CHAPTER 7

CONCLUSION

The coastal zone constitutes a complex ecosystem. It is viewed as a unique resource which is of great importance to humanity. The marine and coastal habitats all over the world are being subjected to tremendous stress due to "marine revolution". Maximum stress in the coastal zone is felt where there is demographic explosion. Nearly, two-thirds of the world’s population live near this area and over 60 per cent of the marine food harvested is from this zone. However, the coastal zone has also the unfortunate privilege of being the depository of all pollutants from the territorial environment, silt and sediments from uplands, residues of fertilizers and pesticides from farmlands, sewage and industrial effluents are all ultimately dumped into this habitat. In many parts of the world and even in our country, the highly productive coastal ecosystems like mangroves, estuaries and coral reefs are in one way or another threatened or endangered at present.

The coastal zone is the bank of dry land and adjacent ocean space (water and submerged land) in which land ecology and use directly affect ocean space ecology, and vice versa. Functionally, it is the broad interface between land and water where production, consumption and exchange processes occur at high intensity rates. Geographically, the landward
boundary to the coastal zone is necessarily vague, but the seaward boundary is easier to define scientifically. However, coastal zones, being regions of interplay of many functions that vary considerably in space and time, form complex dynamic and sensitive environment all over the world.

The coastal zone has multiple use leading thereby to conflicting demands for the exploitation of the various coastal resources by different interest groups and user agencies all over the world. It has, therefore, become very vulnerable to the destructive forces caused by pollution, hazards and several other man-made changes. Long-term sustainable use of coastal resources is at risk because of poor understanding of the adverse effects of land based and other development activities on the coastal and marine environments. There is consequently a need for a comprehensive coastal planning and management for better and effective utilization of coastal resources. National governments and international organizations of the world today have started realizing the importance of the coastal zone and its problems and have initiated and taken many measures to protect and preserve the biological diversity of the coastal zone and manage the various coastal developmental activities since the early 1970s.

Over the last decade there has been a proliferation of interest in coastal area management. The interest and the
practice have moved out from the developed nations to the developing nations. Coastal area management is viewed as an expression of integrated planning and resource management. Coastal resources are foundation blocks needed to support the construction of economic and social development programs. Thus the richness and diversity of coastal resources, the presence and diversity of coastal resources, the presence of many coastal hazards, the mixed pattern of pristine and degraded ecosystem, and the rates of coastal resource development and coastal population growth, when viewed collectively, present a tremendous challenge for the practice of coastal planning and management both in the developing and developed countries of the world.

Coastal planning and management is initiated by government in response to issues -- usually resource degradation, exposure to coastal hazards, multiple use conflicts, or socio-economic development needs. The effort has continuity over time, it is not a one time project. The coastal planning and management needs the government structure to establish the policies and make decisions for allocation decisions. The government arrangement uses one or more management strategies to rationalize and systematize the allocation decision. The management strategies selected should be based on a systems perspective which recognizes the interconnections among coastal/environmental systems as well as public service system. The systems perspective
usually requires that the design and implementation of management strategies be done as a multisectoral effort. The coastal planning and management programme has a geographic boundary that defines a space which extends from the ocean environment across the transitional shore environments to some inland limit. There may be an exception for small islands, there may be no meaningful inland boundary.

Coastal problems are local in nature rendering solutions successful in one area not applicable to another. Underlying principles can, however, be derived and lessons learned in coastal zone development activities. These lessons are invaluable as they have been often obtained at the expense of serious environmental damages, technological developments and of several years experience in the coastal planning and management theory and practice of countries like the Netherlands, the USA and Sri Lanka, etc.

Fortunately, India is bestowed with a vast coastline of over 7000 kms. The advantages and disadvantages attached to this coastline and coastal zone are vast and varied. Hence, this large sensitive zone needs scientific management for optimal utilisation and in order to be protected from indiscriminate exploitation and destruction due to pollution, it demands a long term strategy for multi-use development.
The overcrowding of the coastal lands is a serious threat on the coastal zone. Along the coast, India has 59 districts, spread over 13 states/UTs. Most of the districts have population density of above 200 person/sq km. There are 11 major and 139 operable minor ports with an overall cargo load of more than 200 million tonnes. There are quite a few industrial cities on the coast and the number of places of religious and historical importance is more than 50. Some of these are important tourist spots attracting huge traffic all round the year.

The growing encroachment of the coastal lands would call for support platforms in consonance with the high population densities, airstrips, waste incineration, sewage treatment, power generation, ocean thermal energy conversion and the like. Delineation of various segments of the coastal areas depending on soil qualities, wave thrust and other lithological condition has also become imperative to effectively exploit the potential along the Indian coast and to manage the activities in an economic manner without being detrimental to the environmental aspects.

India’s vast coastal margins in Bay of Bengal and the Arabian Sea are endowed with hydro-carbons and other mineral resources and the waters of the Indian Ocean within the EEZ of India, estimated at 453000 sq.kms. are said to have potential to yield about 40 million tonnes of fish and about one billion tonne of oil. The West coast region is said to
contain 570 oil bearing structures of which 176 have been confirmed and 81 drilled.

India's premier offshore oilfield, Bombay High, is yeilding about 30 million tonnes of crude oil annually, saving precious foreign exchange for other developmental projects and are expected to continue to be productive for another 40 years.

Tidal power potential in India is estimated to be around 9000 mw of which around 7000 mw is in the Gulf of Cambay and the rest in Gulf of Kutch and Sunderbans in the Bay of Bengal.

The sands of our south western coasts are said to contain one of the world's largest reserves of thorium which is used as a fuel in fast breeder nuclear reactors and hence as technology in this area advances the benefits for a power starved country like India are enormous.

As of now, only one quarter of the fishing potential of the coastal waters is harvested. It is regretable that despite its vast coastline and EEZ plus 1.4 million hectares of inland water bodies and a shelf area of 5 lakh km., India produces about 3 million tonnes of fish against 93 million tonnes of world fish production - just 3.12 per cent of the global fish production. Fish resource estimates for Indian waters place the annual potential yield at 45 lakh tonnes. Of this 53 per cent lie in the depth zone of 0.50 meters (in shore), 36 per cent in 50-200 meters (offshore water) and 11
per cent beyond 200 meters depth in the deep sea. There are many regional imbalances in the availability as well as exploitation of different species due to various reasons.

Mangroves is the most important coastal vegetation. Mangrove areas and coastal wetlands serve as essential habitats, food producers, energy storage units, water purifiers, salt traps and shore stabilisers. If such areas are filled indiscriminately, they could greatly reduce the productivity of coastal areas. This would reduce the capacity of the coastal zone to absorb pollutants before they reach coastal waters and estuaries. Such areas also provide important breeding and rearing grounds for valued species. The total mangroves area along the Indian coast is estimated to be approximately 7 lakh hectares.

Aquaculture potential is very high in the Indian coastal zone. Rice-fish farming offers great scope for improving the economy of the rice farmers. The large water bodies of Kolleru and Pulicat in Andhra Pradesh and Chilka in Orissa have a great potential for development of fisheries. In the coastal districts of Krishna and West Godavari of Andhra pradesh, fish farming has seen an unparalleled growth, almost entirely propelled by private enterprises.

The coastal plains of India with a geographical area of 19.6 million hectares (East coast) and 7.3 million hectares (West coast) is a zone of intense agricultural production.
and productivity. The net sown area of the East coast plains is 85.80 lakh hectares and the gross cropped area 114.66 lakh hectares with cropping intensity of 134 per cent. West coast has a net sown area of 27.70 lakh hectares and a gross cropped area of 34.66 lakh hectares and cropping intensity of 125 per cent. Rice grown over an area of over 5.6 million hectares is the predominant crop of both the coasts. The productivity of various crops is also high due to high-tech agricultural practices and the Krishna-Kaveri delta is known as "rice bowl of India".

The Indian shipping industry has grown in fleet coverage, infrastructure and influence over the years. Not only the proportion of cargoes transported by the Indian vessels have recorded an upswing but also the total fleet size, crews and logistic involved. The two major ship-building yards i.e., the Hindustan Shipyard Ltd. and Cochin Shipyard Ltd. have started earning profit. On the other hand, the total capacity of Indian major ports has been estimated at 174 million tonnes and modern methods and technology are being used to increase the productivity.

The social life of the people of the coastal region is tailored according to their places of residence. Life of people in the ports, the industrial towns, the religious spots and tourists centres have their own advantages and disadvantages. Whereas the ports may harbour smugglers, the tourist centres often harbours drugs and immoral traffic.
Some of these places are health resorts, while others are dumping grounds of industrial wastes; for some life style has changed drastically while for others, things are at a stand still. However, generally the quality of life for the coastal communities has not improved much, their literacy levels, health conditions, housing conditions, disguised unemployment rate, purchasing power - are they were decades earlier if not worse.

Coastal resource development and space utilisation in India recently have resulted in many problems - increasing conflicts over coastal uses, the depletion and degradation of coastal land-water resources, coastal pollution and loss of access to the shoreline.

The fishermen regard the aquatic system as a community managed property and never damage it. However, recent intrusions in the form of militarisation, tourism, mining and damming have led to the destruction of unique aqua-human relations, loss of pristine cultures and harmonious resource-use pattern. In the name of beautification and providing comforts to the tourists, a lot of local fishermen were evacuated in Goa, Orissa and Tamilnadu. The missile testing range at Balliapal in Orissa has dislocated the life of local tribal and fishermen.

As regards pollution, large quantities of liquid and solid waste of domestic and industrial origin are being released in the rivers, bays and creeks which ultimately
find their way into coastal waters. The industrial waste added to the sea by the industries along the Indian coast is estimated to be about $0.4 \times 10^9$ cubic meter/year. The domestic sewage added to the sea by the coastal population is $4.1 \times 10^9$ cubic meter/year.

It has been estimated that approximately 5 million tonnes of fertilisers, 55,000 tonnes of pesticides and 125,000 tonnes of synthetic detergents are used annually in India. A substantial portion of these find their way to the coastal waters. A considerable quantity of these substances are biodegradable while others are not. Their cumulative effect over a long time could be quite harmful to the coastal environment. These effects are not very perceptible generally on the Indian coast, but in the vicinity of metropolitan and industrial conglomerates, the effects are indeed alarming. For example, the phosphate concentration in the nearshore waters of Bombay increased from 0.82 to 2 $\mu$ mol/l during the period from 1959 to 1988.

Several toxic heavy metals are expected to be transported to the sea by the rivers. An examination of the suspended and particulate metals in the estuarine region of the Ganges shows that about 10 per cent settles in the lower estuarine region, 50 per cent at the confluence of river water with the seawater and 40 per cent finally flows into the Bay of Bengal. Data collected on mercury in water, zooplankton, fish and sediments along the Indian coast.
indicate a few localised "hot spots" off Bombay.

Recent studies on pesticides residues in sediments along the East and Central West Coasts of India detected nine organochlorine pesticides and their metabolites. Concentration of the residues of these compounds are found to occur at 'ppm' level on the East coast while they are in 'ppb' scale on the West coast. Concentration of pesticides residues in Zooplankton in the Arabian sea decreases away from the shore indicating their terrestrial origin and aerial transport.

Many estuaries, creeks and coastal water which recieve industrial and domestic wastes, sewage, litters etc. through point discharge are found to be grossly polluted on both East and West coast of India. Several other forms of pollution like dumping of dredge spoils and mining rejects in the marine environment affect the ecology. Depletion of fisheries and benthic fauna due to mine failing, rejects and washings in the estuaries have been observed causing damage to the ecosystem.

Several other wastes which pollute Indian coastal waters are garbage, scrap material from ship-breaking yards, damaged and rejected fishing nets and other gear, disposal of unwanted trashfish, waste generated by tourism industry etc. Quantitative data on these are however lacking.

Transportation of about 60 per cent of the world's crude oil and its products along the oil tanker routes
across the Indian seas are prone to oil pollution. Oil pollution in the sea occurs either from maritime accidents due to fire, collision or grounding, intentional discharge of oil or oily wastes or by accidental spillages. Observation on several West coast beaches show the tar deposition 25 gm./m² during May-September and along East coast beaches during December-January.

The phenomenon of global warming and consequential sea level rise is well known and it has been increasingly receiving attention of the scientific research personnel and the policy planners. Since the changing chemistry of the atmosphere is linked with the bio-chemical capacity on the oceans, another aspect that need to be looked into is the intensive local specific research on the capacity of the ocean coast. An attempt has been made in this thesis to study the impact of possible sea level rise on Paradeep coast of Orissa.

In this study area the one meter rise in the sea level would result in the submergence of 335.67 sq.km. which is 19.9 per cent of the total area and for the three meter rise the figures are 905.52 and 53.7 respectively. The wetlands along the coast would be lost to these rises. There will be an increase in the backwater effect in the rivers and severity in the storm surges. Ground water table will also rise. This will allow the saltwater wedge to intrude further landward.
Beach profiles taken across the shore of the area have been examined to estimate the erosion potential. Applying Braun's theory it was found out that on an average beaches would be eroded at a rate of 50 cm./year approximately for a sea level rise rate of 1.2 mm/year (assuming neutrality of local modifying factors).

Most of the area around Paradeep coast is occupied with cultivation (especially of rice): So agriculture is going to be the worst effected field in the land use map. About 10.2 per cent of the estimated population in 96 villages are to be affected with the one meter rise. This also include 13.2 per cent of the cultivable land. With the three meter scenarios 41.3 per cent population inhabited in 488 villages will be affected. The cultivable land to be affected is 52.2 per cent.

Considering the magnitude of human and economic stakes feared for the two sea level rise scenerios discussed, it is suggested that the private and public agencies involved in the development processes in this area should consider the possible effects of sea level rise in their long-range planning and project development.

Further, the enlarging spectrum of maritime activities has brought in new concerns such as the security of offshore platforms, rivalarlys for ocean resources, terrorism at sea, island grabbing, poaching and smuggling. The other flash-points are movements by sea of narcotics, weapons, chemicals
and fissionable materials. This in turn has led to fresh norms, conventions and rules encompassing the legal regime of the seas, maritime boundaries, naval arms control and the necessity to avoid the brinkmanship of the high seas.

The development and management of coastal areas is often a factor of the needs of the people living in and around the coasts and in the hinterland that could be economically served by the coasts. It is no doubt a difficult task to develop an integrated long term plan for the management of the entire coastal zone in view of the diverse natural characteristics of the area such as water depths, sea bed profiles, sediments/rocks, waves, tides, cyclones, weather variations etc. These apart, the complex coastline configurations over thousands of kilometers as well as the process of industrial and economic growth and the will of the implementing agencies are also important issues to be considered. Strong managerial inputs are required alongwith the efforts being made by the science and technology community for a conceptual development of coastal management which, in India, received a formal planned shape in 1985 (seventh plan) with the following objectives:

a) Developing and maintaining data base for assessment of coastal areas, islands, EEZ and its resources.

b) Developing marine resource potential of islands.

c) Technology demonstration in selected areas.
Since then, several structured programmes have been evolved by Department of Ocean Development (DOD), Government of India in collaboration with IITs, CSIR labs, Central Scientific agencies like DOS, CPCB and Ministry of Environment and Forests etc. and other operational sectors of the state and Central Government. A few such programmes are: marine Stallite Information Service (MARSIS), Coastal Ocean Monitoring and Prediction System (COMPAS), Wave Energy System, Island Development, Sea Level Monitoring and Modelling, Joint Global Ocean Flux Studies etc.

In recognition to coastal degradation and pollution, the Ministry of Environment and Forests issued notification under Section 3(i) and Section 2(ii) of the environment Protection Act 1986 and Rule 5(iii)d of Environment (Protection Rules) declaring coastal stretches as Coastal Regulation Zone (CRZ) and regulating activities in CRZ in 1991. With the coming into force of the UN convention on the Law of the Sea in 1994 and India's Ratification in 1995, India is now entitled to delineate the outeredge of the continental shelf upto the end of continental margin.

The Indian Coastal Zone is managed by a host of Central and State Government agencies. Many of these focus on particular sectoral issues such as fisheries, crude oil tourism etc., whereas the others like the Central Ministry of Environment and Forests have wider mandates encomassing composite phenomenon such as 'environment'. Hence, it is
necessary to coordinate and harmonise the diverse activities which in most countries are usually vested in two or three ministries. In India, it extends to approximately 18 ministries and several autonomous agencies with diffused responsibilities and blurred linkages.

One area which is recognised as being of critical importance is centre-state relationship in the coastal zone management. Constitutionally, the states own their resources and have total responsibility for variety of functions. Most land-based activities in the coastal zone is state prerogative. The central government, however, has general jurisdiction over the marine resources and environment. Clearly any effective coastal zone management must rely on continuous coordination between and as well as within different levels of governments.

A National Coastal Zone Management Authority (NCZMA) needs to be established at the centre with a suitable agency in each of the maritime states to ensure proper interaction among various government agencies, voluntary organisations and developers, as well as the public. Public participation should be encouraged in the decision-making process to avoid conflicts.