources in such fragile environment for sustainability. The tourism dependent marine food productions and agricultural productions are the only solution to engage the local people in tourism process. Another way of participation of the local people may be introduced in the form of hospitality services and homestay accommodations for the specialised visitors in the coastal belt.

4.6. Conclusion

The environmental zoning approach in management of low lying coast can be acceptable for specific uses of the diversified lands and their habitats. The coastal regulation zones can be followed on the basis of environmental zoning approach to reduce the negative effect of tourism development. The preservation of wetlands sand dunes and sea beaches are immediately needed to restrict the impact of tourism infrastructural development. Eco-friendly restaurants, hotels, reduced use of ground water and shore protection measure are essential to tackle the advancing sea.

The beach behaves like seasonal dissipative character and sometimes may be eroded very significantly by beach lowering and dune scarping at the episodic storms. Similar sea beaches are also useful for the tourism and recreation leisure. The low lying flat sea beach is highly vulnerable to the advancing high tides, when the development of rip cells and strong long shore currents produce hazardous environment for the sea bathing of tourists. Such low lying sandy beach should be used in the low water stage by the tourists to reduce the drowning cases. No artificial structure should be constructed on the beach front locations at this moment. The tourism development and other infrastructural projects should cooperate and adjust with the dynamic behaviour of the sea.

The topographic micro zonations have indicated the variability of fore dune development and extension of back shore sandy tracts of the region. They are gradually diminishing because of their over uses and landuse alterations through moisture losses and floral damages at this part of the low lying coast. The indigenous plants should be utilised for binding the sand movement in the remote areas.

The tourism infrastructures should be relocated behind 200m distance from High Water Line (HWL) for the sustenance of younger sand dunes along the shoreline. All the hoteliers should obey the restrictions of ground water uses in the shoreline as per CRZ rules.

The livelihood opportunities can be improved by peoples' participation in the tourism process in and around the coastal belt by reducing the conflicts between the visitors and local resident people and by producing and supplying the required products for the tourists.