

CHAPTER VII

SUMMARY AND CONCLUSIONS

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7.1 INTRODUCTION

After examining problems emerging in the coastal zone, the present chapter adds voice to the growing lobby for integrated coastal zone management and examined the potential role of participatory management in achieving the aim of integrated CZM for Tuticorin coast. Here summarizing the thesis and encapsulates findings of the study are dealt in brief. Also considered the implications of the findings in terms of policy perspectives and implementing strategies. The first part of this chapter is the summary; the second part is the findings and the third part provides to assist the organization of environmental information and thus to contribute to the concerted preparation of management plans which could be implemented by all the environmental actors, such as decision-makers, policy makers, administrator, managers, users and scientists. The implementation strategies and suggestions for future studies are also given in last part of this chapter.

7.2 SUMMARY AND FINDINGS

- Conservation and management of coastal land resources and society have transformed the self-regulating character of land and its coastal ecosystem into a deep concern for rehabilitation. Considering all these factors, the area is peculiar and it is highly sensitive to the changes because of its unique geomorphological, meteorological and soil conditions. The impact of all these factors leads to the changes in economic and social constraints. Thus there is an urgent need to study each of the land facets of coastal land. Delineating the coastal sectors and identifying the ecosystems and ecological mapping units for analyzing the advantages and disadvantages of land requirements and land characteristics are the most vital research activities. Therefore the study aims to drawing up an *Integrated Coastal Zone Management (ICZM) for Tuticorin coast* so as to be able to manage and develop its coastal zone in a sustainable manner by having the following objectives:

- To demarcate *coastal sectors* and to identify the different *coastal eco-systems*, a relatively self-contained system composed of a natural community along with its physical environment.
 - To evaluate the present strengths and weaknesses of physical attributes of land, land use and land utilization types of each coastal ecosystem in a way that bring out the lacunae and point out the desirable package of (land) suitability.
 - To study and understand the socio-economic characteristics of the farmers/people of the area and to determine how their utilization of land (littoral and terrestrial space) / coastal ecosystem speaks of their related management characteristics in the present landuse circumstances existing.
 - To formulate management strategies, policies and a planning methodology for different coastal ecosystems of each sector.
- The Tuticorin Coastal Zone of Tamil Nadu state has an extent of 1,489 *sq.km* (*land portion alone*) comprising of Tuticorin (*Toothukudi*) and Ramanathapuram districts of Tamil Nadu state covering 127 villages and 21 islands. The coastline stretches for 196 km. It runs in the N-NE direction from Tuticorin to Dhanuskodi. The elevation is less than 30 m above MSL of which most of the area lies below 2 m contour line.
 - The study area comprises rocks and unconsolidated sediments from Archaean to Recent and unconsolidated sediments deposited during Recent to late Pleistocene epochs. These sediments have been classified as fluvial, marine and fluvio – marine which occupy 19.3 per cent, (274.96 *sq.km*) 53.53 per cent (762.61 *sq.km*) and 10.76 per cent (153.35 *sq.km*) respectively.
 - The coastal zone is drained by the Vaigai, Gundar, Vaippar, Kottagudi Ar, Pal Ar, Korrapallam Odai and Madikettan Odai. They debouch their surplus water into the Gulf of Mannar.
 - The area is carved by fluvial, fluvio-marine and marine land forms. They are the major ecosystems of the Tuticorin coast. They were demarcated and interpreted from remotely sensed data and confirmed subsequently by field work.

- The mean annual rainfall of the study area is about 690 mm. It is characterised by significant variations in the quantum of mean annual rainfall. The mean annual rainfall varies from 542 mm (*at Tuticorin*) to 826 mm (*at Pamban*). The high rainfall zone (>775 mm) includes the entire Rameswaram island and most of the villages of the Ramanathapuram taluk whereas the moderate rainfall (700-775 mm) is found in the south extending upto the area just south west of Pal Ar and Valinokkam. This zone is followed by the normal rainfall zone, further towards south west extending upto the area of east of Vembar. Further south, all along the coast, it is followed by the low rainfall zone, which extends in an arcuate shape extending upto the area just north of Tuticorin. Below this zone, further down south, lies the zone of very low rainfall. Most of the villages of the study area that lie in Tuticorin taluk fall very low rainfall zone. In general, the mean annual rainfall is maximum in the north eastern part of the study area (*in Rameswaram island*) and it gradually decreases all along the coast towards the south.
- The study area has a hot tropical climate. The months of April to July are the hottest. The heat declines to some extent on the out break of northeast monsoon. The mean minimum temperature varies from 18°C in January to 26.5°C in June, and mean maximum temperature from 38°C in May to 30.5°C in December. The relative humidity is 79% on an average. It ranges between 80% and 90% in coastal area.
- The study area has four soils orders namely, *Entisol*, *Vertisol*, *Inceptisol*, and *Alfisol* as per the USDA Classification. Altogether 16 soil series are distributed throughout the study area.
- The spatial land uses of the study area were brought out based on IRS 1D (LISS III) FCC image with field work following the NRSA guidelines. Accordingly, built up lands, agricultural lands, forests, wastelands, water bodies and others contribute 4.6, 48.6, 6.5, 30.7, 6.8 and 2.9 per cent respectively. The Tuticorin, Sayalkudi, Kilakkarai, Tiruppulani, Madapam and Rameswaram are the small urban centres.
- The land use data (maps) and collateral data including precise material regarding the study area are the baseline information used to identify and describe the land utilization types. The crops already under practice have been

taken into account for identifying the Land Utilization Types (LUTs). Based on village-wise crop strategies and the primary survey of the socio-economic conditions such as crop conditions, labour intensity, technical knowledge and attitudes of farmers, mechanization of the farms, size and shape of the farms, cropping characteristics, material inputs, cultivation practices, management, yields and market orientation of the farmers, LUTs have been described according to the FAO procedures (FAO, 1983: Rainfed Agriculture). Accordingly 16 LUTs were identified in the study area. **Cropping System under Fluvial Land** is by the deposition of fluvial sediments. Paddy is the major crop in the fluvial land. **Cropping System in Fluvio-Marine Land** is generally practices Sorgham and other small grains, **Pulses Cropping System** is being cultivated with Grams, **Oil Seeds Cropping System** is dominated by *Ground nut, Sunflower and Gingelly* and in **Fiber Cropping System** cotton is one of the most important commercial crops. Sugarcane is the principle crop under **Commercial Cropping System** which accounts for 6 per cent of the total agricultural area and depends on sugar mills of Tamil Nadu and it is a prominent cash crop. **Condiments and Species Cropping System** is dominated with Chilly as cash crop in the study area. The banana cultivation comes under **Fruit cropping system** which is mainly practiced in the “*Effective rainfall*” and “*effective temperature*” climatic zones with rainfall of 100 mm through out the season. Similarly, the effective temperature through out the season is 27° C or higher. **Marine Land Cropping System** is purely controlled by the coastal environment mainly salt tolerant crop. Horticulture crops are mostly practiced in this system. The Coconut, the Palm, and the Casurina are the major tree crops under **Plantation Cropping System**.

- The population of the study area is **5,49,956** persons of which 35 percent is concentrated in Ramanathapuram taluk (*1,90,995 persons*), Tuticorin taluk accounts for (*86,271 persons*) 16 per cent. Ottapidaram, Vilathikulam, Kadaladi and Rameswaram taluks constitute 49per cent of the total population.
- The density of population is 358 persons per square kilometer. However, there is a wide variation in the population density among the taluks. The density is maximum in Rameswaram taluk with 772 persons per sq.km followed by Tuticorin 529 persons/sq.km and Ramanathapuram 444 persons/sq.km taluks.

In Kadaladi and Vilathikulam taluks it is lesser with 317 and 134 persons/sq.km respectively while the density is noticed in Ottapidaram taluk which has only 174 persons/sq.km

- Sex ratio is 969 for every 1,000 males. Similar trend is observed in Ramanathapuram (905), Rameswaram (936) and Kadaladi (989). The sex ratio is above 1000 in Tuticorin (1043), Villathikulam (1,029) and Ottapidaram (1,018) taluks respectively.
- About 73 per cent of the populations are literates. It ranges from 76 per cent to 58 per cent. The maximum literacy is 76 per cent found in Tuticorin taluk followed by Ramanathapuram taluk 70.23 per cent, Rameswaram taluk 68.42 per cent, Ottapidaram taluk 65.82 per cent, and Vilathikulam taluk 65.80 per cent. The literacy rate is least in Kadaladi taluk which accounts for 58.4 per cent. The non-workers constitute about 57 per cent of the total population. Main workers and marginal workers constitute about 32 and 4 per cent respectively.
- The study area is well connected by the road and rail. The National Highways (NH) No.49 which connects Madurai and Rameswaram passes through the northern part and NH7A passes through the southern part of the study area which connects Tuticorin and other parts of the state. There is a coast guard air port which serves only for defence.
- The hierarchical Ecological Land Classification (ELC) of Tuticorin coast is derived based on a conceptual model known as the geomorphic land classes, which was developed in Intergovernmental Oceanographic Commission (IOC) and is widely used as a framework for resource management and land evaluation procedures for scientific research. While preparing such evaluation table the additional details like geology, relief and rainfall have also been taken into consideration and the same is discussed in the fourth chapter which analyses the various levels of Coastal Zone (CZ), Coastal Origin (CO) Coastal Ecosystems (CE), Coastal Ecological Mapping Unit (EMU) and Ecological Land Unit (ELU). After aggregation of TCOSYS layer, the study area is further grouped into three different landform origins from the natural processes such as *Fluvial*, *Fluvio-Marine*, and *Marine* origins. The fluvial origin contains seven different coastal ecosystems namely, *Deep Buried*

Pediment, River, Natural levee, Alluvial Plain, Deltaic Plain and Delta. Estuary and Shoal coastal ecosystems form *Fluvio-marine* origin. There are eighteen ecosystems in *marine* origin namely, *Sandy Plain, Coastal Plain, Swale & Ridge Complex, Stabilised Dune, Coastal Sand Dune, Sandy Beach, Marine Terrace, Spit, Cliff, Sand Bar, Creek, Salt Flat, Mud Flat, Tidal Flat/Inlet, Tombolo, Islands, Lagoon/Paleo lagoon* and *Coral Reef*. These coastal ecosystems are the planning units and also the environmental indicators.

- The ecological land unit (ELU) is the largest scale in mapping units.
- The building of a **coastal zone management planning model** is sculptured by the GIS Aggregation of the TCOSYS layers in order to suggest the appropriate management.
- Land suitability for each ELU of each EMU was conducted by matching land characteristics using land evaluation techniques and by taking the limiting factor into consideration. Land suitability evaluation for each sector has been assessed by coastal ecosystem, ecological mapping unit, relief, geology, soils, land use/ land cover along with land characteristics and suitability classes for selected sixteen crops with their remarks. The maps and the weightages of composite layers were obtained and followed with the physical suitability map at five classes (S1, S2, S3, N1 and N2) which determine the quality of land characteristics. Accordingly, highly suitable land accounts (S1) for 23,741.42 ha, moderately suitable (S2) 41,368.94 ha, marginally suitable (S3) 28,592.88 ha, currently not suitable (N1) 14,866.90 ha and permanently not suitable (N2) 40,296.47 ha which represent 16%, 28%, 19%, 10% and 27% of the total coastal land area respectively. Currently not suitable land for particular crop could be improved into suitable land by removing the limitations.
- Ecosystem based management brings together the collated experience and wisdom of many subdivisions (village level) and individuals (participatory) and helps to get started on a coastal strategies including, planning activities management practices and policy matters. It purely speaks about only the land (inland) area of the coastal zone (not any water area of the sea zone since it is one man study). A total of 27 ecosystems were brought under four

management zones by integrating their relief, rainfall, geology, soil and land use/land cover with their different factor loading.

- **ECOSYSTEM UNDER CRZ IV:** It is a wider zone of influence, often few many kilometers wide from the shoreline, which influences the management of coastal zone directly or indirectly. About 63.6 (939.45ha) per cent of area comes under the sustainable zone which consists of three ecosystems such as Deep buried pediment, Alluvial plain, and Natural levee.
- **ECOSYSTEM UNDER CRZ III:** These are lands brought under conservation zone covering an area of about 7.6 per cent (112.58sqkm) which includes the four ecosystems such as River, Delta, Deltaic plain and Flood plain ecosystems.
- **ECOSYSTEM UNDER CRZ II:** The area about 29 per cent (424.47 sq.km) of marine land is under Protection zone management for Sand dune, stabilised dune, swale & ridge complex, coastal plain and sandy plain. The ecology of the organisms that inhabit in these regions are extremely important if humankind is to conciliate the use of the environment with preservation of ecological processes so as to take advantage of the services provided by these five ecosystems.
- **ECOSYSTEM UNDER CRZ I:** Sensitive/Marine Protected Environs: It is a critical zone or a narrow band of land and sea with a few hundred metres wide, adjacent to the shoreline, usually of highest ecological value and subject to intense pressures for development. Awareness about 15 ecosystems come under this CRZ I (*Lagoons/paleolagoons, Beach, Creek, Salt pan, Mud flat, Cliff, Estuary, Shoal, Spit, Tombolo, Tidal flat, Sand bar, Islands, Marine terraces and Coral reef*) to be created among the coastal communities in the study area, in order to protect and conserve the coral reefs through effective involvement concerns.

7.3 SUGGESTIONS AND RECOMMENDATIONS

The anthropogenic activities have put tremendous pressure on the fragile coastal environment. To protect the coastal community, from the various disturbances and propagating the natural protecting systems such as mangroves, coral reefs, shelter

belt plantations, along with installation of early warning systems, may be suggested for various coastal protection plan brought under the present study by the suggested CRZ's or Coastal Management Zones. The Tuticorin coastal zone covers the total area about 1,488 sq.km, and it consisting of four management zones formulated by the present study such as Management Zone I comes under the Ecological sensitive areas or CRZ I, this zone usually impact by coastal hazards. This sensitive zone is 23.23 per cent (34,578 ha) occupies in whole study area. And this buffer zone also comes under tourism zone. The Management Zone II activated by Terrestrial Developed areas: It suggested in the area where exotic plantations have been raised at CRZ II, it almost 22.90 per cent (32,741 ha) of the study area. Management Zone III land is called undisturbed areas or CRZ III accordingly, the vacant or the land waiting some other purpose is 22 per cent (34,093 ha) under this coastal zone. Management Zone IV sustained by agricultural productivity land is called undisturbed areas or CRZ IV. Accordingly the productivity land practiced 31.87 (34,578 ha) under this coastal zone.

7.3.1 Management Zone I (CRZ I - Ecological sensitive areas)

This zone including National Parks, Sanctuaries, Reserved Forests, Mangroves, Estuaries, Corals, areas close to breeding grounds of fish and other marine life, areas of outstanding natural beauty. There are about 60 fisheries villages along the coastal part of the biosphere reserve which support some 100,000 people (200,000 seasonally). The highest concentration of sea-grass species lies along India's coast. The shallow water of this reserve has 147 species of seaweeds (algae). It is necessary to create awareness among the coastal communities in the study area. It should be noted that the above said importance concerned under CRZ I is not to be followed the tidal line as the base instead of the ecosystem boundary should be base for demarcation. This sensitive zone is distributed for 23.3 per cent (34,578 ha) of the study area. This boundary will be helpful to manage to their important features by having awareness programmes, participatory approach, etc., at village level.

Fishing Regulations

- Mechanized fishing vessels should not be allowed for fishing in the territorial waters for a period of 45 days during the monsoon season, starting from 15 April to 29 May every year.

- According to the small-scale fishermen, pair trawling is one of the most destructive fishing techniques in the Gulf of Mannar region, as it is known to catch large quantities of pelagic fish without any discrimination of size.
- Though pair trawlers are banned, still they are under operational during lean periods, both in Pamban and Rameshwaram landing centres.

Over fishing

- Total fishing effort going 3 times over the maximum sustainable level
- Commercial fishing encroachment along the coastal boundary depriving small fishers sustainable livelihood from fishing

Destruction of coastal habitats

- Mangroves being rapidly depleted due to harvesting for charcoal-making and conversion into aquaculture ponds, settlements and urban sites
- Destruction and degradation of coral reefs largely due to dynamite fishing, use of beach seine and cyanide.
- The fishermen are instructed while sighting the sea cow where the seagrasses are in abundance.

Water Pollution

- domestic wastes, effluent and sewage from urban centers of Tuticorin, Kilakkarai, Mandapam and Rameswaram have considerably contributed to high nutrient loading of coliform counts of waters near urban areas

Coral Reef Protection and Management

- Providing relevant government agencies with more manpower and equipment
- Promoting interagency cooperation
- Revising unclear and outdated laws and regulations and adopting new ones
- Enhancing local participation in coral reef management

Recommended actions for the protection and rehabilitation of coral reefs

- Establishment of Fish Sanctuaries
- Prevention and Control of Soil Erosion
- Prohibition of Coral Collection
- Establishment of Permanent Mooring in Strategic Places

Mangrove Forest Management and Development

- Rehabilitation of degraded mangrove areas near Kadaladi and Mandapam

Recommended actions for mangrove management and development

- Enforcement of rules and regulations pertaining to mangrove forest protection
- Preparation of community-based mangrove resource management plan
- Rehabilitational reforestation of degraded mangrove areas
- Identification of alternative livelihood projects
- Establishment of mangrove reservation along the swampy
- Non-conversion of existing mangrove forest into other uses

Sand Mining

In this context, before taking up any coastal sand mining activity, the concerned agencies must ensure that the *targeted areas are not important habitats of any marine fauna*. These sensitive coastal stretches need to be identified, properly marked with site boards and labels and removal of sand from such zones or primary dunes should be completely prohibited.

- Must be proceeded by proper impact assessment studies conducted by the development agencies in collaboration with the coastal resource management authorities including environment, forest and wildlife agencies. If sand extraction from the landward side of the berm is permitted, it should be carefully conducted avoiding the main nesting season of sea turtles and other rare and endangered fauna, and hard engineering exercises must be stopped at night.
- Sand mining activities must ensure adequate control to prevent sedimentation of watercourses from spoil deposits and other disturbance on the land surface.
- Sand fill and other restoration processes need to be monitored to confirm whether such restoration processes actually rehabilitate sand dunes, and whether the new fill is compatible with the needs of nesting sea turtles and other coastal fauna and flora.
- The coastal and nearshore marine environment, sea sand in particular, is a source for a variety of minerals of geological and biological origin that have been extracted and utilized by man for centuries.
- The mining or extraction of these minerals, however, tends to be unplanned and unmanaged causing severe and long lasting detrimental impact to the environment.

- Sea beaches are dynamic landforms and are constantly subject to erosion and/or accretion. The sand on the beach is subject to storms, waves, and buffeting from the force of sea waves.
- This in turn results in the movement of sand from one part of the beach by erosion and accretion of the same sand in another region. The condition of a sea beach is the reflection of the local balanced or unbalanced gain due to deposition or loss due to erosion. While natural beachfront and sea erosions do occur, anthropogenic alteration of the beach has significantly contributed to beachfront erosion.
- Therefore, beach conservation should be based on the premise that any removal of sand can have adverse impacts by disrupting the natural cycle.

Ports, Harbours and Jetties

Port, harbour and jetty development facilities on the coastline are required for the shipping industry, offshore oil and gas development, marine fisheries operations, naval and other military operations, and navigation. Major impacts of such developments are

- Shrinkage of natural coastal habitats,
- Dredging and destructive disposal of dredge spoils,
- Obliteration and destruction of nearshore benthic ecology
- Increasing spills and pollution and
- Increased coastal illumination.

Management Considerations: Specific area objective Outline

- Maintain the different characteristics of each ecosystems and landscape to protect the unique habitat.
- to provide facilities and opportunities for purposes of formal and informal education, research for monitoring of the coastal zone.
- to provide opportunities for healthy and constructive outdoor recreation, without hampering the naturalness of the zone.
- Restore the habitat for the endangered species by keeping away biotic influences.

Priorities and Justifications

The coral reef and lagoons, estuary, mudflat ecosystems and various marine organisms depending on these unique habitats have to be maintained for posterity without any destruction. This gets the top priority among the objectives.

The various natural areas in addition to preserving the ecosystems for posterity must also be used for importing conservation consciousness and love for coastal environs among the public. Research and monitoring of the various factors constituting the environment has to be done to assess the various biological phenomena and also the effectiveness of coastal management.

The unspoiled environment can provide healthy and constructive outdoor recreation for interested visitors. These recreational facilities will be so controlled as not to hamper the naturalness of the area.

Biotic influences like flood, cyclone will be kept under control, to restore the habitat for the management for the endangered species like Dugong, Sea cucumber. The planned location of ports, harbours and jetties close to or on marine organism sites and breeding congregations directly impacts their populations in addition to permanent loss of their nesting and congregating habitats. Sea turtles also lose important foraging grounds when large scale dredging operations destroy the seafloor. The increased navigation of ships, boats and other vessels directly interferes with the migratory routes of marine habitats. Since marine habitats are known to have strong affinity and fidelity to their natal nesting beaches, any infringement on their migratory route will have an impact on their reproductive cycle as well as disorienting them from their breeding and congregating grounds.

Encroachment

- The CRZ I is surrounded by natural divisions on all sides.
- They should be protected without any encroachments.
- It must be control and monitoring will be given top priority.

Beach Armouring

The deliberate ‘armouring’ of the coast with the sole purpose of protection of upland structures is rapidly degrading sea turtle nesting habitats in many parts of the country. Sea beach erosion has been a problem especially along the Vallinockam beach in the Kadaladi sector and Kusi beach near Sattakovan valasi, Mandapam

sector. Therefore this coastal armouring may be constructed as it exhibited in many different forms such as

- bulkheads and seawalls
- Revetments
- sandbags and geotextile tubes
- soil retaining walls for control large waves
- dune reconstruction for protection sea waves intensity
- develop defence training centres in all islands for nation protection
- To mitigate erosion, beaches have been armed with concrete tetrapods and sand bags along the coast, like the Kerala Lakshadweep and Andaman & Nicobar Islands.

Early Warning Systems of Coastal Disasters

- Enhancing the Capacities as well as Effectiveness of Early Warning Systems of Coastal Disasters
- Put in place the mechanisms for regional cooperation to enhance the quality of the forecast of storms, tsunami, coastal floods and storm surge in line with the best practices forecast capacities in the region and the rest of the world.
- Mapping of coastal risks in areas, provinces, districts and critical zones for proactive prevention, disaster risk assessment and policy formulation.

Mitigation

Structural and non-structural measures (shelters, Coastal Resource Management etc)

- Sustainable and integrated land use planning to minimize exposure to risks
- Identifying evacuation zones and protecting evacuation routes to identified safe areas
- Identifying buildings for approved vertical evacuation
- Reduce exposure of critical infrastructure to risk including possible relocation
- Siting, design and construction of building and infrastructure considers risks from coastal hazards and protects sensitive coastal habitats
- Management of sensitive coastal resources and natural protective features to reduce risk (eg. Mangroves, coral reefs, etc...)
- Redevelopment policies and systems in place to guide post reconstruction away from high risk areas

Enforcement of construction guidelines and building codes

- Commitment to promote best practice guidelines and adoption of model building codes
- Land use planning and building codes

Information sharing regionally

- Establish structure and mechanisms for information sharing on coastal and marine risk reduction,
- Development and testing of tools to exchange information e.g. internet links, knowledge portals etc,
- Promote and encourage – Scientist to scientist interactions & information sharing; (ii) institution to institution partnerships, and (iii) Government to government cooperation both on bilateral as well as regional level facilitating R&D, better operational strategies, more effective S&T products and services in support of reducing marine and coastal risks along the coast
- Organize the working groups on risk assessment, inundation modeling and interoperable warning system issues through regional cooperation.

Habitat Improvement

- By controlling encroachment, the damage to the habitat will be controlled.
- By constructing boundary checks across the lagoons, sanctuary, estuary and shoal ecosystem.

Management of exotic plantation

- The existing plantation of exotics like casuarina, acacia and coconut should not be disturbed.
- New plantations of exotics may be undertaken in the study area. The usefulness of these plantations are for coastal hazards, reduced cyclone intensity and regeneration of plants.
- While the beach itself is devoid of any vegetation due to the constant action of waves, the sand dune above the high tide line has various types of natural vegetation despite being subjected to wind action.
- Sand dune grass and other spiny vegetation trap blowing sand and help stabilize, maintain and elevate dune structures. There are also other salt tolerant creepers that help bind the sand. Behind the sand dune and towards the landward side are shrubs.

- The natural dune vegetation and sand dune structures are closely interrelated and have coevolved to support a myriad of floral and faunal communities obligate to the coastal sand dune habitat. However, in recent years, as a measure of control of beach erosion, creation of vegetation shelterbelts against cyclonic storms and afforestation of the coastal zone, large scale plantations of alien and exotic plant species have been taken up, without any impact assessment studies.

7.3.1.1 Management Program For CRZ I

In the buffer zone of CRZ I, all activities as per management objectives should be undertaken without spoiling the naturalness of the zone. In the management of Tuticorin coast, the local people should be involved in planning and implementing coastal policies and programmes. Involvement of local people would give a sense of awareness about the environment of the coast.

Road Network development

- Highways connect human settlements along the coast. In the process of construction of highways, coastal geomorphology is considerably altered.
- Engineering actions are often geared towards the highways rather than towards the natural coastal geomorphology and ecological processes.
- Deltaic drainages, coastal vegetation and the seashore sand dunes often get impacted irreversibly. Other than reducing natural coastal habitat, highways also bring in new impact factors not present in the areas before the construction of the highways.
- In the context of marine turtles, coastal highways on sand dunes have invaded sea turtle nesting sites, and highway illumination and vehicular traffic illumination have impacted marine turtles directly.
- With increasing access to the coast, human settlements crop up on the coast and along with human, their accompanying livestock and pets (dogs) cause considerable damage to the coastal ecosystem. Predation on adult and hatchling turtles gets enhanced significantly as the presence of subsidized predator's increases.

Recreation development

Active form of recreation

- Boating along the prescribed sea routes towards Islands may be followed to avoid the damaging the lands of littoral zones of Islands.
- Sea diving and pearl collection sites at Vallinokkam, Sippikulam near Vaippar and Kariasulli Tivu should be permitted on getting proper permission and payment of prescribed fees.

Entrance posts

- Sign boards and hoardings at all entry points of every CRZ's may be introduced for bringing awareness and understanding of the importance of coastal landscape.

Marine park literature

- Pamphlets, folders, stickers and view cards containing information about the coastal important may be brought out for educating the publics residing at Tuticorin coast.

Tourism Related Problems

- Conflicts between Vallinokkam and Rameswaram as they are under different local administration units which hinder the development of enrouting Rameswaram Island

Regulation of Tourism

- There will be strict regulation on the number tourists to be allowed to visit this area during festivals.
- Only natural loving tourists may be encouraged.

Development of visitor centers

- Information centers, tourist bungalow, information desk, Indoor exhibit centre etc., may be constructed at Mandapam for providing interpretive facilities to tourists.

Recommended Actions for Eco Tourism Development

- *Site, design and construction of facilities* – Soil erosion control measures should be implemented to reduce the loss of topsoil and run-off in waterways during construction

- *Set-back* -Development along beaches, a minimum of 60 meters from the mean high water line should be required. Development next to mangroves, a construction setback of 400 meters from the mangrove's edge is recommended
- *Sewage waste disposal* - Adequate measures for sewage waste disposal in all tourism developments
- *Water quality* - Developments adjacent to recreational areas should be evaluated on the basis of their cumulative impacts on the water quality and sea water intrusion.

7.3.1.2 Management of Threats and Endangered Species

On the Estuarine ecosystem to the habitat of during nesting, the female returns to the shore for a period of one to a few hours, depending on the species. Although the time spent on land is minimal, the beach serves as an incubator for the turtle eggs and is therefore a critical part of their life cycle. It is also a period when both eggs and hatchlings are most vulnerable to human related threats. Some sea turtles, like green and hawksbill turtles prefer to nest in Nallathanni Tivu Island, while others like olive ridleys nest in large numbers on sand spits near river mouths of Karampallam Odai estuary, Vaippar estuary and shoal. These nesting beaches are often dynamic in nature and are subject to several natural changes. Human related activities at these sites interferes or aggravates the process of natural change and may permanently alter sea turtle nesting habitats

Threats in Tidal flat/Inlet with the onset of the breeding season, sea turtles leave their foraging areas and arrive in the coastal waters of breeding grounds. Species like olive ridleys congregate in large numbers in the coastal waters off nesting beaches and spend nearly six months in a year in this habitat. Green and hawksbill turtles use shallow water lagoons as their developmental habitat during the juvenile and sub-adult stages of their life. These near shore waters are often subject to heavy use by human beings in terms of marine fishing, aquaculture, coastal tourism and other recreational activities. These coastal zones are also susceptible to indirect pollution from industrial or agricultural run-off. These activities impact sea turtles during various crucial stages of their life cycle.

7.3.2 Management Zone II (CRZ II - Terrestrial Developed areas)

The near far areas already substantially built up and which has been provide with drainage and approach road and other facilities, such as water supply and

sewerage mains which were present before 1991. Such areas cover 22.9 per cent (32,741 ha) of the study area.

A Campaign note in Sanctuary Asia (2000) warns the threats posed of the Gulf of Mannar Marine Biosphere by Sethu Samudram Ship Canal Project which entails the dredging of a canal to enable faster sea travel between the east and west coasts. Aside from the immediate area of the sea bed, the consistent churning of sediment will also smother the coral reefs. The increase in shipping traffic will inevitably result in an increase in oil spills and marine pollution. The area is already under stress from industries along the Tamil Nadu coast. Ash and effluents from the Tuticorin Thermal Power station, Salt and Marine Chemicals already pollute the rich marine eco system on here. So proper measures to take to conserve these natural ecosystems of Tuticorin coast. It also adds that the agricultures from the main land area are also switching over to fishing activities in a large scale due to consistent failure of monsoon rain and crops.

Water Quality and Land Use Management

- Management of water quality should take into account the land use pattern surrounding buffer zones

Recommended actions for water quality management

- Classification of all rivers/creeks that drain in Palk bay, Gulf of Mannar
- Coastal waters/salinity - a similar system of comparing existing water quality to beneficial uses can be used in the marine waters along the coast line up to Mandapam spit.
- The deficient soil-water conditions cause problems for crops grown on these sectors, notably poorly drained soils. In Mandapam sector, soils that make up about 40 percent of the total crop land. Yield reductions of more than 50 percent may develop from stress caused by excessive soil-water conditions on these poorly drained soils. This may result either (1) from the inability to plant and tend the crop at the right time due to poor trafficability or (2) from direct damage to the crop when water stands too long in the field. Excess water may also cause nutrient deficiencies due to eventual leaching or denitrification.

Legal and Institutional Issues

- Vague delineation of responsibilities
- CZM policies and roles of national and local are not clear among participants

- Not effective at managing jurisdictional coastal areas
- Lack of participation and mechanisms for mobilizing broad sectors of coastal communities
- Lack of political will

Flood control measures

- A new network of canal will have to be cut and maintained.
- Connect between Main River and linked tank or paleochannels have to be maintained for effective flood control.
- Flood control and monitoring will be given top priority.

7.3.3 Management Zone III (CRZ III – *Undisturbed areas*)

This will include coastal zone in the riverine lands, rural areas (*developed and undeveloped*) and areas within revenue limits where substantial development has not taken place. About 22 per cent (34,093ha) of the area fall under this zone. Deforestation along the coast and islands of Valinokkam to Dhanuskodi coastal stretch should be banned and may be taken up. Dumping of waste materials should be stopped in the coral reef ecosystem. Many mud flats are agricultural land which supports of conservation of bio-diversity and habitat, economic value, natural filters for water pollutants, waterfowl, protection from storms, and aesthetic values of the coastal zones are converted into agricultural land.

7.3.4 Management Zone IV (CRZ IV - *Agricultural areas*)

This will include wider zone particularly used for agriculture activities and areas within limits where substantial agricultural development has taken place. This agricultural land mainly depends on irrigation for cultivation. It could be developed by the respective organizations or governmental sector. Priorities give to agricultural activities rather than others. This zone covers an area of 31.8 (47,453 ha) per cent of the study area. However as this zone is mainly devoted for agricultural activities, the development programme like rainwater harvesting, water storage and tank rehabilitations may be encouraged to keep the zone under sustainable agricultural productivity.

7.4 POTENTIAL SITES OF TUTICORIN COAST

Accordingly there are 217 locations are grouped into six categories by considering plantations, endemic/threatened sites, marine productivities, natural hazards, defence/proposed sites and tourism as the indicators to arrive intensity of the potential accordingly:

- ✓ Very high at four sites brought under industrial and marketing
- ✓ High at 22 sites based on sea products
- ✓ Moderate at 134 sites with mixed categories
- ✓ Low at 32 villages based on agriculture
- ✓ Very low intensity sites are 25 vulnerable by the natural hazards.

Among the above categories, most of sites comes under CRZ III, whereas 150 sites are much closed to the shoreline (CRZ I) which carry more than five potential activities.

7.5 POLLUTIONS

One of the environmental factors is pollution of coastal waters and beaches are under constant threat from pollution originating from landward activities as well as from the sea. Such pollutants have often proved to be the primary cause of death of marine plants and animals.

Changes;

- Changes in water temperature and quality results in changes in their offshore breeding congregation locations.
- Changes in salinity profile and levels of organic and inorganic pollutants in the vicinity of mass nesting sites will impact adults and hatchlings.

Pollutants;

- In sheltered lagoons, organic sewage, nutrients and fertilizers tend to accumulate hasten the process of algal bloom and seaweed growth, changing the food chain composition.
- Sewage, nutrients and fertilizers discharge, heated water from power station and industrial plants are normally sewerage by the lagoons and offshore waters, altering the distribution pattern of microorganisms. This in turn impacts the distribution of organisms at various trophic levels.
- Petroleum hydrocarbons and crude oil from oil spills

- Considering the large volume of oil transported and high rate of tanker movement and establishment of oil refineries along the coast, the probability of acute and chronic oil spill is very high. There is severe damage to marine life worldwide due to oil pollution along the coasts.
- Floating crude oil in the immediate offshore waters get coated on the eyelids, nostrils and mouths, leading to mortality. This has been recorded along the Kilakarai.
- On nesting beaches, oil deposits could interfere with proper aeration of the nest and impair normal development of the embryos.

7.6 GUIDELINES FOR ECOFRIENDLY COASTAL VEGETATION

The biological and ecological significance of the beach is often overlooked while undertaking developmental activities or afforestation programmes. The following guidelines are therefore suggested for ecofriendly revegetation of the coastal sand dunes.

- As a policy, no uncommon exotic species of coastal zone should be planted in CRZ areas to prevent unknown ecological impacts.
- Vegetated swales are best used in conjunction with wet ponds, infiltration strips, constructed wetlands and rain gardens, but exist as standalone features as well. Accordingly, the same practice could be extended at various locations of Mandapam sector especially, Sattakovanvalasai near the Kushi beach and also along the national highway (NH 49) upto Raghunathapuram.

7.7 ECODEVELOPMENT COMMITTEE

The eco-development committee (EDC) may be constituted to focus on forming and providing alternative livelihood options. Each village EDC must have Executive Committee comprising members of the villages and a government official to look into the implementation/enforcement of regulations relating to the ban on using prohibited nets and catching prohibited species. Shore-seines, roller nets and bottom trawls are to be banned by the EDC, as they adversely affect the benthic fauna.

7.8 OTHER DEVELOPMENT ACTIVITIES

While fishing is considered one of the major threats to the marine resources of the Gulf of Mannar area, there are other developmental activities that pose threats to

the biodiversity of the area, such as the upcoming Sethusamudram canal project, and other industrial projects on the Tuticorin coast. The Sethusamudram canal is coming up at a distance of 20 km from the GOMNP, and the dredging of the canal is displacing rock, shoal and sediments, making the water column turbid.

Sea Wind Power

- As Vallinockkam, Nallatanni Tivu, Mandapam spit, Pamban and Dhanuskodi are ideal locations for sea wind form power project (*inside the sea*), it will give the solution of power lacking issues.

Research personal

- Interested research personal from various institutions, and also the existing scientists should be encouraged to undertake research projects on specific areas in order to bring out the principles and guidelines.

7.9 CONCLUSION

To conclude, the Tuticorin coast is undoubtedly a unique and very sensitive ecosystem. It is also a region where thousands of people depend on marine resources and fisheries for their livelihoods. While all efforts must be taken to protect and conserve resources, it is important to take into consideration the livelihoods of communities who have traditionally depended on the resources. Clearly, for any conservation initiative to succeed, local communities must be part of the decision-making and implementation processes, even more so where these communities have demonstrated their ability for self-regulation. It is hoped that issues of participation and livelihood will be taken more seriously in the future, so as to benefit both conservation and local livelihoods.

In conclusion, there is little doubt that there is need to improve management and conservation of India's rich and diverse marine and coastal resources. However, it is important that this is undertaken in partnership with local and traditional communities dependent on these resources. Without such a balanced approach, the conservation goal of CZM will never go hand-in-hand with the larger aim of poverty alleviation. This present study is an eye opening of the coastal importance how to support human lives, and it must be conserve to next generation.

Finally, the present study concludes that the coastal ecosystem based management would be fruitful in bringing a detailed coastal plan map (lacking) rather than simply following Coastal Regulation Zones of India.