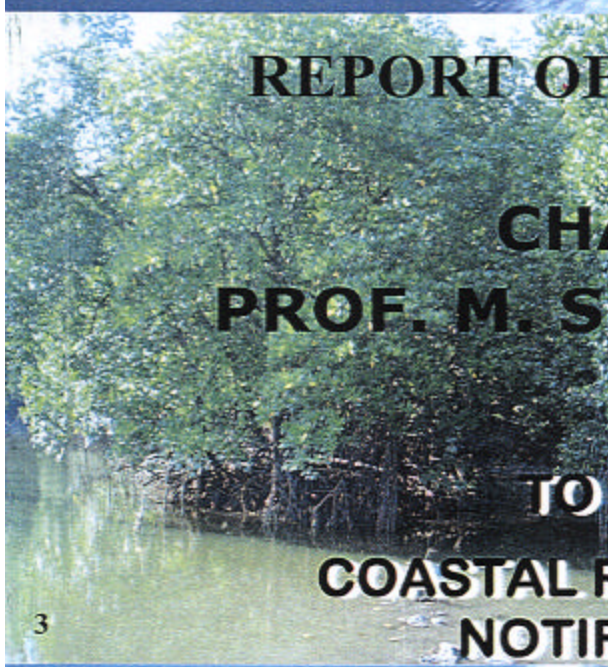
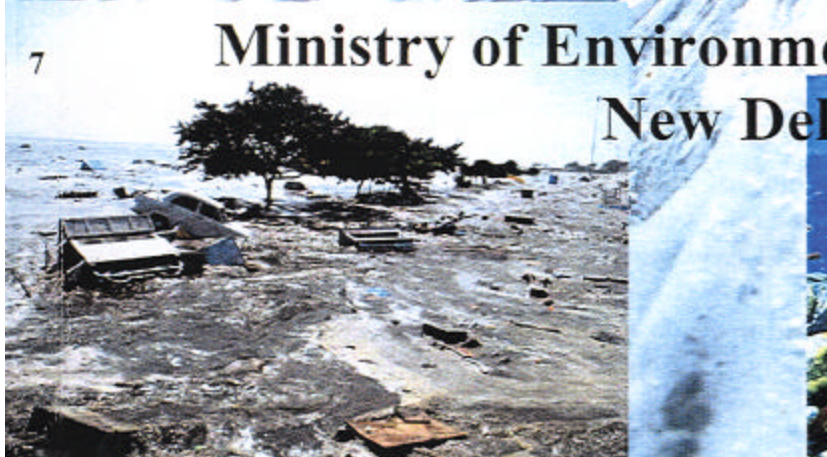




REPORT OF THE COMMITTEE
CHAired BY
PROF. M. S. SWAMINATHAN
TO REVIEW THE
COASTAL REGULATION ZONE
NOTIFICATION 1991



February 2005



Ministry of Environment and Forests,
New Delhi



**REPORT OF THE EXPERT COMMITTEE ON COASTAL
REGULATION ZONE NOTIFICATION, 1991**

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PREFACE

1. Experts on the origin of life, with the DNA molecule as the chemical substance of heredity, all accept that life began in the ocean. Oceans and coastal regions have since long attracted the awe, admiration, respect and reverence of human communities all over the world. Before the arrival of the aviation industry, oceans provided the channel of communication among different continents. Unfortunately, in the post-industrial era, oceans started becoming dumping grounds for unwanted material including toxic wastes and began losing their devotional aura. Their scenic beauty however became the bedrock of thriving tourism industries.

2. The renewable living aquatic resources of the sea represent a unique gift of nature to humankind. Coral reefs are the aquatic counterparts of tropical rainforests in terms of richness of biological diversity. Because of the multiple benefits provided by the coastal environment for human health, wealth and well-being, demographic pressures on coastal resources started increasing during the last century. Extreme cases of intensive pressure of human population on coastal ecosystems are seen in Kerala, as well as in mega-cities like Mumbai. Over 25% of India's population will live in coastal areas during this century. Many large cities and urban habitations are also near the seacoast. Therefore, an integrated and ecologically and socially sustainable coastal zone management system should be put in place jointly by government agencies and coastal communities.

3. The recent Tsunami tragedy underlines the urgent need for revisiting our disaster management and coastal infrastructure development strategies. We should establish soon a Network of Rural Knowledge Centres based on the integrated use of the internet, ham radio, cable TV, vernacular press and loud speakers. With the enhancement of our capacity for issuing early warning on impending coastal storms and tidal waves as well as our existing capacity to predict wave heights and location of fish shoals through the Indian National Coastal Information System (INCOIS), we need a mechanism to reach the un-reached with the right information at the right time. This is where our strength in Information Communication Technology (ICT) will be extremely valuable. We should develop a Digital Gateway for Sustainable Coastal Zone Management as part of our Disaster Management and coastal area conservation programmes.

4. Characteristic of her foresight and vision, the then Prime Minister of India, Smt. Indira Gandhi had proposed in 1981 that no permanent constructions should be undertaken within 500 metres of the high-tide line. This suggestion was given legal content by the Ministry of Environment and Forests through the Coastal Regulation Zone Notification dated 19th February, 1991 under the Environment (Protection) Act, 1986. Since then, numerous representations have been made for exemptions from the provisions of 1991 Notification. The Ministry of Environment and Forests therefore set up in July, 2004 a Committee to review the Coastal Regulation Zone Notification (CRZ) of 1991. This report contains the recommendations of the Committee.

5. In my view, if our recommendations are implemented sincerely and speedily, the concept of sustainable coastal management will not remain a piece of rhetoric but can become a reality. However, for achieving this goal, we must harness the power of partnership among all stakeholders. The livelihood security of the economically and socially underprivileged sections of the coastal communities and the ecological, scenic and cultural security of coastal areas should become mutually reinforcing. We have recommended the

setting up of a National Board for Sustainable Coastal Zone Management under the Chairmanship of the Union Minister for Environment and Forests with the Union Minister for Ocean Development as Co-chair, for providing a structured platform for policy oversight and for promoting symbiotic partnerships and a shared commitment to conservation among all the stakeholders. To be effective, such a National Board should be supported by a professionally-led Coastal Zone Management Authority as well as a National Institute for Sustainable Coastal Management, designed to serve as the repository of national, regional and global information and data on policy and legal affairs. To attend to the special needs of Andaman and Nicobar and Lakshadweep group of islands, it will be useful to establish a National Centre for Coastal Zone Management in island ecosystems. Since the variations in terrain, topography, climate and economic geography are so widespread along our long coastlines, these institutions should undertake specific micro-surveys to enable the listing of coastal assets in great detail. Until the micro-surveys are completed, we should strictly adhere to the current rules of CRZ notification 1991. Also, such public policy facilitation institutions should develop the capacity for fostering professional conflict resolution mechanisms. They should also develop expertise in ecological economics as applied to the coastal zone. Above all, they should spearhead an ecological literacy movement through ICT based Rural Knowledge Centres.

6. The Tsunami tragedy, to quote Prime Minister Dr. Manmohan Singh, provides an opportunity for strengthening socially and scientifically, our capacity for safeguarding human and ecological security in coastal areas. It also provides an opportunity for enhancing the economic well-being of the fisher and farm families along the shoreline through an integrated bio-shield-cum- bio-village programme.

7. It has been a privilege for me to have had the opportunity of working with dedicated and distinguished colleagues on this Committee. A wide range of government, academic, professional and civil society organizations guided us in our work. My gratitude goes to all of them. In particular, we are indebted to Hon'ble Shri A. Raja, Union Minister for Environment and Forests for his interest and to Dr. Prodipto Ghosh, Secretary, Ministry of Environment and Forests for his active participation in all our meetings. Above all, my sincere thanks go to Mr. A. Senthil Vel and Dr. E.V. Muley for their untiring efforts to enable the Committee to complete its work within the stipulated period.

Chennai
9th February, 2005

(M.S. Swaminathan)
Chairman

Introduction

Coastal environment plays a vital role in nation's economy by virtue of the resources, productive habitats and rich biodiversity. India has a coastline of about 7,500 kms of which the mainland accounts for 5,400 kms, Lakshadweep coasts extend to 132 kms and Andaman & Nicobar islands have a coastline of about 1,900 kms. Nearly 250 million people live within a distance of 50 kms from the coast. The coastal zone is also endowed with a very wide range of coastal ecosystems like mangroves, coral reefs, sea grasses, salt marshes, sand dunes, estuaries, lagoons, etc., which are characterized by distinct biotic and abiotic processes. The coastal areas are assuming greater importance in recent years, owing to increasing human population, urbanization and accelerated developmental activities. These anthropogenic activities have put tremendous pressure on the fragile coastal environment.

The coastal areas are also the place where natural disasters are also experienced. The entire East coast of India, the Gujarat coast along the West coast and the islands of Lakshadweep and Andaman and Nicobar face frequent cyclonic conditions which some times cause large scale destruction of life and property. The Super Cyclone had caused massive destruction along the coast of Orissa in 1999 and its impact was felt several kilometres inland. The tsunami, which occurred on 26th December, 2004 was one of the most serious and unexpected natural catastrophes to occur along the Indian coast. The major destruction caused by this tsunami was to the life and property located along the coast of Andaman and Nicobar, Tamil Nadu, Pondicherry and Kerala. It would take several years to restore the damages caused by this natural catastrophe. While it is agreed that no human interference is possible to control such an event but precautionary measures such as coastal area planning for locating coastal communities in safer areas, protecting and propagating the natural protecting systems such as mangroves, coral reefs, shelter belt plantations, along with installation of early warning systems, timely evacuation and relief measures can minimize loss of life and property to a large extent.

For the purpose of protecting and conserving the coastal environment the Ministry of Environment & Forests issued the Coastal Regulation Zone Notification dated 19.2.1991 under Environment (Protection) Act, 1986. This notification regulates all developmental activities in the Coastal Regulation Zone area.

The Ministry after gaining experience from implementation of the Coastal Regulation Zone Notification over a decade, suggestions received from stakeholders and NGO's and taking into the lessons learnt for the Coastal Zone Management programme of other countries, the Ministry is of the opinion that there is a need to ensure that the regulations are firmly founded on scientific principles to ensure effective protection to valuable coastal environmental resources and without unnecessarily impeding livelihood or legitimate coastal economic activity or settlements or infrastructure development. For this purpose, the Ministry is of the opinion that the CRZ Notification should be reviewed to make the approach to coastal environmental regulation more holistic and ensure protection to coastal ecological systems, coastal waters and vulnerability of some coastal areas due to potential sea level rise and other natural hazards. The Coastal Zone Management Plans (CZMPs) need to be reviewed at predetermined intervals to take into account the changes in geomorphological features that take place due to the ocean dynamics and settlement patterns. There has been significant degradation of coastal resources in recent years due to poorly planned developmental activities and overexploitation of natural resources.

Keeping in view the above issues, the Central Government is of the view that there is a need for a comprehensive review of the CRZ Notification, 1991. This review is to be carried out in the light of the findings and recommendations of the previous Committees constituted by the Ministry to address specific issues relating to CRZ, judicial pronouncements relating to the Notification and the concerns raised by various stakeholders including NGOs.

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Government of India
Ministry of Environment & Forests
IA-III Division

Paryavaran Bhavan,
CGO Complex, Lodi Road,
New Delhi-110 003

Dated, the 19th July, 2004

ORDER

Sub: Constitution of an Expert Committee to review and make recommendations with regard to implementation of Coastal Regulation Zone Notification, 1991 – regarding.

The President is pleased to constitute an Expert Committee to carry out a quick but comprehensive review of the Coastal Regulation Zone Notification, 1991, in the light of findings and recommendations of all previous Committees, judicial pronouncements, representations of various stakeholders and suggest suitable amendments, if necessary, to make the regarding regulatory framework consistent with well established scientific principles of coastal zone management. The composition of the Committee will be as follows:-

1.	Dr M.S. Swaminathan , Chairman, MSSRF, 3rd Cross Street, Institutional Area, Taramani, Chennai - 600113, India.	Chairman
2.	Prof. Bharat H. Desai , Associate Professor, International Legal Studies Division, School of International Studies, JNU New Delhi-110 067 (Legal Expert on CRZ).	Member
3.	Prof. S. Ramachandran , Director Institute for Ocean Management, Koodal Building, Anna University, Chennai - 600 025 (Marine Biologist/Biodiversity Issues).	Member
4.	Dr. M. Baba , Centre for Earth Science Studies (CESS), Post Box No.7250, Akkulam, Thiruvananthapuram - 695 031 (Marine Geologist).	Member
5.	Prof. U. Sankar , Madras School of Economics, Anna University, Chennai-600 025 (Environmental Economics)	Member
6.	Dr. Ms Janki B. Andharia , Professor, Tata Institute of Social Sciences, Tata Institute of Social Sciences, Postbox 8313, Deonar, V.N. Purvav Marg, Sion-Trombay Road, Mumbai-400 088 (Socio-economic aspects).	Member
7.	Dr. Shailesh B. Nayak , Space Application Centre (SAC), Ambavadi Vistar P.O., Ahmedabad – 380 015 – Telephone: 079-6761188, 6740256, Fax: 079-6748809, 6767708 (Remote Sensing and GIS).	Member
8.	Shri V. Sunder , Department of Coastal Engineering, IIT, Chennai. (Shore line change).	Member
9.	Prof. A.K. Maitra , Ex-Director, SPA & HOD, Deptt. Of Environmental Planning, New Delhi N-3D, Saket, New Delhi-110 017	Member

	(Mob. 9810413591) (Regional Planning).	
10.	Dr. Mohan Joseph , Director, Central Marine Fisheries Research Institute (CMFRI), Indian Council of Agricultural Research, Post Box No. 1603, Tatapuram PO, Ernakulam, Kochi - 682014.	Member
11.	Secretary , Department of Ocean Development, Block No.12, CGO Complex, New Delhi-110 003.	Special Invitee.
12.	Secretary , Environment & Forests, Paryavaran Bhavan, CGO Complex, New Delhi.	Special Invitee
13.	Additional/Joint Director , MoEF.	Member Secretary.

2. **The Terms of Reference of the Committee will be as under:-**

- (a) To review the reports of various Committees appointed by the Ministry of Environment and Forests on coastal zone management, international practices and suggest the scientific principles for an integrated coastal zone management best suited for the country;
 - (b) To define and enlist various coastal and marine resources and recommend the methodology for their identification and the extent of safeguards required for conservation and protection;
 - (c) To revisit the CRZ, Notification, 1991 in the light of above and recommend necessary amendments to make the regulatory framework consistent with recommendations on (a) and (b) above and the Environment (Protection) Act, 1986;
3. The Chairman may associate any other expert in the relevant field in the deliberations of specific issues concerning coastal zone management.
 4. The Committee will submit its report within two months.
 5. The Committee may hold the meeting in Delhi or any other place as desired by the Chairman and also undertake site visits if required.
 6. TA/DA as well as sitting fees of Non-official Members of the Committee shall be borne by the Ministry as per Rules.

Sd/-
(A. Senthil Vel)
Joint Director

The following experts were Co-opted by the Committee:

1. Dr. J.R.B Alfred, Director, Zoological Survey of India, Kolkata.
2. Dr. N. Sanjappa, Director, Botanical Survey of India, Kolkata.
3. Dr. Y.S. Yadava, Member Secretary, Aquaculture Authority, Chennai.
4. Cmdt. M.M. Sharma, Indian Coast Guards, New Delhi.
5. Shri Ronesh Ray, Heritage and Architecture, New Delhi.
6. Dr. S. Ayyappan, Director General, Fisheries, New Delhi.
7. Director, National Institute of Oceanography, Goa.

CHAPTER 1

1.0 COASTAL ZONE MANAGEMENT – NATIONAL AND INTERNATIONAL PRACTICES

1.1 Indian Initiatives

The then Prime Minister (PM) Smt. Indira Gandhi in 1981, after taking a note of unplanned development in the coastal areas wrote letters to all the coastal States to take adequate measures for protecting the coastal environment. As the follow-up of the PM's directive, the then Department of Environment & Forests initiated preparation of a guideline for protecting the beaches of the country. These guidelines were prepared by experts and were provided to the coastal State Governments/Union Territory Administrations for implementation in 1997. However, none of the State/UT Governments took the guidelines seriously since, it had no statutory backing.

Taking into note the failure of such guidelines without statutory backing, the Ministry of Environment & Forests carried out an in-house consultation and issued a draft Coastal Regulation Zone (CRZ) Notification, 1989 under Environment (Protection) Act, 1986 inviting suggestions and objections from public. Based on the comments received from the public, the Ministry finalized the CRZ Notification on 19.2.1991. This Notification regulates all developmental activities in the CRZ area.

Marine resources management programmers were initiated as early as 1897, when the Indian Fisheries Act was passed. Several issues related to coastal management were addressed by various Ministries and Departments of State and Central Governments. However, all these management initiatives were concentrated on specific issues such as coastal erosion, coastal pollution, ports and harbours, etc. The Coastal Regulation Zone Notification issued in 1991 was the first major legislation that was aimed at regulating various coastal activities and protecting the coastal environment. Several institutions have taken up projects and pilot studies in the area of coastal zone management. Important being the Integrated Coastal and Marine Area Management (ICMAM) studies by Department of Ocean Development, Integrated Coastal Zone Management (ICZM) studies funded by Ministry of Environment & Forests and executed by agencies like Institute of Ocean Management of Anna University, Centre for Earth Science Studies, Thiruvananthapuram, Institute for Wetland Management and Ecological Designs, Kolkata, participatory management approaches and coastal system research by M.S. Swaminathan Research Foundation, Chennai, coastal mapping by Space Application Centre, Ahmedabad, Fisheries Management by Central Marine Fisheries Research Institute, Kochi and oceanography by institutes like National Institute of Oceanography, Panjim and National Institute of Ocean Technology, Chennai.

1.1.1 Indian coast

India's coastline has been undergoing physical changes throughout the geological past, although the last tectonic phase in the Indian peninsula has been one of the general emergence, the present coastal geomorphology of India has evolved largely in the background of the post-glacial transgression over the pre-existing topography of the shore,

coast and offshore zones. The Holocene sea fluctuated in the course of the last 6,000 years and the marked regression is indicated between 3,000 to 5,000 years B.C.

There are more than 100 rivers, which bring large quantities of sediments to the coast. The mightier ones are the Ganges, Brahmaputra, Krishna, Godavari and Cauvery on the east coast and Narmada and Tapi on the north-west coast.

The continental shelf is narrow along the east coast. On the west coast, the wide shelf of about 340 kms of the north tapers to less than 60 kms in the south. With a monsoon climate, the southwesterly winds during the period from June to September bring high waves closer to the southwest coast. The east coast generally becomes active during the cyclones of the northeast monsoon period (October-November). The tidal range also varies significantly from south to north. While the southern coast, have a tidal range of less than 1 metre, the northwest peaks at 11 metres and the northeast reaches 4 metres.

Gujarat coast can be classified into five regions viz., the Rann of Kachchh, the Gulf of Kachchh, the Saurashtra Coast, the Gulf of Khambat and the South Gujarat Coast. The coastal area of Gujarat including the Rann of Kachchh is the largest in the country and covers an area of about 28,500 sq km. The Ranns of Kachchh comprise of the Great Rann and the Little Rann, which remain saline desert for the greater part of the year. The area of the lower Indus deltaic plain situated on the west of the Great Rann of Kachchh is characterised by the tidal creeks (e.g. Kori creek) and mangroves. High tidal flats with or without salt encrustations are seen. In the Gulf of Kachchh shoreline has extensive mudflats and is highly fringed by a number of cliffed rocky islands. It is fringed by coral reefs at many places. Mangroves, algae, salt marsh, dunes and salt pans are common. The Saurashtra coast is less fringed, but has numerous cliffs, islands, tidal flats, estuaries and embayments. Dunes (near Mahuva), sandy beaches, spits, bars, bays, marshes and estuaries predominate. Raised beaches area present around Veraval and Porbandar. The presence of 23 strandlines (old shorelines) for most part of the Saurashtra coast and the cliffs with undercutting reveal the dynamic nature of mudflats, dunes and sporadic beaches. The different levels of mudflats and other features are indicative of high tidal range (upto 11 m). The paleomudflats are related to the phenomenon of regression of the Flandrian sea. The south Gujarat coast is comparatively uniform and is broken by few indentations. Series of estuaries, creeks, mudflats and marsh vegetation are present. The river mouths of Purna, Ambica and Damanganga are eroding. Deposition is observed near Umargam. Similar geomorphology continues upto Mumbai in Maharashtra. This region has extensive creek systems which are flanked by mudflats, mangroves and salt pans. Numerous islands both barrier and offshore are observed. Isolated cliffs and sandy beaches are seen.

The southern Maharashtra and Goa coasts are characterized by pocket beaches flanked by raised platform, rocky cliffs and promontories (all of Deccan basalt), estuaries, bays and mangroves. Mudflats are found mainly along estuaries, bays and creeks. Ratnagiri has rich mangrove forests. Iron ore mines are located at Redi. The Marmagao bay flanked by Mandovi and Zuari estuaries is the largest estuarine system on this part of the coast. Beaches in Goa are long, linear and wide and are flanked by headlands (promontories). These beaches are extensively used for recreation.

The coastal zone of Karnataka is narrow except around estuaries. Headlands and pocket beaches characterize the northern coast (Ankola -Karwar) and long linear beaches are seen on the southern coast. Spits, estuaries, mudflats, shallow lagoons, islands and few

patches of mangroves are also observed. Erosion is seen near Mangalore and deposition in Kalinadi creek near Karwar. Mangalore is found to be emerging as evidenced from geological and tide records. Consequent to this, change in the course of rivers near the coast is quite common here.

On contrast to the Mangalore coast, Kerala coast is described as a sub-mergent coast. Lateritic cliffs, rocky promontories, offshore stalks, long beaches, estuaries, lagoons, spits and bars are characteristics of Kerala coast. The sand ridges, extensive lagoons and barrier islands are indicative of a dynamic coast with transgression and regression in the recent geological past. The central Kerala coast around Kochi is of recent origin. There are about 700 land-locked islands (including barrier islands) in Kerala. The mudbanks of Kerala are unique transient nearshore features appearing during monsoon. Though there are 41 rivers bringing enormous quantity of sediments, deltas are not formed due to the high energy condition of the coast. Cochin-Vembanad is one of the largest estuarine systems in the country. Ashtamudi is another major estuary in Kerala. It is estimated that 30 kms of the coast is undergoing high erosion and 21 kms is accreting. About 360 kms of the 570 kms coastline is protected by seawalls. There are rich heavy mineral deposits in Chavara. Though the Kerala coast is described as a mangrove forest in the resourced history, it is left with just 16 sq. kms of mangroves restricted mainly at Valapatanam and Puthuvaipu (Kochi).

The Tamil Nadu (including Pondicherry) coast is straight and narrow without much indentations except at Vedaranyam. Fringing and patch reefs are present near Rameswaram and Gulf of Mannar. Ichavaram, Vedaranyam and Point Calimere have well developed mangrove systems. In Tamil Nadu about 46 rivers drain into Bay of Bengal forming several estuaries adjoining coastal lagoons. The Cauvery River and its tributaries form a large delta supporting extensive agriculture. The other landforms of the Tamil Nadu coast are rock outcrops of Kanyakumari, mudflats, beaches, spits, coastal dunes and strand features. Deposition is observed at Point Calimere, Nagapattinam, South Madras, etc., while erosion is reported at Ovari Paravarnattam, Mahabalipuram and North Madras near Ennore. Rich deposits of heavy minerals are available in Muttam-Manavalakuruchi coast. The southern tip is also known for the Tera sands.

The Coastline of Andhra Pradesh is long with indentations only in the extreme south (in the saltwater lagoon of Pulicat lake) and between the Godavari and Krishna deltas (which are growing outwards). North of Godavari delta is rocky, south of Krishna delta is a sandy and in between the interdelta is vegetated with mangroves. The residual hills and ridges of the north are common here. The deltaic coast comprises of bays, creeks, extensive tidal mudflats, spits, bars, mangrove swamps, marshes, ridge and swale areas and coastal alluvial plains. The Kolleru lake is situated in the interdelta. This was formed due to the coalescence of the deltaic deposits of the rivers and later it was cut off from the sea. The Pulicat lake has extensive tidal flat and 12 km long spit, where Sriharikotta is situated. The lake is shrinking especially from the northern side. The deltaic and southern coast are rich in agriculture and aquaculture production. These coasts are frequented by cyclones.

The Orissa coast is mainly depositional in nature formed by the Mahanadi and the Brahmani-Baitarani deltas. It is exposed to severe cyclones (latest in October, 1999). The Chilka lagoon is the largest natural water body of the Indian coast. The width of the beaches of the Orissa coast vary. The Bhitarkanika and Hatmundia reserve mangroves are extensive (190 sq. km). Gopalpur is rich in heavy minerals. Mudflats, spits, bars, beach ridges, creeks,

estuaries, lagoons, flood plains, paleomudflats, coastal dunes, salt pans and paleochannels are observed along the Orissa coast.

The West Bengal coast represents a typical deltaic strip with almost a flat terrain. The Hoogly and its distributaries form the most conspicuous drainage system and form an estuarine system. The Sundarbans with coverage of about 1,430 sq. kms, is one of the largest single block of the halophytic mangrove systems of the world. The major geomorphic features are mudflats, bars, shoals, beach ridges, estuaries, extensive network of creeks, paleomudflats, coastal dunes, large number of islands (e.g Sagar) and salt pans.

In Lakshadweep Islands, situated in the Arabian Sea, there are about 36 islands (11 inhabited), a number of sunken banks, open reefs and sand banks. These coral islands are 3-9 metres above Mean Sea Level (MSL), have an area of 32 sq. kms and all of them have well developed coral reefs. Lagoons are integral part of all Lakshadweep islands.

The Andaman and Nicobar group of islands of Bay of Bengal are about 350 in number. These islands are volcanic in origin and emerged part of a mountain chain. The coastline has coral reefs, sandy beaches, lagoons, mangroves, creeks, bays, cliffs, saline areas and forestland. The southern most island (Indira Point) is the country's southern most point, latitudinally. An active volcanic island is observed in Nicobar group of islands.

1.1.2 Indian Laws and Regulations

Apart from the Coastal Regulation Zone Notification, 1991 there are many legislations /Acts and rules related to coastal activities. The following are the important ones: Indian Fisheries Act, 1897; Indian Ports Act, 1902; Merchant Shipping Act, 1974, Wildlife (Protection) Act 1972; Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981; Indian Coast Guards Act, 1974; and Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981 and Environment (Protection) Act 1986; The Petroleum Act, 1934; National Environment Tribunal Act, 1995; Hazardous Wastes (Management and Handling) Rules, 1989.

In addition to this, India has signed and ratified several international conventions relating to oceans and related activities. Some of these are related to marine environment and applicable to coastal area also. The important ones are the following: MARPOL 1973/1978; London Dumping Convention, 1972; Convention on Civil Liability for Oil Pollution Damages (CLC 1969) and its Protocol, 1976; Fund, 1971 and its Protocol, 1979; CITES, Convention on Biodiversity, 1992 includes coastal bio-diversity also.

1.1.3 Institutional Infrastructure

The Ministry of Environment and Forests and the Department of Ocean Development are the two nodal Departments that deal primarily on the coastal and ocean areas. In addition to this, there are several Ministries, Departments, State Government Bodies looking after several issues relevant to coastal management in this country and are listed below:

Departments/Agencies	Responsibilities
Ministry of Agriculture	Fisheries Management, Coastal Aquaculture
Ministry of Defence (Coast Guard)	Oil Pollution, Poaching, etc

Pollution Control Board	Coastal Pollution
Ministry of Commerce	Marine Products Development, Special Economic Zones
Ministry of Surface Transport	Ports and Harbours
Ministry of Tourism	Tourism Development
Ministry of Urban Development	Town and Country Planning
Ministry of Industries	Coastal Industries
Ministry of Mines	Coastal and Offshore Mining
Ministry of Home	Disaster Management
Ministry of Petroleum and Natural Gas	Exploration and Exploitation of Oil and Natural Gas.
Ministry of Chemicals and Fertilizers	Storage and Handling of Chemicals and Fertilizer in the port areas.
State/Union Territory Environment Department	Coast and Marine Management under Water Act, Air Act.

However, Coastal Regulation Zone Notification 1991 implemented by the Ministry of Environment and Forests (MoEF), is the single regulation that takes care of most of the activities in the coast.

1.2 Committees and Reports

During the last 14 years of implementation of the CRZ Notification, the MoEF has been receiving several representations/suggestions from various stakeholders including NGO's requesting MoEF to amend the notification for permitting certain activities. Taking into consideration these requests/representations, the Ministry has been constituting Committees consisting of experts to look into specific issues raised by the Central Governments, State Governments, local communities, Association and NGOs. Most of the Committees were constituted to address specific issues from time to time. The details of the Committees constituted so far, their recommendations alongwith the action taken by MoEF is briefly discussed below -

1.2.1 Shri B.B. Vohra Committee – on issues relating to tourism

Shri B.B. Vohra Committee was constituted on 1st January, 1992 mainly to examine CRZ vis-a-vis coastal tourism. The Committee submitted its report on December 31, 1992. One of the recommendations of the Committee was reduction of distance of the NDZ in selected coastal stretches for promoting tourism. The Ministry amended the CRZ Notification, 1991 on 18th August, 1994, reducing No Development Zone (NDZ) area all along the Tidal water bodies from 100 to 50 mts. The amendment also permitted construction in NDZ. This amendment was challenged in the Supreme Court of India in W.P. No.664 of 1993, and the above amendment was quashed and status quo maintained.

The B. B. Vohra Committee report also noted that the HTL demarcation was not clearly defined. Based on the recommendations, the Ministry defined the HTL and demarcation agencies in the amendment dated 8th August, 1994.

The B. B. Vohra Committee Report also recommended no drawal of Groundwater in the NDZ including CRZ area, except by manual extraction. The Report recommended

landscaping in the NDZ by dressing of sand dunes, live fencing along the resorts and permitted playfields but not swimming pools in the NDZ.

Vide the same amendment dated 8th August, 1994, the Ministry prohibited flattening of sand dunes in the CRZ area, while maintaining status quo as in CRZ Notification with regard to height and Floor Space Index (FSI), subject to ground+one only. For the construction of basement, NOC was to be obtained from the Ground Water Board. Public access between two resorts was suggested as 6 mts by the Committee, however the Ministry maintained 20 metre distance between two resorts.

1.2.2 Prof. N. Balakrishnan Nair Committee - on issues relating to Kerala on Coastal Regulation Zone

The Balakrishnan Nair Committee which was constituted on 30th December, 1996 recommended inclusion of census towns and panchayats, which are substantially built up to be declared as urban areas (CRZ-II). The extent of CRZ area in case of inland tidal water bodies to be relaxed, to permit all ports and harbour constructions and port related industries. However, the Ministry took no action with regard to these suggestions. The report also recommended storage of petroleum products in CRZ which was considered by the Ministry and an amendment was issued on 9th July, 1997 after obtaining the views of Ministry of Petroleum & Natural Gas. The Committee also recommended reclamation to be made permissible for the approved projects, which the Ministry did not consider. It also recommended locating non-polluting industries, relaxation for tourism potential areas and construction of fishermen houses in 200-500 mts. These recommendations were not considered by the Ministry. The Committee also recommended drawl of ground water between 0-200 metres by manual method, which was considered in the amendment dated 9th July, 1997. The report recommended setting up fish processing units. But the Ministry in its amendment dated 9th July, 1997 amended the Notification permitting modernizing of the fish processing units and setting up of effluent treatment plants for such existing plants. The report also suggested reduction of CRZ to 50 mts along tidal water bodies keeping in view the unique conditions of Kerala. However, the Ministry took no action in this regard. The amendment of 9th July, 1997 has been challenged in the High Court of Delhi since suggestions/objections from the public had been waived off while issuing the said amendment. The matter is subjudice as on today.

1.2.3 Fr. Saldanha Committee (I) - to advice on withdrawal of groundwater and extraction of sand in Andaman & Nicobar Islands

The Committee which was constituted on 5th December, 1996 and submitted its report in January, 1997. The report recommended extraction of groundwater extraction by manual method in 50-200 metres from the HTL for local communities of Andaman & Nicobar Islands.

With regard to mining of sand the Committee recommended mining of sand in the CRZ area for a short period for 1-2 years only, since the sand was of coral origin, which takes several years for formation. The rate of replenishment of this biological sand is very slow. Based on the recommendations of the Saldanha Committee, the Ministry amended the Notification by permitting mining of sand in the CRZ area, and thereafter MoEF has been periodically extending on yearly basis. The recent ICZM studies carried out by the Institute for Ocean Management, Chennai has indicated severe adverse impact due to sand mining.

The Committee has also examined the Supreme Court's Order in one of the matters pertaining to Forest Division, wherein the Supreme Court has permitted mining of sand on a reducing balance. The Ministry has now amended the CRZ Notification, 1991 permitting mining of sand in the CRZ area for a quantity of 28,266 CBM for a period upto 31st December, 2005 with a condition that no further permission would be granted. This Committee agrees with the condition.

1.2.4 Fr. Saldanha Committee (II) - to examine specific issues relating to CRZ

The Committee was constituted on 26th June, 1997 and the report was submitted in September, 1998. The report recommended construction of dwelling units within 200 metres in CRZ-III. For permitting such dwelling units in CRZ-III the report laid down criteria which included construction of dwelling units only for bonafide traditional settlers subject to the condition that the area is adequately protected with sea-wall, the proposed construction is on the landward side of the existing buildings and the construction shall not be more than 100 sq m with 4.5 m height.

Based on the Fr. Saldanha Committee report the Ministry had issued a Draft Notification inviting suggestions and objections for amending the CRZ Notification, 1991. Based on the suggestions and objections received, the Ministry did not amend the CRZ notification.

1.2.5 Shri D.M. Sukthankar Committee (I) – to examine the issues relating to Mumbai and Navi Mumbai

This Committee was constituted on 29th May, 2000. The report recommended increase in Floor Space Index (FSI) for undertaking slum redevelopment schemes and rehabilitation of dilapidated structures. The report also recommended Transfer and Developmental Rights (TDR) in Coastal Regulation Zone area wherever the FSI has not been consumed fully. With regard to Navi Mumbai the Committee recommended to amend the notification so as to provide for expansion of mega cities in Coastal Regulation Zone areas. In case of the violations in the 161 Versova the Committee recommended development of plots which have been allotted in the inter tidal area and also construction of missing links in Coastal Regulation Zone area. The Ministry took no action on the report since the report had 3 dissent notes from its members. Further the recommendations were not in line with the CRZ notification. With regard to amendment pertaining to increase in FSI, the Ministry had to comply with the directions of High Court of Bombay in the W.P. No.1019 of 1999, which prevented increase in FSI in CRZ area.

This committee observes that the Sukthankar committee did not take into consideration the environmental issues while framing the recommendations.

1.2.6 Shri D.M. Sukthankar Committee (II) - to prepare a National Coastal Zone Policy of India (NCZP)

The above Committee was constituted in March, 2000 and the report of the Committee was submitted to the Ministry in September, 2000. For the first time Ministry had constituted an Expert Committee to examine the issues of coastal zone management in a holistic manner.

The report was submitted in September, 2000. The report suggested a legislative framework for framing Coastal Zone Management Policy. The recommendations of the report were based on the study report prepared by CESS.

The report recommended that the coastal zone should be demarcated based on risk from erosion and flooding. The report listed out areas/features that have to be protected and the high-risk zone and low risk zone in the coastal area. List of various developmental activities were also annexed in the report, which can be taken up in low risk and high risk areas. The report also suggested the environmental clearance procedure to be adopted for such developmental activities. No action was taken on the report.

This Committee feels that the Ministry should have initiated actions with regard to demarcation of sediment cell and preparation of shoreline management plan maps as suggested by the Committee. The recommendations of the Committee for siting developing activities based on the vulnerability to the coast due to natural hazards such as erosion and flooding is a right approach.

1.2.7 Dr. Arcot Ramachandran Committee – on Ocean Regulation Zone

The Department of Ocean Development constituted an expert committee under the Chairmanship of Dr. Arcot Ramachandran, former Secretary, DST to recommend the activities that need to be included in the seaward side of the coast. The Committee submitted its report in the year 1996. The Committee suggested inclusion of several activities for prohibition/regulation in the ocean part of the coastal zone. These activities include construction of Ports and Harbours, waste disposal, sea bed mining, OTEC plant, oil and natural gas exploration, ship breaking, etc., which are not covered under CRZ. The ocean area from Low Tide Line upto territorial waters was proposed as Ocean Regulation Zone (ORZ) and this zone was categorised into Ecologically sensitive area (ORZ-I), Sea off developed areas (ORZ-II) and Sea off undeveloped and underdeveloped areas (ORZ-III). The activities that are to be prohibited in ORZ-I include construction of civil and other manmade structures like breakwaters, disposal of untreated waste etc. Exceptions to these activities were to be given based on the no impact distance from the outer limits of the ecologically sensitive areas. The reclamation of seabed for human settlement, construction of artificial islands, etc., dumping of plastics are also to be prohibited in all the three zones. Regarding permissible activities in ORZ II and ORZ III, some of them include disposal of treated wastes, the volume and characteristics of which will be limited within the waste assimilative capacity of receiving seawater body. EIA was made mandatory for all the activities irrespective of the zones. The report was received by the Ministry of Environment & Forests from Department of Ocean Development and no action was taken on the report by Ministry of Environment & Forests.

This Committee is of the opinion that the ocean waters upto the territorial limits should be an integral part of the coastal zone management. There are several activities in the coastal areas such as dredging, seawall constructions, breakwater construction, jetties, etc. which have direct impacts on the inter-tidal area. Therefore, it is necessary that such activities taken up in the waters are examined from the point of coastal zone management.

1.2.8. Prof. M. S. Swaminathan Committee – to review the CRZ Notification, 1991

The present Committee was constituted by the Ministry to carry out quick but comprehensive review of the CRZ Notification, 1991 in the light of the findings and recommendations of all the previous Committees, judicial pronouncements, representations of various stakeholders and suggest suitable amendments to make the regulatory framework consistent with well-established scientific principles of coastal zone management. The Terms of Reference of the Committee are given in the Order constituting the Committee.

1.2.9. Summary of the Recommendations of the Committees on which the Ministry had taken action

(i) **Shri B. B. Vohra Committee** – on issues relating to tourism.

Sl. No.	Issues	Recommendations	Action Ministry of Environment & Forests
1.	Depth of the No Development Zone (Hotel industry will require 20-30 km of coastline).	FHI – To reduce the No Development Zone (NDZ) in identified areas. NGO – Concerns of SLR, ecology. Reduction of No Development Zone based on Region specific features with Environmental Impact Assessment.	Amended on 18 th August, 1994. <ul style="list-style-type: none"> Reduced NDZ along the tidal water bodies to 50 mts uniformly. Permitted construction in NDZ. Quashed by Supreme Court in 1996.
2.	High Tide Line demarcation	Not defined clearly. MoEF to define and decide the agency for demarcation.	Amended on 8 th August, 1994 and 2000. <ul style="list-style-type: none"> 7 agencies authorized – NHO, Centre for Earth Science Studies, IRS Anna University, Space Application Centre, National Institute of Oceanography, IWED, NIOT. Guidelines issued.
3.	Depth of NDZ along tidal water bodies	Ministry of Environment & Forests to decide	Amended on 8 th August, 1994 and 21 st May, 2002 <ul style="list-style-type: none"> Upto the point of tidal influence i.e., 5 PPT during summer.
4.	Groundwater drawl in NDZ (Hotel asso, to draw by mechanical pumps in NDZ)	No change to be made only manual extraction in 200 – 500 mts	-
5.	Landuse in NDZ	Landscaping can be done in NDZ by dressing of sand dunes. Live fencing. Playfields but no	Amended on 8 th August, 1994 <ul style="list-style-type: none"> No flattening of sand dunes.

		swimming pool in NDZ.	
6.	Height and FSI	No change. Basement based on No Objection Certificate from Groundwater Board. Ground + one.	No change
7.	Corridors between hotels	Gap of 6 mts instead of 20 mts.	No change
8.		To improve enforcement. High Unhygienic conditions prevailing.	No action

(ii) **Fr. Saldanha Committee** - to advise on withdrawal of groundwater and extraction of sand in A&N Islands.

Sl. No.	Issues	Recommendations	Action Ministry of Environment & Forests
1.	Availability of water	<ul style="list-style-type: none"> Water supply is less acute. Large scale groundwater not permitted. Alternative sources to be studied. 	Amended on 31.1.97 <ul style="list-style-type: none"> Permitting manual drawl of groundwater in 50-200 metres.
2.	Sand from Coastal Regulation Zone area	<ul style="list-style-type: none"> Sand in Coastal Regulation Zone can be mined for a short period for 1 or 2 years only. Alternate sources to studied. 	Amended on 31.1.1997 Permitting mining of sand in CRZ area on yearly basis.

(iii) **Father Saldhana Committee – (II)** – to examine specific issues relating CRZ

Sl. No.	Issues	Recommendations	Action Ministry of Environment & Forests
1.	Criteria to reduce CRZ along tidal water bodies	Can be reduced if – <ul style="list-style-type: none"> Areas falls in CRZ-II, Population density is more then 400 person/km, 1/3rd area of panchayat is built up, Area of the barrier island is less than 1000 metres, Area elevated more than 100 mtres. 	Draft amendment 11 th January, 2002 but not finalized in view of large number of objections from NGOs from Bombay.
2.	Criteria for construction of dwelling within 200 mts in CRZ-III	Dwelling of fisherman and bonafide traditional settlers, subject to – <ul style="list-style-type: none"> Where the area is 	-do -

		<p>protected.</p> <ul style="list-style-type: none"> • Landward side of existing building. • Constructions permitted upto 4.5 mt with 100 sq. mts plinth. 	
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(iv) Prof. Balakrishnan Nair - on issues relating to Kerala

Sl. No.	Issues	Recommendations	Action Ministry of Environment & Forests
1.	Setback of 500 mts – Notification does not taken into account the unique features of the coastal areas and is detrimental to development on long run. Untenable and unjustified.	A multidisciplinary Committee to be constituted.	No action.
2.	Delineation of CRZ-II <ul style="list-style-type: none"> • To include census towns and panchayat substantially built up. 	No action proposed	No action.
3.	Extent of CRZ inland incase of tidal water bodies	No action proposed	No action
4.	Operation of Ports and Harbours	No action proposed	No action
5.	Port related industries recognized the need to permit port related industries.	No actions proposed in absence of concrete suggestions	No action
6.	Handling, storage and distribution at ports.	To permit handling of substances as mentioned in 2(ii)	Amended on 9.7.1997 Permitting 13 POL products. The list was provided by Ministry of Petroleum & Gas
7.	Powers to be delegated for reclamation	Not agreed	No action
8.	Already approved projects land reclamation to be permitted	No comments	Amended on 9.7.1997 Reclamation for construction modernization and expansion of ports.
9.	Non polluting industries to be included	Multidisciplinary Committee to be assigned to permit industries with additional environmental safeguards and pollution control measures.	No action
10.	Bunding for	No comments.	No action

	Aquaculture		
11.	Relaxation for tourism area	To be studied by Multidisciplinary Committee.	No action
12.	Construction of fishermen houses in 200-500 mts	To permit construction	Fr. Saldhana Committee constituted to frame criteria for such constructions.
13.	Drawl of Groundwater	Manual drawing of groundwater in 0-200 mts	Amended on 9.7.1997 Permitting manual drawl of groundwater in 50-200 mts for the entire country.
14.	Fish processing units to be permitted	To permit for modernizing and to equip effluent treatment plants.	Amended on 9.7.1997
15.	Setback as 50 mts along tidal water bodies.	To reduce to 50 mts due the unique conditions of Kerala.	No action.

(v) **Shri D. M. Sukthankar (I) - on Mumbai**

Sl. No.	Issues	Recommendations	Action Ministry of Environment & Forests.
1.	To increase FSI for the SRD.	To permit increase in FSI for such SRD schemes	No action in view of the judgment of the High Court of Mumbai.
2.	To increase FSI for the dilapidated str. MoEF has issued a clarification the FSI shall be as on 19.2.1991.	To permit increase in FSI for such schemes	No action in view of the judgment of the High Court of Mumbai.
3.	To permit TDR in CRZ area	To permit TDR generated in CRZ within CRZ	No Action
4.	Violation of CRZ by construction of Navi Mumbai by destruction of mangroves.	To permit Navi Mumbai as there is need of counter magnet townships.	No action.
5.	To permit dumping of solid waste	Not recommended.	Supreme Court directed Government of Maharashtra to relocate landfill sites.
6.	Constructions within inter-tidal areas	To permit where already construction carried out	No action since CRZ to be amended.
7.	To permit Government housing schemes already initiated prior to 19.2.1991.	Recommended	Amended on 21 st May, 2002.
8.	Missing link roads in CRZ-I areas to be permitted.	Recommended.	No action.

1.3 Coastal Zone Management - International Best Practices

1.3.1 Developed countries

(i) United States of America

It is estimated that about 60% of the population are living along the coastal areas of USA. The maritime jurisdiction is 12 nautical miles from the shore. The major coastal and marine issues are discharge of effluents, decline in fishery stocks, development of off-shore oil platforms, coastal erosion and natural coastal hazards including storm surges. For the purpose of protecting the coastal environment, USA has issued marine and coastal sectoral laws in 1972, which is called Coastal Zone Management Act in 1972. The Act lays-down a framework for voluntary cooperation between Federal Government and coastal States. The approach for coastal zone management is top down and bottom up and is focused on regulatory mechanism including coastal planning.

The Coastal Zone Management is supervised by National Oceanic and Atmospheric Administration (NOAA) of Department of Commerce. The Coastal Zone includes coastal waters upto 3 miles of shore with land boundary being flexible in order to protect the sea from the effects of land based activities or to deal with sea level rise. The Act identifies 10 National Policy objectives such as Protection of natural resources, coastal development, public access, etc. Each coastal State brings out its own Act such as California Coastal Act of 1976, Connecticut Coastal Management Act, Massachusetts Coastal Zone Management Programme. Federal grants are provided to the coastal States to develop, administer and manage the programmes. The main activities at all levels of government are directly linked. Under the Coastal Zone Management Authority all three levels of government, federal, state and local, are given important roles to play and considerable flexibility in defining those roles.

At the national level the OCRM is the administering office. It interprets the statute through rules and regulations, interacts with oversight and reauthorize committees in the Congress, and approves (or rejects) state management programmes and programme amendment submitted to it for approval. Additionally, it awards grants to states for planning and administration of coastal programs, evaluates the progress of the states in implementation and oversees implementation of federal consistency provisions of the Coastal Zone Management Authority.

The states are the action arm of the coastal management systems. The states follow the frame and guidelines laid out in the federal act. States, for example, determine the boundaries of the coastal zone, the key coastal problems, the policies and laws that address them, and the state and local organization required to be involved in implementation. Within each state, a designated lead agency is the author and lead implementor of the coastal management programme and the recipient of federal grants and matching funds for planning or administration. Frequently, the states provide technical assistance to other entities, build constituencies, research coastal management issues and trends, and promote new policies.

Local Government, includes cities, counties and substate regional entities, are often primary implementors of state coastal policies and programs. They use traditional land use power and infrastructure improvement to achieve coastal policies objectives. Another

important means of implementation is through state agencies with resource management mandate, such as state agencies with submerged lands, fish and wildlife, or environmental responsibilities. These units work closely with the lead state agency, and as a result can receive federal funds and benefit from the federal consistency under the Coastal Zone Management Authority.

(ii) The United Kingdom

The major coastal and marine issues are pollution from industrial and townships, damage to productive ecosystems, resource depletion, erosion of coastal areas. In United Kingdom, there are various laws for protecting the marine sectoral laws and for the coastal environment. There is no single law for protecting the coastal environment. There are laws for fishery conservation, special ecological zones and other flora and fauna. About 30 legislations apply to coastal developmental activities. Most of them are sectoral and applies either to the land or to the sea. The urban areas are planned as per Town & Country Planning Act, 1990. Due to lack of an integrated policy for protection of coastal environment, the coastal zone management is not implemented properly. Erosion and flooding are the major issues. Shoreline management plans based on sediment cell concept have been prepared on priority and are being implemented.

(iii) Canada

About 25% of the population of Canada is supposed to be living along the coastal areas. Some of the major issues of Canada coast is loss of wetland, decline in fishery stocks resource conflict, pollution from non-point and point sources including off-shore oil development. There are various laws and Acts, which include Fraser River Estuary Management Programme of 1985, Great Lakes Water Quality Programme, 1987, Atlantic Coastal Action Plan, 1986 and Canada Ocean Act, 1996. The Ocean Act has the framework for integrated management of sea and protection of the marine environment from land based activities that have an impact on estuaries, coastal waters. The Act has 3 parts, Part-I defines Maritime Zones (12 mile territorial sea, 24 mile contiguous zone & 200 mile EEZ) in accordance with UNCLOS. The Part-II of the Act has management of ecosystems while the Part III has responsibilities and jurisdiction of agencies. The approach adopted for the coastal zone management programme under Canada Ocean Act is top down. There is also involvement of consensus building. It has been observed that community based programmes are highly effective.

(iv) The Netherlands

About 60% of the total population is known to be residing along the coastal areas of Netherlands. The major coastal problems of the Netherlands include impacts due to construction of coastal defence, water pollution from industries and agricultural areas, loss of wetland, sea level rise, adverse environmental effects due to sand mining, off-shore oil and gas platforms. The coastal management is mainly at the national level. For the purpose of protecting the coastal environment, the Netherlands has North Sea Harmonisation Policy, 1984, Dynamic Preservation Strategy, 1991 and Coastal Defence Act, 1995.

(v) Australia

About 75% of the population is known to be living along the coast. The marine zone includes 12 nautical miles of territorial sea and 200 nautical miles of EEZ. The main problems faced by the Australian coast are habitat destruction, resource depletion, stakeholder conflict, and Government fragmentation due to sectoral approach, offshore development programmes, and excessive coastal fisheries. The primary level of coastal management is mainly the responsibility of the State and the national and local levels. Various laws have been enacted which include State level and Federal level legislations/policies such as Western Australia State Coastal Review of 1994 and 1995, Queensland Coastal Management Bill, 1995, Victoria Coastal and Bay Management Act, 1995, New South Wales, Revised Coastal Policy, 1996, Tasmanian Draft State Coastal Policy. The Commonwealth Coastal Policy, 1997 and the National Ocean Policy of 1996. The Australian Government is moving towards Integrated Coastal Policy.

(vi) Spain

About 35% of the population are living along the coastal areas of Spain. Coastal erosion, tourism development, general urbanisation, sedimentation, loss of productive ecosystems, inter-governmental duplication, marine pollution, competition for fishery resources. The coastal management programmes are mainly initiated at the national level but the regional and local levels government play a role. Some of the legislations include Shore Act, 1988, Regional Guidelines for Coastal Zone, 1992 have been put in place. The Coastal Management Programmes are mainly regulatory in nature having top down and bottom up approach. There has been very little move towards integrated coastal policy.

1.3.2 Developing Countries

(i) Brazil

About 38% of the population is living along the coastal areas of the country. The major coastal and ocean issues include destruction of mangroves, coastal erosion, large scale tourism, urbanisation, shipyard development, non-point source of pollution, multiple use competitions, excessive offshore fisheries. The primary level of implementing coastal zone management programmes are at national level. Various legislations have been enacted by the Brazilian Government, which included Ocean Planning of 1974, Environmental Laws of 1980, Coastal Programme, 1983. The approach for coastal zone management is top up especially for protecting coastal ecosystem. Very little effort has been taken for integrating coastal zone management issues.

(ii) Thailand

About 70% of the population is residing in the coastal stretches of the country. The main issues of coastal and marine areas are destruction of coral reefs, mangrove deforestation, decline in fishery stocks and pollution from agricultural areas. The primary enforcement of coastal management programmes is from the national level. Various national initiatives have been taken up which includes National Coral Reef Management Strategy, 1991, Integrated Coastal Management Plan in Ban Don Bay and Phangaga Bay. The coastal zone management has been moderately effective and some initiatives have been taken up for integrated management of the coastal area.

(iii) Malaysia

About 70% of the population is living along the coastal areas of Malaysia. The main coastal and marine issues are erosion, mangrove destruction, coral reef destruction, and pollution from tourism and industries. The initiatives taken for coastal zone management are mostly at national level, which includes National Coastal Erosion Study, 1984, National and Coastal Resource Management Policy, 1992, South Johore Coastal Plan, 1992. The approach is mostly regulatory for preventing erosion and conservation of mangrove forest. Few initiatives have been taken for integrated coastal zone policy.

(iv) China

About 40% of the population is living along the coastal areas of China. The major environmental issues include large scale economic development, pollution, reclamation, mangrove loss, coral, sand mining and fishery depletion. The initiative taken for coastal management is generally by the Provincial Governments. There is no comprehensive regulatory framework for managing the coastal activities. Pilot studies of integrated coastal zone management programmes have been initiated in Xiamin Province. Very little initiatives have been taken for the protection of the coastal environment.

(v) Sri Lanka

About 34% of the population lives in coastal areas in the country. The coastal stretches are thickly populated. The provincial level has autonomy to implement coastal programmes. The initiatives taken for coastal protection is mainly national. The various coastal and management programmes and legislations include Coast Conservation Division, 1978, Coast Conservation Act, 1983, Coast Permit System, 1988, Coastal Zone Management Plan, 1980, Marine Pollution Prevention Authority, 1990 and Special Area Management Plan, 1996. The setback line on the landward side is 300 mts based on coastal erosion rate, exposure to cyclones, geomorphological characteristics, vulnerability to coastal habitats, cultural sites, etc. The seaward reference line is mean sea level. Developmental activities are regulated in the zone. The coastal zone management plans are prepared for each of the identified sites and enforced by the local bodies. Sri Lanka has taken initiatives for integration of coastal zone management programmes and has been relatively effective.

1.3.3. International agencies

The coastal zone management approach suggested by various multilateral and bilateral agencies such as:

(i) United Nations Conference on Environment and Development (UNCED)
(AGENDA 21)

Chapter 17 deals with Protection of the Oceans, all kinds of Seas, including Enclosed and Semi-enclosed Seas, and Coastal Areas and the protection, Rational use and Development of their living resources. This chapter recommends Integrated Management and Sustainable Development including EEZ, with emphasis on marine environment protection, sustainable use & conservation of living resources and climate change. It also recommends integrated policy and decision making process for all sectors, identification of existing and

projected use of coastal areas and their interactions, concentration on well-defined issues concerning coastal management, application of preventive and precautionary principles in planning and implementation of major projects, address issues of pollution, erosion, loss of resources and habitat destruction to be addressed with participation of people in planning and decision making.

(ii) United Nation Environment Programme (UNEP) Guidelines

The guidelines state “integrated management of coastal areas is required to lay the foundation for sustainable development.” ICZM guidelines are given in three main stages: initiation, planning (preparation of ICZM master plan), and plan implementation. Many of the challenges to sustainable development (population pressure, industry growth, coastal tourism) are illustrated in the context of the Mediterranean region. UNEP suggests multidisciplinary approach, problem solving, not problem transfer, priority on prevention rather than cure and precautionary approach. With regard to the management area UNEP does not recommend specific boundaries. However, the first step of the planning stage is to prescribe definition of coastal area boundaries. The goals are to provide guidelines for legal and institutional strategy in area management and planning, form ad hoc committees for dispute resolution and combine land use control and economic tools for pollution control and conservation. The guidelines endorse use of the National Coastal Management Act or other legal means of ensuring enforcement of various sectoral laws. Guidelines utilise a “top-down” approach.

UNEP suggests an administrative structure which includes national and regional government budgets, for infrastructure and pollution control by means of fees, taxes, economic incentives and for conservation and also allocate funds from interested environmental groups, park entry fees, etc.

(iii) Organisation of Economic Cooperation and Development (OECD) Guidelines

These guidelines are the result of investigations using country information papers prepared by respondents in several countries and a survey carried out. The main stress is on ecologically sustainable development of the coastal zone. Recommendations are given for structure and processes for Integrated Coastal Management (ICM), including creation of the institutional body, generation of information, assessment of current policies, preparation of alternative plans, selection of a final plan, and monitoring and evaluation. OECD recommends multidisciplinary approach, problem solving, not problem transfer, priority on prevention rather than cure and precautionary approach. Guidelines do not recommend specific boundaries. However, the first step of the planning stage is precise definition of coastal area boundaries. The Functions/Goals are to achieve and maintain critical stocks of resources, maintain or enhance critical environmental quality, preserve certain natural resources (usually public goods) and maintain the amenity value of the coastal zone.

The guidelines suggest that legislation is needed to create institutional bodies or the management council (legal agency) and to allow for coordination. Of importance is “a consistent government policy at national or regional level that provides clear direction and support for integration.”

Guidelines state that a major factor of successful ICM is how well the government implementing the programme can raise its own funds, either independently or with assistance

from the national government. This flow of financial resources must be dependable and ongoing. It is emphasised that scientific analysis, natural resource monitoring, and impact assessment play a crucial role in successful ICM.

(iv) International Union for Conservation of Nature (IUCN) Guidelines

Guidelines are provided for the development of a coastal area plan that can be applied at a national level, through a review of coastal problems and the need for Integrated Cross-Sectoral Management (ICSM). The process by which ICSM can be achieved by seven steps which include problem definition, assessment and analysis, issues and options, formulation, adoption, implementation and monitoring and evaluation. Guidelines state that the starting point of ICSM is sustainable development. Therefore, the guidelines endorse a long-term and intra and inter-generational focus. To be effective, the effort should be holistic, that is, interdisciplinary, combining social and natural sciences.

However, the guidelines provide no specific recommendations or suggestions for setting up those legal and institutional arrangements; they only emphasise the need for integration among the legal, administrative, socio-economic, and biogeophysical components among the public, scientists, managers, and users, including some form of dispute resolution.

(v) World Bank

Guidelines are designed to “ensure that development and management plans for coastal zones are integrated with environmental (including social) goals and are made with the participation of those affected.” Included are sections on institutional roles and responsibilities and on triggering of the need for ICZM. A three-stage process of plan formulation, programme implementation, and monitoring, enforcement, and evaluation is recommended. The principles are based on precautionary principle, “polluter pays” principle, use of proper resource accounting, Transboundary responsibility, and Inter-generational equity. The management zone includes all of the coastal resources of interest and all activities that are capable of affecting the resources and waters of the coastal zone (implies from the watershed to the 200 nautical mile limit). Functions suggested are to strengthen and harmonize sectoral management, to preserve and protect the productivity and biological diversity of coastal ecosystems and to promote rational development and sustainable utilization of coastal resources. The goals set are Agreed-on goals and objectives by line agencies and sub-national governments. Legislation for boundary setting and zoning of the coastal area but not necessarily a comprehensive coastal zone act. Funding to put ICZM programme in place can come from budgets of existing government agencies. New funding for research needs and new institutional arrangements should come from the national government, with assistance from international agencies. The guidelines also suggest to give the value of natural coastal resources and the fact that the coastal zone is a “dynamic area with frequently changing biological, chemical and geological attributes.”

(vi) World Coast Conference Report

Guidelines stress the urgent need for coastal states to strengthen their capabilities for ICZM; and the need to develop strategies and programmes by the year 2000. ICZM is described as the most appropriate process for anticipating and responding to long-term concerns and needs while addressing the present day challenges. It is to be achieved through a planning process involving data collection and analysis, monitoring and evaluation, and an

implementation process. The Principles follow the principles set out in the Rio Declaration – in particular, sustainable development and its long-term focus and the precautionary principles. Case studies illustrate a wide diversity of strategies, from only the land side of the coastal zone to somewhat integrated coastal and ocean management. The ICM functions/goals are to anticipate and respond to long-term concerns while addressing present-day challenges and opportunities, stimulate sustainable development of coastal areas and promote increased economic development and benefits. The guideline suggests strong tie between the IPCC and the World Coast Conference, natural science aspects are stressed, with emphasis on the role of vulnerability assessments in ICZM and the effects of sea level rise.

1.4 Scientific Principles in Coastal Zone Management

Conflicts in coastal management are primarily because coast requires space for functioning whereas coastal space is required for various uses. In addition to this there are competitions for resources among various stakeholders.

Current approaches in Coastal Zone Management are based on environment protection and conservation of resources rather than sustainable development and this is not adequate.

Coastal Zone Management based on Environmental Protection approach is defensive or remedial in practice (National Parks and Sanctuaries), relies primarily upon regulations and zoning to set limits on environmental damage and works well where Governments have the resources and will to impose regulations and it also aims towards long term preservation of ecosystem.

1.4.1 Specific Management Methodologies to implement Coastal Zone Management

1.4.1.1 Zoning

A popular management action employed as part of Integrated Planning and management is zonation. A zonation scheme aggregates activities that are appropriate to one another and segregates those that are contrary. Likewise, it ensures that areas that are able to sustain multipurpose development are identified and those for protection are covered by legislation. Therefore, areas of coastal erosion and flood control, vulnerable areas to natural hazards, water catchments, habitat protection, and marine resources management, including fisheries, can be identified and mapped. Suitable areas for aquaculture, recreation, tourism, industrial use and sand mining can also be identified. Zonation is a useful tool in development and planning. Using a zonation strategy and resource specific management plans, action plans could be developed for specific sites that are currently experiencing critical resource use conflicts or have proposed resource development that may result in such conflicts.

1.4.1.2 Vulnerability Mapping

Most of the developed countries such as USA, UK, New Zealand have prepared the vulnerability maps of the coastal areas. The New Zealand vulnerability map is based on rate of erosion and flooding of coastal areas. The western coast of USA, has been mapped based on the vulnerability to natural disasters. For the purpose of demarcating vulnerability map along the western coast of USA, seven parameters have been taken into consideration, which include evaluation, geology, geomorphology, sea level trends, horizontal shoreline

displacement, tidal ranges and wave heights. The document pertaining to “Coastal Hazard Database for the U.S. West Coast” (available from National Technical Service, US, Departemnt of Commerce, 5285, Port Royal Road, Springfield, VA 22161) shows in detail the procedure adopted for mapping the vulnerability line based on the above seven parameters. All developmental activities are located based on the vulnerability map. In case of U.K., the vulnerability maps are prepared on the basis of erosion and flooding.

1.4.1.3 Setback zones

According to shoreline setbacks or exclusion zones, certain uses are restricted within a specified distance. The benefits of setback zones are:

- (a) Avoidance of risks arising due to cyclone, flooding, erosion and other geomorphologic/geological events such as tsunamis.
- (b) Sufficient spaces for the functioning of the coast.
- (c) Protection of sensitive ecosystems.
- (d) Public access and preservation of the natural beauty of the shoreline.

Different set back zones for different activities on their impacts:

e.g.	Housing	20 m-200 mts
	Tourism	50 m-200 mts
	Non-polluting Industries	300 m-500 mts
	Polluting Industries	more than 1000 m

Different Setback Zones in different areas based on their importance:

e.g.	Critical Habitats	1000 m
	Infrastructure developed areas	200 m
	Under developed areas	500 m

Different Setback Zones in different areas based on their risk

Based on geomorphic events such as erosion and natural hazards such as earthquakes, cyclones, etc., the coast could be classified into the following zones and setback distances are determined accordingly.

e.g.	High Risk Zone
	Low Risk Zone
	No Risk Zone

Different Setback Zones in different areas based on geomorphology/geology

Based on geomorphology of the coast such as rocky cliff, muddy coast or sandy coast, the setback zones could be decided.

Different Governments have adopted, different setback zone based on developed activities, geomorphology, ecosystems etc. The setback zones adopted by different countries/States are as given below:

COUNTRIES	SETBACK ZONE
Brazil	33 m
Colombia	50 m
Costa Rica (Public Zone)	50 m
Costa Rica (Restricted Zone)	50-200 m
Chile	80 m
Denmark	1000 – 3000 m
Ecuador	8 m
France	100 m
Greece	500 m
Hawaii	13 m
India	500 m
Indonesia	50/400 m*
Mexico	20 m
New Zealand	22 m
Norway	100 m
Oregon	Permanent vegetation line (variable)
Philippines (Mangrove Green Belt)	20 m
Sweden	100 m
Spain	100-200 m
Uruguay	250 m
USSR-Coast of the Black Sea	3000 m
Venezuela	50 m

1.4.1.4 Special Area Management Plans

Advantages of Area Specific Management Plans:

- Considers the physical settings of the coast, its resource and its developmental potentials.
- Considers the area specific issues and problems.
- Enables the participation of local uses and communities.
- ICZM approach is much easier because of limited areas.
- Easy to implement and easy to correct.
- Designed for sustain able development.

The Coastal Zone Management has two Approaches:

- (i) Top Down – In this approach, there is no participation of people. Decisions are made by Governments. The decisions of the public are not given due weightage.
- (ii) Bottom Up – In this approach there is participation of public in planning and development. There is also provision for collaborative management through multi-stakeholder process/voluntary participation of all the parties concerned.

1.4.1.5 Integrated Coastal Zone Management (ICZM)

ICZM is a continuous and dynamic process that unites government and the community, science and management, sectoral and public interests in preparing and implementing an integrated plan for the protection and development of coastal systems and resources. ICZM is a unitary programme and it has to manage development and conserve natural resources and, while doing so, it has to integrate the concerns of all relevant sectors of society and of the economy. Also, it is important that coastal economic development be generated for the people of a country, not just for those who are already rich and powerful. The goal of the ICZM is to improve the quality of life of human communities who depend upon coastal resources while maintaining the biological diversity and productivity of coastal ecosystems.

Major functions of Integrated Coastal Zone Management:

- Area Planning - plan for present and future uses of coastal and marine areas; provide a long term vision.
- Promotion of Economic Development - promote appropriate uses of coastal and marine areas (e.g. marine aquaculture, ecotourism).
- Stewardship of Resources – protect the ecological base of coastal and marine areas; Preserve biological diversity; ensure sustainability of uses.
- Conflict Resolution - harmonize and balance existing and potential uses; address conflicts among coastal and marine uses.
- Protect of Public Safety - protect public safety in coastal and marine areas typically prone to significant natural, as well as human-made hazards.
- Proprietorship of Public Submerged Lands and Waters - as Government's are often outright owners of specific coastal and marine areas, manage government-held areas and resources wisely and with good economic returns to the public.

The status of ICZM programmes in different countries

Country	Research and inventory	CZM authority linkages between departments	Sectoral plan	ICZM planning	Implementation in progress	Evaluation and feedback
Bangladesh	✓	X	✓	X	X	X
Barbado	✓	✓	X	✓	X	X
Belize	✓	✓	✓	✓	X	X
China	✓	✓	✓	✓	X	X
Ecuador	✓	✓	✓	✓	✓	✓
Egypt	✓	✓	X	X	X	X
Israel	✓	X	✓	✓	✓	✓
Netherlands	✓	✓	✓	✓	✓	✓
New Zealand	✓	✓	✓	✓	✓	✓
Sri Lanka	✓	✓	✓	✓	✓	✓
Syria	✓	✓	✓	✓	✓	✓

USA	✓	✓	✓	✓	✓	✓
Croatia	✓	✓	✓	✓	✓	✓
Turkey	✓	X	✓	✓	X	✓
Germany	✓	X	X	X	X	X
Greece	✓	X	X	✓	✓	X
Indonesia	✓	✓	✓	X	X	X
Malaysia	✓	✓	✓	✓	X	X
Mexico	✓	X	✓	✓	X	X
Philippines	✓	✓	✓	✓	✓	✓
Tanzania	✓	✓	X	✓	X	X
Thailand	✓	✓	✓	X	✓	X

CHAPTER-2

2.0 COASTAL AND MARINE RESOURCES – THREAT & SAFEGUARDS

2.1.0 Non-Living Resources in coastal and marine areas

The non-living resources include the sand, rocks, heritage and archeological sites etc. The coastal and marine areas have a wealth of minerals resources. Some of these minerals have high economic potential such as oil and gas, monozite, rutile etc. Apart from these minerals the sand, rocks, cliffs etc. not only play a major role in maintaining the functional integrity of the coastal but also provides a substrata for the several organism. Sandy beaches are required for turtle nesting sites. There are several valuable man made and natural sites that have archeological and heritage importance. These may be of prehistoric and/or historic significance. The importance of some of the non-living resources is described below-

2.1.1 Hydrocarbons

Hydrocarbon sector in India has been the key driver of energy security in the country in recent times, as nearly 45% of the total energy needs of the economy are accounted by oil and gas. In order to boost exploration activities in a time bound manner, Government have initiated programmes of reforms in the hydrocarbon sector.

Most of the oil and gas reserves are found in inland and shallow offshore areas. Some oil and gas fields are also located in the deep water areas. Since most of the available areas are totally virgin, significant efforts are required to build the geological knowledge base through aggressive data acquisition programs. Major petroleum reserves have been identified in the onshore and offshore region like Bombay High, Gulf of Kachch, Godavari basin, offshore regions of Andhra Pradesh. Keeping in view the importance of oil and gas for the nation's economy and security this sector should be encouraged to develop after taking into consideration all the environmental issues.

2.1.2 Placers and other Minerals

Placer deposits are found as a result of selective concentration of valuable minerals lineated by mechanical disintegration from preexisting rock. A placer deposit is conceived as segregated group of sediments that correspond to a common tectonic and geomorphological processes and climatic setting. The coast of India has large deposits of the placer minerals, which are distributed in pockets along the east and west coast of the country. Some of the minerals are found at the seabed at varying depths. It is reported that the Maharashtra and Goa coast have deposits of ilmenite, magnetite deposits in pockets and also along the sea bed with depth ranging from 1m to 17 m. While the Kerala and Karnataka coast have the large deposits of ilmenite, monoxide, zircon, rutile, and garnet. These deposits are found from the shore to a depth of 15 m. The Chavara and Varkala sector in Kerala have deposits ranging upto 25 sq kms. Along the east coast Tamil Nadu, Andhra Pradesh and Orissa sector has some of the riches deposits ilmenite, magnetite, garnet, sillimanite, zircon, rutile and other heavy minerals. Along Tamil Nadu these deposits are found upto the depth of 1m from the shore while in Andhra Pradesh and Orissa the deposits are found from the shoreline to a depth of 15 m. It is estimated that of the coast line of 7,500 kms placer mineral deposits are found in 2,643 kms stretch with a resource availability of 340 metric tonnes. At present, mining of these minerals are being undertaken by Indian Rare Earth Minerals, Kerala Rare

Earth Minerals and few private sector units. The mining of placer minerals and other minerals, which are not found elsewhere should be permitted to be mined, subject to incorporating appropriate environmental safeguard measures in their mining plan.

2.1.3 Salt and Chemicals

The high temperatures and windy conditions prevailing along the coastline are congenial for several salt pan activities. These saltpan activities are mainly concentrated along the coast of Gujarat, Tamil Nadu and Andhra Pradesh. The methods adopted for this activity are a simple technique where a tidal water is embanked and taken into the pans located in the along the inter tidal areas of the coastal stretch. Salt is formed in these pans by natural evaporation of the seawater. In case of the coastal areas of Tamil Nadu especially in Tuticorin the brine is pumped from the groundwater, which are taken into the pans for solar evaporation.

The coastal stretches of Gujarat have also several industries, which are based on salt as raw material. The saltpan activities not only provide livelihood for large number of unskilled workers but also provides raw material for several such chemical industries. The adverse impact of the saltpan activities includes salinity ingress into groundwater, destruction of mangroves and mudflats. There is also occupational health hazards associated with this activity, since the workers in the salt pans are in constant contact with the high concentration of brine solution. This activity needs to be regulated.

2.1.4 Fresh Water

The freshwater for the coastal areas of the country mainly comes from surface water (pumped from inland sources) and ground water. Rainwater harvesting and desalination are beginning to be practiced in areas facing scarcity. Since the demand for the surface water sources are ever-increasing in the hinterland, the sustainable source for freshwater requirement of the coastal areas is groundwater.

The principal aquifers in the coastal area belong to unconsolidated sediments of Quaternary and Upper Tertiary age, deposited under various sedimentary environments like fluvial, back swamp, deltaic, sub-marine and marine environments. These aquifers occur both in unconfined and confined condition. Two major problems are likely to be cropped up consequent to extensive ground water development in coastal areas are saltwater intrusion and land subsidence.

The Cenozoic sedimentary formations constitute the regionally extensive coastal aquifers in Malabar and Coromandal coasts (artesian aquifers encountered down to a depth of 400 m) and coastal fringes in Kutch and Saurashtra. Alluvial and Deccan Trap formations also form part of west coast aquifers. In eastern coasts, the coastal belts constitute a narrow elongated crescent shaped area, formed in the outfall regions of the major rivers like Mahanadi, Godavari, etc., where the groundwater is saline down to a depth of 100-135 metres.

The coastal area of West Bengal comprised of Bengal Delta formed by Hoogly-Bhagirathi river systems and underlain by unconsolidated fluvial sediments. Groundwater is saline down to a depth of 110-150 m within 20-30 km inland from the coast. The quality of groundwater in coastal areas by and large is fresh, except in certain areas where it is found to

be saline/brackish, either due to salinity ingress or inherent salinity in the geological formations constituting the aquifer systems.

Table: Groundwater resource potential in coastal states.

State/Union Territory	Resources (Million ha. metre/yr)	Development (%)
Andhra Pradesh	3.52909	26.10
Goa	0.02182	8.30
Gujarat	2.03767	49.29
Karnataka	1.61750	33.06
Kerala	0.79003	18.99
Maharashtra	3.78677	34.70
Orissa	2.01287	15.22
Tamil Nadu	2.64069	62.55
West Bengal	2.30914	32.19
UT of Dadra & NH	0.00422	12.81
UT of Daman	0.00071	80.00
UT of Diu	0.00037	94.84
UT of Lakshadweep	0.003042	39.12
UT of Pondicherry	0.01746	77.63
Total	18.79875	Average 35.38

The major problems in the groundwater sector of coastal areas are over development leading to the ever-increasing fresh water demands, declining water table leading to reduction in sustainability of tubewells and salinity ingress in coastal aquifers. A regulated development regime is crucial particularly, in the coastal areas due to the high vulnerability for salinity intrusions causing and permanent damage of the aquifers. Similarly, groundwater recharge schemes need to be taken in the coastal areas on a priority.

If the fresh water withdrawal results into a critical situation for salt water intrusion, groundwater development may be regulated. Once the aquifer is already threatened with the danger of salt water intrusion, the following remedial measures like limited water usage, artificial recharge, creation of pumping trough, construction of cut-off walls and direct salt water removal are adopted. To increase the amount of stored water in otherwise depleted aquifer consequent to extensive developmental activities, artificial recharge by injecting fresh water can be done. To break the contact between fresh and salt water an artificial impervious barrier, may be constructed which will close the aquifer near the sea to store the fresh water and prevent it from being wasted as well as isolating it from the sea water. Drilling a battery of deep wells, close to the sea-front and along a line parallel to that front in order to pump salt water only would deepen the fresh water zone and would compel the salt water mound to retreat towards sea. Subsidence of the ground surface due to heavy pumping of confined aquifers have occurred in the coastal areas.

The roof water and other rainwater harvesting techniques practiced in Lakshadweep and in a few villages of Kerala, Tamil Nadu, etc., need to spread to the entire coastal belt for the sustainability of the groundwater, which should be used only in emergencies. For larger requirements, if surface water sources are inadequate, instead of depending on the traditional

systems desalination schemes needs to be adopted as it is declared for Chennai. It is worth mentioning at this point that desalination has been successfully practiced by the industrial units and some localities (e.g. Narippayur, Ramnad in Tamil Nadu).

2.1.5 Renewable Energy Resources (OTEC, Wave Energy, Tidal Energy, Wind Energy etc.)

The ocean energy is due to wave action, tidal action, thermal differences between the bottom and the surface layer called Ocean Thermal Energy Conversion (OTEC), salinity gradient and ocean currents. Usage of ocean energy sources for generation of electricity is in experimental stage all over the world including in India.

The wave energy potential in India varies from location to location and an experimental 150KW wave energy plant of DOD is operational at present at Vizhinjam, Kerala. The plant has structures like caisson on which the wind turbine is mounted. Wave action generates wind force in the caisson and the movement of wind due to wave action rotates the turbine, which is used to generate electricity. Since the power developed from the wave energy plant is low, variable and cost prohibitive, a stand alone wave energy power plant is not economical for the coast of the mainland. However in isolated remote locations like islands they might be economically viable.

OTEC is based on the principle of evaporating liquid ammonia by circulating the warm ocean surface water in a chamber and the vapour generated is used to derive turbine to generate electricity. The vapour ammonia is cooled to become liquid using ocean bottom water that has a temperature of 8 to 10 Deg. Celsius. Location of deep water with a temperature of 8 deg. In tropical waters holds key for the economic viability of the OTEC system. Such locations are available close to islands of Lakshadweep and Andaman and Nicobar. The National Institute of Ocean Technology (NIOT) has already fabricated a floating OTEC plant, which is under testing in the sea off Tuticorin. OTEC has good potential for application in India. The major impact from the OTEC plants is sudden change in temperature of the surrounding seawater due to discharge of cold water from the plant and as it may affect the biota around the discharge area.

Extraction of electricity using tidal energy almost resembles the energy generation methods adopted in hydro-electric power systems. In areas, where the tidal amplitude is more like Gulf of Khambhat, Gulf of Kachchhh and Hooghly estuary, the high tide water is encircled in a dam like structure and during low tide, the sluice gates are opened to derive the turbine located at the gate. The rotation of turbine generates electricity. The Committee feels that such non-conventional energy methods should be promoted especially in the coastal villages and in the islands of A&N and Lakshadweep.

2.2.0 Areas of Incomparable Value

Significant or irreversible risk and harm to human health and life as well as critical to ecological systems and resources including unique species and other natural and manmade entities such as Monsoon cycles, Royal Bengal Tiger, Valley of Flowers, resulting in serious and large scale detrimental impact, would be considered incomparable. As such the society will not accept and measure these risks and harm in terms of monetary or conventional goods

and services. Being irreplaceable and invaluable, they shall be given special and overriding priority for allocation of resources for protection and conservation.

2.2.1 Areas of Scenic Aesthetic Value, Heritage and Archaeological Sites and Areas of Outstanding Natural Beauty

Sea and its coast is an aesthetic gift of God, only comparable with the majestic mountains. The sound and serenity provided by the sea is one of the most sought after endowments of nature. Therefore, aesthetic considerations should play a significant role in development of the coastal areas.

The view of the vast expanse of the sea is in itself of great aesthetic value. Therefore any development that obstructs the view of the sea is undesirable. Unfortunately, it is not physically possible to provide unobstructed views from everywhere in built up settlements. Very careful analysis of topography, physical features and built form is called for to ensure that certain vantage points are protected to provide unobstructed views and the beach areas should be free from any obtrusive structure. The identification of locations, and control over development can only be ensured through the Development Plan prepared by the local civic authority. Close interaction between MOEF and local civic bodies is called for to ensure environmentally sustainable development.

Apart from the view of the sea, the landform, vegetation, etc around the coastal area are of aesthetic value, which deserves conservation. The same process of careful analysis is called for by the civic authorities while preparing Development Plans so that these areas of scenic beauty are conserved and kept out of obtrusive development. Some of these areas of scenic beauties may be classified as areas of outstanding natural beauty, and these may be graded for their significance and ecological importance.

There are several man made structures in and around the coastal stretches, which are of heritage value. Only a small number of them have been listed by the ASI as monuments of national importance or by the State Archaeological Survey of India (ASI) as monuments. Majority of the ancient structures are unprotected by any legislation although they are of significant historic and/or architectural value, at least to the local people.

In order to protect these monuments and conserve them, the British practice of recording is based on fairly systematic and transparent criteria; which are as follows: (i) world heritage monuments, (ii) monuments of national importance, (iii) monuments of local importance which are graded into three classes of A, B, and C according to their; (a) architectural merit, (b) historic value, (c) part of an ensemble of buildings, where a collection of buildings form a homogenous architectural presence, e.g.; Regents Park Crescent, Bath Crescent etc. (d) modern buildings by great modern architects; e.g. the National Centre for Performing Arts in Mumbai at Nariman Point . The local civic authority then determines the degree of protection they would accord in accordance with the grading. The process of listing is transparent and accessible in the public domain. These monuments become part of the development control ensured through the Development Plan.

2.3.0 Living Resources in coastal and marine areas

Several coastal ecosystems like coral reefs, mangroves etc., have high species diversity. At the same time beaches are poor in biodiversity. With all the threats to marine ecosystems, there is little evidence for an imminent major loss of marine biodiversity at the species level. A distinction of the sea is its limited endemism: marine species and subspecies are only rarely confined to limited areas. There is great mixing of the oceans and its species and few sharply defined bio-geographic provinces with unique species composition. Since very few species are confined to narrowly bounded habitats, the chance that any species would be extinguished by human activities is very low.

Many human interventions/activities diminish biodiversity. Pollution through discharge of effluents or otherwise cause mortality, which may lead to extinction. Restrictions of freshwater flow into estuaries and reclamation have also affect biodiversity. Over fishing and selective fishing is against sustaining biodiversity. Introduction of exotic species and diseases are other detrimental factors. There are two levels of production. First the primary level comprising autotrophs (primary producers), who rely on photosynthesis and use inorganic compounds to accomplish growth. The main primary producers are green plant and are dependent on light availability. In coastal environments, the rapid attenuation of light in water places a restriction in primary productivity to only a few metres from the surface. Secondly heterotrophs or secondary producers, grow by the devouring and digesting of organic matter. These are chiefly animals.

A productive ecosystem is characterized by a high degree of biological diversity. It contains a large assemblage of plant and animal organisms in which each species has a well-defined role to play. A high level of species diversity in an ecosystem, therefore guarantee stability because many species provide numerous path ways for the energy flow. Thus each species plays its role in the food cycle, and if, because of human activities, there is destruction of one group of organisms, it would lead to the predominance of the other which had earlier formed its food components, thus leading to an inevitable ecological disturbance.

2.3.1 Marine Biodiversity

The coastal areas of the country experiencing tropical climate and having a diverse geological geomorphologic set up favours a multitude of coastal and offshore marine ecosystems. A total of 208 species of protozoan, foraminifera, tintinnid, dinoflagellate, sponges, cnidarian, Hydrozoa, siphonophores, polychaetes Crustacea, Copepoda have been reported in India, which includes 15 families and 60 genera. Among the four major reef areas of India, Andaman and Nicobar Islands are found to be very rich and Gulf of Kachchh is poor in species diversity. Lakshadweep Islands have more number of species than the Gulf of Mannar. Among the deepwater (ahermatypic) corals, so far 686 species belonging to 110 genera and 12 families have been reported from the world, of which 227 species belonging to 71 genera and 12 families have been reported from the Indian Ocean region. However, in India so far only 44 species have been reported and very little attention was paid to deep water corals.

The diversity of the fish population in the Indian waters is explained by 2,546 species of fish belonging to 969 genera, 254 families and 40 orders. Fifty seven percent of the Indian marine fish genera are common to the Indian Ocean and to the Atlantic and Mediterranean

The reptilian population that the coastal and marine habitat harbours consist of the 26 species of sea snakes, 5 species of sea turtles. Nesting sites of an amphibious snake is reported from the shores of North Andaman Islands. Leatherback sea turtle, *Dermochelys coriacea* is the sole representative of the family *Dermochelyidae* and is a rare species. The remaining four species namely the Green turtle (*Chelonia mydas*), the Olive Ridley (*Lepidochelys olivacea*), the Hawksbill (*Eretmochelys imbricata*), and the Loggerhead (*Caretta caretta*) are contained in a single family, *Cheloniidae*. Various mammals that are present in the Indian waters are in endangered list. All the five species nest on Indian coast. Marine mammals belong to three orders *Cetacea*, *Carnivora* and *Sirenia*. 120 species occur worldwide and of these 40 are reported from Indian Ocean. 25 species of marine mammals belonging to the order *Cetacea* and *Sirenia* are reported from Indian waters. Sea cow, Dugong dugon occurs in near shore waters of Gulf of Mannar, Gulf of Kachchh and Andaman and Nicobar Islands. Dolphins and some whales live or breed in tropical waters, such as humpbacks, are occasionally seen near shore areas.

The coastal habitat and marine environment offers areas for reproduction, recruitment, feeding and shelter and should be protected. The euphotic zone of the sea (of nearly 200 m depth) is teeming with life having phyto-zooplankton, copepods, eggs, larvae of fishes, jelly fishes, molluscs, pelagic fishes, turtles and mammals. The sediments and chemicals, the runoff water carries to the sea, have profound effect on fertilization of eggs of marine species. Many areas in Andaman and Nicobar Islands, Gulf of Kachchh and Gulf of Mannar have large quantities of sediment laden freshwater runoff impinging on coastal reefs, causing high levels of coral mortality. The conservation of these faunal resources will help in the sustainability of coastal fishery and thereby ensure livelihood of the coastal communities.

2.3.2 Fisheries

The fisheries in India as such can be put under 4 phases namely underdeveloped, developing, mature and senescent. Some of the fishes and shellfishes are over exploited and some are underexploited and 51 resource groups contribute more than 75% of the total marine fish landings of India. About 40% of the resource groups are in mature or senescent phase, 60% in developing phase and tending towards the next phase. Most of the stock exploited at near optimal/beyond optimal level. The fishery sector provides employment to 1 million active fishermen of which 0.2 million are in the mechanized sector, 0.63 million are artisanal and the post-harvest employs 1.2 million (25% women). The annual production is 2.7 million tonnes. There is a need for concern in the fisheries sector since there is dwindling catches over the last 4 years. Low quality catch have led to unemployment and there is no alternative employment or means of income generation for the fishing communities.

There are 33 minor and 6 major fishing harbours serving as base for over 20,800 traditional non-mechanised crafts, 55,000 small scale beach landing motorised crafts, 51,500 mechanised crafts and 180 deep sea fishing vessels.

Variety of gears and methods are adopted in the fisheries sector. The small mesh (8-10 mm) targeting for juvenile prawns leads not only in depleting the stock as also traps non targeted groups leading to significant discards. A species of catfishes is extinct, as the brooders have been indiscriminately caught and the trawlers have been destroying the entire sea bottom of coastal waters where several of the demersal species inhabit. Experts opined that gill nets and hooks and lines are the best gear to exploit the resource. According to them

a Mechanised bottom trawling within 30 m depths has to be regulated and purse seines should avoid catching brooders. To ease pressure on the fisheries sector such as usage of Multi-gear, targeting multi-species, Open Access Fisheries etc., can be adopted. There is no National Marine Fisheries Policy and there is a need for popularization of code of conduct for responsible fisheries.

India has 3,638 fishing villages and 2,251 fish landing centres. The total marine fish production is about 2.695 million tonnes. Out of which, nearly 50% comes from nearshore waters and contributed by traditional fishermen. The major problems in coastal fisheries are overfishing, habitat destruction and degradation, pollution, post-harvest damages due to lack of infrastructure, fishing during monsoon, conflicts, among mechanised and traditional sectors, inter-state problems, etc. In addition to these, fishing communities also face compensation from other resource users. For example, coastal tourism interferes with traditional fishermen in their activities by replacing them and denying access to their traditional fishing grounds and beaches. Thus, the livelihood of the fishermen is threatened.

Fisheries experts are unanimous in the need for preserving the coastal areas, particularly on the guidelines to preserve the beaches, mangroves, lagoons, estuaries, intertidal habitats, rocky outcrops, swamps, mudflats, coral reefs, oceanic islands, small highly populated islands (“Thuruthu”) of west coast backwater system etc. Fisherman require freedom for construction of sheds for dry docking boats and storage of fishing gear, engines etc., for construction of fish drying platforms, construction of fish curing tanks, storage sheds, construction of ice plants, cold rooms, ice storages, erection of repair yards for small crafts, diesel and kerosene supply installations, boat building and repair, construction of sheds for net mending, storage, auction of fish, construction of dwelling houses, public facilities, community halls, places of worship, construction of permanent hatcheries, seawater intake systems, effluent treatment tanks, nursery ponds, grow out ponds, pump houses, Seawater reservoirs, traditional curing of fish in pits and tanks, drying of fish (cement platforms), racks, peeling of shrimp in sheds, handling and packaging of processed and semi-processed fish/shellfish in sheds, ice storage, cold room storage of fish and ice vending, storage of dried fish before weekly sale to wholesalers, traditional fish processing in “Chappas” by small scale fish processors, crab and lobster fattening in tanks with seawater pumping, beach ponds for recreational fish keeping, educational ponds for marine biodiversity, dolphinarium, oceanarium, marine aquaria, turtle conservatories, constructions related to open sea mariculture, laboratories working on live marine fish and shellfish breeding, wet labs where flowing seawater is needed, pollution control labs, coastal fish survey and monitoring stations, fisheries patrols, etc.

2.4.0 Coastal Ecosystems

The Indian coast has diverse coastal flora and fauna. Some of them are endemic to certain areas. The Islands of Andaman & Nicobar and Lakshadweep and the Sunderbans are some of the hot spots where such endemic flora and fauna are found. These coastal ecosystems are not only protect the coast from the natural phenomena but also provide livelihood security to nearly one quarter of the Indian population. Some of the major ecosystems are listed below alongwith their importance and threats -

2.4.1 Mangroves

Mangrove vegetation is found in the tropical and subtropical coasts. Mangroves consist of a number of species of trees and shrubs that are adapted to survival in the inter-tidal zone. They are basically land plants growing on sheltered shores, typically on tidal flats, deltas, estuaries, bays, creeks and the barrier islands. The best locations are where abundant silt is brought down by rivers or on the backshore of accreting sandy beaches. Their physiological adaptation to salinity stress and to water logged anaerobic mud is high. They require high solar radiation and have the ability to absorb fresh water from saline/brackish water. Mangroves occur in variety of configurations. Some species (e.g. *Rhizophora*) send arching prop roots down into the water. While other (e.g. *Avicennia*) send vertical "Pneumatophores" or air roots up from the mud. In size, mangroves range from bushy stands of dwarf mangroves found in Gulf of Kutch, to 30 m or taller stands found in the Sunderbans. Mangroves propagate by producing water borne "propaguls", which are not seeds but rather embryonic plants.

The mangrove swamp harbours a complicated community of animals, which are not evident. The roots provide a rich substratum for variety of attached animals, especially barnacles, bivalves, worms and truncates. Fish, molluscs and crustaceans find shelter in between roots. In the mud there are large numbers of burrowing crabs, molluscs and fishes. The branches of the trees are evidently habitats of insects, lizards, snakes and birds, including the migratory ones. All the animals depend on the leaves and detritus which when carried by the estuary contribute to the production of organic matter, which is the basic food available to other animals and plants. Plankton and other micro organisms, which proliferate in the mangrove and its surroundings, are eaten by fishes, prawns, crabs and mollusc larvae. Many of them are commercially important, such as king and banana prawns, mud crabs, barramunds, mackerel, mullet, threadfin salmon, bream, whiting, huderik and flatheas. Mangroves provide the nutrients and rich feeding grounds for many marine species from various tropic levels. The fertility generated by the mangroves extend also to the marine areas. Hence many productive fishing grounds of the world are found adjacent to mangrove areas. The mangrove forest is also a special nurturing ground for the juveniles of many important species of finfish and crustaceans.

Almost the entire Indian Coast was rich in mangrove vegetation till the recent past. Significant mangroves are still available in Sunderbans (West Bengal), the deltaic regions of Mahanadi of the Bhitarkanika area (Orissa), the Krishna and Godavai delta in the Andhra Pradesh, fringing the coast in Andaman and Nicobar islands, on the coral reefs and fringing the mainland in the Gulf of Kutch, the deltaic regions of Kori creek in Gujarat coast and Pichavaram-Vedaranyam of the Tamil Nadu coast. Compared to the estimate of mangrove spread of the late eighties of 6740 Sq km, the present estimate of 4120 sq. km show that the mangroves are fast degrading in the country. They are destroyed due to their use as fuel, fodder and conversion of these area for agricultural, aquacultural and industrial purposes.

The mangroves of Sundarbans are the largest single block of tidal holophytic mangroves of the world. The major species of this dense mangrove forest include *Sonneratia fomes*, *Rhizophora* spp., *Bruguiera* spp., *Ceriops decandra*, *Sonneratia* spp. and *Avicennia* spp., *Nypa fruticans* are found along the creeks. This mangrove forest is famous for the Royal Bengal Tiger and crocodiles. Mangrove areas are being cleared for agricultural use. The mangroves of Bhitarkanika (Orissa), which is the second largest in the Indian sub-

continent, harbour high concentration of typical mangrove species and high genetic diversity. Mangrove swamps occur in profusion in the intertidal mudflats on both side of the creeks in the Godavari-Krishna deltaic regions of Andhra Pradesh. These and the well-developed mangroves of Pichavaram and Vedaranyam are degraded mainly due to construction of aquaculture ponds and salt pans.

On the west coast of India, mangroves, mostly scrubby and degraded occur along the intertidal region of estuaries and creeks in Maharashtra, Goa and Kamataka. The mangrove vegetation in the coastal zone of Kerala is very sparse and thin. In Gujarat (north-west coast) mangroves *Avicennia marine*, *Avicennia officinalis* and *Rhizophora mucronata* are found mainly in Gulf of Kachchh and the Kori creek. Mangroves are of scrubby type with stunted growth, forming narrow, discontinuous patches on soft clayey mud. The condition of the mangroves is improving especially in the Kori creek region, which is a paleodelta of the Indus river. On the Andaman & Nicobar Islands, the small tidal estuaries, neritic inlets and the lagoons support a dense and diverse undisturbed mangrove flora.

In addition to the diversity of the habitat, the mangroves play an important role in a sediment repository, stabilises shoreline, a buffer against storm surges (that would otherwise have a more damaging effect on the coast. Its positive impact was noticed in the Bangladesh cyclone of 1991. In the recent Gujarat and Orissa cyclones the devastation was reported to have been lesser where sufficient mangrove buffers were present. The major ecosystems provide a safe and favourable environment for breeding, spawning, rearing of several fish and shell fish, reptiles and mammals. Some of the shellfish and fishes are highly economically important.

Threats to mangrove ecosystems:

While mangrove forests have specific ecological role in the coastal ecosystem and they provide a life support system and income for millions of people, thus destruction is wide spread for shorter economic benefits. This happens because mangroves are too often considered wastelands of little or no value unless they are "developed". In the recent times there has been increased ingress to convert them into agricultural areas. The irony of the situation is that the conversion of mangroves for aquaculture is detrimental to the very same activity as the shrimp fry (baby shrimp) availability decreases, as the mangroves are the natural wild fry collection habitats. The overdose of chemical fertilizers and pesticides not only destroy the aquaculture farms but also become detrimental to the remaining mangrove ecosystems in the vicinity. Even in the case of capture fisheries low recruitment will consequently affect production. With the fishing grounds already overexploited, mangrove destruction can only further reduce stock recruitment and production.

In general the mangroves are resistant to many kind of environmental perturbations and stresses. However, mangrove species are sensitive to excessive siltation or sedimentation, stagnation, surface water impoundment and major oil spills. Salinities high enough to kill mangroves result from reductions in the freshwater inflow and alterations in flushing patterns from dams, dredging and bulk heading. Seawalls, bunds and other coastal structures often restrict tidal flow, resulting in the killing of mangroves.

It is important to recognize that many of the forces, which detrimentally alter mangroves, have their origin outside the mangrove ecosystem. Traditional settlers of the mangrove area normally do not cause destruction to the system.

Management approach:

The value of the mangrove resource in terms of its marketed products can be expressed in economic terms. The "free" services provided by the mangroves are difficult to measure and consequently are often ignored. These "free services would cost considerable energy, technology or money if provided from other than natural resources. Since these values are seldom taken into account in the governmental decision process, the total value of the mangrove resource is most often quite significantly understated.

With the purpose of conserving the remaining mangroves the CRZ declared total prohibition on development in the mangrove areas. This has created awareness on its importance. Afforestation programmes are initiated at least in a few locations. Substantial reduction in the conversion of mangrove forest into aquaculture farms was noticed particularly after the Hon'ble Supreme Court's intervention in 1994/95. Mapping and research on mangroves improved. The management issues include developers consider the ban on mangroves as a threat and destroy them directly and indirectly reducing its coverage, the Sundarban mangrove biosphere area which has about 3 lakh resident population has to be given special provisions for certain developmental activities. The local governments, at several occasions, neither endorsed central government's view nor evolved efficient mechanisms to protect, resulting in their turning blind eyes to the wanton destruction. Distinction between mangroves and their associates are required.

The committee recognizes the importance of the mangroves in protecting the coastal areas and the coastal communities from storm, cyclones, flooding etc. Government should take up aggressive programmes to conserve the existing mangroves and initiate intensive mangrove plantation programmes at identified mangrove potential sites so as to develop bioshields.

2.4.2 Coral Reefs

Coral reefs are one of the most productive and complex coastal ecosystems with high biological diversity. They occur in shallow tropical areas where the sea water is clean, clear and warm. The high productivity is owing to the combination of its own primary production and support from its surrounding habitat. Reef building corals are a symbiotic association of coral animals and zooxanthellae, the microscopic algae from 160 to 800 tonnes of calcium carbonate per acre are deposited each year on coral reefs. The corals are generally slow growing colonies of animals with growth rate ranging between one and ten centimeters in height annually. Even though corals live in nutrient poor waters, their capability to recycle the scarce nutrients (by the whole nutrient community) is enormous. This nutritional advantage, the exotic marine life of different hues and shapes combined with their ability to build physical habitat -the limestone structures built by the corals with the aid of their zooxanthellae - makes the coral community a truly remarkable habitat.

The coral reefs are classified depending on their locations into fringing, patch, barrier and atoll. The fringing reefs are contiguous with the shore and they are the most common - by occurring reef form, found in Andamans. Patch reefs are isolated and discontinuous

patches, lying shoreward of offshore reef structures as seen in the Gulfs of Mannar and Katchchh. Barrier reefs are linear offshore reef structures that run parallel to coastlines and arise from submerged shelf platforms. The water body between the reef and the shore is termed as lagoon. Barrier reefs are seen in Nicobar and Lakshadweep. Atolls are circular or semi circular reefs that arise from subsiding sea floor platforms as coral reef building keeps ahead of subsidence. The examples are the atolls of Lakshadweep and Nicobar. When the reef building do not keep pace with subsidence reefs become submerged banks as seen again in Lakshadweep.

Indian coral reefs are mainly in the Andaman and Nicobar and Lakshadweep islands. On the main land coral reef formations are found in the Palk Bay, Gulf of Mannar, Gulf of Kutchchh and Malwan coast. When sea grasses grow on Kavaratti atoll, mangroves are prevalent on Andaman and Nicobar coral reefs. Primary productivity of Indian coral reefs is comparable with that of the reefs of the rest of the world.

Functions of Cor al Reefs

- Coral reefs are natural protective barriers against erosion and storm surge The coral animals are highly adapted for capturing plankton from the water, thereby capturing nutrients
- Largest biogenic calcium carbonate producer
- They provide substrate for mangroves
- Coral reefs provide habitat for a large variety of animals and plants including avifauna.

Threats to Coral Reefs

Coral reefs are constantly degraded. The degradation is both due to natural and anthropogenic reasons. The natural causes may be due to the outbreak of reef destroying animals, storms, "bleaching" and depletion of essential symbiotants. According to a study, the most destructive cause of coral reefs is man. The destruction may be due to chemical pollution, mechanical damage, nutrient loading or sediment loading. The pesticides or fertilizers reaching coral reefs from agricultural areas, destructive fishing practices, heavy metals from industrial sources, petroleum hydrocarbons. etc chemically damage the corals. Dredging, shipping, tourism, mining or collection is detrimental to the coral reefs. Nutrient loading due to aquaculture practices sewage discharge both from land and ships cause pollution leading to eutrophication and oxygen depletion. Similarly sediment loading resulting from construction activity, run off of sediments, dredging and turbidity can choke the coral growth.

The corals of Indian mainland consisting of fringing reefs and coral patches are severely threatened by siltation, pollution from industry, sewerage from settlement, shipping, thermal plants, tourism, mining and collection, fishing etc. Symptoms of degradation are visible in the islands also mainly due to mining and fishing.

Management Approach

All the development activities in the coral areas are at present prohibited. Considerable awareness and research also was initiated after adoption of CRZ. Future management action shall include. Effective enforcement / punishment mechanisms against illegal mining is still lacking. The industries and activities existing before the initiation of

CRZ have damaged the coral reefs. Necessary actions are required to check further damage. Schemes for enhancing the present coverage by suitable intervention including financial support are necessary. The implementing agencies though are convinced about the need for regulation needs further vitalisation.

The committee suggests that the government should take up measures in protecting and conserving the coral areas on war footing.

2.4.3 Seagrass Beds

Sea grasses are specialised angiosperms that resemble grass in appearance and form dense underwater meadows. They are the only group of higher plants adapted to life in the salt water. They occur in shallow nearshore coastal waters that are sheltered from high wave energy and in estuaries and lagoons.

Major Sea grass meadows in India occur along the south east coast of Tamil Nadu and in the lagoons of a few Lakshadweep Islands. There are some grass beds around Andaman and Nicobar islands also, but they are poorly documented. Flora comprises 14 species of sea grass dominated by *Thalassia hemprichii* and *Cymodocea species*. The total standing crop is species of marine algae have been observed in the beds of sea grass. Few economically important species of algae such as *Gracilaria edulia* could be cultivated in the sea grass beds on a large scale.

Functions of Seagrasses

Seagrasses function as stabilizers and sediment accumulators of inter tidal and sub tidal areas of the coast. There are only 58 described species of sea grass worldwide, within 12 genera, 4 families and 2 orders. IUCN has accorded high priority for the conservation of sea grass. Fourteen species of seagrasses have been recorded from Indian coast. They are commonly distributed from inter-tidal to sub-tidal region down to 8 m depth. Associated faunal population, especially juveniles are abundant in the seagrass and algal bed areas. In the lagoons wherever seagrass beds are widespread, in such areas, the population of fish and migratory birds is also higher. It is due to the availability of food and shelter in such habitat. It is reported that the net primary production of *Cymodocea serrulata* was 6.4 g/cm²/d and this was 6 times more than that by the phytoplankton. They trap the nutrients and supply them to the ecosystems. *Halophila ovalis* biomass in Ashtamudi estuary varies from 3.6-48 g/m² (dry weight). Common seagrasses found in Lakshadweep coral island are *Thalassia Lakshadweep* coral islands are *Thalassia hemprichii*, *Cymodocea rotundata*, *Halophila ovata*, *Syringodium isoetifolium* and *Halophila univervis*. The seagrass *Portesia coarctata* is an important socio-economic component distributed in and around certain island of Sunderbans.

In Tamil Nadu, seagrass species diversity is high in Gulf of Mannar and Palk Bay while it is low in the Bay of Bengal. The rich growth of seagrasses along the Tamil Nadu coast and Lakshadweep islands is mainly due to high salinity, clarity of the water and sandy substratum. Since the seagrass require comparatively calm areas for distribution, about 30% of the total lagoon area was covered by seagrass meadows. The green tigerprawn *Penaeus semisulcatus* contributes over 50% of total prawn catch of Palk Bay, and it is mostly captured from the seagrass meadows.

Sea grass ecosystems provide a sheltered, nutrient rich habitat for diverse flora and fauna. Sea grass beds physically help to reduce wave and current energy, help to filter suspended sediments from the water and stabilise bottom sediments to control erosion. The habitat complexity within sea grass beds enhances the diversity and abundance of animals. Sea grasses on reef flats and near estuaries are also nutrient sinks, buffering or filtering nutrient and chemical inputs to the marine environment. They provide a direct source of food for herbivorous animals such as some urchins and fish, green turtles and dugongs. They form a nursery and often feeding areas for fish, crustaceans, molluscs and other invertebrates many of which are economically important (e.g Penaeid shrimp, pearl oysters). They are a major input to food chains, which provide an indirect source of food for many marine organisms (e.g Sea urchins, turtles). The high primary production rates of sea grass are closely linked to the high production rates of associated fisheries. The associated economic values of sea grass beds are also very large, although not always easy to quantify.

Threats to sea grass beds

Large scale exploitation of marine algae is depleting these resources. A sea grass called *Enhalus acardoides* is now a threatened species. Dugong, a mammal dependent on sea grass for food, is also on the verge of extinction. Several causes have been suggested for deterioration of sea grass beds. Eutrophication, siltation, trawling, coastal engineering constructions and removal for commercial purposes are the major threats for sea grass beds.

Sea grass occurs in shallow water bodies and since water bodies are not brought under regulations, the CRZ notification is ineffective to protect sea grass beds as the seagrass beds are below the Low Tide Line. The major seagrass beds should be mapped and identifying areas for preservation. Dredging should be carried out far away from seagrass beds as siltation /turbidity destroys seagrass beds.

2.4.4 Sea Weeds

Seaweeds, the larger and visible marine plants, are one of the important living resources of the oceans. These are found attached to rocks, corals and other submerged strata in the intertidal and shallow subtidal zones of the sea. To be very specific, seaweeds are thalloid plants called algae, which means they have no differentiation of true tissues found in land plants such as roots, stems and leaves. They only have leaf-like appendages. Based on the colour of their pigmentation, sea weeds are broadly classified into different classes and families such as Cyanophyceae (blue- green), Chlorophyceae (green), Phaeophyceae (brown), Rhodophyceae (red) etc.

In Indian coast about 770 species of seaweed species are distributed, of this 184 species are green (Chlorophyta) 166 species are brown (Phaeophyta) and 420 species are red algae (Rhodophyta). Seaweeds are growing in shallow coastal waters wherever sizable substrate is available. It is estimated that the total standing crop of seaweeds available in India is 91,339 tonnes (wet weight) consisting of 6,000 tonnes of agar yielding seaweeds, 16,000 tonnes of algin yielding seaweeds. The standing crop of algae yielding seaweeds, *Sargassum* and *Turbinaria* is abundant in Indian waters. In Kerala, the biomass of seaweed is around 0.5 km/m² and mostly they are present upto 0.15 m depth level. By the biodegradation of seaweeds methane like economically important gases can be produced in large quantities. Extracts of selected seaweed species show antibacterial activity. Iodine yielding seaweed (*Asparagopsis taxiformis*) resources are available in the sub-tidal reefs of Saurashtra coast.

Seaweeds are also used as the potential indicators of pollution in coastal ecosystem, particularly heavy metal pollution due to their ability to bind and accumulate metals strongly.

The total world seaweed production is estimated to be about 1821×10^4 tonnes (wet weight) annually. Of this, about 4.83% is being harvested from the eastern and western Indian Ocean. The potential harvest from the Indian Ocean is 870,000 tonnes of wet weight. From this, only 22,000 tonnes, largely red and brown sea weeds are actually harvested from both western and eastern Indian Ocean. About 20,000 marine algal species are reported to be distributed throughout the world whereas it has been estimated that the yield of seaweeds along the Indian coast is only about 70,000 tonnes on fresh weight basis. About 624 marine algal species of various groups are recorded from Indian waters, with a maximum number of 302 species in Tamil Nadu, followed by 202 species in Gujarat, 152 species in Maharashtra, 89 species in the Lakshadweep group of island and 75 in Goa.

Uses of sea weeds

Seaweeds are important as food for humans, feed for animals, fertilizer for plants. Seaweeds are used as a drug for goiter treatment, intestinal and stomach disorders. Products like agar-agar and alginates, which are of commercial value, are extracted from seaweeds.

Functions of seaweeds

Food for marine organism, habitat for breeding grounds, source of sediment.

Threats to seaweeds

Over exploitation for commercial uses and CRZ regulations do not apply to as the water part hence sea weeds are not covered.

2.4.5 Horseshoe (HS) Crab Habitats

Horseshoe crab is an important component of the food chain. Beach geomorphology is the most important factor in determining beach stability for the nesting behaviour of marine animals. Nesting behaviour of the Indian horseshoe crab, *Tachpleus gigas* (Muller) in India. The H.S Crab breeds practically through out the year. Migration and concentration in large numbers of mating pairs, in the intertidal zone, is a characteristic feature of the life history of horse shoe crab. Along the coast of India, *T.gigas* is common in selected beaches in the north east coast. Balramgari in Orissa is one of the favourite breeding spots. Urgent measures need to be taken up for the protection and conservation of horseshoe crabs as these habitats are being destroyed by various developmental activities.

2.4.6 Turtle Nesting Grounds

Most of the turtle locate their nesting grounds when they mature. Of the seven or eight species of sea turtles, two species are unique in displaying one of the most spectacular reproductive phenomena, the mass nesting. In India there are three major mass-nesting sites of the olive ridley (*Lepidochelys Olivacea*), all on the east coast, in Orissa. The nesting at Gahirmata (a part of Bhitarkanika sanctuary) at the mouth of the river Maipura near Dhamra, is the largest sea turtle rookery in the world with 100,000 to 500,000 turtles nesting there each year. There are smaller rookeries at the mouth of the Devi River (north of Puri) and

Rushikulya in Ganjam district in Southern Orissa. Recently a small nesting site has been located in Payyoli beach, north Kerala.

2.4.7 Coastal Forests and Wildlife

The coastal forest includes the natural forest and the shelter bed plantations undertaken by the Forest Department. These coastal forests are not only habitats for several flora and fauna including wildlife but also protect the shoreline from erosion, cyclones and flooding. Most of the coastal forests are found in along the western ghats including western coastal part of Maharashtra, Goa, Karnataka and Kerala. Coastal forests are found along the Tamil Nadu and Andhra Pradesh coasts. Several of the local communities depend upon the resources from these forest areas.

2.4.8 Protected areas - Marine Parks and Sanctuaries

The following definition of marine protected areas was developed at the 4th world Wilderness Congress and adopted by IUCN at its 17th General Assembly in 1988:

Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment.

Sites, which fit in this definition, have been given a variety of names. In common with protected areas on land they may be called 'reserves', 'sanctuaries', 'parks', or have some other title. To clarify the situation and guide protected area managers, the IUCN, through its Commission on National Parks and Protected Areas, has developed and refined a list of the categories of protected area. Ten categories were identified in 1978 and, following the most recent review, the list has been reduced to six. These are areas managed mainly for:-

- I. Strict protection (i.e., Strict Nature Reserve/wilderness Areas)
- II. Ecosystem conservation and recreation (i.e., National Park)
- III. Conservation of natural features (i.e., Natural Monument)
- IV. Conservation through active management (i.e., Habitat/Species Management Area)
- V. Landscape/seascape conservation and recreation (i.e., Protected Landscape/Seascape)
- VI. Sustainable use of natural ecosystems (i.e., Managed Resource Protected Area).

The current focus on biodiversity conservation is an important influence on MPA programmes. This has implications for site selection but it remains unclear whether much will change. The types of area listed by IUCN as especially important for marine biodiversity, for example, are the sorts of site which have been selected traditionally as MPAs:

- Areas of high diversity
- Areas of high endemism
- Areas of high productivity
- Spawning areas that serve as a source of recruits
- Nursery grounds
- Migration stopover points and bottlenecks.

The need for community involvement in Marine Protected Areas (MPAs) cannot be stressed strongly enough, Members of the community can be involved in roles as varied as identifying sites, putting forward proposals, being involved in consultations and being responsible for the management of MPAs. In addition to the existing marine sanctuaries and protected areas, the government may identify similar areas, where there is occurrence of high marine biodiversity including migratory sites of fauna, nursery grounds of fishes and reptiles and declare such sites as protected areas.

2.5.0 Coastal Geomorphic Systems

2.5.1 Coastal Dynamics

Coastal environments are among the most changeable on the earth's surface, although this statement must be qualified as there are several facets to "change." At the outset, it must be emphasized that many coastal changes are circulatory in space or periodic in time. The idea of change is not a new one in coastal studies. Descriptions of coastal changes date from the Middle Ages, especially in the context of harbour silting and seafood harvests. What is new is a realization that these changes may be linked, perhaps via tortuous pathways. Testing-out these links from a data mass is a considerable challenge. For coastal scientists, many of the best clues come from geologists, meteorologists and biologists. In recent years, all these disciplines have undergone a revolution in approach, with greater emphasis being placed on dynamic processes rather than static description. Allied to this has been a general stiffening of methodology and increasing sophistication in techniques. The widespread introduction of information technology and attendant data acquisition and handling methods is beginning to have a profound effect on the field sciences, coastal studies included.

While careful assessment of coastal changes must form the cornerstone of effective coastal management, it is often insufficient to monitor sequential variations without paying due regard to the causes of change. There are several good reasons for this:

- (i) By exploring the root cause it is possible to provide a better basis for understanding, thus allowing more confident prediction.
- (ii) The results of such an examination are likely to be more universally applicable.
- (iii) Reliance only upon indicators of response may understate the overall problem.
- (iv) Environmental reaction may be tempered or buffered by external influences.
- (v) Reaction may be incremental, or related to thresholds. An obvious case arises with cliff erosion. Simply measuring the retreat of the cliff top says very little about the causative factors, which may in time accelerate or decelerate the process.

Knowledge of these causes would obviously assist attempts at stabilization. The human influence on coastlines looms large. Man is a major factor in coastal change, at various scales. The impact may take many forms: it can be gradual or sudden, premediated or inadvertent. The ability of coastal environments to buffer such impacts is crucial. Hence it is important to understand the interaction between the solid and fluid media, which characterises the coastal environment.

Coastal geomorphological features like beach, sand dune, mudflat, estuaries, cliffs, etc. are characterised by unique ecosystems like mangroves, coral reefs, seagrass beds, etc.

These ecosystems are important for the sustainability of the biodiversity and productivity of the coastal zone.

Some of the features/formations due to these interactions are described below:

2.5.1.1 Mudbanks

Mudbanks, defined as transient accumulations of dense fine-sediment suspensions, which form sub-circular/elliptical depositional areas having dimensions from 2-5 km alongshore and 1.5 to 4 km offshore, occur yearly along some stretches of the west coast of southern India. Mud banks nearly always occur shortly after the arrival of the southwest monsoon in late May/June. However, instances of earlier formation (and sometimes of no formation) have been noticed. They usually form in the same place each year and often show a down coast migration during their brief existence (generally 1.5 months). When active they are noted for their wave damping effects that a 1.8 m high wave outside the mud bank is reduced to 0.5 m within the mud bank, within a distance of 1.1 km. This reduction can be 100% in a fully developed mud bank. The mud bank also provides protection to the coastal zone, by way of allowing accretion. However due to the presence of mud banks the downcoast, areas are found to be eroding during the monsoon. The mud bank provides an attractive environment to the local fishermen in which they can continue fishing while the 2-3 m high monsoon waves make fishing outside the mud bank impossible. The mud bank appears to be a biologically fertile, perhaps due to the abundance of organic matter (=5%) attached to the sediment particles or perhaps due to the reduced turbulence and the enhanced turbidity, which seem to attract the juvenile fishes and the larger fishes, which feed upon them. Mudbank accretes the coast behind, boosts fishing and it is an economic harbinger to the fisher folk. However, it erodes the down coast and it is unpredictable. The challenges are to predict mud bank formation, artificial generation, take precautions against down coast erosion, integrated management of mud bank areas taking into account the phenomena, coastal protection, socio-economics and infrastructure development.

2.5.1.2 Beaches

Beaches consist of accumulated, unconsolidated sediments transported to shore and moulded into characteristic forms by wave generated water motion. Beaches are located between the lowest low tide level and a landward limit, which is usually defined by a coastal cliff, a foredune ridge, and permanent vegetation or, by some physical man-made structure. Quantitative limit can be broadly termed as the highest high tide line. The unconsolidated sediments range in size from rock fragments to fine-grained sands and mud. The general composition of beach materials tends to vary with locations, but the processes that create and maintain beaches throughout the world are similar.

Beaches are not stable entities, but rather are dynamic landforms that are constantly subjected to erosion and/or accretion. The changes on a beach are responses to processes acting from outside the beach. These include waves and currents as well as inland dune systems, which induce the erosional and depositional cycles. Difference in beach form (or type) and position reflect the local balance or imbalance between deposition and erosion.

Functions

- Beaches act as a buffer against coastal erosion

- Habitats for many plants and animals
- Spawning ground for turtles
- Provide the energy base to support the beach's diverse population of deposit and filter-feeding organisms
- At highest level of food web, beaches serve as energy sources for many species of coastal birds and fish
- Aesthetics

Major uses

- Supports fishing and related activities
- Acts as the activity area for coastal population including settlements
- Beach sand serves as a major source of construction aggregate though declared illegal
- Mining of placer deposits & minerals
- Recreation and Tourist attraction
- Construction of ports, wharfs or piers over the beaches
- Agriculture

Threats

- Industrial and settlement siting and related constructions
- Overexploitation by sand mining (for construction and minerals)
- Constructions on the beach decrease the aesthetic value of beaches
- Activities which accelerate the erosional processes (such as river dams, barrages, and diversions that either trap sedimentary materials, thus preventing their entry into the coastal zone, or reduce the river water's transport power)
- Poorly designed coastal engineering works (that alter longshore currents or wave forces and lead to undesirable erosion and deposition patterns)
- Coastal dredging/mining projects (that remove beach-building materials from the longshore transport process)

Management approach

- Site specific studies may be required at each locality to ensure wise planning decisions
- Develop a setback line for construction activities
- Where a major obstruction to longshore sand transport is built, plan adequate sand by e-passing system or replenishment
- Use soft solution rather than hard solution to solve beach erosion problems i.e. nature-synchronous techniques
- Maintain a prominent fore dune ridge
- Restrict mining of sand from dune, beach or nearshore if it induces erosion
- If storm alters the beach, let the normal beach cycle return the sand
- Identify sustainable multiple use like: Tourism/human settlement/ agriculture; Spawning ground/source of food for humans; Tourism/spawning ground/food.

2.5.1.3 Sand Dunes

Coastal Sand dunes develop where the sediment transport by the wind is impaired through the interaction of air stream with surface vegetation in the coastal region. The

sediment for dunes is derived from marine sand delivered to the beach by waves. Dunes range from well vegetated, coast parallel ridges to non-vegetated irregular topography. Fore dunes are in a pioneer stage of dune formation and are susceptible to removal by storms or high tides. They will be still receiving a significant wind-blown sand-input. Rear dunes are in an intermediate or mature stage and are stable. The embryo dune, which occurs within 200 mts from the shore should not be altered/disturbed.

Man's impact on coastal dunes has caused extensive ecological and geomorphological changes. Increasing pressures place the dune communities under immense physiological stress, both from direct damage (trampling, grazing) and indirect damage through alterations in climate, soil and moisture regimes. Many dune systems around the world are in advanced stages of despoliation as a result of man's activities. In some cases the dunes have been completely removed.

Functions

- Acts as sand reserve for coastal protection and stability
- Provide protection and shelter for supply and recharge of fresh water aquifer in coastal areas.
- Habitat for several plants and animals
- Constitute important agricultural, industrial and recreational resource
- Protects the coast and the coastal communities living behind the dunes from tidal surges, large waves such as the tsunami waves.

Major uses

Dune-based activities include agriculture, mineral extraction, active and passive recreation. Over the last century the impact of recreation has been considerable, many dune systems having suffered badly from an uncontrolled influx of visitors. In some countries the coastal dunes are an essential part of integrated shore protection measures (as in Netherlands, UK, USA).

Threats

- Sand mining for minerals and construction
- Dressing of sand dunes
- Leveling for construction of beach resorts
- Leveling for industries.
- Road, rail and other infrastructure development included unplanned tourism facilities.

Management approach

- Conservation of fore dunes
- Preservation of rear dunes in the intermediate stage
- Restriction of sand mining
- Promote usage of alternative materials for construction activities
- Develop setback lines for beach resorts
- Develop setback lines for siting industries
- Develop artificial dunes and stimulate dune growth

- Identify multiple uses like coastal protection, water recharge, recreation, agriculture and urban/industrial use and zonate for different uses.

2.5.1.4 Earth Cliffs

The most important characteristic of 'earth cliffs' is their tendency to instability and rapid change, unlike 'rock' cliffs where change is infrequent and particularly localized.

The form of earth cliffs and the process by which they are changed depend primarily upon rock cohesion, groundwater conditions, the effectiveness of marine erosion of the foreshore, the cliff foot, and the debris derived from the cliff, the amount and effectiveness of cliff-foot protection, both natural and man-made, offshore relief, sea level change;

Marine cliffs are usually considered to be special case of slope development in which the removal of weathered material from the base is especially efficient. The type and structure of the rock in which the cliffs are cut affect to a considerable extent not only the cliff form but also the dominant processes modifying it.

Usage

Cliffs and the immediate cliff-top are used mainly for the establishment of resorts, all forms of agriculture and recreation. Earth cliffs in coastal areas act as barriers against strong winds, cyclonic storms thereby protecting the life and property at the area. The urban use of cliff-top land poses most problems for the management of cliffs.

2.5.1.5 Rocky Cliffs

The principal value of rocky cliffs does not lie in agriculture, forestry, or any other commercial development, but in their exhilarating scenery and wildlife. Rocky cliffs are usually composed of hard materials such as sandstone, limestone, slate, basalt, serpentine, or granite. They are rarely smooth: the action of wind and sand, waves and spray, picks out the softer materials to form a complex pattern of ledges, flats, cracks, and gullies. This provides some flatter surfaces on which vegetation can establish with lichens nearest the sea, salt-tolerant flowering plants higher up and more normal, inland vegetation towards the cliff-tops. Rocky cliffs are distinctive in terms of their habitat and vegetation. The rocky cliffs are natural barriers to strong winds especially during the cyclonic conditions. Hence, the rocky cliffs should be protected.

Uses & threats

The economic uses of rocky cliffs are extremely limited. The rock itself is sometimes used for the extraction of valuable minerals, e.g. chromium from serpentine, or as a road stone as with granite and basalt, limestone for cement factories. These activities usually produce serious scars but are localized. A few industrial plants may be located on cliff-tops and whilst these are generally considered visual intrusions in the landscape, their effects are again fairly local.

2.5.1.6 Rocky Foreshores

Rocky foreshores occur most extensively where the coastal region is mountainous or at least rugged. Topographically they are more variable than other coastal habitats. Depending on the geological character of the coast they range from steep, inaccessible cliffs to wide, gently-sloping platforms. The majority of rocky shores, on open coasts, experience the relatively stable conditions of fully marine situations. The CRZ notification prohibits mining of rock in the CRZ area.

Functions

- Provide anchorage for many types of algae and mussels
- Habitat for different crabs and molluscs
- Provide aesthetically important site
- Coastal protection

Uses

- Tourism
- Commercial exploitation of algae

Threats

- Unplanned tourism structures
- Pollution
- Mining of rocks for construction purposes.

2.5.1.7 Sand Bars

Sand bars in the nearshore and longshore area and swales on the beaches are sand reserves. These sand bars play a very important role in coastal processes. These are formed by wave beach interaction.

2.5.1.8 Estuaries

An estuary is a semi-enclosed coastal body of water, which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from 'land drainage'. Estuaries depend upon fresh-water flow from upland rivers in order to maintain their characteristic processes. The two-way flow of estuaries, the currents set up by the mixing of fresh and saline water and the continuous variations, which take place in both velocity and discharge through the tidal cycle all provide a marked contrast with fluvial processes.

The most important control of estuarine processes is the tidal range. This determines the tidal current and residual current velocities, which in turn has impact on sediment movements.

When tidal range is less than 2 m (microtidal) the estuarine processes are dominated by fresh-water discharge from upstream of the estuary mouth and by wind-driven waves

outside the mouth. The dominant fresh-water flow produces a salt-wedge estuary with a delta at its mouth. However, on the seawards of this delta, wind waves produce spits and barrier islands, which enclose a bar-built estuary. It is often difficult to distinguish between different types of estuaries.

Estuaries which experience tidal ranges between 2 m and 4 m (the meso-tidal range) are no longer dominated by salt-wedge circulation, instead tidal currents begin to assume importance.

The outstanding feature of estuaries, from the aspect of applied ecology, is the high productivity, which results from the constant supply of nutrients to a sheltered but dynamic habitat. Estuaries and tidal marshes are regarded as amongst the most fertile natural areas in the world. The greatest immediate commercial value of this high productivity, however, lies in fisheries within the estuary, mostly for bivalve molluscs.

The CRZ notification regulates all developmental activities along the CRZ area of the estuaries upto the extent of 5 Parts Per Thousand (PPT) of salinity felt upstream of the estuary. The measure of 5 PPT salinity during the driest period is one of the issues for implementing the CRZ Notification, 1991. Some of the estuaries become dry during peak summer seasons as there is no flow of fresh water. In some situations based on the geomorphological characteristics and hydro dynamics of the estuary, a salt wedge is formed at the bottom of the estuary while the upper surface has freshwater. Further, due to constructions of barrages, dams, upstream of the river, the salt water flow from the sea is also affected in the estuaries. Hence the Committee feels that biological indicators such as the extent of mangroves found upstream and presence of salt marshes may also be taken into consideration along with the salinity level of 5 PPT measured at the bottom of the estuary for determining the extent of tidal influence in the estuary.

Major Functions

- Spawning, nursery and feeding ground
- Beds for clams and mussels and sea grass beds
- Sites of mangrove, marsh stability
- Shifts sediments, creates mudflats
- Controls coastal stability
- Controls salinity
- Transports nutrients
- Cleanses the system of pollutants by flushing away the waste products
- Absorbs wave energy
- Absorbs floods

Major uses

- Human settlement and urbanisation on the banks
- Industrial sites
- Sheltered sites for locating ports and harbours
- Fishing grounds
- Sources for clams and mussels
- Aquaculture and mussel culture
- Transportation routes

- Filtration ponds
- Salt production
- Tourism
- Disposal grounds for urban and industrial waste

Threats

- Reclamation
- Pollution from urban and industrial waste disposal
- Reduction in fresh water discharge due to dams
- Prevention of fresh water flow.
- Dredging for water-ways

Management approach

- Restrict reclamation for essential activities
- Prohibit disposal of untreated waste
- Ensure sufficient fresh water discharge to maintain estuarine characteristics
- Ensure sufficient tidal exchange
- Determine the waste treatment level based on the assimilative capacity of the particular estuarine system and away from critical habitats
- Zonate areas for aquaculture, salt manufacture, ports & industries and tourism to avoid critical habitats and conflicts in use
- Avoid locating chemical plants with toxic discharge near estuaries

2.5.1.9 Lagoons

Lagoon is shallow body of brackish or seawater partially separated from an adjacent coastal sea by barriers of sand or shingle, which may leave narrow openings through which seawater can flow. Coastal lagoons are usually found on low-lying coasts and are normally aligned with their largest diameter parallel to the seashore. In general, lagoons are associated with coastlines, which have experienced or are experiencing change in the relative land-sea level. Lagoons associated with coral reefs of atolls have different characteristics and functions. These are treated separately with corals.

Human activities often affect the structure of lagoons, primarily by hydraulic works (e.g. dikes, dams, and artificial bars), also by land-reclamation activities and through changes in the inland watershed. Lagoons are highly productive ecosystems. Large oscillations in the populations of individual species occur. Many species migrate into lagoons to feed, thereby taking advantage of the considerable production of organic matter and the lack of competing species: although phytoplankton and benthic plants are the primary producers upon which the ecosystem ultimately depends, much of their production is consumed only after its decay and decomposition by microbial organisms, i.e. the detritus food-chains are quantitatively important in lagoons. The CRZ notification lists lagoons as tidal influenced water bodies. However, the water part of the lagoon is not covered in the notification.

Functions

- Nursery, breeding and feeding grounds for marine fauna
- Habitat for mussels and clams

- Seagrass beds
- Absorbs flood waters
- Absorbs wave energy
- Influences shoreline stability
- Act as sediment buffers

Uses

- Natural sites for harbours
- Potential aquaculture sites
- Recreational uses
- Sites for industrial purpose
- Culture and removal of mussels, shrimps, crabs, fish, etc. for human consumption and forms a valuable source of protein for the populations

Threats

- Reclamation
- Pollution due to urban and industrial waste disposal
- Modifications for aquaculture
- Discharge from aquafarms
- Constructions like dike, artificial bars, jetties affect the structure of lagoons.
- Construction of dams affect the freshwater discharge

Management approach

- Reclamation be permitted only for essential activities based on EIA
- Discharge of untreated effluents be prohibited
- The number of boats for recreation be restricted based on carrying capacity estimates
- Discharge points be decided based on studies on circulation systems of lagoon
- Discharge points be away from critical habitats, like sea grass beds and mussel and clam beds
- Zonate areas for multiple uses like recreation, aquaculture etc.

2.5.1.10 Mudflats

Mudflat is formed by the deposition of fine inorganic material and organic debris in particulate form, which has been held in suspension in the sea or in estuaries. Because of the fine texture of this material, deposition tends to occur where the turbulence of the sea is most abated and the gradient of the underlying land is low. Mud-flats are thus formed in the sheltered parts of embayments, inlets, and estuaries or behind the protection of shingle spits or dune systems. Mudflats are also referred as tidal flats.

This environment is rich in invertebrate life. Moreover, mudflats possess special ecological significance because they are the main feeding grounds for many migratory birds and wild fowls, which congregate on the coast in great numbers during migration periods and in the winter months.

The CRZ notification is silent about the protection/conservation of mudflats. However, the Coastal Zone Management Plans have listed the mudflats as eco-sensitive areas.

Functions

- Mudflats that harbour large populations of several species of birds and other fauna.
- Act as flood plains controlling floods
- Controls flow regions and act as sediment source for the shore
- Coastal stabilisation

Major uses

- Fishing grounds
- Nursery grounds
- Potential area for agriculture
- Potential new land for development

Threats

- Reclamation
- Urban and industrial waste disposal
- Waste disposal/effluent discharge

Management approach

- Restrict reclamation
- Prohibit discharge of untreated waste
- Restrict dumping of dredge spoil
- Identify multiple uses and zonate for different uses
- Ensure enough amount of sediment laden water to sustain fertility of mud flats.

2.5.1.11 Deltaic Areas

Deltas form where riverine and marine systems meet. The piling up of carried sediments at the mouth of the river creates deltas of various sizes and shapes. Deltas are highly productive and have fertile soils, which attract large agricultural settlements. The CRZ notification is silent about the delta formation.

Functions

- Barriers to tide, wind and wave actions
- Sites of mangrove, marsh and seagrass beds

Uses

- Human settlements
- Industrial sites, ports and harbours
- Agriculture
- Salt production

Threats

- Reclamation
- Flooding

Management approach

- Identify multiple uses and zonate different uses
- Take into account threats due to floods/cyclones
- Ensure sufficient drainage and tidal flow

2.5.1.12 Tidal Inlets

Tidal inlets form at the confluence of terrestrial fluvial systems with the sea. Inlets play an important role in coastal ecosystems facilitating mixing of water, sediments, nutrients and organisms between terrestrial and marine environments. These are also the water routes across the coast for ships between inland harbours and the open sea. Efforts to keep the inlets permanently open and in the same position necessitate dredging and stabilisation structures. The tidal inlets are grouped under the tidal influenced water bodies with CRZ notification. The water part of the tidal inlets is not covered under the notification.

Major uses & Functions

- Helps to sustain the brackish water systems
- Provides water routes between inland waters and open sea
- Provides the route for marine organism to estuarine habitat for breeding/spawning

Threats

- Dredging for maintaining the channel increases turbidity
- Channel stabilisation disrupts the natural by e-passing of sediment.

Management approach

- Channel dredging and stabilisation should consider its impacts on shoreline stability
- Tidal inlet stabilisation interventions be avoided at identified critical habitats

2.5.1.13 Barrier Islands

Barrier islands occur along the lowland coasts. They run parallel to the mainland coast but are separated from the mainland by lagoons and bays. Barriers are best developed where the tidal range is relatively low and the wave energy is low. Barrier islands are formed by the long-shore extension of spits, which subsequently are broken through by storms - forming series of disconnected islands. They also form due to the post-glacial sea level transgressions, which swept sediments to the present day coastline. The best examples of barrier island formation in India are the stretch of barrier beaches extending along the Kerala coast. The CRZ notification does not put any separate regulation for such islands.

Threats

Sand mining, pollution from tourism activities and erosion.

Management approach

Discourage settlements and agriculture, regulate tourism activities, restrict permanent constructions.

2.5.1.14 Lakes

Many of the processes found along the shores of lakes are similar to those found on seacoast. There are several distinctive aspects about the lakes shores particularly with relating to geomorphology, hydrodynamics and the ecosystems. The Pulikat lake is comparatively different from that of Chilika lake. These semi enclosed water bodies act as breeding and spawning grounds for several fishes and shellfishes. The local communities depend upon these resources. The lakes are categorised as tidal influenced water bodies under a CRZ notification however the water part is not covered in the notification.

2.5.1.15 Salt-marshes

Salt-marsh can be defined as natural or semi-natural halophytic grassland and dwarf brushwood on the alluvial sediments bordering saline water bodies whose water level fluctuates either tidally or non-tidally.

Salt marshes are a source of minerals (clay, salts, sand) trapped from the floods, which will be resupplied after removal. They are also a source of plant materials, which can be utilized for agricultural purposes. A part of these materials may be transported, as detritus, towards the near-shore waters, contributing to their fertility. The salt marshes are one of the most productive habitats. The marshes act as buffer areas during flooding and storm surges. Direct protection of tidal marshes against pollution from the sea seems to be practically impossible, as an open relationship with the tides is a prerequisite for the survival of the marsh ecosystem. The CRZ notification does not include such salt marshes.

Functions

Habitat for various flora and fauna helps recharging of groundwater by trapping rainfall and provide protection to the coast.

Threats

Reclamation, cutting and removal of marsh vegetation for agriculture and construction of embankments.

Management approach

Regulate reclamation, development activities to be permitted based on EIA and only treated effluent be allowed.

2.5.1.16 Islands

Islands are created by geologic processes like changes in the sea level or the eruption of volcanoes or through coral building process. For many small islands, such as Lakshadweep and Andaman- Nicobar, the entire area of the island can be considered to be the coastal zone.

It is well known that islands are particularly vulnerable to natural phenomena such as cyclones, subsidence, etc. and coastal management and planning efforts should take into consideration the likelihood of such occurrences.

The Andaman and Nicobar group of Islands and Lakshadweep Islands are the major marine islands in the country. The former has 325 islands out of which 38 are inhabited while the latter is an archipelago of 36 tiny islands of which 10 are inhabited. The Andaman- Nicobar islands have forests and hilly terrains in many islands. Though narrow, the islands are marked by bays, lagoons, creeks and reefs. Lakshadweep islands are basically coral atoll formation. The CRZ notification categorises Andaman & Nicobar, Lakshadweep Islands as CRZ-IV and has stipulated separate conditions for developmental activities in the CRZ area. It was brought to the notice of the Committee that in most cases the width of the island is much less than 500 metres. These groups of Islands harbour some of the richest and unique biodiversity in the world. Due to their scenic beauty, the islands are considered to be tourism potential zones. Keeping in view the need for economic development of the island communities, the activities such as high yielding agriculture, fisheries and tourism may be promoted. The Committee is of the opinion that a holistic approach may be adopted rather than sectoral approach. An ICZM approach is one of the most appropriate management tools for managing the fragile island environment.

2.6 Coastal Communities

About 20% of the Indian population resides in the coastal area and they desire their resources from the coast. The coastal population is dependent on fisheries, agriculture, aquaculture, horticulture, tourism, boat building, traditional manufacturing units and allied activities.

From both on economic and livelihood perspective, fisheries are one of the most important of the resources available in coastal areas. It is estimated that the fishermen population living along the coastal areas of the country is around 67,30,300 (as per livestock census 1992) of which 26.86,000 are males, 19,80,000 are females and 23,64, 000 are children. This fishing population are involved in full time or part time fishing. The population involved in full time fisheries is around 7,38,000 while part time fishing is 7,13,000. The population, which is involved in marketing and other allied activity pertaining to fishing are about 6,89,000.

Living aquatic resources make a crucial contribution to food security, particularly in the coastal zone, as a source of high-value protein, providing the sustenance that supports livelihoods, social structures and economic development. For example, in South Asia, fish contributes more than half of the animal protein intake in the diets of coastal communities. In the Maldives and Bangladesh, for instance, fish contributes as much as 80 percent of the animal protein intake. This has direct nutritional implications for the fishery-dependent and poor marginalised coastal communities.

2.6.1 Livelihood and Social Dimension

A focus on the social dimension, although intertwined with the environmental, physical economic and the political remind us that development is about people and not merely about economic growth captured in macro statistics. In this context, the concerns of the poor and marginalised sections of the coastal communities must be reflected in the state policy. The fact that development is conflict ridden must be recognised and the role of the state in resolving such conflicts has not been unproblematic.

India's natural capital – land, water, forest and air – is being depleted at an alarming rate and those communities who depend on it for their livelihood are being displaced and marginalised.

The CRZ policy, the goals of biodiversity conservation and local people's livelihood security need to be placed at the centre stage of all decision making pertaining to infrastructure development or economic considerations of revenue generation. If objectives and principles of National Environment Policy, 2004 are to be upheld, governance structures become significant.

We must recognise the ecological, human and economic significance of coastal areas, and of the resources within them. These dimensions have not been sufficiently incorporated in the implementation of environmental laws and regulations and in the macroeconomic policies. Often it is the alert interventions by public interest groups the positive attitude of the judiciary which has played a crucial role in protecting and enhancing environmental resource conservation in India.

In a country like India, where a large number of people are dependent on natural resources for their survival, social dimensions of livelihood and ecological security have to be incorporated. In Coastal Regulation Zone policy, the goals of biodiversity conservation and local people's livelihood security need to be placed at the centre stage of all decision making pertaining to infrastructure development or economic considerations of revenue generation. If objectives and principles of National Environment Policy, 2004 are to be upheld, governance structures become significant. In harnessing scientific and technological know-hows the key ideas to be included in the new Coastal Regulation Zone policy framework are:

- (i) Recognise the vital contribution that coastal ecosystems make a sustaining livelihoods, particularly of fishing communities.
- (ii) Distinguish clearly between needs of locals for drinking water and other natural resources and those of commercial interests. Under the garb of permissible "human activity", commercial interests have plundered the environment.
- (iii) Institute inadequate institutional mechanisms to implement and enforce the new Coastal Regulation Zone legislation.
- (iv) Facilitate the preparation of well-coordinated land-use project plans, site plans, using GI and other planning methods through multidisciplinary teams.

There is a general obligation to protect threatened or endangered species and natural systems, of special importance to sustaining life, providing livelihood, or general well-being. If for exceptional reasons of overriding public interest such a protection can not be ensured, there shall be due process for the purpose and offsetting measures that must be taken, by the proponents of such activity, for the purpose will include restoration or replacement as far as

possible of the lost environmental value to the same public as well as the critical ecological systems. This, however, may be permissible only in the rarest of the rare cases and not allowed as a pretext for laxity in complying with statutory obligations, to provide fait accompli for relaxation of established norms or obligations emanating from public trust.

2.7.0 Infrastructure

Development infrastructure such as electricity, water, gas, roads, bridges etc., are designed to serve multiple uses and is usually planned and provided by Government. Developing infrastructure systems in coastal zones can have wide range of environmental impacts. The details of some of the infrastructure and its impact on the coastal environment is described below -

2.7.1 Zonation and Planning for Locating Infrastructure Facilities

Several major urban centres have come up along the coast line. The average coastal population density is 432 persons per sq. km as against 256 persons for the entire country. Apart from protecting the community and resources, there is a need for providing necessary infrastructural facilities for the communities to maintain a better standard of living and their economic development. While the coastal areas have a tremendous developmental potential, there needs to be proper planning process so as to integrate developmental process with the Regional Plans. Coastal Regional Plans are required to work out broad Regional Policy for development under the concerned State Town and Country Planning Act. The Regional Plans should indicate broad settlement system depending upon the potential of development and the Coastal Zone Management Plans should be an integral part of the regional plan. This plan should give broad framework for development code and the regulations for controlling constructions and building activities. It must be ensured that the development and management should be incorporated within this plan. For the purpose of protection from natural hazards, the development plan also should indicate protection measures against the natural hazards.

2.7.2 Coastal Aquaculture and Mariculture

The potential area available in the coastal regions of the country for aquaculture is estimated between 1.2 to 1.4 million hectares. Presently, about 157 000 ha area is under shrimp farming with an average production of about 100 000 tonnes of shrimp per year. Andhra Pradesh is the most important State for tiger shrimp (*Penaeus monodon*) farming. In 2002 - 2003, it accounted for 47.1 percent of the total production of farmed shrimp, followed by West Bengal (26.3 percent), Orissa (11.0 percent), Kerala (5.73 percent), Tamil Nadu (5.3 percent) and Karnataka (1.6 percent). The practices adopted by the shrimp farmers range from traditional to improved traditional within the Coastal Regulation Zone (CRZ) and extensive shrimp farming outside the CRZ, with an average productivity of 660 kg per hectare per year. About 91 per cent of the shrimp growers in the country have farm holdings in between 0 to 2 ha, 6 per cent between 2 to 5 ha and the remaining 3 per cent have an area of 5 ha and above. Farmed shrimps contribute about 50 per cent of the total shrimp exports. The State-wise details on potential brackishwater area, area under culture and production as on 31.3.2004 are given in Tables 1 and

Presently, about 280 shrimp hatcheries have been set-up in the coastal States with an installed capacity of 12 475 million seed (Post larvae) per annum. Out of this, as many as 148 are set up in Andhra Pradesh, followed by 73 in Tamil Nadu. As *P. monodon* is the most

popular farmed species in India, most hatcheries raise tiger shrimp. However, some hatcheries also breed *P. indicus* and freshwater prawn – also known as scampi (*Macrobrachium rosenbergii*). The state-wise details of shrimp/ scampi hatcheries is given in Table 3.

It is estimated that there are about 33 feed mills producing shrimp feed in the country with an installed production capacity of 1 50 000 metric tonnes. Besides, there are a large number of small-scale feed manufacturers, mostly located in Andhra Pradesh. The current feed requirement of the sector is about 1 35 000 metric tonnes. Shrimp farming provides direct employment to about 0.3 million people and ancillary units provides employment to about 0.6 – 0.7 million people.

The Supreme Court's delivered its judgment on shrimp aquaculture in December 1996. The judgment said that that aquaculture is an industry and hence covered by the prohibition in the CRZ Notification, 1991. The Court permitted traditional and improved traditional practices within the CRZ. It further directed that farming practices outside CRZ were to be regulated to ensure that there was no impact on the environment. As setting up of shrimp hatcheries is a permitted activity in the CRZ Notification, 1991, the Court maintained a status quo on the setting up of shrimp hatcheries in its above-referred judgment.

The Aquaculture Authority has been set up under Section 3 (3) of the Environment (Protection) Act, 1986 to perform the functions indicated in the Supreme Court judgment delivered on 11 December 1996. Constituted vide Ministry of Environment and Forests' Notification No SO 88 (E) dated 6 February, 1997, the Authority is functioning under the administrative control of the Government of India in the Ministry of Agriculture, with its headquarters at Chennai. Justice G. Ramanujam, a retired Judge of Madras High Court, heads the Authority, which has seven-member composition.

The Aquaculture Authority is mandated to exercise powers under section 5 of the Environment (Protection) Act, 1986 for issuing directions and for taking measures with respect to matters referred to in clauses (v), (vi), (vii), (viii), (ix) and (xiii) of subsection (2) of Section 3 of the said Act. The Authority is further responsible to ensure that agricultural lands, salt pan lands, mangroves, wet lands, forest lands, land for village common purposes and the land meant for public purposes should not be used (or) converted for construction of shrimp farms and it shall also implement the "Precautionary Principle" and the "Polluter Pays Principle" in sustainable development of coastal shrimp farming activities.

There are few economic activities, which have globally witnessed high growth rates as shrimp farming in a large number of countries, situated both in the eastern and western hemispheres during the last two decades. In India, commercial-scale shrimp culture started gaining roots during the mid-eighties. It was a relatively late start in India; by this time, shrimp farming had reached peak in most of the neighbouring Asian countries, especially China and Taiwan. The boom period of commercial-scale shrimp culture in India started in 1990 and the bust came in 1995-96, with the large-scale outbreak of white spot disease (w.s.d). The fact that some States in India were new to commercial-scale shrimp farming, the general ignorance of good farming practices, and the lack of suitable extension services, led to a host of problems. Presently, the repeated occurrence of w.s.d and the lack of good quality shrimp broodstock are the major constraints faced by the shrimp aquaculture sector.

Sustainable shrimp farming entails issues ranging from farm level management to integration of shrimp farming into coastal area management, shrimp health management and

policy, socio-economic and legal issues. However, it must be admitted that the days of production-oriented shrimp farming are gone. Present day production has to take note of not only the markets but a host of technical issues as well as the concerns of the environment.

In many areas, shrimp farms have developed in close proximity (in clusters) along the creeks and estuarine watercourses. The Kandaleru creek in Andhra Pradesh is an excellent example of farms set up in large-scale clusters. As sustained development of shrimp culture relies on good-quality source water, over-development of shrimp farms – either through management intensification or increased farm area – along a creek can impact estuarine water quality to levels unacceptable for shrimp farming. This brings to focus the need for investigations on carrying capacity, which will address not only the physical areas of shrimp farms, but also their density and geographical distribution along a watercourse.

Of the many good management practices that are currently in vogue and adopted by the farmers, low stocking densities in grow out ponds have proved to be successful in attaining sustainability. The Aquaculture Authority permits up to 6nos/ m² for farms within the CRZ and up to 10-nos/ m² outside the CRZ. Adoption of low stocking densities is one of the key elements of sustainability of shrimp farming in the country.

While production from capture fisheries around the world has stagnated, aquaculture is viewed as a strong option to increase fish production, and play a vital role in providing food and nutritional security. Returns from shrimp farming continue to be rewarding, benefiting small-scale farmers and communities, as well as entrepreneurs engaged in seed production, farming operations or ancillary activities. Sustainable utilisation of available areas and infrastructure can lead to the development of unexploited resources with the potential of generating a large number of jobs and enormous social and economic benefits to the coastal regions of the country. The Committee feels that:

- In many areas, shrimp farms have developed in close proximity (in clusters) along the creeks and estuarine watercourses. Setting up of farms in such areas should be considered after an assessment of the carrying capacity of the open water (or Environment Impact Assessment) and incorporation of remedial measures like common wastewater treatment plants to reduce organic loading in the open waters.
- Potential areas for shrimp aquaculture in the country should be re-assessed through remote sensing. The identified areas should also find a place in the Integrated Coastal Zone Management Plan of the coastal States/ Union Territories to ensure optimal utilisation of the scarce coastal resources and planned and sustained development of the coastal region in future. This would also avoid inter-sectoral conflicts with the other legitimate users of the coastal resources.
- No drawal of groundwater should be permitted for carrying out shrimp farming within or outside the CRZ. The other restrictions imposed by the Supreme Court (example: ban on conversion of agriculture land, use of mangrove forests, etc.) should continue to ensure that shrimp farming is only done in inherently saline and degraded land, which otherwise is unsuitable for any other productive purposes. The latter category should also include such agricultural lands, which are classified as agricultural land in the revenue records but have been rendered unproductive due to long disuse.

- Shrimp hatcheries (and also hatcheries for freshwater prawn and fin fishes requiring sea water) should continue to be a permitted activity within the CRZ and there should be no restrictions on their location/ proximity to the waterfront.
- Several illegal aquaculture ponds have come up after reclamation of mangrove lands. Such aquaculture activities should be stopped and action should be initiated with regard to restoration of mangroves.

Mariculture involves rearing of marine forms in the marine environment itself. Generally the habitat chosen for mariculture is the coastal waters, in-shore base, coves, inlets and can be in circumscribed floating cages in the open sea as well. In the recent years, many maritime countries have taken up mariculture in a big way. In India mariculture is still in its infant stages. CMFRI has been carrying out several activities and undertaken research projects for the purpose of pearl oysters, edible oysters, mussels, clams and cockles. Several economically important shell fishers such as lobsters, prawns, crabs, sea cucumber have also been tried and some of them have been successful. Fishes like the pearl spot, mullets, milk fish, eels have been experimented. The Committee feels that mariculture should be promoted so that the local communities are benefitted.

2.7.3 Ports and Harbours

There are twelve major ports and 185 minor ports situated all along the entire coastline of India. The major ports are the autonomous bodies under the Administrative control of the Ministry of Shipping. The Ennore Port, which is under Companies Act. The management of the minor ports vested with the concerned Maritime State Government/Union Territories.

Around 95% of India's foreign trade by volume and 70% by value is being carried out through sea transportation, where ports is being carried out through sea transportation. Such a transfer of cargoes require necessary infrastructure facilities such as Jetties, Berths, SBM, Cruise terminal, etc. Similarly, for the efficient port operation, the cargoes are to be transferred to the land, for which on land transport system such as railways, roads, pipelines and adequate transit storage facilities are to be necessarily created within the ports of shipping industry require facilities like dry docking, slipways, bunkering, ship building, etc. which are also to be necessarily created in the port area.

The Chennai, Ennore, Tuticorin, Paradip ports are situated along the coast on artificial harbours, whereas ports like Cochin is situated in the backwaters with reclaimed land. Kandla is in creek/estuary, Kolkata/Haldia are Riverine ports and Jawaharlal Nehru Port has been developed as an offshore port. With the natural site conditions, implementation of the Coastal Regulation Zone Regulation and the conditions being stipulated by the Ministry of Environment & Forests for various projects at the time of its clearance widely vary from port to port. Ports are not only an one time fixed infrastructure for transfer of the cargo from the ship to shore or from shore to ship, but it also require the backup area on the land side (which incidentally falls within the Coastal Regulation Zone) which is very crucial considering the required development for the port related activities, like port based industries, processing units, container freight stations, container yards, storage sheds, POL storage facilities, SEZs, petrol pumps, service centres, recreational facilities, etc. Ports are to serve for a long period and have to consider all the development in the subsequent years.

The minor ports handled about 115 Million MT during 2003-2004. As per the Tenth Plan document for port sector, projection of 415 Million Tonnes have been made for all the major ports by the terminal year 2006-07. A number of development projects have been identified during Tenth Plan period with a total investments of around Rs.16,000 crores and the targeted capacity to be created will be around 470 Million Tonnes. In addition, the Minor Ports are poised to handle around 150 million MT by the end of Tenth Five Year Plan.

In addition there are engineering structures to protect the ports, harbours, intake structures, inlets and entrance channels (breakwaters).

2.7.4 Coastal Protection Structures

The Indian coastline is marked with a variety of geomorphological features, namely tidal flats off the Gujarat coast, flat beaches off Goa and a few regions off Maharashtra and Karnataka, mud banks off the Kerala coast, presence of the large number of outcrops particularly, off the Tamil Nadu coast on the western coast, the Southern tip of the Indian peninsula, the culmination of India, Arabian Sea and Bay of Bengal, although the wave activity is severe, the sediment movement in this stretch is not significant. The west coast is exposed to the wave activity being seasonal, net "Littoral drift" or the sediment transport is quite varied. There are pockets of net drift towards North, pockets of nil net littoral drift as well as pockets of net drift towards the South.

In the east coast, the seabed is generally steep, frequently exposed to cyclones, so the wave activity is seasonal. The net drift is to an extent of about 1×10^6 m³/annum. This quantity of sediment transport focused towards one direction is probably the largest in the world, which indeed is a challenging task to Coastal Engineers, planners and managers.

The general problems along the Indian coast are:

- Silting up of entrance channels
- Closing of river mouths
- Problems concerning aquaculture
- Silting up of intake structure
- Inundation into land
- Sand bar formation near mouths of inlets, rivers and estuaries
- Erosion of the coast.

Of all these problems, coastal erosion is a major concern, while other problems being equally important to be addressed. Coastal protection need to be given top priority as this is extremely important even for the fixing of the High Tide Line. Any structure (hard measure) should be considered only if soft measure is not possible. The agency considering the hard measure, particularly groins or breakwaters should be made responsible for protecting the shoreline at least 500 m on either side of the shoreline from erosion. In case of breakwaters for harbours, the stretch of the shoreline to be considered for protection should be atleast 1 km on either side of the structure. The agency responsible for the construction of the said structures should be made responsible for the monitoring of the shoreline for a minimum period of one year so as to cover the seasonal variation in the wave climate, which dictates its dynamics.

Similarly, within the said distance, if rivers, inlets or any water course is blocked by sand bar formation on its up drift side due to the construction of barriers jetting into the sea,

suitable control measures are to be incorporated in the planning state of the project. Here again, the agency responsible for the construction of the said structures should be made responsible for the monitoring of the shoreline for a minimum period of one year.

At locations, where shoreline advances towards the ocean, construction of huts, houses to be banned (strict enforcement absolutely essential).

The construction sequence as per the season is extremely important. This should be spelt out clearly prior to obtaining the necessary clearance/sanction from the appropriate authority/body.

The sizes of the stones usually adopted for the construction of seawalls, groins or breakwaters are arrived at using empirical formulae. If the weight of the individual stones adopted for construction is underestimated, this would result in the scattering of such stones all over the seafloor resulting in several other problems (typical examples are the seawalls along Royapuram in Tamil Nadu, North of Paradip port, a long stretch of the coast of Karnataka and few other locations). Verification of the stability of the cover layer of these structures in Laboratories (CWPRS, IIT Madras, NIT Karnataka, IHH Poondi are some of the Institutes that carry out such studies) should be made mandatory prior to the commencement of such projects.

2.7.5 Settlements (including cities)

It is estimated nearly one quarter of the Indian population is living along the coastal area. This population is likely to grow in coming years. The settlement along the coast includes large metropolitan cities towns, census towns etc. The majority of the coastline has a settlement, which are of rural nature inhabited by fisherman, agricultural, cottage industries etc. The shoreline real estate is in strong demand for human settlement agriculture trade industry amenity and marine support activities for shipping, fishing and recreation. While the waterfront expansion may be necessary or the coastal cities it may jeopardize coastal resources. The sewage let out from these major cities and towns are the major source of pollution of coastal waters. Expansion of townships and cities has put certain ecosystems such as mangroves, salt marshes, and mudflats under pressure. The settlements of local communities have to be protected against natural calamities. The coastal areas of some of the major coastal cities are also place where several unplanned constructions have cropped up such as the slums. These slums are located mostly in the seafront. The unhygienic conditions of such slums and the adverse environmental impact caused by these slums are a matter of concern which the Ministry has to address and take action in a time bound manner in order to provide decent housing and living conditions for all communities living along the coast.

2.7.6 Tourism

It is universally accepted that the tourism industry is an infrastructure industry, an economic driver and is an intrinsic part of the development of a region. It is the country's largest employment generator and foreign exchange earner. The Ministry of Tourism aims to increase foreign tourist arrivals from the present level of 2.8 million to 5.0 million. Coastal states are unable to tap this great economic potential to their advantage. Due to the high aesthetic value of the coast there is an enormous potential for tourism development. High capital investments in various sectors like beach resorts, location of industrial complexes, human settlements are being planned in the coastal zone for the economic development of the

country. The Tourism in the coastal areas of India has been on a high growth curve during the last few years and particularly during the last two years i.e., 2003-2004 and 2004-2005. The foreign tourist arrivals to places like Kerala and Goa have been booming to unprecedented levels, showing a growth of 25 to 30% every year. These coastal states are the most sought after by foreign tourists. At the same time there is a very high demand for such beach tourism among the domestic tourists also. Particularly in Goa a large number of charter flights are landing every week bringing foreign tourists to the state.

Kerala is also developing new beach resorts in Bekal area and Maharashtra is developing the coastal area of Sindhu Durg for tourism. Similar developments are also taking place in coastal areas of other states, like Tamil Nadu, Andhra Pradesh and Orissa.

It is expected that there will be 20% plus growth in tourism in all the developed coastal areas and beach resorts during the next five years. There is already a shortage of hotel rooms in many such areas, particularly in Kerala and Goa. It is expected that there will be high demand for new construction of hotels in the coastal areas during the next five years, particularly during the next three years. State governments will also be taking action in extending the areas of existing developments and looking for new sights

2.7.7 Infrastructure for National Security

Extensive security interests exist in the coastal zone and the coastal seas because they are the frontiers where invasion and other anti-national activities like smuggling might occur. Naval ports and harbours, coastal airfields, and special bases of all kinds are sited in the coastal zone, usually with high priority and intense security.

2.8.0 Natural Hazards

Storms, cyclones, tidal surges, flooding, erosion etc. bring about large scale destruction of life, property and natural resources in the coastal regions of the country every year. In Bay of Bengal, storm surges attain heights of several meters, causing severe devastation. The 1999 "Super Cyclone" which devastated the Orissa coast was one of the severest to hit Indian coasts. In addition, heavy monsoonal rainfall and the swelling up of river discharge augment the coastal floods. The result is that water piles up along the low lying coast as a surge flooding vast areas and causing loss of life and damage to property. The country has been experiencing loss of resources and degradation of coastal ecosystems as a result of changes in the shoreline due to erosion

However, the intensity of natural hazards such as storms, cyclones, tides, waves etc are not felt to the same extent along the inland tidal water bodies as they do along the coast facing the sea. Tides, tidal currents and river discharge are the main physical processes in the inland tidal water bodies.

2.8.1 Coastal Erosion

Coastal erosion is a common problem in many parts of the country. The causes of beach erosion are either natural or man-made. Sometimes, it is a combination of both. While the former is a relentless process which is often impossible to resist, the latter is often due to man's ill-planned activities and can certainly be contained, or even reversed. Coastal erosion in one area may lead to accretion in another area, which is a transient phenomenon. The cause

of erosion and accretion can be due to natural and/or anthropogenic activities (See Table below).

No.	Nature	Man Made
1.	Rise in sea level	Dams, dykes and other coastal structures causing rise and concentration of tides.
2.	Protruding head lands, Reefs, Rocks causing erosion on the down drift side	Groins, Breakwaters or jetties causing erosion on the down drift side.
3.	Tidal entrances & river mouths causing interruption of littoral drift	Manmade entrances causing interruption of littoral drift
4.	Shoreline geometry causing rapid increase of drift quantity	Fills protruding in the ocean to an extent that they change local shoreline geometry radically. Such fills are often bulk headed.
5.	Removal of beach material by wind drift	Removal of material from Beaches for construction and other purposes.
6.	Removal of beach material by sudden outbursts of flood water.	Digging or dredging of new inlets, channels and entrances. Offshore dumping of materials.

Erosion due to natural phenomena: The combined action of different processes on the coastline like waves and tides maintain the stability of the shoreline. If, for any reason, the sediment supply to a section of beach is reduced due to littoral drift/sea level rise or constant impact of waves, it can cause severe erosion. Even cliffs can get undermined at their base and slumped.

River deltas are especially prone to dramatic changes. Shift in the course of rivers leads to changes in the sediment supply. Tributaries are abandoned as the river shifts its course. The abandoned delta lobes, having lost their sediment supply, erode as a result of wave action and tidal flow. New deltas are created and protrude into the sea when there is sufficient sediment supply.

Catastrophic events like severe storms, tidal surges and cyclones cause the sea level to rise to abnormal heights and cause severe erosion.

Man-induced erosion

Coastal activities can also directly or indirectly result in beach erosion. The following are some examples:

- (i) Dams on rivers reduce or arrest the river-borne sediment supply to the sea, upset the sediment budget and can, in some cases, deprive the beach of its normal source of sand.
- (ii) Harbours often have shore-perpendicular/inclined solid quays and breakwaters, which obstruct the longshore transport of sand and cause accretion on the updrift side, and erosion downdrift.
- (iii) Sand removal above replenishable quantities from the coast upsets the longshore sand transport budget and can result in erosion downdrift.

- (iv) Groins and jetties and other structures on the coast/shoreline interfere with longshore sand transport and can result in erosion when these are ill-designed.
- (v) Artificial inlets, when they are very narrow can often have high current velocities which prevent long shore sand transfer from one side to the other, resulting in erosion.
- (vi) Seawalls, bulkheads and breakwaters, which are shore protective structures, have side effects in terms of erosion of adjacent areas.

Precautions against erosion: The three nature friendly options are 'do nothing', 'retreat' and 'supply sediment' to the affected area. Removing the causes for coastal erosion is another method. There are other technological options available to control/prevent erosion. One of the most practised methods is to construct seawalls on the eroding coast. Over a period, it has been concluded that there is more harm done to the coast by these seawalls, since they disturb natural sediment budget, which leads to erosion in adjacent coastal area. Soft engineering measures such as coastal vegetation, beach nourishment, etc. are preferred for coastal protection. Setback limits are fixed in coastal areas so as to prevent major developments coming up in the eroding zone and reduce the impact of erosion. The location of these lines is based on scientific criterion taking into account the extent and nature of beach erosion.

The purpose of the establishment of setback lines is two-fold. In the first place, they are intended to ensure that beach erosion is not triggered or worsened as a result of coastal construction activity, which interferes with beach processes. However, this may not always be possible or successful. For example, the location of a harbour or an artificial inlet is often determined by economic or physical needs, rather than by the consideration of erosion. The consequences have to be managed if it is decided to carry out construction activity beyond the limits. In the second place, perhaps the primary objective is to protect buildings and investments, e.g. housing, roads or plantations, by locating them away from the zone of probable worst-case erosion.

2.8.2 Cyclones and Storm Surges

Concerned State Government/UT has to identify the coastal areas, which are prone to cyclone and storm surges. Though it may not be possible to relocate the people and property from such areas, the Governments ought to take up measures to minimise the risk by installation of early warning systems/alarms, communication systems, cyclone shelters, early evacuation measures and movement of relief measures to the affected.

2.8.3 Flooding

Flooding due to cyclones, storm surges etc: Coastal storms can be devastating because of their sheer speed and effects on coastal water level. Onshore winds and atmospheric pressure fluctuations combined with wave effects create storm surges. The magnitude of a storm surge at a given point depends on wind vectors, shoaling depth gradients and coastal configuration. In semi-enclosed seas like the Bay of Bengal, storm surges may attain heights of several metres. Surges plus high waves penetrate considerable distance inland, especially on low-lying coasts like mudflats and deltas. Heavy loss of lives and damage to properties usually accompany storm surges. Salt intrusion and ground water

contamination are also part of storm surge damage. With the present technology and information, the occurrence of cyclones can be predicted but it would be still difficult to pinpoint the exact nature and magnitude of the hazard that would occur in the coastal area. Sometimes the magnitude of the cyclone is so large that it brings about devastation not only in the coastal districts but also well interior into the hinterlands. Even the most developed countries with sophisticated early warning systems suffer huge loss of property and lives in the coastal areas due to flooding caused by hurricanes, typhoons, tidal waves, tsunamis and storm surges.

Flooding due to river discharge in inland tidal water bodies (still water flooding): Banks of water bodies get flooded due to rise of water level as a result of precipitation and river discharge. This rise in the water level without the influence of wind leads to water logging in the adjacent areas. Data is available in historical records with the Central Water Commission/ irrigation departments and these flood lines are also depicted in the topo sheets for certain areas. This flood line if demarcated shall also include the unforeseen rise of water due to man's intervention.

2.8.4 Sea level rise due to Greenhouse effect

Sea level rise is one of the major factors influencing coastal erosion. As the sea level rises low lying areas will be inundated, the reach of active marine forces like the waves will be raised relative to the land surface, which will lead to coastal erosion and drowning of estuaries. Recent estimates of global sea level rise vary from a high scenario of one metre to a low scenario of 15 cm during the next century.

2.8.5 Salt Water Intrusion

Many coastal communities rely on potable ground water for requirements of water. Often it is the only reliable source, seawater not being potable without expensive desalination. Both fresh and salt water seep into the coastal terrain; the fresh water, being less dense, overrides the salt water often forming a shallow lens between the recharge and the discharge zones. In these shallow, unconfined aquifers, permeability is often very high, due to porous or even cavernous sediments, and consequently the through flow (transmissibility) is rapid. Thus natural fluctuations in the in the freshwater head, often due to seasonal factors., can have a marked effect on the position of the saltwater-freshwater interface. Several processes disturb this relationship. Perhaps the most common is the abstraction of ground water by pumping. Lowering of the freshwater head encourages the incursion of salt water, which can rapidly render the supply undrinkable. Removal or lowering of coastal dunes has similar effect. Dunes act both as recharge zones and as support for an elevated water table. Draining of coastal wetlands, and cutting or dredging of coastal navigation channels may breach the brackish interfacial zone often leading to increase in salinity. The projected rises of world sea level in the next century may also lead to severe salt intrusion problems. The shallow coastal aquifer is liable to pollution. Coastal ground water extraction may lead to subsidence. Siting wells and boreholes further inland is not a long-term solution and alternative supplies may have to be provided.

2.8.6 Tsunami

The devastating earthquake of magnitude 9 occurred off the west coast of northern Sumatra which lies in the Andaman-Nicobar Island arc on December 26, 2004 at 06:28:50

IST. This earthquake has generated tsunami which travelled crossing the boundaries of Sumatra and reached the entire Bay of Bengal rim, Indian Ocean islands, west coast of India and African coast.

The Andaman - Nicobar Arc in the Bay of Bengal is a zone of frequent earthquakes. The earthquake is generated by the subduction of the Indo-Australian plate under the Asian (Burma) plate below the Andaman archipelago. It is known to the scientific community that all under-sea earthquakes do not generate tsunamis. Only those earthquakes with a maximum intensity and right characteristics generate tsunami. The tsunami waves generated at the earthquake site off Sumatra travelled in all directions.

As per the known scientific information, the tsunami waves travel at a speed of more than 700 km in deep sea. The tsunami waves have a very long wave length of more than 750 km and a very short crest of height often less than 1m. Hence in the deep sea areas, the ships and other ocean vessels do not even notice them. These waves slow down when they enter continental shelf areas due to which the wave length decreases and the crest starts peaking up. Very near to the shore line, the crest takes the shape of a wall and enters the coast. It is reported that during the present tsunami the height of the crest near the shore reached around 10 meters in the east coast and 5 meters in the Kerala coast. There was a general belief that the waves will not reach the shadow zone. But in the present instance the waves reached the shadow zone (e.g. Kerala), which is believed to be due to processes such as wave diffraction and reflection.

It has been observed that the tsunami waves reached the coast unawares. In the directly exposed coasts, they approached as waves, which broke at different points in the shelf and finally entered the land. But in the shadow zones, enclosed bay areas, deep sea islands without a shelf (eg. Maldives & Lakshadweep), they were felt as sudden increase in the water level at the coast. Once the waves entered the land, they generated a flood flow. The affected areas were submerged and the high speed and turbulence of the flow uprooted houses and trees in addition to throwing away of the floating objects. In those coasts where the land was sloping towards the sea, the entire water returned to the sea with tremendous force, carrying whatever was uprooted.

The Andaman- Sumatra section of subduction zone had produced many large and destructive earthquakes in the past some of which also generated destructive tsunamis. The M8.7 earthquake of 1833 is reported to have ruptured about 550 Km segment of this arc southeast of the current source; it also generated a tsunami. Another great earthquake of 1861 (M8.5) broke a segment north of the Equator, also triggering tsunami. 1833 and 1861 earthquakes and the attendant tsunamis occurred before the introduction of harbour tide gauges data for these events. However, there are better documents of tsunamis due to earthquakes of 31 December 1881 and 26 June 1941, both of which caused a run-up in the eastern coast of India. The 1941 earthquake occurred during the Japanese occupation of the Andaman islands. It appears to have ruptured the region near the Andaman Islands. There are anecdotal accounts of 3,000 deaths from the eastern coast, resulting from a tsunami associated with this earthquake.

Historically an earlier earthquake appears to have occurred in the Andaman offshore on 28 January 1679, with its felt area similar to the 1941 north Andaman event. This earthquake may have also generated tsunami, which was probably not properly documented.

In the context of CRZ provisions, during the present episode of tsunami in the Indian coast, the following preliminary observations are made:

- a) The maximum damage has occurred in low lying areas near the coast.
- b) High casualties are found in most thickly populated areas.
- c) The mangroves, forests, sand dunes and coastal cliffs provided the best natural barriers against the tsunami.
- d) Heavy damage is reported in areas where sand dunes were heavily mined (eg. Nagapatinam & Kolachal) and where coastal vegetation was less.

The buffer provided in the Coastal Zone and our approaches for conservation of mangroves/sand dunes/coral reefs/coastal forests were all put to test during this event and were found to be reasonably effective even in calamities of this magnitude. This leads us to the necessity for effective mechanism to correct our approaches and to incorporate vulnerability indices in the management practices of the coastal zone.

2.9.0 Coastal Pollution

The major activities that are responsible for coastal pollution in India are discharge and disposal of untreated domestic and industrial wastes, discharges of coolant waters, harbour activities such as dredging, cargo handling, dumping of ship wastes, spilling of cargo's chemicals and metal ores, oil transport, fishing activities, etc. The mechanised fishing activities such as draining of waste oil, painting of fishing vessels, scrapping of metal linings of fishing boats, dumping of waste and trash fishes, etc. The oil transport, oil exploration and oil refining activities, ship breaking, recreation and tourism activities, salt production, etc. also create concern in the coastal pollution sector.

Domestic wastes are discharged mostly in untreated conditions due to lack of treatment facilities in most of the cities and towns. It has been estimated that approximately, 5,060 km mld reach the coastal waters of the country (Table below).

Table: State & Union Territory-wise Wastewater Generation, Treatment and Disposal in Cities and Towns along the Coast (source: CPCB).

State	No. of Cities/Towns	Wastewater Generated (MLD)	Treatment Facility Available (MLD)	Untreated Wastewater Disposed (MLD).
Andhra Pradesh	8	203.90	0.00	203.90
Goa	3	17.00	38.50	0.00
Gujarat	13	329.06	76.00	253.06
Karnataka	3	72.00	27.50	44.50
Kerala	19	326.45	27.50	298.95
Maharashtra	6	2,508.6	126.00	2,382.64
Orissa	4	114.90	0.00	114.90
Tamil Nadu	12	488.02	226.01	262.02
West Bengal	6	1,466.0	0.00	1,466.08
Andaman & Nicobar Islands	1	6.00	0.00	6.00
Pondicherry	2	28.94	0.00	28.94
Total	77	5,560.90	521.51	5,060.68

India is one of the largest industrialized nations in the world. Major industrial cities and towns of the country such as Surat, Bombay, Cochin, Madras, Vishakapatnam and Calcutta are situated on or near the coastline. The estimated total quantity of waste discharged by about 308 large and medium industries is estimated to be approximately 1.35 million cu. metres per day as per the Central Pollution Control Board.

There have been cases of accidental spillages and leaks from the offshore and on shore oil installations leading to pollution of coastal areas and waters of the country. The responsibility for the prevention of pollution is shared by the Coastal States and the Central Government. The pollution control boards of the maritime States/Union Territories work in close coordination with the Central Government's Ministry of Surface Transport (MoST) through the Indian Merchant Shipping Act(1958) (for control of pollution from and offshore platforms in the EEZ), and the Indian Ports Act (1963); the Ministry of Petroleum and Natural Gas (MPNG) (concerning pollution oil platforms and structures); and the Ministry of Environment and Forests'(MEF) Water (Prevention and Control Pollution) Act (1974) ,Environmental (Protection) Act 1986, and Coastal Regulation Zone Notification 1991,(for the control of pollution arising from land-based sources in the sea).

In 1996, the Coast Guard formulated National Oil Spill Disaster Contingency Plan (NOS-DCP). This lays down a series of actions to be taken in the event of a major disaster. It also contains standard formats for reporting spills as well as forwarding data on equipment holding in the country. It maintains oil pollution response equipment and chemicals.

But there is a need to strengthen the infrastructure of Pollution Control Boards and Coast Guards in the area of surveillance, monitoring and immediate response action for mitigating spills and accidental discharges into the water.

The quantity of waste water discharged by aquaculture farms is 10-12 MLD. Pesticides and fertilizers used in agriculture also find its way into the coastal waters. Government of India formulated comprehensive policy statement for abatement of pollution. The policy aims at prevention of pollution at source, apply the best available technology, implementation of the principle of 'polluter pays' policy, emphasis on protection of heavily polluted areas and river stretches, involvement of the public in decision making.

Control measures taken in the country at the present are providing treatment facilities for municipal sewage, providing effective treatment facilities for industries, development and implementation of industry specific effluent standards and primary criteria for coastal water quality, identification of 17 categories of highly polluting industries and CREP programme adopted for effective implementation, National River Action Plans, industrial zoning, implementation of effluent treatment system for aquaculture, implementation of National Oil Spill Disaster Contingency Plan, enactment of environmental laws and Acts and its implementation.

CHAPTER-3

3.0 COASTAL REGULATION ZONE NOTIFICATION - REVISITED

3.1 Background

As per Allocation of Business Rules framed by the work allotted to the Ministry of Environment and Forests includes "Environment and Ecology, including Environment in Coastal Waters, in mangroves and coral reefs but excluding marine environment on the high seas". The Ministry of Environment and Forests is responsible for framing legislations and implementing measures for protecting and conserving the environment of the country including the marine environment upto EEZ. For the purpose of protecting and conserving the environment the Environment (Protection) Act 1986, (EPA) umbrella legislation has been enacted.

Under EPA, Ministry of Environment & Forests has issued various Notifications for control of pollution and conservation of environmentally sensitive areas. Keeping in view, the fact that multifarious activities in coastal zone has resulted in over exploitation of marine and coastal resources and marked degradation of the quality of coastal habitats and environments, the Coastal Regulation Zone Notification has been issued on 19th February, 1991 under the provisions of the Environment (Protection) Act, 1986.

Origin of Coastal Regulation Zone Notification

In 1981, the then Prime Minister wrote to the Chief Ministers of all the coastal States directing them to keep clear of all activities upto 500 metres from the water at the maximum high tide along the coast. In the wake of this direction, the then Department of Environment set up a Working Group on "Environmental Guidelines for Development of Beaches." This Working Group was to address issues relating to land/marine interact eco-system and to prepare guidelines for environmental management of beaches. It comprised experts in Pollution Control, Town and Country Planning, Tourism, Oceanography, Ecology and Human Settlement. The report of the Working Group submitted in June, 1983 was prepared after a scientific study taking into account the coastal and marine environment, natural hazards, socio-economic problems and developmental activities.

These guidelines were prepared in consultation with the coastal States and Union Territories. These guidelines also suggested that construction along the coast, irrespective of their location, i.e., even beyond 500 metres of the high tide mark, should be subjected to environmental impact assessment studies. These guidelines were circulated to all coastal States and Union Territories in March, 1984. However, at that time, none of the States or Union Territories prepared Environmental Management Plans for coastal areas as suggested by the Department of Environment.

As neither the Prime Minister's directive nor the guidelines issued by the then Department of Environment were followed by the State Governments, the Ministry of Environment and Forests issued a notification under the Environment (Protection) Act, 1986 regulating developmental activities in the coastal area.

Issue of Coastal Regulation Zone (CRZ) Notification, 1991

Keeping in view the degradation of the coastal environment and rampant construction activities along the coastal areas, MoEF issued a draft CRZ Notification twice inviting suggestions and objections from the public on June 27, 1990 and 18th December, 1990. Based on the suggestions and objections received, the Ministry issued the CRZ Notification declaring coastal stretches as Coastal Regulation Zone (CRZ) and regulating activities in the CRZ. As per this, the CRZ area is defined as coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action (in the landward side). As per the notification 500 metres on the landward side from the High Tide Line (HTL) and the land area between the Low Tide Line (LTL) and HTL including 500 metres along the tidal influenced water bodies subject to a minimum of 100 m on the width of the water body, whichever is less is declared as CRZ area. Based on the ecological sensitivity, geomorphological feature and demographic distribution, the CRZ area is classified into four categories namely, CRZ-I (sensitive and inter tidal), CRZ- II (urban or developed), CRZ-III (rural or undeveloped), CRZ-IV (Andaman & Nicobar and Lakshadweep Islands).

3.1.1 Prohibited and Permissible Activity

The Notification regulates developmental activities in the CRZ area by prohibiting certain activities and permitting the essential activities. The prohibited activities include setting up of new industries and expansion of existing industries, manufacture or handling or storage and handling of hazardous substances (except specified petroleum products in port areas), fish processing units, disposal of wastes and effluents, mining of sands, rocks and other rare minerals and mechanized drawal of ground water. The permissible activities include those activities that require water front and foreshore facilities such as construction activities related to defence requirements for which foreshore facilities are essential (e.g. slipways, jetties, etc.), operational constructions for ports and harbours and construction of hotels and resorts in specified areas.

3.1.2 Amendments to the CRZ Notification

The Ministry of Environment and Forests has been receiving proposals from the coastal States/Central Ministries, industry associations, local communities and NGOs requesting for amendment to CRZ notification on certain specific issues. The Ministry after examining the proposals had constituted Committees to examine the specific issues. Based on the recommendations of the Committee/request made by the various agencies the Ministry had amended the CRZ Notification, 1991 as per the provisions laid down in the Environment (Protection) Act, 1986. Some of the amendments constituted to look into specific issues are:

- S.O.595(E), dated 18th August, 1994 – Relaxed Coastal Regulation Zone area to 50 mts along the tidal influenced water bodies. This was based on B. B. Vohra Committees report. However, the Supreme Court in the Writ Petition 664 of 1993 quashed the above amendment.
- S.O.73(E), dated 31st January, 1997 – Permitted mining of sand and drawal of groundwater in the Coastal Regulation Zone area in Andaman and Nicobar.
- S.O.494(E), dated 9th July, 1997 – Permitted reclamation within port limits, constructions for operation expansion and modernization of ports. Development of public utilities within Sunderbans areas and storage of 13 POL products within port limits.

- S.O.730(E), dated 4th August, 2000 – Permitted storage of LNG in the inter-tidal area and exploration and extraction of oil and gas in Coastal Regulation Zone areas
- S.O.329(E), dated 12th April, 2001 – Permitting setting up of projects and Department of Atomic Energy, Pipelines and conveying systems in Coastal Regulation Zone areas.
- S.O.550 (E), dated 21st May, 2002 – Permitted non polluting industries in the field of IT and other service industries in the Coastal Regulation Zone area of special economic zones. Housing schemes of State Urban development Authorities initiated prior to 19.2.1991 was also permitted.
- S.O.110(E), dated 19th October, 2002 – Permitted non conventional energy facilities, desalination plans, air strips in Coastal Regulation Zone of A&N and a Lakshadweep. Storage of non-hazardous cargo such as edible oil, fertilizer and food grain was also permitted.
- S.O.460(E), dated 22nd April, 2003 – Project costing more than 5 crores requires clearance from Ministry of Environment and Forests.
- S.O.636(E), dated 30th May, 2003 – Permitted construction of embarkation facilities for Lakshadweep in Coastal Regulation Zone –I areas.
- S.O.725(E), dated 24th June, 2003 – Permitted construction of trans-harbour sea links passing through Coastal Regulation Zone –I areas.
- S.O.838(E), dated 24th July, 2003 – Relaxed No Development Zone to 50 mts from 200 mts from HTL in A&N and Lakshadweep for promoting tourism based on Integrated Coastal Zone Management study.

Based on the reports of the above committees and the requests made by Central Ministries, State Governments and NGOs, the Ministry had from time to time carried out amendments to the CRZ Notification.

3.2.0 Working of the CRZ Notification

3.2.1 Efforts by the Ministry and the Courts

Neither the Ministry nor the State Governments had taken serious note of the CRZ Notification. A Writ Petition was filed in the Supreme Court in 1993 by Enviro Legal Action Group Vs. Union of India regarding non-implementation of CRZ Notification, 1991. The Supreme Court in its order in April, 1996 directed the State Governments of coastal States and UT Administration to prepare the Coastal Zone Management Plans (CZMPs) and get them approved from the Ministry within 3 months. The CZMPs submitted by the State Governments/UTs were accorded approval by the Ministry of Environment and Forests on 27th September, 1996, subject to the incorporation of some general conditions and other conditions specific to each coastal State/Union Territory. Each of the coastal States/UTs were required to prepare the revised CZMPs incorporating the suggestions and modifications which are still pending.

For preparing the CZMPs, demarcation of the HTL/LTL is required to be carried out in the Coastal Regulation Zone area. For this purpose, the Ministry has authorized seven institutes for demarcating. Guidelines have also been issued for demarcating HTL and LTL.

Those projects, which are permissible as per the provisions of the CRZ Notification are examined and environmental clearance procedure similar to that under EIA Notification is followed for approval of such projects.

3.2.2 Enforcement and monitoring of Coastal Regulation Zone Notification

The Coastal Zone Management Authorities (CZMAs) are responsible for enforcement and monitoring of the CRZ notification and the CZMPs. For taking punitive action against the violations Section 5 of Environment (Protection) Act, 1986, powers have also been delegated to the Authorities.

3.2.3 Positive aspects of the CRZ Notification, 1991

The CRZ Notification has created awareness among the decision makers and the people regarding the importance of the coastal environment. The Notification has been responsible in maintaining *status quo* by not permitting major developmental activities along the coast. It has established the traditional rights of fishing community. It emphasized the need for planned development of the coast. By disallowing polluting industries and controlling effluent/sewage disposal, the stage has been set for the control of pollution of the coastal areas. Protection of life and property from natural hazards such as erosion, flooding, sea level rise etc., has been largely ensured. All these measures will have positive impact on fisheries, which will ensure the economic development, fisherman community in particular and the coastal areas in general. The protected coastal environment envisaged in the CRZ is expected to enhance the tourism potential of the coast.

3.2.4 Violations of the Notification

The violations of the CRZ area include destruction of CRZ-I areas such as mangroves, coral reefs, breeding sites of endangered species, etc., Illegal constructions coming up in No Development Zones of CRZ-III, construction in CRZ-II areas without adhering to the norms laid down in the Notification and constructions within CRZ-I areas are some of the major violations of the Notification. The State Governments have insufficient infrastructures facilities to take action against such violations. Further there is lack of will of the concerned and inadequate enforcement machinery. This is one of the reasons for the high number of Cases pending in various Courts in the States and Supreme Court.

3.2.5 Constraints/Problems

The precautionary principle approach of the Notification, which lays down uniform regulations for the diverse coastal environment, is one of the major constraint areas for implementation of the notification. This is the reason why the Ministry has been, time and again constituting expert committees with eminent scientist to address some of the problem areas and carrying out amendments based on the recommendations of the reports. Some of the constraints faced by the implementing agencies include ambiguities and lack of clarity of terminologies existing in the Notification. Further, the Notification is badly structured. A common man cannot easily understand the Notification hence he is put into great difficulties even for undertaking a small dwelling unit.

There had been lack of agreement on satisfactory definition of the coastal zone. It has been criticized that the CRZ lacks a scientific approach. The State Governments and

development agencies complaint that the notification is too restrictive in nature and lacks statements on the objectives expected to be achieved. Though, there is enormous private investment in coastal area the notification treats it as a common property resource. The Notification does not provide information sufficient for take decisions and there is no motivation for conservation of the ecosystems. Lack of awareness, lack of enforcement, lack of funding and attitudinal problems are enlisted as some of the reasons for the difficulties in implementing the CRZ notification.

3.3.0 Issues raised by Governments with regard to Coastal Regulation Zone Notification

3.3.1 General issues

Due to various constraints faced by the implementing agencies, which include the State Governments and the State Coastal Zone Management Authorities, the Ministry has been providing clarifications and amendments to the Notification from time to time. However, there are several areas, which have not been addressed adequately by the Central Government even after a decade of issuing the CRZ Notification, 1991. The critical issues include the demarcation of High Tide Line, permission for constructions of dwelling units for local communities, etc. Most of the States have expressed their inability to implement the Notification, since they lack adequate infrastructure including funding mechanism. Lack of maps indicating CRZ-I, II, III and IV areas in the implementing scales, which is 1:4,000 is also attributed for not implementing the Notification. Some of the States where there is tremendous pressure due to increasing urbanization faces rampant violations of the Notification.

3.3.2 Mechanism and Funding

As per the Supreme Court's Order in W.P. No.664 of 1993, the Ministry has constituted the NCZMA and State CZMA for enforcement and monitoring of the CRZ Notification. These Authorities have been delegated powers under Section 5 of the Environment (Protection) Act, 1986 for taking punitive action against the violations. Further, the State Environment Departments, which also are responsible for enforcing the Notification.

No funding mechanism is available under the Notification for undertaking pro-active role by the State Governments in preservation and conservation of the coastal area. In most of the cases, the State Governments have to depend upon the internal finance available, which is highly inadequate. It is seen that in some States scrutiny fee is being levied while assessing the development project. However, there is no information available with regard to utilization of such funds.

3.4.0 Issues pertaining to Economic Development

3.4.1 General

The developing country like India is experiencing increased economic activity due to changing economic policies. The economic activities, which include infrastructure development such as port and harbours, road networks, special economic zones etc., are

located along the coastal stretches since the port and harbours are corridors for economic activity.

Many of the economic activities are site specific such as mining of rare earth minerals, setting up of coastal tourism facilities, ports and harbours, fishing activities, etc. Most of the developmental activities in the mainland directly or indirectly depend upon the infrastructure available along the coastal areas. Due to the stringent provisions of the CRZ notification several economic activities are affected. Under the CRZ Notification about 67 activities are listed. These developmental activities can be carried out based on the norms provided in the CRZ notification and the Coastal Zone Management Plans of the concerned States/UTs. The table below summarizes the various activities that can be taken up in the Coastal Regulation Zone area and the locations where they can be set up based on the category of the Coastal Regulation Zone is given below.

Sl. No.	Activities	CRZ-I (i)	CRZ-I (ii)	CRZ-II	CRZ-III (HTL-200)	CRZ-III (200-500)	CRZ-IV
1.	Agriculture	X	✓	✓	✓	✓	✓
2.	Airstrips	X	X	X	X	X	✓ (Lak)
3.	Ash from TPS	X	X	X	X	X	X
4.	Blasting Underwater	X	X	X	X	X	X
5.	Bridges	X	✓	✓	✓	✓	✓
6.	Complex commercial	X	X	✓	X	X	X
7.	Control erosion	X	✓	✓	✓	✓	✓
8.	Conveying systems	✓	✓	✓	✓	✓	✓
9.	Demolition/reconstruction of archaeological, heritage, public structures	X	X	✓	X	X	X
10.	Dispensaries	✓ (SB)	X	✓	✓	X	X
11.	Drainage	X	X	✓	✓	✓	✓
12.	Drains storm water	X	X	✓	✓	✓	✓
13.	Drawal groundwater	X	X	✓	X	✓	✓
14.	Drying fish	X	X	✓	✓	✓	✓
15.	Edible oils storage of	X	✓	✓	✓	✓	✓
16.	Effluents treated	X	X	✓	✓	✓	✓
17.	Energy non-conventional	X	X	X	✓	✓	✓
18.	Energy projects atomic	✓	✓	✓	✓	✓	✓
19.	Facility embarkation	X	X	X	X	X	X (Lak)
20.	Fertilizers storage of	X	✓	✓	✓	✓	✓
21.	Fields play	X	X	✓	✓	✓	✓
22.	Fisheries (aquaculture)	X	X	X	X	✓	✓
23.	Food grains storage of	X	✓	✓	✓	✓	✓
24.	Forestry	X	X	✓	✓	✓	✓
25.	Hatchery	X	X	✓	✓	X	X

26.	Horticulture	X	✓	✓	✓	✓	✓
27.	Industries expansion	X	X	X	X	X	X
28.	Industries new	X	X	X	X	X	X
29.	Information technology	X	X	X	✓ (SEZ)	✓ (SEZ)	X
30.	Jetty	X	✓	✓	✓	✓	✓
31.	Landfill	X	X	X	X	X	X
32.	Lines transmission	✓	✓	✓	✓	✓	✓
33.	LNG	✓	✓	✓	✓	✓	✓
34.	Minerals rare	X	X	✓	✓	✓	✓
35.	Mining coral	X	X	X	X	X	X
36.	Oil and gas exploration	✓	✓	✓	✓	✓	✓
37.	Parks	X	X	✓	✓	✓	✓
38.	Pipelines	✓	✓	✓	✓	✓	✓
39.	Plants desalination	X	X	✓	✓	✓	✓
40.	Plants thermal power	X	X	X	X	X	X
41.	Ports/harbours expansion of	X	✓	✓	✓	✓	✓
42.	Prevention of salinity ingression	X	✓	✓	✓	✓	✓
43.	Processing fish	X	X	X	X	X	X
44.	Products POL	X	X	X	✓	✓	
45.	Projects defense	X	✓	✓	✓	✓	✓
46.	Projects SEZ	X	X	X	✓ (SEZ)	✓ (SEZ)	X
47.	Quays	X	✓	✓	✓	✓	✓
48.	Radars weather	✓	✓	✓	✓	✓	✓
49.	Rain shelters public	✓ (SB)	X	✓	✓	X	X
50.	Reclamation of land	X	✓ (P&H)	✓ (P&H)	✓ (P&H)	✓ (P&H)	✓ (P&H)
51.	Regulators tidal	X	✓	✓	✓	✓	✓
52.	Resorts beach	X	X	✓	X	✓	✓
53.	Roads	X	X	✓	✓	✓	X
54.	Saltpan	X	✓	✓	✓	✓	✓
55.	Sand dunes altering	X	X	X	X	X	X
56.	Sand/rock mining	X	X	X	X	X	X
57.	Schemes housing	X	X	✓	X	X	X
58.	Schools	✓ (SB)	X	✓	✓	X	X
59.	Sea-links	✓	✓	✓	✓	✓	✓
60.	Sewerage	X	X	✓	✓	✓	✓
61.	Shipways	X	✓	✓	✓	✓	✓
62.	Structures reconstruction of	X	X	✓	✓	✓	✓
63.	Supply water	X	✓	✓	✓	✓	✓
64.	Toilets community	✓ (SB)	X	✓	✓	X	X
65.	Units dwelling	X	X	✓	X	✓	✓

66.	Waste municipal	X	X	X	X	X	X
67.	Wharves	X	✓	✓	✓	✓	✓

Legend

CRZ-I (i) – Ecologically sensitive areas

CRZ-I (ii) – Inter-tidal areas

CRZ-II – Built up areas

CRZ-III – Rural areas

CRZ-III (HTL to 200 metres) – No Development Zone within rural areas

CRZ-IV – Andaman & Nicobar Islands and Lakshwadweep Islands

Lak - Lakshadweep

P&H – Port & Harbours

SB - Sunderbans

SEZ – Special Economic Zone

3.4.2 Dwelling Units of Local Communities

Most of the fishermen associations are satisfied with the present CRZ regime as it safeguards the coastal and marine ecosystems with the areas protected and no large developmental activities being permitted in the CRZ area. The No Development Zone of 200 mts in the rural areas, i.e., in the CRZ III areas have helped the fishermen to berth their boats, drying fish, mend nets, etc., thereby protecting their fishing rights. The CRZ notification permits construction of such dwelling units in the CRZ area other than the CRZ-I and the NDZ area of CRZ-III. These restrictions affect the construction of dwelling units of local communities especially living along the backwaters of Kerala. The situation in Kerala have to be considered separately as the State has the highest population of 2176 persons per Sq Km living along the coastal and backwater areas of Kerala. The restrictions of the CRZ Notification have affected the constructions of public amenities and housing in the CRZ area.

As can be seen from a table most of the developmental activities are not permitted in the CRZ-I(i) and (ii) areas except foreshore requiring facilities such as port and harbours, jetties etc., in the inter tidal area. The large inter tidal mangrove area in case of Sunderbans is also a place where more than 3 lakh population are living. The Ministry has amended the notification for providing certain basic amenities such as schools, dispensaries etc for the local population. However, for the welfare and upliftment of communities living in eco-sensitive areas such as Sunderbans, Chilka, Pulikat, etc., special provision in the notification have to be provided and which have to be integrated within the integrated area management plan.

Keeping in view the impact of Tsunami it is necessary to protect mangroves and take up shelterbed plantations along the habitations, prevent reclamations of sand dunes, mudflats, lagoons, etc. to locate dwelling units behind appropriate set back zone. This set back zone should be demarcated on the basis of the vulnerability of the coast to natural hazards. The Government may consider ICZM approach for locating the dwelling units of the communities.

3.4.3 Ports and Harbours and other Foreshore Activities

Ports and harbours are one of the major gateways for economic development of the country. At present there are 14 major ports and several minor ports. These ports are experiencing increasing economic activities. Further, there are proposals from the Central Governments and State Governments for setting up of new ports and harbours including upgradation and expansion of the ports and linkages between the ports. The CRZ notification provides for setting up of expansion of ports and harbours except in areas classified as eco-sensitive areas. Capital dredging and maintenance dredging are some of the serious environmental concerns. These aspects of port development are not covered under the notification, since the jurisdiction of the CRZ ends at Low Tide Line and does not include the water part. Hence, the Committee is of the opinion that the marine part should be included within the jurisdiction of the new coastal regulation regime whereby dredging, maintenance dredging, deepening, dumping of the dredged material can be adequately regulated.

3.4.4 Setting up and Expansion of Industrial Units

As per para 2(i) of Coastal Regulation Zone Notification setting up of new industries and expansion of existing industries except for project of atomic energy, non-polluting industries such as Information Technology etc., to be located in SEZ areas are prohibited activity. This prohibition has affected setting up of certain important non-polluting industries activities such as cement, fertilizer, pharmaceutical, chemical, gas handling, packaging./bottling units even within the port area. The Committee is of the opinion that while prohibiting the polluting industries care may be taken that some of the non-polluting industries may be permitted along the identified stretch of the coastline after taking adequate environmental safeguard as per EIA.

3.4.5 Mining Activities

Para 2(ix) of the Coastal Regulation Zone Notification permits mining of rare minerals, oil and gas in the Coastal Regulation Zone area and prohibits mining of all other materials. The word 'rare- mineral' has not been explained which has led to confusion among the State Governments and the mine operators. The word 'rare minerals' can be replaced with 'placer minerals' and shall be permitted to be mined in the coastal areas since these minerals are not found elsewhere.

With regard to other minerals found in the coastal and off-shore areas, mining can be permitted subject to Environmental Impact Assessment (EIA) studies. However, mining of sand, clay, rocks, pebbles, shells and corals shall not be permitted to be mined.

3.4.6 Non Conventional Energy

The Coastal Regulation Zone Notification permits setting up of non-conventional energy equipments such as solar panels etc. however, the notification silent about wind mills, OTECs, wave energy etc. In view of increasing energy sources the Committee is of the opinion that such non-conventional energy resources should be promoted in a big way all along the coastal areas of the country since, as these energy will benefit the local communities. But it may be ensured that EIA is carried out before implementation of such programmes.

3.4.7 Fishery and Allied Activities

The notification permits construction of fishing jetties and harbours in the Coastal Regulation Zone area other than the eco-sensitive areas. However, the allied facilities for a fishing harbours such as storage halls, ice factories, ice crushing units, fish processing units, workshops, storage units, fish ware housing are not permissible. The fish and shell fish being highly perishable commodity the port harvest technology are very important for improving the shelf life of fish for purpose of marketing and processing. Therefore, the Committee is of the opinion that an integrated fishing unit should be setup after adequate environmental safety measures are incorporated in the project.

3.4.8 Structures to prevent Erosion and Salinity Ingression

The notification [para 2(viii)] provides for taking measures against erosion and salinity ingress. However, the notification is silent about the type of erosion measures to be taken in the various stretches of the coastal areas. Some of the erosion measures such as seawalls and their hard structures can be detrimental to a mangrove or coral ecosystem. Hence, adequate care needs to be taken with regard to the type of erosion measures and its location. World wide there has been change in the erosion control measures. Some of the developed countries are using soft measures such as beach nourishment, shelter bed plantation, geo-textile measures etc. these methods have to be carefully studied before implementation.

3.4.9 Extraction of Oil and Gas

The notification [para 2(ix)] provides for exploration and extraction of oil and natural gas. However, the exploration in the ocean part i.e. below the Low Tide Line is not covered under the notification. Keeping in view, the importance of this sector the Committee is of the opinion that exploration and exploitation of oil and gas should be permissible in the coastal and marine areas after incorporating adequate environmental safety measures. Proper monitoring mechanism should be inbuilt and should be assigned to the Coast Guards for monitoring and enforcing the regulations since the Coast Guards are equipped with necessary infrastructure including oil spill combating. The Ministry has to draw up guidelines to speed up the clearance procedure for this sector since delay would cause huge economic loss to the public.

3.4.10 Extraction of Groundwater

The notification provides for drawal of groundwater by only manual method in the Coastal Regulation Zone area beyond 200 mts on the landward side. Keeping in view, the facts and figures provided by Central Ground Water Boards, the groundwater situation along the country is highly distressing. The Ministry should come out with a comprehensive plan to map areas of ground water depletion, the drawal of groundwater and take up recharging of the aquifers. Desalination, water recycling, rainwater harvesting should be some of the methods which should be encouraged in coastal areas.

3.4.11 Land Reclamation

The Notification [para 2(viii)] prohibits land reclamation in the coastal area except for expansion of port and harbours. The Committee is of the opinion that this prohibition is necessary since reclamation causes ecological and geomorphological changes, which can have adverse impact on other areas. Reclamation can be permitted only in places such as within special economic zones, port and harbours, defence units, for construction of bridges, sea links after detailed EIA studies.

3.4.12 Storage of Chemicals and Petroleum Products

The notification [para 2(ii)] permits storage of 14 petroleum products and food grains, edible oil etc. The notification is silent about several other materials and chemicals, which are handled all over the world such as iron ore, coal, sulphur including variety of chemicals and products. The Committee is of the opinion that within a port and harbours all handling and storage facilities should be governed by the Ports Act. The Ministry may draw up specific guidelines for handling and storing of the chemicals and other commodities within such port and harbours area including EIA procedures.

3.4.13 Discharge of Effluents

The notification [para 2(v) and (vi) and (viii)] prohibits discharge of untreated effluents from industries and cities, dumping of solid waste including fly ash. As per the information provided by Central Pollution Control Board (CPCB) it is observed that most of the cities/settlements are letting out their sewage without any treatment into the coastal waters. The upstream rivers are also bringing along large quantities of effluents from the settlements and industrial units into the estuary and then to the coastal waters. The Ministry had done very little to overcome this problem. In view of this, the Ministry should take adequate measures to regulate such pollution in a time bound manner.

3.4.14 Transportation Systems

The notification prohibits construction of roads those not approved in the Coastal Zone Management Plans, airstrips, railway lines etc., in the Coastal Regulation Zone area. Airstrips have been permitted only in Lakshadweep and Andamans. This provision needs to be reconsidered in view of the growing economic activity of the ports, which need connectivity to the major cities. The Committee is of the opinion that the roads and airstrips may not be laid in eco-sensitive areas. Roads along the coastal stretches for the purpose of decongestion of cities, industrial towns etc. may be approved after proper EIA studies are carried out.

3.4.15 Agriculture Activities

Agriculture, horticulture activities etc., are permissible under the notification except in eco-sensitive areas. The Committee agrees with this provision. The Committee is also of the opinion that the Ministry should map such agriculture and horticulture areas and prevent change of land use of such areas for the purpose of safeguarding the livelihood security of the local communities.

3.4.16 Defence Projects

The notification provides for locating defence units along the coastal areas, but are subject to scrutiny by a separate Committee constituted in the Ministry. Since, there are no major criticism about the procedure the Committee has no view on the subject.

3.4.17 Transmission Projects

The notification provides for laying of transmission and conveying systems including eco-sensitive areas. The Committee has no comments on this item.

3.4.18 Public Amenities

As per the notification public amenities such as dispensaries, schools, rain shelter, community toilet, bridges, roads, water supply, drainage, sewerage are permissible in the rural areas including in Sunderbans. However, as per the notification toilets, drinking water facility, rain shelter, medical care centers, telecom booths cannot be set up on the beaches for the tourist where tourism facilities are located. This not only causes inconvenience to the tourist but also spoils the beaches. Therefore, the Committee is of the opinion that certain public amenities which are of essential nature should not be prohibited in the coastal areas.

3.4.19 Salt Pans

The saltpan activities are permissible in the inter tidal areas other than eco-sensitive areas. The Committee agrees with this provision.

3.4.20 Recreational and tourism

The notification provides for setting up of hotels and tourism projects beyond 200 mts on the landward side from the High Tide Line. The tourism associations have indicated that this provision is too stringent and has been detrimental to the tourism projects. While the NGOs are of the opinion that this provision should not be relaxed, the Committee keeping in view the potential for the beach tourism development in the country, is of the opinion that the concerned Ministry may identify tourism potential areas along the country and draw up integrated tourism management plans for promoting this industry. All developments in the identified tourism areas shall be taken up based on the ICZMP.

3.4.21 Housing and Settlements

The notification provides for construction of houses behind authorized structure on the landward side in municipal areas in CRZ II areas. It also permits construction of dwelling units for local communities beyond 200mts from the High Tide Line on the landward side in rural areas i.e CRZ III. For the purpose of undertaking constructions, Floor Space Index and Floor Area Ratio have been frozen as on 19.2.1991. On account of this provision, several housing schemes such as slum redevelopment and rehabilitation schemes, rehabilitation of old structures have been affected. The Committee is of the view that developments within municipal limits and other populated areas may be taken up based on ICZMP taking into consideration the vulnerability of the area, to coastal hazards.

3.4.22 Projects of Department of Atomic power

As per para 6(2) (a) sub-heading CRZ-I of Coastal Regulation Zone Notification, 1991 projects relating to Department of Atomic Energy has been included vide the amendment dated May, 2002. Keeping in view the impact of tsunami on the Kalpakam Atomic Power Plant, it would be advisable if such nuclear power plants are located a little away from the coast rather than very near the coast.

3.4.23 Categorization of the CRZ Areas

The CRZ Notification, 1991 [para 6(i) and 6(ii)] categorizes the CRZ areas into CRZ-I, II, III and IV. The para 6(ii) lists specific activities that can be taken in each of these categories. The categorization of the CRZ area is based on the eco-sensitivity of the coastal zone and the extent of development. But it is seen from the list under CRZ-I it includes several of the eco-sensitive areas and areas, which are very subjective and cannot be defined for example, areas of outstanding natural beauty, areas rich in genetic diversity. Such subjective and broad base terminologies have led to problems in demarcating CRZ-I areas by the State Governments in their CZMP maps. The Committee is of the opinion that there needs to be a clearly defined terminology alongwith a boundary for the purpose of Administration of such identified areas. Similarly, under CRZ-II and III the terminologies used are highly vague and subjective such as 'developed area, substantially built up, relatively undisturbed areas, legally designated urban areas etc'. For the purpose of implementation and enforcing the CRZ policy the Committee is of the view that there needs to be a clearly defined terminologies along with the administrative boundaries. In the absence of such clarity, there will be confusion within the enforcing machinery, which will lead to hardship for the local communities and also for taking up developmental activities.

3.4.24 Demarcation of High Tide Line, Low Tide Line and CRZ Boundaries

As per para 1(i), of the notification High Tide Line needs to be demarcated uniformly by an authorized demarcating agency. For this purpose the Ministry has issued guidelines and also identified 7 Central and State Government agencies for demarcating the HTL and LTL. The Committee has noted that the definition given for High Tide Line demarcation has led to confusion among various authorized agencies. The guidelines issued are also being interpreted differently by the different agencies. Since, each of the authorized agency employ different methodologies for demarcation there is significant variation between the High Tide Lines drawn by one agency to that of the other for the same area. Further, there is also no clarity with regard to the scale at which the demarcations have to be carried out. Most of the High Tide Line maps are classified hence cannot be accessible by common man. This has put the local communities into great difficulties even to construct small dwelling units, schools, village roads etc. Further the expense towards High Tide Line demarcation cannot be afforded by small entrepreneurs.

In view of the above difficulties and the complications involved in the entire process, the Committee is of the opinion that this procedure of High Tide Line demarcation should be simplified or done away with. The Ministry may think of the other methods such as considering permanent structures (safe for the period of last 20 years along the sea front as a line of setback) in the metropolitan cities and towns. In case of eco-sensitive areas the administrative boundary or the biological boundaries drawn by some of the scientific

institutions or available in the State plans/revenue map shall be taken into consideration. In case of the rural areas the demarcation of such High Tide Line may not be necessary. The development in rural areas can be taken up as per the revenue maps after leaving adequate buffer from the shoreline indicated in the revenue maps.

3.4.25 Preparation of Coastal Zone Management Plans

In compliance with the Supreme Court Orders vide Writ Petition No.664 of 1993 the State Governments had prepared the Coastal Zone Management Plan maps within period of 3 years. Such a hurried exercise undertaken by the State Government for the fulfilling the Court direction contains lots of mistakes and factual errors. The Ministry also, in order to comply with the Court directions, approved these Coastal Zone Management Plans on 27th September, 1996 with certain conditions and modification and directed the State Governments to submit the revised management plans within a period of 3 months. However, till date no State Government has submitted the revised CZMPs for the entire states as per the procedure laid down in the CRZ notification. In the absence of such approved revised CZMPs is very difficult for a developer to undertake developmental activities in the coastal area. Further, lack of clarification in the notification with regard to the categorization, High Tide Line demarcation, scale of the maps have led to further confusion.

The Committee is of the opinion that Ministry should revise the procedure and bring out a simplified Coastal Zone Management preparation guideline, which will be easy for a common man to understand.

3.4.26 Clearance Procedure for Developmental Projects under CRZ Notification

Para 3(i) and 3(ii) of the notification lays down clearance procedures for permissible projects in CRZ area. It is not clear which of these activities require clearance from the Central or State level agencies. The method and documents required for obtaining clearance under the notification is also not laid down. The entire procedure is very vague. It is left to the Ministry and the State Governments to request for information/details from the entrepreneurs. Such discretionary powers are hurdle to developmental project. It is also observed that even a small project less than Rs.1 lakh worth tourist resort project needs to come to the Ministry for clearance for which the project proponent has to come to Delhi for making a presentation before the Expert Committee for Infrastructure Development and Miscellaneous Projects.

Further, as per the same notification a major project such as a maintenance dredging or ship breaking unit can get away from the notification since, they are located below the Low Tide Line. It is also observed that the monitoring and enforcement of such cleared projects are lacking.

The Committee is of the opinion that the Ministry should lay down a clear procedure, documents required, list out activities that require central clearance, state clearance or clearance from local bodies in the guidelines. The Ministry should also maintain database with regard to the baseline information for the purpose of preparing EIA for the marine sector since it is difficult and expensive to obtain information with regard to flora and fauna in the marine areas. The monitoring programmes for the cleared project should be undertaken at regular periods.

3.5.0 Enforcement and monitoring of Coastal Regulation Zone Notification, 1991

In compliance to the same orders of the Supreme Court in Writ Petition No.664 of 1993 the Ministry has constituted National Coastal Zone Management at the Central level and 13 State and Union Territory level Coastal Zone Management Authorities under the Environment (Protection) Act, 1986. These Authorities have about 8 members, of which 4 of them are bureaucrats from concerned Departments of the State Government and 4 experts in the field of coastal management. The scope of work of the Authority include enforcement and monitoring. For this purpose necessary provision of Environment (Protection) Act, 1986 has been delegated. The State and UT Authorities have also a technical role to play such as preparation of Integrated Coastal Zone Management Plans, awareness creation etc. But till date no major technical activities have been taken up by the Authorities.

During the meetings of the Committee and the interactions with the NGOs it was brought to the notice that these Authorities have not taken up proactive role in the Coastal Zone Management programmes initiated by the Ministry. None of the Authorities have prepared the Coastal Zone Management Plans for the entire State. Very few violations have been booked by the State Coastal Zone Management Authorities. The reasons for such weak enforcement by the Authorities are mainly due to lack of infrastructure, funds and training to the officials. The Ministry should help these Authorities to strengthen their capacities and provide adequate infrastructure to the State and Union Territory Authorities. Appropriate representation of NGOs involved in coastal management should be made.

3.6.0 NGOs perceptions

Due to lack of sufficient motivation from the concerned State Governments, lack of adequate financial mechanisms, weak enforcements, the NGOs have been playing a critical role in identifying the violations and bringing them to the notice of the concerned governments. In several cases, the NGOs have taken up the matter to the Courts. The NGOs have been playing a very proactive role in protecting the coastal environment. However it is seen that most of the activities of the NGOs are confined to areas such as Mumbai, Goa and Kerala.

3.6.1 Suggestions made by the NGOs

Most of the NGOs are of the opinion that the CRZ Notification has been relaxed time and again. The NGOs have raised the issue with the Ministry stating that the CRZ Notification has been amended about 17 times and in each amendment relaxations have been made for taking up developmental activities which are contrary to the principle of Environment (Protection) Act, 1986 and the objective of the CRZ Notification. The NGOs have indicated that stringent enforcement mechanism should be put in place for implementing the notification. The CZMPs should be prepared and put on the website and other public domain for transparency in implementing the notification. They also suggested that the livelihood security of the communities should be adequately addressed and the notification should be further strengthened by protecting the rights of the fishermen communities and other communities, who are dependent upon the coastal resources. For this purpose, the NGOs have indicated that the ocean part should be brought under the CRZ notification. They are also of the opinion that the Coastal Zone Management Authorities have been highly ineffective in enforcing the Notification hence; the NGOs should be included in the Authority.

3.6.2 R&D Sector

The CRZ Notification and the efforts to implement had created an awakening among the research community on the challenges in the management of coastal resources. The scientific community also came forward with both appreciation and criticism on the various provisions of the regulatory regime. It has also created opportunities for the application of the latest tools such as IT, GIS, GPS and remote sensing, of which the latter was extensively used and became particularly handy both in high speed mapping and monitoring. The high rate of degradation of the coastal ecosystems/violation of the CRZ came to the limelight in this process. There had been substantial contribution from rational, state and private institutions and played an important role in exposing the criticality of the ecosystems.

In spite of the increased vigour in scientific research, the community had not been able to address several vital issues related to CRZ and come out with well-studied suggestions. Some of these include the impact of sea level rise, the impact of settlements on the coastal waters, the delicacy of groundwater aquifer, the limit upto which activities to be regulated in the inland tidal water bodies, etc. However, there had been positive inputs on the type, extend of regulation for the coastal geomorphic units, management of mangroves, ICZM, etc. Even then studies are yet to reach their logical conclusions.

Considering the increased importance on one side and the greater vulnerability due to developmental demands on the other in the coastal areas the strengthening of R & D sector has become more important. There is R&D agencies that have been working in the areas of coastal environment include the Central, State and private. Coastal Systems Research (CSR) which takes into account both sea and land surfaces in an integrated manner needs to be fostered. CSR will help to promote the sustainable and equitable use of coastal bioresources.

3.7.0 Summary of current CZM

3.7.1 Weak Implementation by State Governments

The Committee has observed that there have been very few initiatives taken by the concerned State Governments and Union Territories for preparing the Coastal Zone Management Plans. The Ministry had directed the State Governments to prepare the revised CZMPs in September, 1996 within a period of one year. However, till date no State Government has come up with a detailed CZMP for the entire State. This has led to non-development in some areas and delay in project implementation. The State Governments have not earmarked sufficient funds and created infrastructure for the implementation of the Notification. As on today only the state like Kerala and Tamil Nadu have scientific institutions to advise the State Governments with regard to the implementation of the notification. In the absence of such scientific institutions the implementation programme was grossly inadequate. The weak implementation by the State Governments are one of the reasons for increasing number of court cases which are pending in the Supreme Court and various High Courts.

3.7.2 Initiatives by the Centre

The Ministry time and again has been amending the Notification based on the recommendations of the various Expert Committee and in-house exercise. However, there

has been no concrete effort in addressing some of the major issues such as degradation of the eco-systems due to anthropogenic activities, pollution of coastal areas and coastal waters due to effluents, sewage and solid waste. There has also been no effort by the Ministry for strengthening the enforcement mechanism by the State Governments. The Committee takes a serious note of the lack of manpower and infrastructure existing within the Ministry itself, which is entrusted with protecting and conserving the vast coastal and marine resources. There has been a vast change in the management approach of the coastal and marine area worldwide. The Ministry has done very little work to initiate the programmes in a integrated way. There has been no initiative in strengthening or setting up of scientific institutions dealing with coastal management. Training programmes to the officials have been carried out very few times and there is no continuity in the programmes. All these factors have accounted for failure of the notification to a large extent. The Committee also observed that the Ministry has no special norms for the EIA procedure to be undertaken in coastal and marine areas. The EIA procedure followed for a breakwater project is similar to the EIA procedure for a road project. Lack of database is another area of major concern. The Ministry should take initiatives in identifying specialized institutions such as ZSI, BSI, Universities and other R&D institutions to address this issue and provide authorisation for preparing a database of various resources of coastal and marine areas and for conducting specialized studies for the coastal resources managements and ICZM.

3.7.3 Awareness Programmes

The Ministry inspite of having a separate division called as environmental education and information division has done very little in creating awareness. Till date no brochures, information material, guidelines etc., have been published by the Ministry. The developers, industry associations, central Ministries, NGOs and other stakeholders have no information with regard to various norms and procedures prevailing under the notification for obtaining environmental clearance. Several of the procedures have not been brought into the public domain. This has lead to delay in project implementation, though, it may be permissible under the notification.

3.7.4 Conflict Resolution

The Ministry has not been active on addressing the conflict issues between the stakeholders except in resolving certain specific cases. This is evident from the increase in number of court cases. The conflict resolution is one of the major areas, which the Ministry has to address while according clearance to the projects. It is observed that there is no public hearing mandatory for the projects falling in CRZ. In the absence of involvement of the public in decision making there is bound to be conflicts occurring during the implementation and operation of the project.

CHAPTER-4

4.0 SUGGESTIONS OF THE COMMITTEE FOR INTEGRATED COASTAL ZONE MANAGEMENT

Since 1991, various Expert Committees have gone into specific issues relating to Coastal Regulation Zone Notification, 1991. There have also been several judicial pronouncements. Large-scale violations of the regulatory framework in coastal areas are also being reported from time to time. Anthropogenic pressures on several fragile ecosystems have been growing, particularly with reference to housing, tourism and hotel industry, sand mining and industrial projects. Coastal pollution has also become a major issue of concern. It is in this background that the present Committee was set up to review the current situation with reference to Coastal Regulation Zone and suggest ways of ensuring that the principles of ecology, intra-and inter-generational equity and the livelihood security of the fisher and farm families living near the coast, become fundamental to the management of our coastal zone.

Due to pressures of development, recreational and housing activities, the Coastal Regulation Zone Notification has been frequently amended. Aquaculture enterprises have often led to the denudation of precious mangrove forests. Large-scale sand mining, extraction of coral reefs and dumping of sewage and toxic wastes into the sea are still in progress. While the Committee started its work in this background, it ended its deliberations in the context of the extensive damage caused by the titanic tsunami to lives, livelihood and property on 26th December, 2004. **Tsunami served as a wake-up call.** Any further neglect of sustainable Coastal Zone Management practices will spell doom to the future of coastal communities. Good ecology alone can ensure sustainable human security to coastal habitations. Compounding the serious problems arising from demographic and commercial pressures as well as the greed of the rich and the genuine needs of the poor, which confront us today, we have also to be prepared to face the prospect of sea level rise within the next few decades as a result of global warming and the consequent melting of glaciers and the arctic and antarctic ice deposits.

Based on in-depth discussions and widespread consultations with the principal stakeholders, the Committee developed the following 12 basic guiding principles, which should govern future decisions on coastal zone management:

- (1) Ecological and cultural security, livelihood security and national security should be the cornerstones of an integrated coastal zone management policy.
- (2) The coastal zone will include an area from territorial limits (12 nautical miles), including its sea-bed to the administrative boundaries or the biological boundaries demarcated on the landward side of the sea coast. The coastal zone management will also include the inland tidal water bodies influenced by tidal action and the land area along such water bodies. This area should be taken up for an integrated, cohesive, multi-disciplinary and multi-sectoral coastal area management and regulatory system.
- (3) Regulation, education and social mobilization should be the three major components of a participatory and sustainable Coastal Zone Management strategy.

Panchayati Raj institutions in coastal areas should be fully involved in the educational and social mobilization programmes.

- (4) The protection and sustainable development of the marine and coastal environment and its resources should be in conformity with international law, as laid down in 1982 UNCLOS, as well as with the suggestions contained in Chapter 17 of Agenda 21. The Draft National Environment Policy of India also contains useful guidelines. Every effort should be made towards ensuring an Integrated Marine and Coastal Area Management (IMCAM) as prescribed in the 1995 Jakarta Mandate under the 1992 Convention on Biological Diversity.
- (5) Coastal regulation needs to be based on sound, scientific and ecological principles and should safeguard both natural and cultural heritage. Heritage sites need particular care and should be conserved in their pristine purity. These include buildings, artifacts, precincts of spiritual, historical, aesthetic, architectural or areas of environmental significance such as richness of biodiversity and scenic beauty. Bird sanctuaries and parks and breeding grounds of migratory birds should be protected.
- (6) The precautionary approach should be used where there are potential threats of serious or irreversible damage to ecologically fragile critical coastal systems and to living aquatic resources. Scientific uncertainty should not be used as an excuse for the unsustainable exploitation of coastal resources – both living and non-living as well as to prevent environmental degradation, injustice and harm.
- (7) Significant or irreversible risks and harm to human health and life, critical coastal systems and resources including cultural and architectural heritage would be considered unacceptable. Ecological economics should underpin economic activities, so that present day interests and future prospects are not antagonistic. Significant biological, cultural and natural assets should be considered incomparable, invaluable and irreplaceable and should receive overriding priority in the allocation of resources for coastal area protection and conservation.
- (8) Coastal policy and regulations should be guided by the principles of gender and social equity as well as intra-generational and inter-generational equity, (i.e., the interests of future generations). They should be based on Mahatma Gandhi's dictum, "Nature provides for everyone's needs, but not for everyone's greed." All stakeholders should be involved in decision-making. Precious biological wealth, coming under Marine Biosphere Reserves, should be managed in a Trusteeship mode, with all the stakeholders protecting the unique natural wealth of biosphere reserves as Trustees and not as owners. A case study should be made on how the Gulf of Mannar Biosphere Trust is functioning, so that the Trusteeship pattern of sustainable management by the principal stakeholders can be replicated.
- (9) Coastal protection and bio-resources conservation policies should be guided by techno economic efficiency, the precautionary approach, 'polluter-pays' principle(s) and 'public trust' doctrine. There should be strict liability on the part of those engaged in hazardous or inherently dangerous coastal activities, including the liability to compensate the victims of all human made hazards such as marine pollution and fish contamination. They should also bear the cost of restoring the

coastal environmental degradation. The onus of proof in such cases should be on the developer/industrialist for demonstrating that their “development” activities are environmentally benign.

- (10) The principles contained in the Biodiversity Act (2002), should be applied to coastal bio-resources management. This will involve concurrent attention to conservation, sustainable use and equitable sharing of benefits. To address the issue of pressures on marine and coastal ecosystems, as defined in the Johannesburg Plan of Implementation (Part IV) adopted at the 2002 World Summit on Sustainable Development, every effort should be made to promote sustainable fisheries, prevent loss of biological diversity, prevent all forms of marine pollution and ensure that coastal area development and urbanization are eco-friendly.
- (11) The regeneration of mangrove wetlands, coral reefs and sea grass beds as well as the promotion of coastal forestry and agro-forestry will confer both short and long term ecological and livelihood benefits. Carbon sequestration through coastal bio-shields will make an important contribution to promoting a balance between carbon emission and absorption, in addition to offering protection during coastal storms and calamities like Tsunami. An important lesson taught by the tsunami disaster is that the rehabilitation of degraded mangrove forests and the raising of coastal plantations of salicornia, casuarina and appropriate species of halophytes will represent a “win-win” situation both for nature and coastal human habitations. No further time should be lost in initiating a national coastal bio-shield movement along the coasts of the mainland of India as well as islands. This can be a priority task under the National Rural Employment Guarantee and Food for Work Programmes.
- (12) The severe loss of life and livelihoods as well as property caused by Tsunami in Andaman & Nicobar Islands and in the coastal regions of Tamil Nadu, Kerala, Andhra Pradesh and Pondicherry teaches us that short term commercial interests should not be allowed to undermine the ecological security of our coastal areas. Human memory tends to be short and neglecting the lessons of Tsunami will be equivalent to writing off the future of coastal communities.

Thus, Coastal Zone Management requires cohesive, multi-disciplinary approaches as well as multi-dimensional vision. Sustainable human security in all its dimensions - ecological, economic, ethical, cultural and human well-being, in terms of the health and happiness both man and nature, should be the goals of an enlightened Coastal Zone Management policy. The implementation of such a policy will require appropriate regulations supported by effective monitoring systems as well as education, public and political understanding of risks and benefits of development activities and above all, social mobilization through Panchayati Raj institutions.

It is on the basis of the above 12 guiding principles that we have formulated our recommendations. We appeal that our recommendations may be considered in toto and not in a fragmented manner and that both the letter and the spirit of the recommendations be respected.

4.1 Recommendations with regard to Terms of Reference

4.1.1 ToR-(I) To review the reports of various Committees appointed by the Ministry of Environment & Forests on coastal zone management, international practices and suggest the scientific principles for an integrated coastal zone management best suited for the country;

- (i) The Coastal Regulation Zone Notification, 1991 has been framed with an objective to protect the coastal environment. In the process, the notification has laid rigid regulatory measures for undertaking developmental activities including those activities, which are essential for coastal fishing communities such as dwelling units. The Ministry of Environment and Forests has been receiving several representations and requests from various stakeholders in the coastal areas, which include central Ministries, coastal State Governments and Union Territories, developmental associations and civil society organisations. Keeping in view these representations the Ministry has been appointing Expert Committees from time to time to examine the issues raised by the stakeholders and suggest measures for addressing these issues. The reports submitted by these Committees were examined in detail by this Committee. After examination of the recommendations of the various Committees and the action taken by the Ministry with regard to each of the recommendations, this Committee is of the opinion that the recommendations of the earlier Committees contained in their reports are quite comprehensive and address the specific issues in detail. However, the Ministry has selectively chosen specific recommendations and have amended the Coastal Regulation Zone notification. Such a selective approach has been described by the NGOs and conservationists as dilution of the notification. Had the Ministry taken note of all the recommendations of each of the Committees constituted so far, the Coastal Regulation Zone notification would not only have been strengthened but also brought clarity for implementation.
- (ii) The Committee is of the view that for addressing the coastal problems in a holistic manner, the water part i.e., the ocean, tidal water bodies should be included.
- (iii) The Committee examined various international practices of Coastal Zone Management adopted by both developed countries and developing countries. The Committee found that the practices followed by these countries are not confined to regulatory systems. The practices provide greater emphasis on the management approach rather than merely on regulation. Further it also reveals that the developed countries have adopted a more pragmatic approach in their coastal zone management programme, while giving due attention to protection and conservation of ecological systems, geomorphic features, water bodies and the vulnerability of the coastal areas to natural hazards.
- (iv) An integrated, multidisciplinary and multi-sectoral coastal land and sea area management system is an urgent need. The regulatory framework should aim at integrated and sustainable coastal zone management.
- (v) It is necessary to encourage collective and democratic initiatives at the level of the local communities for preparation and implementation of Integrated Coastal Zone Management. This will encourage using, caring for and managing the coastal

environment and resources on the principle of common property resources, and not private ownership.

- (vi) It is necessary to ensure that area and region-specific plans are prepared and a regulatory framework is put into place. The Coastal Regulation Zone framework has been used to protect principles of maintenance of ecological diversity and social justice. The principles of the notification can be strengthened by well-thought out, sensitive and firm policy mechanism to prevent any further degradation of coastal zones from irreversible consequences.
- (vii) An Integrated Coastal Area Management (ICAM) approach will address problems in coastal areas in an integrated and inter-sectoral manner so as to achieve environmentally and socially sustainable development. It seeks to identify the links between environmental problems in coastal areas with activities that take place outside it, in inland areas or in the deep seas. It seeks to bring together users of coastal resources, together with government agencies active in the coastal zone, to evolve a plan for eco-development of coastal resources. A major objective should be to coordinate, manage and reduce conflicts between the activities of various sectors in coastal areas for a long-term sustainability of coastal resources. It is suggested that various resource users be brought together in the planning process. Coordinating the activities of various government departments with jurisdiction in the coastal zone is crucial.
- (viii) Stakeholders participation and decentralization of decision-making processes and management are desirable objectives in their own right. For example, if the classified categories are retained, suggestions must be invited from the public and stakeholders regarding the new classification of areas being proposed as 'ecologically sensitive areas', 'areas of particular concern' and 'other open areas', "islands of Andaman & Nicobar and Lakshadweep". It is also difficult for the government to watch every part of the coastal zone. Powers must be devolved to the local self-governing bodies in accordance with the letter and spirit of the 73rd and 74th Constitutional Amendments. Grassroot democratic institutions need to be harnessed by the new Coastal Regulation Zone Management system. The MoEF should consider any projects proposed within the coastal zone for clearance only after fair, transparent and due public hearing. Institutions of the local self-government must be given adequate authority and resources and a clear role in community development as well as in conserving and enhancing biodiversity. Local-level institutions need to be supported by, and should work in co-operation with, appropriate decision-making bodies at the state/provincial and national levels. Management needs to be oriented towards actually controlling and guiding the development process in a manner which benefits coastal communities in an environmentally sustainable manner. There is a need to recognize the advantages of allocating appropriate responsibilities at different levels. In projects where public hearings are mandatory, a public awareness programme should precede so that the local citizens can be well informed about the purpose and rationale. The right to information must be respected.
- (ix) It is also necessary that Central and State Governments ensure that different Departments are unambiguous on the allocation of responsibility and accountability. While many characteristics and needs of local communities

dependent on coastal resources such as fisheries are unique, there are several aspects which need to be integrated into a broader approach to coastal area management. In particular, there is a need to harmonize policy objectives between different natural resource users, and to establish mechanisms for conflict resolution. All aquaculture projects should be strictly reviewed so as to ensure that these projects do not destroy the natural bio-shields such as mangroves, corals and are not detrimental to the coastal ecological security.

- (x) Environmental as well as social impact assessments should be a compulsory part of the procedures in the approval process for potential developmental activity. Provisions for a public review process should be made mandatory. In the present Environment Protection Act (1986), compulsory public hearing is applicable only to projects subjected to EIA. 'Social Assessment' refers to analyzing, monitoring and managing social dimensions or consequences of a development process or of planned interventions such as policies, programmes, plans and projects. These consequences may be intended or unintended. The primary orientation of social assessment is to bring about a more sustainable and equitable biophysical and human environment. The direction for ICZM will come from a detailed mapping of ecological and social/community dimensions which must constitute the base-line information of all decision making for proposed development projects. Further, environmental impact assessments (EIAs) of new developmental projects must be prepared in the context of existing activity in the area and their burden on the ecosystem. EIAs need to take traditional as well as 'modern' scientific knowledge into consideration. Wherever the information base is poor, or the likely adverse impact can not be predicted with adequate certainty, the 'precautionary approach' must be applied, and developmental activities should not be undertaken. All EIAs should account for the social and economic costs which environmental degradation causes to local communities. There must also be ways and means for accounting for the costs to be borne by future generations whose rights may be jeopardized by current developments. We recommend that MoEF may help to strengthen national capacity in the area of assessing the economics of inter-generational equity. Our capacity in this area is very meager at present. Once such costs are internalized, a purely economic rationale to pursue many 'development' policies or projects must cease to exist. There are clearly many areas where harmonious development is possible, and these areas need to be identified and prioritized.
- (xi) Defense related projects though necessary for national security, should also be subjected to assessment process in order to avoid possible negative social and ecological outcomes. Such environmental and social assessment processes can help to reduce the resistance of local populations to the defense projects by helping to address the concerns and also to mitigate possible hazardous environmental impacts. All projects including defense projects should go through a well-defined process of identifying impacts so that efforts can be made in mitigating them while clearing important projects.
- (xii) It is essential that balance must be maintained between development and conservation, i.e. while it is essential to promote socio-economic development, it is equally essential to maintain the unique scientific and cultural values of the sites. Coastal Zone Managers, well versed in the principles of ecology, economics

and social and gender equity, will have to be trained in suitable institutions. Capacity building in the science and art of environmentally and ethically sustainable development is an urgent need.

4.1.2 ToR-(II) To define and enlist various coastal and marine resources and recommend the methodology for their identification and the extent of safeguards required for conservation and protection;

- (i) The coastal resources and issues have to be viewed in an integrated and inter sectoral manner. It is necessary to identify the links between environmental problems in coastal areas with activities that take place outside in inland areas and in the deep seas. Therefore, it is necessary to bring together impacts of all developments on the coastal zone and all the concerned agencies, to evolve a plan for the sustainable utilization of coastal resources. The Committee examined the different living or non-living resources of the coastal zones and the threats and safeguards involved in their utilization particularly, in the context of their finite nature. It is necessary to prepare a biodiversity index for the coastal and marine areas, which is to be integrated into ICZMP. There is a need to distinguish clearly between the genuine needs of local communities and those of commercial interests.
- (ii) The Committee, after discussing in detail various coastal and marine resources, came to a conclusion that it may not be possible to conserve and protect each of the entities. Already much has been lost, as for example in the Krusodi island in the Gulf of Mannar which was formerly described in Zoological literature as a “paradise for crustaceans.” The resources which need priority attention are mangroves, coral reefs, sand dunes, inland tidal water bodies such as estuaries, lagoons, lakes, creeks, straits, mudflats, marine parks and sanctuaries, coastal forest and wildlife, coastal freshwater lakes, salt marshes, turtle nesting sites, horse shoe crab habitats, sea grass beds, sea weeds and breeding grounds for migratory birds. These ecosystems/features should be demarcated as ecological sensitive areas and an Integrated Coastal Zone Management plan should be prepared for the protection and conservation of these resources.
- (iii) The well recognized protection role of sand dunes, beaches, sand bars, coastal cliffs and such other geomorphologic features on one side and the ecosystems such as mangroves, coastal forests, corals, bio-shields, etc., on other side against coastal and marine natural hazards shall be respected and integrated into the coastal area management schemes.
- (iv) There is need for initiating a coastal ‘bio-shield’ movement by raising mangroves, plantations of casuarinas, salicornia, leucaena, atriplex, palms, bamboo and other tree species and halophytes that can grow near the sea. These will serve as speed breakers in the event of coastal hazards like cyclones, storm surges, tsunami, and monsoonal and high wave activity. Community nurseries can be raised for this purpose. There is a need for people’s participation in the conservation and enhancement of mangroves, other wetlands, reefs, coastal/marine biodiversity and coastal geomorphology. It is necessary to prepare a comprehensive biodiversity index for the coastal and marine areas, which can be integrated into ICZMP. The National Institute of Disaster Management has prepared a state wise vulnerability atlas for the entire country. This needs to be integrated in the ICZMP. In the ecologically sensitive areas while adopting restoration mechanisms, necessary precautions have to be taken to avoid entry of exotic and invasive alien species

and it is necessary to ensure propagation of indigenous species. The conservation, preservation and development of the areas of ecological sensitive nature and particular concern shall be on the basis of the Integrated Coastal Zone Management Plan prepared based on the guidelines issued by the Central Government.

- (v) The Committee is of the view that there are several issues and resources such as heritage sites of unmeasurable value, ecological security, livelihood security, traditional rights, national security, cultural heritage, bio-diversity and food security which are non negotiable. Site specific taxes in public domain, lease rights and ecological cess especially for mining, chemical industries and other hazardous industries need to be introduced to account for socio-economic and environment cost. Ecological mining principles should be fully enforced.
- (vi) Closely interrelated with natural resources are cultural resources, and along the Indian coastline are regions and sites of great cultural and spiritual significance encompassing a precious and vulnerable range of heritage both tangible and intangible. The total number protected by the Centre and States constitute a very small percentage of the total wealth distributed over the country, and apart from these, few are, indeed, even listed. Thus only a fraction of the total wealth of India's built heritage is actually known. The Archaeological Survey of India, jointly with the State Departments of Archaeology and the Ministry of Environment and Forests, would need to identify such heritage sites within and relevant to the coast, prepare a comprehensive inventory pertaining to their components and demarcate their respective regulatory zones. Structures for their management and conservation would need to be in evidence in order to integrating the sites into the overall framework of the CRZ. Special attention must be given to declare World Heritage Sites and potential World Heritage Sites. In the coastal zone management plans prepared by the concerned States, a majority of heritage sites have not been delineated, and where they have been, the States and Union Territories are yet to formulate their approach and plans for conservation management and future development. It must be noted that there are various kinds of built heritage and heritage sites related to the Indian coast (living heritage areas such as historic/*Adivasi* settlements, monuments of worship, imperial centers, ports, colonial heritage, traditional settlements, forts, urban landscapes, cultural landscapes; walls, pillars, towers, water-structures and systems; archaeological parks, underwater/underground heritage, and natural landscapes, sanctuaries and particular physical and biological formations). These may exist singly as apparently isolated forms, natural formations, structures or remains; in groups or clusters; within/a part of/around living settlements; or a site may cover several square kilometers. There is an urgent need to identify, define, and protect a large number of these sites that are currently neglected.
- (vii) The Committee recommends that the burden of proof should be on the developers (including government agencies) to show that their activities will not cause harm to the coastal environment or the coastal communities. In cases of coastal areas of 'incomparable value', the developers shall have strict and absolute liability. Moreover, consultation and involvement of the local communities or representatives of the affected communities, including women and members of disadvantaged groups, in all phases of planning and implementation must be made obligatory.
- (viii) **Ground water in coastal areas must be declared as a social resource.** Limit for exploitation need to be placed while prioritizing drinking water needs. Indiscriminate

extraction, especially near the coast can prove disastrous. Along the coast of Gujarat, limestone mining has extended towards the coast. Exploitation of ground water, if not regulated, results in salinity ingress into fresh water aquifers near the coast. Monitoring and enforcement structures remain weak. A clear regulatory framework on ICZM must include the dimension of the sustainable management of the aquifer.

- (ix) Significant or irreversible risk and harm to human health and life as well as critical coastal systems and resources including cultural and heritage sites, resulting in serious and large-scale detrimental impact, would be considered 'incomparable' and unacceptable. As such, they will not be measured in terms of monetary or conventional goods and services. Being irreplaceable and invaluable, they shall be given special and overriding priority for allocation of resources for coastal protection and conservation. Coastal policy and regulations shall be guided by the principle of 'equity', both in entitlements to and participation of the relevant public in processes of fair, just and transparent environmental decision-making especially as regards critical coastal systems and resources including those of cultural and heritage value.
- (x) A comprehensive policy with respect to heritage sites specific to coastal zones needs to be arrived at, detailed and integrated with the CRZ regulations. Based on this, a workable control and monitoring mechanism should be determined and made operational. The Ministry of Culture should accomplish this process as soon as possible.
- (xi) Addressing the issue of pressures on marine and coastal ecosystems, as defined in the Johannesburg Plan of Implementation (Part IV) adopted at the 2002 World Summit on Sustainable Development (WSSD), every effort shall be made to promote sustainable fisheries, prevent biological diversity loss and pollution from various sources including land-based sources of marine pollution, ship-generated marine pollution, oil spills, hazardous waste dumping, contaminated ships brought for breaking purposes, etc., and minimize/nullify impacts of coastal development and urbanization.
- (xii) Every effort shall be made towards ensuring 'integrated marine and coastal area management (IMCAM), as prescribed in the Jakarta Mandate (1995) and its Programme of Action (1998) under the 1992 Convention on Biological Diversity, as the best tool for the conservation and sustainable use of marine and coastal biodiversity.
- (xiii) As required under the 1992 UN Framework Convention on Climate Change, climate - related impacts would require response options that could also address issues such as sustainable coastal development and the protection of mangroves and other ecosystems. Coastal bio-shields will help to enhance carbon sequestration.
- (xiv) Coastal village communities and school children should be encouraged and enabled to prepare local level biodiversity and cultural heritage registers, as is now being done with reference to community bio-diversity registers. This will also be helpful in implementing the provisions relating to prior informed consent and benefit sharing enshrined in the Biodiversity Act (2002).
- (xv) Coastal bioresources conservation needs the understanding and support of all those who are currently using both the living and non-living aquatic resources in the ocean. For example, modern fishing trawlers have destroyed sea grass beds and this in turn has led to the destruction of the habitat of dugongs. Unfortunately, there is no mechanism for a

proactive action-reaction analysis before this so called “modernization” of coastal commercial activities including fishing is undertaken. There is need to build the capacity of local Panchayats, educational institutions and civil society organizations, as well as of relevant government departments in conducting environmental and biodiversity audits. This will enable greater public understanding and participation in the conservation and enhancement of coastal bio-resources, both on the landward and seaward sides of the coast. Many precious halophytes occur on the coast and these are now endangered with the threat of extinction. The Botanical and Zoological Surveys of India should undertake a massive programme of coastal bioresources inventorisation and conservation together with the National Bioresources Board, the National Medicinal Plants Board and the National Bureau of Plant, Animal and Fish Genetic Resources.

4.1.3 ToR-(III) To revisit the CRZ, Notification, 1991 in the light of above and recommend necessary amendments to make the regulatory framework consistent with recommendations on (a) and (b) above and the Environment (Protection) Act, 1986.

- (i) On the basis of various presentations made before the Committee, representations made by different stakeholders, deliberations among the members of the Committee, as well as based upon the 12 basic principles, the different issues relating to Coastal Regulation Zone Notification were addressed. The Committee is of the opinion that there needs to be a comprehensive, holistic and transparent approach towards management of the coastal zone, which is lacking in the present Coastal Regulation Zone Notification, 1991.
- (ii) The range of amendments presents a trend that has allowed commercial and industrial expansion in coastal areas. Many of these activities have proved to be extremely harmful to the ecological and livelihood security of the coastal areas. The Committee is of the view that CRZ notification needs to be strengthened and made more scientific in its overall approach, keeping in mind both the needs of the coastal communities (including fishing, agricultural) and the conservation of the coast.
- (iii) The several amendments brought into the original notification have to some extent distracted from the original objectives and the spirit of the Coastal Regulation Zone Notification, 1991.
- (iv) As already stressed, coastal policy and regulation for protection and conservation of the coastline will be governed by principles of ecological economics and polluter pays. As such there shall be absolute liability for those who engage in hazardous or inherently dangerous coastal activity including the liability to compensate the victims of all man made hazards, including pollution as well as the cost of restoring the coastal environmental degradation. The ‘onus of proof’ in such cases shall be on the actor/developer to show that his/her action is environmentally benign.
- (v) Coastal policy and regulations overall approach shall be to protect fragile coastal zones of India, in view of the growing demographic and economic pressures, especially to protect and regenerate the mangroves and the coral reefs as well as other ecologically sensitive areas. In the wake of the serious loss of life, property

and the destruction of precious habitats caused by unprecedented Tsunami that ravaged Andaman and Nicobar Islands and coastal states such as Tamil Nadu, Kerala, Andhra Pradesh and Pondicherry on 26th December, 2004, it should be ensured that short-term commercial interests do not undermine the ecological security of Indian coastal areas. The strategies for disaster preparedness shall comprise emphatic prohibition on construction of any permanent structures within the vulnerable areas, except for those required to protect the community such as disaster shelters, infrastructure for rescue and relief, sea walls, where essential, to prevent erosion and ingress of sea water, look-out posts, etc.

- (vi) That Coastal Zone Management requires multi-disciplinary approaches as no single field or sector adequately addresses all the complex issues of conservation, preservation, restoration and development of coastal resources and ecosystems including livelihood security and food security and the security of cultural and heritage sites.
- (vii) There are complex issues which were not addressed in the Coastal Regulation Zone notification adequately such as different property right regimes and the benefits generated by the coastal resources, living and non-living resources in term of marketable values, non-market benefits, immeasurable and intangible benefits. Many of the conflicts arise because of difficulty in resolving intra-generational and inter-generational equity and a mechanism should be put in place to resolve such conflicts in the policy and regulatory framework concerning the coastal areas. There shall be code of conduct for coastal management and ecological security including a package of rewards for initiatives in the areas of landward and seaward oriented buildings, energy efficient construction, use of non-conventional energy sources, rainwater harvesting, effluent treatment and use of biodegradable material. The coastal ecological security literacy programme should bring to the attention of builders the opportunities now available for mainstreaming ecology in building design and construction.
- (viii) Although there are several R&D institutions engaged in coastal zone conservation and management in the country, there is no well-planned and coordinated effort. We suggest that MoEF in cooperation with Department of Ocean Development sponsor an all India Coordinated Research Project for Sustainable and Integrated Coastal Zone Management. Such an All India Coordinated Project should bring together various institutions now functioning under Indian Council of Agriculture Research (ICAR), Council for Scientific and Industrial Research (CSIR), DoD, Department of Science & Technology (DST), Indian Space Research Organisation (ISRO), Department of Atomic Energy (DAE), Defence Research & Development Organisation (DRDO), Indian Institute of Technologies (IITs) and Universities, into a working partnership based on a sharply focused and prioritized agenda. This will also help to fill gaps in ongoing work, particularly in the areas of ecological economics and the economics of inter-generational equity. Coordinated efforts will help to maximize the benefits of the vast R&D infrastructure available in the country and will minimize avoidable duplication and transaction costs.
- (ix) There is need to identify and notify areas such as sensitive areas, hotspots, potential land based and sea based mariculture sites, etc. The mandated

institutions under the various Ministries may be approached to prepare the GIS based sitemaps, which should be notified and legalized by the MOEF for future developmental and conservational activities. The issue of demarcating the High Tide Marks perhaps could be done away with and a more distinct natural boundary may be adopted. Coastal people particularly fishermen and women are severely affected by some of the existing provisions of the CRZ regulations and are targeted by local authorities by denial of traditional and essential activities on the coasts.

- (x) Sustainable livelihood strategy should be based on the principles of social inclusion and gender equity. It must cover fisher and land-based farming communities as well as landless labour families. Male fishers who are unemployed for about half of the year and the women who are under employed shall be brought under the sustainable livelihood strategy by introducing agrarian reforms, integrated capture and culture fisheries, seawater farming, coastal biovillages, a coastal grid of farm schools and demonstration centers, etc. A Network of Rural Knowledge Centres should be established all along the coast, as soon as possible, with good connectivity, a digital gateway and capacity building for care and management.
- (xi) Enforcement is the weakest dimension of most of the environmental legislation. Unless strict penal measures are instituted, policies will remain on paper. Fixing of responsibility on the bureaucrat /state official as well as elected representatives, as per the 'public trust doctrine', will be necessary to create a higher level of political will and commitment. The implementation of the provisions of notification should be rigorously enforced. Placing within the public domain full details of projects proposed within the Zone can generate the necessary public and media attention and involvement.
- (xii) At present, the extent of the coastal zone is defined in various ways and is managed by a multiple set of agencies. Various Government departments such as the Public Works Department, Port Department, Department of Mines and Geology, Forest Department, Fisheries Department, Department of Ocean Development, Coast Guard etc. control various features and activities on the coast. In the presentations made by the various Departments of the Government before this Committee, it was clear that there an urgent need for greater inter-departmental interaction and cooperation when it comes to the conservation of the coastline. Data sharing as well as sharing of plans and procedures are important. Furthermore, it is critical that there is an awareness related to national security, biodiversity conservation, livelihood and related issues simultaneously in all these Departments.
- (xiii) All activities that are permissible within the coastal zone need to be allowed only after a comprehensive EIA and safety/disaster planning analysis that takes into account climate change implications and extreme events. All aquaculture projects should be reviewed so as to ensure that these projects are not destroying mangroves, corals, etc. or polluting the ground water. No new roads should be permitted within the CRZ unless EIAs are conducted and ICZM Plans are put in place, except for providing fisher communities access to the sea.

- (xiv) The construction of sea walls has been proposed by some States as one of the solutions for preventing damage by tidal waves. However, the construction of sea walls alters long-shore currents and modifies coastal geomorphology. In many places it also causes loss and fragmentation of coastal habitats. As a result it also prevents the access to the beach and estuaries which marine organisms need for breeding and rearing their young. Estuaries, which serve as habitats of mangrove species will be affected. Structures for preventing coastal erosion should be located beyond the High Tide Line. Instead of building concrete seawalls, it will be advisable to initiate a programme of raising bio-shields and coastal green belts. Construction of concrete sea walls can be restricted to areas, which are very vulnerable to sea erosion.
- (xv) Sand mining is the foremost factor leading to erosion of beaches. There are studies to indicate that at least 21 beaches have been lost in the Nicobar to sand mining in a period of ten years. It is critical that alternate and environment friendly technologies for controlling erosion are employed. These include replanting sand dune vegetation and mangroves where they existed earlier. All natural barriers – such as coral reefs, mangroves and sand dunes must be protected at all costs. No activities that affect these natural assets should be permitted. Earthen bunds can also be encouraged wherever possible. These activities can be built into coastal zone management plans and can be monitored by the CZMAs. Any structure (hard measure) should be considered only if soft measures are not possible. The agency considering the hard measure particularly groins or breakwaters should be responsible for protecting the shoreline at least 500 mts on either side of the shoreline from erosion. In case of breakwaters for harbours, the stretch of the shoreline to be considered for protection should be at least 1.5 km on either side of the structure. The agency undertaking the construction of the said structures should be responsible for the monitoring of the shoreline for a minimum period of one year so as to cover the seasonal variation in the wave climate, which dictates its dynamics. Here again, the agency responsible for the construction of the said structures should be responsible for the monitoring of the shoreline for a minimum period of one year.
- (xvi) At locations, where, shoreline advances towards the ocean, due to shore defense measures undertaken by the Government, construction of huts and houses should be totally banned. The local Panchayat could monitor and report to the District Collector or enforcing department. The construction sequence as per the season is extremely important. This should be spelt out clearly in consultation with an expert in the field of specialization prior to obtaining the necessary clearance/sanction from the appropriate authority/body. The sizes of the stones usually adopted for the construction of seawalls, groins or breakwaters are arrived at using empirical formulae. If the weight of the individual stones used for construction is underestimated, this would result in the scattering of such stones all over the seafloor resulting in several other problems. (Typical examples are the seawalls along Royapuram in Tamilnadu, North of Paradeep port, a long stretch of the coast of Karnataka and a few other locations). Verification of the stability of the cover layer of these structures through physical modeling in Laboratories is absolutely essential prior to the commencement of such projects.

- (xvii) Vacant plots within municipal limits should be left open. They can be used for parks, gardens, playgrounds etc. All efforts should be made to discourage and reduce population densities and new activities in these areas. There is need to sensitise Panchayat Members on the population supporting capacity of fragile ecosystems. No construction activities, pipelines, cables, jetties, reclamation, should be permitted in ecologically sensitive areas. Only repairs of existing authorized structures should be permitted within open spaces. Reclamation for ports and harbours should be kept to the barest minimum.
- (xviii) Coastal tourism and recreational facilities may be promoted in identified tourism potential areas after taking into consideration the social issues of the area, vulnerability and resources. Ecological literacy programmes should be initiated for tourists, so that they do not dump non-biodegradable plastics and other wastes in the coastal areas. There should be pride in preserving areas of great scenic beauty.
- (xix) The notification permits construction of fishing jetties and harbours in the coastal zones other than the ecologically sensitive areas. However, the allied facilities for fishing harbours such as storage stalls, ice factories, ice-pressing units, processing units, workshops, storage units, fish warehousing are not permissible. The fish and shell fish being highly perishable commodities, the post-harvest technologies are very important for improving the self-life of fish for the purpose of marketing and processing. Therefore, the Committee is of the opinion that integrated fish processing units should be allowed after adequate environmental safety measures are incorporated in the decision making process. Land for such purposes should be made available on a priority basis by the district administration. Eventually, the maps of the town and country planning departments could be amended to make these allocations possible. Improved post-harvest technology is essential for ensuring the quality and nutritional safety of fish and to prevent *Salmonella* infection.
- (xx) The role of the Coastal Zone Management Authorities needs to be expanded from a mere a policing the coast for conservation purposes to one of sustainable and integrated management. National and State Coastal Zone Management Authorities have been constituted by the Central Government. However, in most cases their composition is imbalanced, having none or very few local community representation. These CZMAs if they are to be effective, both at national and state level need to be reconstituted such that they have representatives of local communities; community based organizations and non-governmental organizations. The CZMAs need to be constituted at district levels as well, perhaps in the form of district level authorities. At present, the state level CZMAs have too large an area to monitor efficiently. There needs to be an active participation of local communities in the planning and monitoring of activities on the coast. This also dovetails with the point that local community representatives need to be on CZMAs. At present this is missing at both national as well as state levels. It should be incorporated at any other level also where such monitoring is taking place. Unfortunately, because this aspect has not been explicitly stated in the notification, it is ignored in practice.

4.2 For implementing the National Coastal Management Programme, the Central Government should strengthen the technical and human resource capacity. It may be useful to establish the following institutional structures for this purpose:

1. A separate Division in the Ministry of Environment and Forests to handle Coastal Zone Management in the country headed by an eminent technical expert. This Division may service the proposed All India Coordinated Research Project on Integrated and Sustainable Coastal Zone Management.
2. A National Board for Sustainable Coastal Zone Management may be set up on similar lines to that of the Wildlife Board of India. This Board may consist of about 21 members including representatives of all major stakeholders:
 - i. Union Minister for Environment and Forests - Chairman,
 - ii. Union Minister for Ocean Development – Co-Chair.
 - iii. Technical experts from reputed national and State Government Institutes in the area of coastal and marine management/research.
 - iv. Representative of the National Commission for Women.
 - v. Representatives of electronics and print media.
 - vi. Representatives from fisheries, aquaculture, tourism, hotel, industries, mining, shipping, sectors.
 - vii. Legal experts (national and international law).
 - viii. Representatives from selected coastal Panchayats.
 - ix. Representatives from Andaman & Nicobar and Lakshadweep islands.
 - x. Representatives from Non-Governmental Organisations involved in activities related to coastal zone management, fishermen welfare and conservation of bioresources and cultural heritage.
 - xi. Early warning and Disaster Management experts.
 - The Board may meet as often necessary.
3. National and State/UT level Coastal Zone Management Authorities:
 - (i) A National Coastal Zone Management Authority may be set up to monitor the state of environment in the coastal zone and to suggest implementation procedures for the decisions made by the National Board for Sustainable Coastal Zone Management. The Authority should be headed by an eminent expert in the area of Sustainable Coastal Zone Management.
4. National Institute for Sustainable Coastal Zone Management:

The proposed National Institute should be autonomous but may be located in an appropriate existing Institution/University.

- (i) Functions:
 - a. This Institute shall be set up to address policy and legal issues of coastal zone management and to undertake conflict resolution studies.
 - b. Awareness and education programmes in the areas of coastal zone management and ecological literacy.

- c. Litigations, violations and other issues referred to by the National and State/Union Territory Coastal Zone Management Authorities.
- (ii) Under the National Institute, two regional centers may be set up to address the issues of:
 - (a) Andaman & Nicobar Islands.
 - (b) Lakshadweep Island.
- (iii) A digital gateway for sustainable coastal zone management may be set up within the National Institute for Sustainable Coastal Zone Management. The gateway shall be responsible for providing upto date information on integrated sustainable coastal zone management.

Thus, we are proposing a 3 tier structure to strengthen our national capacity in the area of environmentally and socially sustainable integrated coastal zone management:

- 1) A National Board for Sustainable Coastal Zone Management for policy guidance.
- 2) A professionally led Sustainable Coastal Zone Authority for task implementation.
- 3) A National Institute supported by 2 island centers for serving as repositories of policy and legal decisions and guidelines, undertaking conflict resolution studies and for promoting ecological literacy as related to sustainable coastal zone management.

In addition, we have proposed the initiation of an Inter-organisational and inter-disciplinary All India Coordinated Research Project on Integrated and Sustainable Coastal Zone Management, in order to achieve convergence and synergy among numerous on-going R&D efforts and to fill gaps in critical areas such as social and gender audit, economics of inter-generational equity and technological empowerment of Panchayati Raj institutions.

An organogram indicating the Institutional Structure for Sustainable Coastal Zone Management is placed at item 6.5 at page 108.

CHAPTER-5

5.0 Conclusion of the Committee

We should build on the strengths of existing regulations and institutional structures, eliminate weaknesses in regulatory procedures and fill gaps in core areas, such as ecological economics and social and gender audit, where our national competence is inadequate.

Our goal should not be just conservation but also enhancement of the living and non-living resources of the coastal zone. This is our duty to the generations yet to be born. For example, we should rehabilitate all damaged mangrove wetlands and involve local youth in preserving coral reefs and promoting the creation of artificial coral reefs. The coastal ecological literacy movement should place emphasis on both conservation and natural resources enhancement.

Above all, we should create structures for generating coordinated and cooperative action among the different Central and State Government agencies. The absence of inter-departmental and Centre-State coordination is the biggest obstacle to fostering a Sustainable Coastal Zone Management Strategy. We hope that the proposed National Board will help to fill this void.

CHAPTER-6

6.0 A NATIONAL COASTAL ZONE MANAGEMENT ACTION PLAN

6.1.1 Objective

The objective of the coastal zone management is to protect with peoples participation the livelihood security of the coastal fisher and other communities and, the ecosystems which sustain productivity of the coastal; areas while promoting sustainable development that contribute to nation's economy and prosperity.

6.1.2 Definition

Coastal zone is defined as an area from the territorial waters limit (12 nautical miles) including its sea bed upto the landward boundary of the local self government abutting the sea coast.

Coastal zone also includes inland water bodies influenced by tidal action including its bed and the adjacent land area upto the landward boundary of the local self-government abutting such water bodies.

In case of ecologically sensitive areas, the entire notified area/biological boundary of the area will be included.

6.1.3 Classification

For the purpose of management, the coastal zone is divided into four:

- (i) **Coastal Management Zone-I (CMZ-I)** – consists of areas designated as ecologically sensitive (ESA), which are listed in Annexure-II.
- (ii) **Coastal Management Zone -II (CMZ-II)** – consists of areas identified as areas of particular concern (APC) such as economically important areas, high population areas and culturally/strategically important areas. The administrative boundaries of these areas would be boundaries of CZM-II. The list of such areas is given at Annexure-III.
- (iii) **Coastal Management Zone-III (CMZ-III)** – consists of all other open areas including the coastal seas but excluding those areas classified as CMZ-I, CMZ-II and CMZ-IV.
- (iv) **Coastal Management Zone-IV (CMZ- IV)** - consists of Islands of The Andaman and Nicobar and Lakshadweep.

6.1.4 Management Methodology

As part of the management of the coastal zone, the following preservation, conservation and development criteria are to be followed in the zones identified above:

- (i) **Coastal Management Zone-I** – MoEF shall identify and declare the ecologically sensitive areas falling under this zone. An indicative list of these areas is enclosed in Annexure-II. Integrated Management Plans for these sensitive areas shall be prepared by the Ministry of Environment & Forests

through scientific institutions which will be implemented by the concerned States/Union Territory and monitored by the Coastal Zone Management Authority of State/Union Territory. Necessary funding will be earmarked and provided by MoEF.

- (ii) **Coastal Management Zone -II** –Integrated Management Plans (IMP) prepared by the local bodies /concerned agencies following the guidelines which will include vulnerability status (demarcated as per the guidelines in Annexure-I). Necessary funding for the preparation of Integrated Management Plans (IMPs) will be provided by the Ministry of Environment. The guidelines for the preparation of IMPs are given in Annexure IV.
- (iii) **Coastal Management Zone -III** - The activities to be permitted or prohibited on the seaward side of the vulnerability line and the agencies responsible are enlisted in the Annexure-V.
- (iv) **Coastal Management Zone -IV** - The management of the Andaman and Nicobar and Lakshadweep islands will be based on the Integrated Coastal Zone Management plan prepared by the MOEF.

6.2 Funding

The MoEF shall have funding mechanism for preparation of ICZMP for ESAs, IMP for APCs monitoring and enforcement, capacity building, awareness programme, bio-shields afforestation, women empowerment, participatory planning and development, warning systems and shelters against natural hazards and all other programmes necessary for the integrated coastal area management in the country etc.

6.3 Legislative mechanism

For the successful implementation of Integrated Coastal Zone Management a coastal policy and rules on the lines recommended by this Committee shall be issued notification under Environment (Protection) Act, 1986.

6.4 Policy and Implementation Oversight

The proposed National Board for Sustainable Coastal Zone Management may review periodically the implementation of the National Coastal Zone Management Action Plan, to initiate timely mid-corrections, where needed.

6.5 ORGANOGRAM INDICATING THE INSTITUTIONAL STRUCTURE SUGGESTED FOR SUSTAINABLE COASTAL ZONE MANAGEMENT



Annexure I

VULNERABILITY MAPPING

The setback lines in the zones categorized as CMZ –II and III will be based on vulnerability of the coast to natural and manmade hazards. This procedure is followed in many countries including USA where the coast has been mapped for vulnerability to coastal hazards.

For the purpose of mapping the vulnerability of the coast seven parameters are taken into account: elevation, geology, geomorphology, sea level trends, horizontal shoreline displacement (erosion/accretion), tidal ranges and wave heights. A brief on each of the parameter which can be considered for drawing up the vulnerability line are given below:

- (i) **Elevation:** - The elevation data shall be obtained from the available coastal toposheets satellite data surveys.
- (ii) **Geology:** - The geology identifies the rock types for all coastal segments.
- (iii) **Geomorphology:-** the land forms will be identified on the maps based on the available toposheet and remote sensing data. Bathymetry to be derived from naval Hydrographic Charts on location specific surveys
- (iv) **Sea level trends:** - The sea level trend data shall be obtained from the data available in the Ministry prepared based on primary data published by Survey of India.
- (v) **Horizontal shoreline displacement** - The erosion/accretion data used for horizontal shoreline displacement shall be obtained from long term information derived from Survey of India Topographic maps (1967) and the latest satellite data.
- (vi) **Tidal ranges:** - Tide table published by the Survey of India.
- (vii) **Wave heights:** - Wave heights obtained from ship observations published by National Institute of Oceanography or other locally available measured data.

Based on the above data a relative risk factor chart will be drawn up indicating vulnerability of the coast.

The vulnerability lines will be demarcated based on the above parameters using the guidelines for the entire country on cadastral scale (1:4000) by the NISCM proposed by Ministry of Environment & Forests.

Early warning systems are available for few of the hazards like cyclones, storm surges and Tsunamis (being put in place). Earthquakes however cannot be predicted. For protecting the population from these hazards appropriate resistant buildings units, disaster shelters and other necessary infrastructure facilities need to be provided.

Annexure -II

CMZ-I: INDICATIVE LIST OF ECOLOGICALLY SENSITIVE AREAS (ESA)

- (i) Mangroves
- (ii) Coral reefs
- (iii) Sand Dunes
- (iv) Inland tide/ water bodies such as estuaries, lakes, lagoons, creeks & straits
- (v) Mudflats
- (vi) Marine parks and sanctuaries
- (vii) Coastal forests & wildlife
- (viii) Coastal fresh water lakes
- (ix) Salt Marshes
- (x) Turtle nesting grounds
- (xi) Horse shoe crabs habitats
- (xii) Seagrass beds
- (xiii) Sea weed beds
- (xiv) Nesting grounds of migratory birds.

Guidelines for preparation of ICZMP of CMZ-I

- The above ecologically sensitive areas will be mapped and notified by the Ministry of Environment & Forests.
- The NISCM under Ministry of Environment & Forests will prepare the ICZMP to protect the notified areas.

Activities, which are essential shall be permitted in the area based on the ICZMP and after public hearing.

Annexure -III

CMZ- II : AREAS OF PARTICULAR CONCERN (CMZ II)

- (i) Coastal Municipalities/Corporations
- (ii) Coastal Panchayats with population density more than 400/sqkm.
- (iii) Ports & harbours
- (iv) Declared Tourism Areas
- (v) Mining sites
- (vi) Approved Industrial Estates
- (vii) SEZ
- (viii) Heritage areas.
- (ix) Archaeological sites
- (x) Defence areas/installations
- (xi) Atomic/thermal/other power plants

The guidelines for the preparation of the integrated management plans for these notified area are given in Annexure IV.

**GUIDELINES FOR PREPARATION OF INTEGRATED MANAGEMENT PLAN
FOR CMZ II AREAS**

- The entire notified Corporation, Municipality, Panchayat, revenue area, shall be the outer boundary of the APC.
- IMPs will be prepared for these areas indicating all present and future developments, conservation and preservation schemes.
- Integrated Management will address vulnerability to human life and property based on vulnerability lines prepared by Ministry of Environment & Forests.
- No constructions shall be permitted on the seaward side of any existing (as on 2004) approved building or a tarred or surfaced road in the area.
- All the existing roads including the internal roads shall be strengthened, as these roads will serve for the purpose of livelihood, communication, relief and evacuation measures.
- Adequate cyclone shelters shall be constructed taking into account the population of the area.
- The new schools, market areas and other public facilities where large number of public congregate shall be located beyond the vulnerable area.
- Along the seaward side sufficient bio shield with local vegetation, trees including mangroves shall be planted
- The beaches shall be left free of any development.
- Appropriate coastal protection structures be constructed where ever required on a scientific basis
- New houses and settlements be planned landward of the vulnerability line.
- Sand dunes being natural speed breakers in the event of hazards shall be maintained or regenerated by planting shrubs or through appropriate measures.
- All the areas notified by the Ministry of Environment & Forests as CMZ I be clearly demarcated in the plan and for their conservation by the Ministry of Environment & Forests.
- The IMPs will be approved by the proposed NISCM of the Ministry.
- The enforcement and monitoring will be the responsibility of the concerned state/Union Territory Coastal Zone Management Authorities.

CMZ III: PERMISSIBLE DEVELOPMENTAL ACTIVITIES ON THE LANDWARD SIDE OF THE VULNERABILITY LINE

- (i) **Activities, which are permitted by the local/concerned authorities without CMZ clearance**
- ◆ Boating, shipping and navigation.
 - ◆ Fisheries including traditional fish processing units and ice crushing facilities.
 - ◆ Mariculture including hatcheries and traditional aquaculture.
 - ◆ Agriculture and horticulture.
 - ◆ Public toilets and rain /cyclone shelters.
 - ◆ Repair of existing buildings including reconstructions.
- (ii) **Activities to be permitted with the approval of State/UT Authority**
- Temporary construction for tourism facilities.
 - Construction of boat jetties and fishing harbours to be approved with EIA.
 - Coastal Protection-the approach shall be to avoid hard engineering; soft engineering options shall be preferred.
 - Bunding for the purpose of preventing coastal erosion, salinity ingress, maintenance of waterways.
 - Saltpans-making salt by solar evaporation of seawater.
 - Water sports and recreation facilities.
 - Discharge of treated effluents shall be permitted as per the State/UT pollution Control Boards norms.
 - Forest related activities.
 - Boat building and repair.
 - Boat re-fuelling facilities
- (iii) **Activities that can be permitted with EIA and EMP to be approved by MoEF.**
- ◆ Integrated port, harbour, jetties and moored facilities.
 - ◆ Dredging and disposal of dredged materials.
 - ◆ Reclamation within port limits and for coastal protection.
 - ◆ Bridges and sea links and approaches and reclamation therefor.
 - ◆ Hydrocarbon exploration and extraction.
 - ◆ Mining of placer minerals and offshore mining.
 - ◆ Constructions of communication, power supply, lighthouses and water supply.
 - ◆ Pipelines for transfer of petroleum /chemicals, storage facilities for storage of petroleum/chemical products and regasification facilities.
 - ◆ Defence related projects.
 - ◆ Shipbuilding yards.
 - ◆ Ship-breaking in existing locations.
 - ◆ Non conventional energy
 - ◆ Any other activity which requires foreshore facilities.
- (ii) **Mangrove, corals and other bio shields afforestation activities in CMZ-III will be supported by Ministry of Environment & Forests**
- (v) **All other activities are prohibited.**

ABBREVIATIONS USED IN THE REPORT

- APC** - Areas of Particular Concern
- CRZ** - Coastal Regulation Zone
- CWC** - Centre Water Commission
- CZM** - Coastal Zone Management
- ESA** - Ecologically Sensitive Areas
- EIA** - Environmental Impact Assessment
- EMP** - Environmental Management Plan
- HHTL** - Highest High Tide Line
- IRS** - Indian Remote Sensing Satellite
- MoEF** - Ministry of Environment and Forests
- NCZMA** - National Coastal Zone Management Authority
- SBL** - Setback Line
- SCZMA** - State Coastal Zone Management Authority
- SOI** - Survey of India
- PWD** - Public Works Department
- UT** - Union Territory
- UTCZMA** - Union Territory Coastal Zone Management Authority
- NISCM** - National Institute for Sustainable Coastal Management
- IMP** - Integrated Management Plan
- ICZMP** - Integrated Coastal Zone Management Plan
- ICT** – Information Communication Technology

Legend to the photographs on the cover page from top left to right

1. Traditional fishers.
2. Women participation in the Integrated Coastal Zone Management process.
3. Mangroves.
4. Remote Sensing image showing flooding of villages in Nagapattinam by tsunami waves in the area where the plantations have been removed.
5. Huge tsunami wave striking the coast of Kanyakumari.
6. Agriculture along Kerala coast.
7. The tsunami waves submerging the Marina beach at Chennai.
8. Coral biodiversity in Lakshadweep waters.



Chinese Dip net in Kochi (Kerala) - India