

**SOUTH ASIAN PERSPECTIVE ON
COASTAL ZONE MANAGEMENT**

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CERTIFICATE

Certified that this dissertation entitled "South Asian Perspective on Coastal Zone Management", submitted by Mr. Anand Malik, Centre for International Politics, Organisation and Disarmament, School of International Studies, Jawaharlal Nehru University, New Delhi for the award of the degree of Master of Philosophy, is an original work and has not been submitted so far, in part or full, for any other degree or diploma of any University. This may be placed before the examiners for evaluation for the award of the degree of master of Philosophy.

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Dedicated to

My

Elder Sister

ANITA

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CHAPTER - I

INTRODUCTION

Man has had a long, but often uneasy relationship with the coast. Initially, the coast provided food and security. Later, coast became foci for industrial and commercial development, and in recent years the emphasis has shifted towards leisure and conservation, although all former uses remain important. Though these shifts of emphasis, man's perception of the coast has changed from one of respect to one of depreciation.

Coastal areas contain some of the world's most diverse and productive resources, today. They include extensive areas of complex and specialized ecosystem, such as mangroves, coral reefs and sea grasses. Many coastal problem being encountered world wide have been cropped up because of lack of integrated and holistic approach towards coastal management keeping sustainability at bay. Because these attitudinal problems towards environment, population growth and associated economic developments place additional demand on coastal areas and resources poses yet another threat to the sustainability of the areas. Also coastal

zone likely to be affected significantly by climatic change and accelerated sea-level-rise (Anonymous, 1994)¹

All these are resulting in certain grave consequences like accumulation of contaminants in coastal areas, erosion and the rapidly increasing decline of habitats and natural resources. Recent decades have witnessed a new well documented expansion and intensification in the world seas (Couper 1983).² The movement has been paralleled, or perhaps more accurately exceeded by an expansion and intensification in the use of coastal land and near - shore water (Clark 1987).³

Besides unsustainable coastal developments, coastal zone can also be significantly affected by the climate change and sea level rise due to some human induced or some other physical forces. One of the many anticipated effects of climate change is an accelerated raise in global mean sea level. The Intergovernmental Panel on Climate Change (IPCC) estimates that over the next century the sea level will rise

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1. Anonymous (1994) Preparing to meet the Coastal Challenges of the 21st Century, conference Report, World Coast Conference Report 1993; 1 PCC, 1994.
 2. Couper, A.D. (ed) (1983): The Times Atlas of the oceans, London, Times Books.
 3. Clark, R.B. (1987): The Water Around the British Isles' their Conflicting Uses, Oxford: Clardon Press.

by 31-110cm by the year 2100 (Anonymous, 1994)⁴ and that this could have severe impacts on coastal areas and their resources. Wetlands are likely to be threatened coastal erosion will increase, and coastal resources, population and economics will be adversely effected (Asthana and Srivastava 1993).⁵ Already in the shorter term, other aspects of climate change may have serious effects, these include change in the frequency, intensity and patterns of extreme whether events such as tropical cyclones, intense precipitation, associated strom surges and flooding. Some low lying coastal areas, particularly those that are frequently hit by tropical cyclones and monsoons are already now facing significant threats poses by climate variability, independent of climate change (Asthana 1993b.)⁶

The world's coastal zone thus faces a multifaceted challenge, which will become apparent over various time scale. The IPCC's systematic assessment of the vulnerability of coastal zones to climate change and

4. Ibid. bp.I

5. Srivastava, P.B.L. (1985) Environmental Trade offs in Managrove forest management. In, I Katoetal (eds) An Environmental Protection and Coastal zone Management in Asia and the Pacific. pp. 105-123.

6. Asthana V (1993b) Accelerated SLR Impact Assessment of the coastal states of Maharashtra and Goa, west coast of India. In IPCC regional workshop eastern Hemisphere workshop on the Vulnerability Assersment of Sea level Rise and Coastal zone Management, Tsukuba, Japan.

accelerated sea level rise clearly show that climate related impacts and impacts resulting from present day human activities in the coastal zone can not be separated (Anonymous, 1995).⁷ On the contrary climate change and climate variability are likely to aggravate the impacts of unsustainable developments of coastal areas and resources. In terms these impacts will further exacerbate the vulnerability of coastal areas to the consequences of climate change and associated sea level rise. A raise in sea level of even three feet could cause substantial erosion of beaches and coastal wet lands, increased flooding, and intrusion of saltwater into rivers; bays and aquifers.⁸ Fortunately, many of the adverse consequences can be avoided by taking timely measures in anticipation of sea level rise. Nevertheless, many coastal zone managers are reluctant to take these measures until the prospects of sea level rise becomes more certain.

7. Anonymous (1995) climate change 1995. The science of climate change contribution of working group I, to the second assessment report of the IPCC Uni. Press, Cambridge.

8. Titus James G. (1986), Green Hosue Effert, Sea Level Raise, and Coastal Zone Management, 'Coastal Management Journal, vol.14, no.3, pp.147.

Most nations of Asia and the Pacific were involved in United Nations conference on the Environment and Development (UNCED) 1992 in Rio de Janeiro and have given support to provisions and proposals which are contained in chapter 17 of Agenda 21.⁹ These call for programs to achieve integrated coastal zone management and sustainable use and management of marine and coastal environments and natural resources. Such calls are not new. In 1992 one of the four fundamental principles of the United Nations Stockholm Declaration states: 'In order to achieve more rational management of resources and thus improve the environment, states should adopt an integrated and coordinated approach to their development planning so as to ensure that development is compatible with the need to protect and improve the human environment.' Similar conclusions were reached in 1980 in the World Conservation Strategy.¹⁰

One consequence of this increasing inventory use of coastal areas is the growing requirement of their effective planning and management, or the effective planning and management of their areas of origin. Instead, however, a

9. UNCED, 1992. Agenda 21, United Nations Conference on Environment and Development, Rio de Janeiro.

10. IUCN, UNEP, WWF (1980) World Conservation Strategy, International Union for the Conservation of Nature and Natural Resources, Gland, Switzerland.

variety of factors have combined to produce a series of a disparate systems of control. These are typically characterized either by uncoordinated, use specific directives or by more frequently in response to crisis.¹¹ Decision making on the use of natural resources needs making trade off. Many uses of natural resources are mutually exclusive. For instances, a forest can not be cleared for logging, while at the same time being used as nature reserve for an endangered species of bird. The opportunity of using natural resources in one way necessarily involves giving up the opportunity to use them in another way.

An environmental impact assessment can be useful to identify areas where possible trade off or compromise may be needed. For example consider the case of aqua farming in the West Bengal coastal areas, where land was previously either a paddy field or natural mangrove forest. Now a days it is a common practice to convert a paddy field or mangrove forest in coastal area to economically lucrative aqua farming. However this conversion may effect the basic primary food production or the reduction of mangrove forest land which is the habitats of many endangered animals.

11. Holiday, J.E and H.D. Smith (1992) : "The Integration of Coastal and Sea Use Management." In H.D. Smith (ed.) Advances in the science and Technology of Ocean Management. Routledge, London : 165-1982.

Therefore, a trade off must be made between the short-term benefits of aqua farming, versus the long term benefits of primary food producing land or natural forest land. Again in a coastal areas where tourism is an important source of income, the continued making of tourist resort could lead the reduction of beach area, which in term affect the ecology and bio-diversity of the area. So if the laws are introduced to prevent uncoordinated use of the coastal land, they will need to be supported by a wide spread education program to explain the reasons behind them.¹² Careful consideration will also be needed for the individuals who will suffers the economic consequence of such a change in practice. Existing Laws are not sufficient meet the challenge of the present day. So laws to be made according to the maximum benefits of the habitats.

Integrated coastal zone management (ICZM) has been identified as the most appropriate process to address current the long term coastal management issues, including habitat loss, degradating of water quality, changes in hydrological cycle, depletion of coastal resources and adaption to sea level rise and other imparts of global

12. Heik J.M. (1977): Coastal Resources Management. Ann Arbor Sci Pub Inc Mich. USA : PP 287.

climate change. It also is a means to identify and anticipate future opportunities. Thus ICZM is a major tool for achieving sustainable development in coastal areas.¹³

The objective of the study is to find most appropriate process to anticipate and respond to long-term concerns and needs while addressing present day challenges and opportunities. The implementation of ICZM can stimulate and guide the sustainable development of coastal areas, it can minimize the degradation of natural system, provide a framework of the management of multi sectoral activities and maintain options for future use of resources.

The present study can develop the capabilities for and implement integrated management of the coastal resources, that provide local and national benefits including enhancing economic development and improving quality of life of the habitats.

Data will be collected for the study area from the secondary sources such as census of India, Central Ground Water Board, Central Pollution Control Board, Survey of India, Geological Survey of India, Indian Agricultural Research Institute, Central Statistical Organization, State

13. Srivastava, P.B.L. (1985) Environmental Trade offs in Mangrove Forest Management. In I. Kato et.al (ed.) An Environment Protection and Coastal Zone Management in Asia and the Pacific PP. 105-123.

Statistical Organization. National Remote Sensing Agency, Indian Meteorological Department and Port Commission etc.

The coastal management systems can be divided essentially between those which are defined by the area, that is, those which focus on a complex of resources in a particular locality, and those which are defined by resources themselves. The dominant managerial framework in coastal areas remains resource or use specific. So methodology as a general management principles areas the coastal area taking into account the above said objectives and to coordinate all the major factors playing in the coastal areas to optimize the scientific, economic and sustainable use of the area.

CHAPTER - II

COASTAL ZONE MANAGEMENT : CONCEPT AND SCOPE

Prior to the industrial revolution, man's activities were determined strongly by his environment. Any impact man had on his environment was negligible compared to the effect the environment had on man. The often ruthless environmental exploitation and ruination from 1850 to 1950 has now been countered by a growing awareness in environmental issues and need to preserve, conserve or sustain the quality of life afforded by our surroundings.

Coastal environments are among the most changeable on the earth's surface, as many coastal changes are circulatory in space or period in time. Thus rapid erosion of beach sand in winter gives way in spring and summer to slow accretion, averaged over a year no net change is apparent. Where as, coastal ecology in which ecosystem linkages involves the flow of nutrients and energy. In coastal context many of these are achieved with the direct assistance of physical process - breaking waves, blowing sand and tidal currents being three examples. Ecological knowledge provides a basis for biophysical management of coasts. The ability to assess the impact of development on coastal ecosystems, nutrients are constantly re-used. In

some coastal ecosystems, recycling is highly efficient and sophisticated for example, coral reef communities are "Islands" of high productivity in "sea" of low productivity.¹ There is also considerable transfer of nutrients from one coastal system to another. Nutrient pathways through coastal ecosystems often rely on the turbulence and energy loss encountered as waves break or tides dissipate along the shore.

2.1 Coastal Zone Management : Nature and Scope

The coast is a region of interface between the land and the sea and although it is defined by in some states, it doesn't conform itself to rigid political boundaries. It is the receiving end of river catchments and is therefore directly affected by all land use decisions, not just those near the immediate coastline. The coast is also the boundary of the ocean and is equally affected by the sea through storms, cyclones, sea level changes and general condition of marine environment, all of which can impact on land use. It is also important to recognise that coastal issues are as much about cultural, social and economic interactions as they are

1. I. Chapman, C. (1983) : Fresh Water Discharge in Coastal Ecosystem Management : A Technical Manual for the Conservation of Coastal Zone Resources. J.R. Clark (ed.). Robt E. Krieger Publication Co-Malborne F.L. Pp. 634-639.

about the physical interactions as they are about the physical interaction between land sea, atmosphere and biosphere. In a very simple term, the coast is where land, water and air meet. This triple conjunction is further complicated by the fact that the water may be fresh or salt. The coast is best viewed as a zone of mixing or adjustment. A more formal definition can be:

"The coastal zone is that space in which terrestrial environments influence marine (or Lacustrine) environments and vice-versa. The coastal zone is of variable width may also change in time. Delimitation of zonal boundaries is not normally possible, more often such limits are marked by an environmental gradient or transition. At any one locality the coastal zone may be characterized according to physical, biological or cultural criteria. These need not, and in fact rarely do coincide."²

The concept of coastal zone management is a very broad one, and requiring inputs from pure, applied and social sciences. At present a number of intergovernmental bodies, professional societies, non - governmental organisations, universities and scientific expert groups are crying out work in the field of coastal zone management. Such work,

2. Haruo Akoi, 1989: A Comprehensive Utilization 'Method for Coastal Areas River Bureau, Ministry of Construction, Tokyo, Japan. Pp. 265-267.

however, deals with particular scientific and technical questions and doesn't attempt to relate the economic issues of coastal management to the general development planning process. Coastal management, as recognized by economic and social council in resolution 1802 (LV) is an integral part of national development.

Coastal zone management is a hybrid concept, combining elements of regional analysis and environmental management. The coastal zone is a band of varying width, which includes a land component and sea word component. With in the national context, it is a region which contains a certain proportion of national capital, income and employment. The question of how to allocate these aggregates among the various national regions is one of the traditional problems of development planning. Coastal zone management has been described by Dorcey (1986)³ as a "wicked problem". Wicked problems are not necessarily wicked in the perverse sense of being evil. Rather, they are wicked like the head of hydra. They are ensured with tentacles. The move you attempt to time them, the more complicated they become.

3. Dorcey, A.J.H (1986) Baigaiving in the Goverance of Pacific Coastal Resources : Research and Reform. West Water Research Centre, Faclility of Graduate Studies, University of British Columbia, Vancouver.

Pitts (1993)⁴ noted that the recurring themes in the Australian inquiries relevant to the coastal zone bear a strong resemblance to the six characteristics of complex wicked problems identified by Mason and Mitroff (1981)⁵ :

(a) Interconnectedness : strong connections link one problem with another'

(b) Complicatedness ; numerous elements including feedback loops;

(c) Uncertainty; wicked problems exist in an uncertain environment which creates a need to accept risk, perhaps incalculable risk.

(d) Ambiguity : The problems can be seen in quite different ways depending upon a person's characteristics and experience. There is no single "correct" view.

(e) Conflict : Competing claims, conflicts of interests and complex interactions among powerful interests that are unlikely to reading enter cooperative arrangements;

4. Pitts D (1993), Analysis of Steategic Planning Processes of Initives for Coastal Zone Management Resource Assessment Commission Consultancy Report, Commonwealth of Australia, 53 pp.

5. Mason, R.O. and Mitroff I.T. (1981), Challenging Stetegic Planning Assumptions : Theory, Cases and Techniques, John Willy and Sons, New York.

(f) Societal constraints : Social, political and technological constraints been on perceptions of feasibility and desirability of solutions.

Thus from above, it becomes very much clear that the paramount objective of coastal management is to devise a framework with in which man may line harmoniously with nature. Or, to provide "sustainable utilization" of coastal resources. Thus, effective managers should aim at balancing cause and effect, but remain alert to change and have the skill to adjust.

Coastal zone management can be divided into three broad areas, policy, planning and practice. Policy relates to the political and administrative frame work through which coastal management is regulated, be it legislation, education or a combination of both. Planning is the process or resource allocation, be it by environmental, ecological, social, or economic yaldsticks. Practice covers the techniques needed for implementation of planning decisions, or for understanding restorative or remedial work. Practice range from building seawells to planting beach grass and to disposing to nuclear waste.

According to Sorenson and Mc Creary, "The Coastal zone is defined as the interface or transition zone, specially that part of the land affected by its proximity to the sea

and that part of the Ocean affected by its proximity to the land.... an area in which processes depending on the interaction not fixed - it changes daily with tides, with the moon stages, seasonally with astronomic forces, and sporadically with sea stroms and great river floods.⁶

The Coastal zone may be drawn wide or narrow in order to meet program goals.⁷

2.2 Geographical Characteristics of Coast Zone.⁸

(a) Narrow and prone to flooding :

Where the land meets the sea, the sea is generally at its shallowest and the land its lowest. Flooding is common both by daily tidal flooding of sand and mud flats and strome tides that occurs from time to time. In coastal zone, new land is frequently claimed from the sea by rivers and currents and by strong winds by piling sand above sea level.

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6. Sorensen, J.C. and S.T. McCreacy (1990) Institutional Arrangements for Managing Coastal Resources and Environment, Coastal Management Publication No. 1 (Rev.). NPS/US AId Series. National Park Service. Washington D.C. 194. Pp.
 7. Singh. H.S., 1994. Manager, Gulf of Kutch Marine Park, Gujrat, India Personnel Communication.
 8. Ket Cheem Bostoick. H (1972) : The water Edge : Critical Problems of the coastal zone. The Massachusetts Institute of technology.

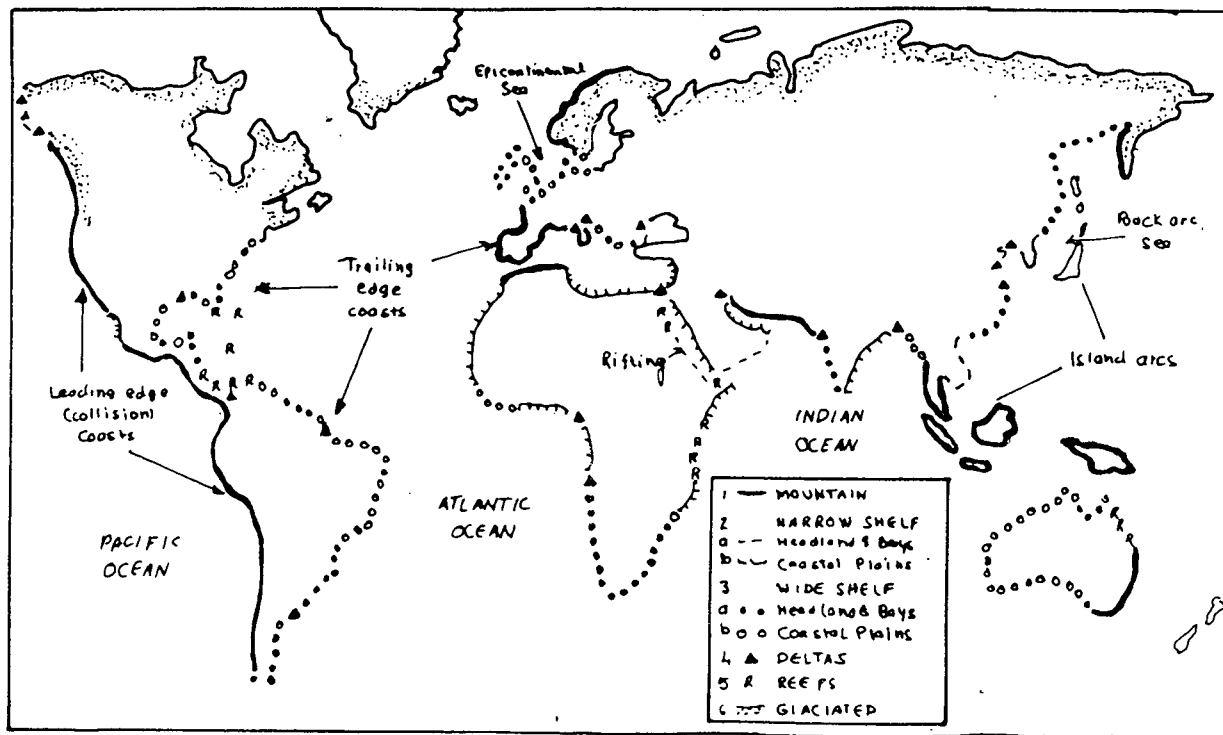


FIG: The tectonic classification of the world's coastlines

SOURCE: Inman and Nordstrom (1971) - The Coast; Macmillan, New York,

(b) Beaches Beaches are mainly unconsolidated sediments (mainly sand and gravel) that most parts of the shore. Erosion of beaches, both natural and caused by people, has attracted much attention in recent days. Man can affect coastal zone by dredging and filling to create extra land, damming rivers, construction of jetties or coastal structures and destruction of coastal dune area.

(c) Coastal Changes and Placer Deposits :

The shallowness of the sea near the sea shore has an effect on the concentration of sea energy at the coast. Much of the wind energy on the sea surface is carried in the form of waves, which with little diminution until it meets the land. Where it is quickly dissipated in the breaking up of waves against the shore. The position of bars may be changed, channels may get filled in and braces may be moved up and down and may even disappear completely. Some of these one produced by the shore processes themselves while others are placer deposits which are subsequently placed in the coastal zone by rising sea level.

(d) Estuaries, Lagoons and Marshes :-

These are another common feature of many coastal areas. An estuary is a body of water partially enclosed by land that has connection to the ocean as well as to a river. This an area where salt water and fresh water mix. Lagoons

are somewhat similar to estuaries Chilka lake on the southern side of the Mahanadi river delta in the Bay of Bengal is a good example of a lagoon. Where a Marshes are generally located intertidal areas along the banks of tidal rivers, or behind barrier beaches.

(e) Delta :- Deltas are large accumulation of sediments that are deposited at the mouth of a river. All rivers transport sediments to the Ocean. Usually some or all of the sediments is deposited when the river enters slower flowing or standing body of water. Delta are generally flat areas that are extremely fertile because of sediments deposited by river after is rich in nutrients.

2.3 The Nature of Management Problem

Coastal zone management problems are fundamentally different from land use and environmental management problems in several important ways. It affect an assemblage of terrestrial and aquatic environments. It includes the off shore continental shelf - an are with potential for significant new types of economic development strike a balance between the growth of its material out put and the level of environmental quality. This fundamental problem of economic choice applies to coastal zone. Although not fundamentally different from other management problems on land, coastal zone management is a decidedly more complex

process. This is because of the relatively rudimentary state of knowledge of the coastal environment, compared to transitional ecosystems. The coastal area is an ecotone, a transitional environment between two distinct systems (lands and marine). Management of such a system is therefore more difficult than terrestrial management. Three major problems of coastal zone management are identified:

a. The first problem involves interactions among uses of the coast, two or more uses of the coast can physically conflict can occur between groups of uses of coastal facilities. An example would be the case a fishing harbour which is chosen to become a supply base for off-shore oil activities.

b. The destruction or deleterious modifications of valuable environment. These environments includes wetlands, salt marshes coastal peat and mangroves. There is always a strong pressure to develop these areas for commercial and residential purposes.

c. The third problem to be dealt with is the pollution of coastal and estuarine waters. The pollution of coastal waters and the resulting threat to human health, amenities and fisheries, represents a particular class of what economists call external effects or "externalities". Pollution, however is a by product of economic growth, and no society

can afford simply to, state of "zero discharge" of all pollutant materials.⁹ There can be few causes for charting out coastal zone management problem, particularly in the developing countries, are the lack of an explicit government policy for the development of coastal and management of its resources. The reasons for lack of a national policy are manifold namely.¹⁰

- a) National economic problems;
- b) Cultural differences in the valuation of environmental quality;
- c) Lack of awareness of potential interactions between coastal development activities;
- d) Coasts associated with a policy which are perceived to outweigh the benefits.

Thus, the lack of a national policy for coastal development is the fundamental obstacle to effective management of the zone and its resources.

9. E. Robes Piquer, "The threat of fast development on the coastal areas in developing countries" paper presented in the fifteenth Congress of the international Federation of landscape Architects, held at Istanbul in September 1976.

10. James K. Mitchell, "Coastal Area Management: Approaches and overlay Mapping Techniques" (paper delivered at the Work Shop on coastal Area Development and Management in South East Asia and Pacific, Manila, Philippines, (Dec. 3-12-1979).

2.4 Evolution of The Concept of Coastal Zone Management in International Context

There have been two major stages in the process of world wide recognition of the importance of marine affairs in national economics.¹¹

One: During the decade of the 1970s there was general recognition of the importance of marine resources for economic growth of states, an increase in scientific research activities, and a sustained negotiation effort at the international level that culminated in the adoption of the UN Convention on the law of the sea (1982). Concern of the part of developed countries over the quality of their coastal and marine environment prompted enactments such as the US coastal zone management Act 1972 (Archer 1987) and specific measures in various European countries. There experiences, although not formally replicated in the developing world. International organisation started research and training programmes in this field.¹²

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11. Vallego, Stella Maris A. (1986) 'Coastal Areas and the Exclusive Economic Zones : Basic Consideration for Planning and Management', Integrated Ocean Use management 5 : 9.30.
 12. Vallego. S. (1987) Existing Coastal Zone Management Training programmes and Resources at the International Level, report prepared for the Coastal Resources Centre, Kingston, R.I. University of Rhode Island.

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Two: During the decade of the 1980s there has been an incipient response of governments of the opportunities available, as well as a further recognition of the responsibilities involved, in the newly acquired rights over exclusive economic zones (EEZs). Countries are taking concrete measures relative to the legal, economic and technological aspects of ocean development specially in the area of coastal zone management.¹³

These two decades have witnessed profound legal and technological changes as well as the emergence of new management practices that are intended to replace adhoc crisis responses to marine resource problems with planned, anticipatory and integrated strategies. The evolution of the conceptual basis and its practical applications presents particular characteristics. First, the 'marine dimension' has conceptually emerged as having two distinctive geographical components : a the coastal zone and (2) the ocean area. The first significant modern state legislative action directed at an explicit coastal management problem was undertaken in 1959. In that Texas passed an open beaches law designed to confirm public ownership of, and

13. Archer, A.N. (1987) Coastal Management in United States : a Selective Review and Summary, report prepared for the Coastal Resource Centre, Kingston, R.I.: University of Rhode Island.

unimpeded access to, beaches.¹⁴ But it was the passing of the coastal zone Management Act (CZMA) in 1972 that created the greatest interest. The CZMA was designed as a finite life Bill, authorizing and funding the establishment of coastal zone management programmes in all coastal states.

The Act had four objectives:

- (i) to protect fragile coasts (reefs, wetlands, lagoons)
- (ii) to minimise life and property loss from coastal hazards;
- (iii) to create better conditions for coastal resource use, especially in terms of access for recreation
- (iv) to promote inter-governmental cooperation through policy and procedural standardization, leading

hopefully, to a reduction in bureaucracy. In addition, the CZMA contains recommendations on public participation urban water front renewal and other issues. But it did not long survive in that form and changed in many new forms. Unlike the US model, the British coastal management equivalent is cumbersome, muddled and unlikely to be effective. Much the best coastal management in Britain is provided by non-

14. Earl H. Bradley, Jr. and John M. Armstrong, A Description and Analysis of Coastal zone and shoreland Management Programs in U.S., Sea grant Technical Report no.20 (Ann. Arbor : University of Michigan, Sea Grant Program Coastal zone Management Project, 1972) pp.385-87.

statory organizations like the National Trust. Both Sheil (1976) and Steers (1978)¹⁵ have explained how the overhaul of UK coastal planning procedures. Coastal management in Britain has two distinct faces. A large and increasing portion of coastline is privately owned by the National Trust. This is strictly maintained, perpetuity, for open space and amenity purposes. And other most of remaining coastline come under the direct control of planning of local planning authorities who major may not make special provisions for its unique character and problems. In Holland coastal management is of paramount concern to the nation the susceptibility of over 50% of the country to marine flooding during storm surges has led to one of the most rigorous coastal zone management programmes in the world. The Dutch are highly conscious of the need to preserve the shoreline, and they have created a successful industry importing their expertise other countries, including S.Korea, Bangladesh Guyana and Egypt.

Thus, after the U.S., Britain, France and the Netherlands successful attempt towards CZM, many other developed nations also pursue active coastal management

15. Sheil John (1976) "Coasts and Planning in Great Britain", Geographical Journal 142 (July 1976) : 411-37.

programs, like Sweden. Denmark, Japan etc. Coastal management in Denmark is integrated in a general nation wise urban and environmental planning system.¹⁶ New Zealand legislation and town planning practices one modeled on those of England, some recent innovations in coastal management have been borrowed from US experience.¹⁷

While looking into the matter of coastal zone management in developed nations, the historical circumstances had played an important role. Every nation tends to face its own distinctive assemblage of contemporary problems.¹⁸ Hence, on a priori grounds one would not expect close similarity between different nation coastal zone management politics. It is pedagogically useful to characterize certain CZM programs in developed western nations as alternative, "ideal" types or models, but it is misleading to think that these represent the full large of possible approaches the 'best' programs. As these CZM policies in developing countries falls different problems

16. Richard G. Hildreth, "Costal Land use control in Sweden and Denmark". Coastal zone Management Journal 2 (1976): 1-30.

17. R.F.Mclean, "Coastal Research in New Zealand, "Geoscience and man vol in Coastal Research (Baton Rouge: Lovisiana State Uni., School of Geoscience.

18. Valtejo Stella Maris A. (1987): Existing Coastal Zone Management Training Programms and Resources at International level, Report prepared for the Resource centre, Kingston, R.I: Univeristy of Rhode Islan.

for example, the physical environment of developing world costs usually contains features, communities and processes not frequently encountered in established American or European C2M programs. These include corals, mangroves and beach rock.¹⁹ One of the another aspect of C2M in developing nations, the characteristics of overuse or conflict among competing coastal resource uses tend to differ from those found in western countries. The example can be of the worth Asian countries India Bangladesh and Srilanka. Another case can be taken of south East Asian Countries, where conflicts many occur between recreational uses and off shore mining, sewage disposal or industrial dumping. Expansions of port and coastal metropolitan districts bring more serious problem.

In bringing the management and planning the coastal zone, at international level, United Nations has played a vital role. The United nations, through the Ocean Economics and Technology Branch (OETB) has played a fundamental role in promoting coastal zone management and enhancing the capacity of countries to deal with the variety of technical problems and policy issues involved in the design and

19. UNEP Report No.4. (UNEP 1980): Ecosystem in danger Nainobi.

implementation of a national programme. There can be five fold specific goals underlie the efforts at the international levels.²⁰

- (a) Creating awareness and familiarizing government officials with concept and prerequisites involved in CZM.
- (b) Training Specialists in the scientific disciplines that concern Coastal zone planning and management.
- (c) Studying undertaking training courses on specific coastal problems in selected areas.
- (d) Preparing region - wide or country diagnoses of the environmental conditions and economic activities taking place along the coastal areas.
- (e) Training trainers.

There are the five important objectives which UN is projecting since 1973. The various activities of the programme includes a number of training elements and the preparation of a world register of courses. A series of seminars and workshops were implemented at the inter-regional, sub-regional and national levels. They were designed to familiarize participants with the broad range of

20. Vallego Stella Manis A. (1987): Existing CZM Training Programs and Resource at International Level, Report Prepared for the Resource Centre, Kingston, R.I. Uni. of Rhode Island.

environmentals socio-economic, technical and institutional and legal issues encountered in process of planning and management.

The likelihood of a rise in sea-level in the future, as a consequence of global warming, has major implications for coastal areas. This has focussed international attention on the management of the world's sensitive and vulnerable coasts (IPCC 1990, 1992). As a result, the Intergovernmental Panel on Climate Change (IPCC) Coastal Zone Management Subgroup (CZMS) proposed that all coastal nations implement integrated coastal zone management by the year 2000. Coastal zone management is an essential prerequisite for sea-level rise impact mitigation policy formulation (IPCC 1990, 1992). The IPCC-CZMS recommendations regarding the need to develop integrated coastal zone management plans have been greatly strengthened by two of the outcomes of the United Nations Conference on Environment and Development (UNCED),²¹ namely the Framework Convention on Climate Change and Agenda 21 (UN 1992a, 1992b).

Agenda 21, is a non-legally binding set of guiding principles for national governments and international

21. United Nation (1992): "Agenda 21". In: The Outcomes of the United Nations Conference on environment and Development Rio de janerio, Brazil, 3-14 June, 1992.

organizations on the future directions of environment and development programmes. Agenda 21 devotes one of its forty chapters (Chapter 17) specifically to the protection of oceans and seas. Programme Area A of Chapter 17 is entitled: "Integrated management and sustainable development of coastal and marine areas, including exclusive economic zones."

While every section of Programme Area A contains text of relevance to coastal managers and decision makers. Sections 17.5 and 17.6 are perhaps the most important in the context of this paper. Section 17.5 - "Objectives", states: *Coastal states commit themselves to integrated management and sustainable management of coastal areas under their national jurisdiction.*

Section 17.5 contains a number of sub-sections which elaborate specific coastal management objectives, including inter-sectoral planning, adopting a precautionary approach, and monitoring needs.

Section 17.6 - "Management Related Activities" states: *Each coastal state should consider establishing, or where necessary strengthening coordinating mechanisms (such as a high-level planning policy body) for integrated management and sustainable development of coastal and marine areas and their resources, at both local and national levels.... Such*

national coordinating mechanisms could provide, inter alia, for.....

(b) Implementation of integrated coastal and marine management and sustainable development plans and programmes at appropriate levels.

Unlike the Climate Convention, there are no implementation deadlines within Agenda 21. However, Section 38.9 of Agenda 21 states that the UN General Assembly "could consider" holding a special Agenda 21 review and appraisal session before 1997.

CHAPTER - III

Coastal Zone Management Issues in South Asian Countries

South Asia as defined by the South Asian Association for Regional Cooperation (SAARC) includes seven countries - India, Pakistan, Bangladesh, Nepal, Bhutan, Srilanka and the Maldives. But the coastal countries are only five, excluding Nepal and Bhutan. Thus, the countries - India, Pakistan, Bangladesh, Srilanka and the Maldives form the South Asian Sea region.¹ Important to note here is that Burma is not officially recognised member of UNEP's South Asian Seas program.² Political entities within the South Asian seas region, which contains the most densely populated country in the world (apart from small city-states), range in type and size from small atolls such as Maldives, measuring 298 km², to continental nation such as India, measuring 3.14 million km². The South Asian region may be significantly affected by global changes resulting from atmospheric trace gas loading, including warming and

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1. Milliman. J.D. 1988, Rising Seal Level and Changing Sediments Cupluxes : Real and Future Problem for Indian Ocean coastal Nation. Pages 195-202 in IOC/UNESCO workshop on regional cooperation in marine science in the Central Indian Ocean and adjacent seas and gullets. Workshop report ND. 37.
 2. UNEP Report 1986, South Asian Seas Programme, pp.2.

subsequent rise in ocean levels. The South Asian seas region includes many islands (Srilanka, the Maldives, and India's Andaman Nicobar and Lakshadweep) that have for more coastal zone per unit of land area than do continental areas. Changes occurring in atmosphere and to relative mean seal level are beginning to concern more and more governments and government planners.³

One most important physical characteristics of the region is, it includes some of the larger deltas in the world, in terms of rudiment discharge and freshwater runoff, include the Ganges, Meghna, Godavari, Indus, Malmada; major population centres have evolved on or near delta (e.g. Karachi and Calcutta). These deltas, already a low elevations, tectonically subside at rates ranging from lum to many centimeters per year, adding the problem of relative sea-level-rise. For South - Asia Seas region several aspects of climate change are most critical : temperature increase, sealevel-rise, precipitation changes, and monsoon storm climate.

3. Mintzer I - 1988, Living In A Warmer World : Challenges for policy Analysis and management, Journal of Policy Analysis and management 7(3) : 445-459.

Table

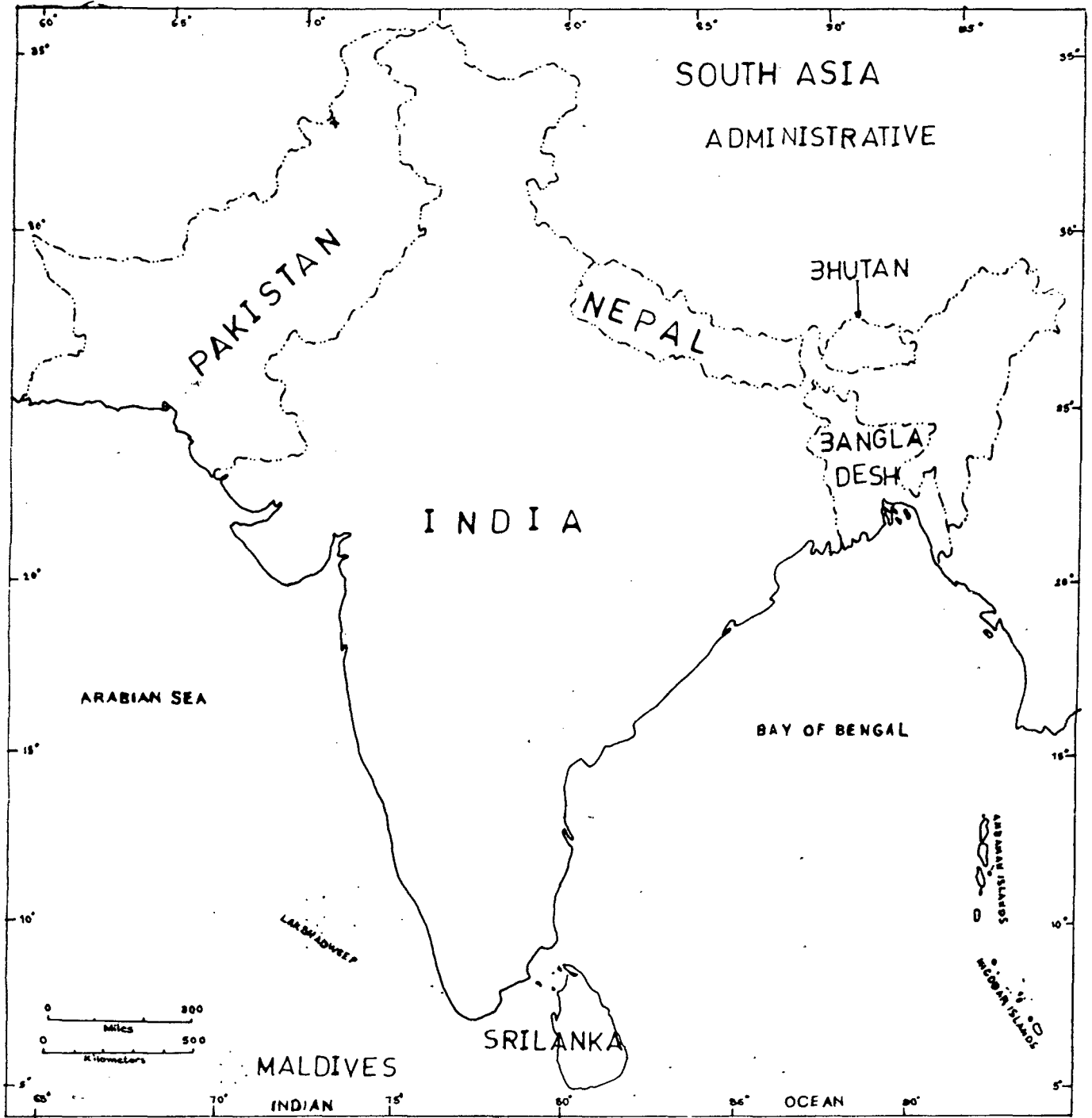
3.1 South Asian Seas Region General Geographic Information*

Country	Area ^a (sq.km)	Coastline KM	Sovereignty costs	GNP US\$ per capita	Total (000)	Population growth rate to	Density (per km ²)
Srilanka	65,000	1,340	1984	400	17619	2.1	273.4
Pakistan	803,000	1,046	1947	350	122802	4.2	154.3
Maldives	298	644	1965	300	205	3.8	799.9
India	336,500	7,003	1947	300	870000	3.1	264.7
Bangladesh	142,000	580	1971	160	111400	2.6	754.9

* Source ; The Europe Year Book 1995, A World Survey, vol. I and II (London England).

a : The ocean Year Book 3, 1983; University of Chicago Press).

All of the countries in the South Asian region have national environmental departments and laws for the protection of the environment. India for example, enacted the Government (Protection) Act providing the central government the authority to protect all areas of the environment, also, has the Coastal Zone Regulation and recently the Ocean Regulation Plan; Pakistan passed an Environmental Protection Ordinance in 1983 instructing the



direction general of the Environmental Protection Agency to prepare Pakistan's National Environmental Policy.⁴

3.1 Regional Seas Programme

The South Asian Seas Regional Programme with the participation of India, Bangladesh, Maldives, Pakistan and Srilanka is one of the 13 Regional seas Programmes of the United Nations Environment Programme. An Action Plan for protection and management of the marine environment in South Asian Seas, was adopted on 24th March 1995, in a meeting of the Plenipotentiaries held in New Delhi. India is the repository of the Final Act conveying the adoption of the Action Plan by the countries concerned.

The objective of the Action Plan is to protect and manage the marine environment and related coastal ecosystems of the region.⁵ This objective includes the promotion of sustainable development and sound management of regional marine and coastal resources. The Action Plan has identified the following priority projects:

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4. Ramakrishna, K., 1989, legal regime for environmental protection in the South Asian Seas Region. Presented at the Joint armed Convention of the British International Studies Association and I. Studies London March 28, - April I. 1-16 pp.
 5. UNEP Report South Asian Seas Programme, 1995.

- * Development of model integrated coastal zone management plans.
- * Development and implementation of National and Regional Oil and Chemical spill contingency Plan.
- * Human Resource Development Through strengthening of Regional Centres of Excellence.
- * Protection of the marine environment from land-based activities.

South Asian Co-operation Environment Programme (SACEP) has been designated as the secretariat of the programme. The activities of the detailed project reports for submission to various international funding agencies for implementation of the projects.

3.2 Problem of Defining the Coastal Zone in South Asian Countries

A major problem in instigating coastal zone management (CZM) is defining the coastal zone. Whereas the Law Of Sea Convention (LOSC) has set out the definition of territorial water and the EEZ, it is far from clear just how the coastal zone should be defined. The objectives of CZM aim to ensure the sustainability of coastal ecosystems. These are often not best protected with in the prescribed recognition of boundaries such as those adopted by the LOSC. Reef systems for instance may not be entirely with in the EEZ or

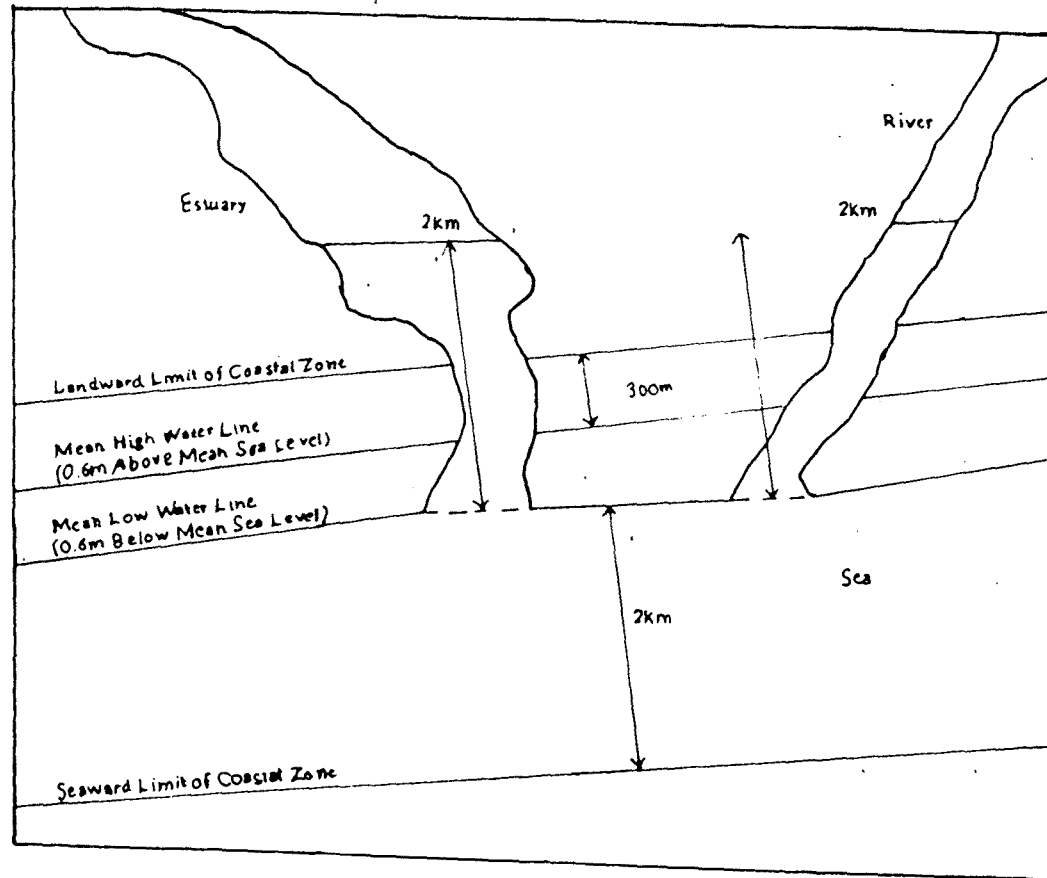


Fig: The Sri Lanka coastal management program
 Source: D.P. Amarasinghe: The Coastal zone Management in Sri Lanka: Coastal zone
 1996, pp 23.

territorial water. More subtle are the interactions which are essential to ensure the health inners of all parts of the ecosystems; thus fisheries may be dependent upon mangrove areas for nursery grounds, but the adult stages of the life cycle may be spent outside protected water.⁶

In Srilanka, the government, in its coast conservation Act (No. 57, 1981), defined the coastal zone as that are lying within a limit of 300 m land wards of the Mean Hhigh Water Time and a limit of 2 km sea wards of the Mean Low Water Line and in the case of rivers, streams, lagoons or any body of water connected to the sea either permanently or periodically, the landward boundary shall extend to a limit of 2 km measures perpendicular to the straight base line drawn between the natural entrance points there of and shall include waters of such rivers, streams and lagoons or any other body of water so connected to the sea.⁷

Such prescribed approaches to definition work in some cases, but do not in others. In Bangladesh, it is

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6. Pernetta, J.C. and D.L. Elder, Climate & Seas Level Rise and The Coastal Zone : Management and Planning For Global Changes. Ocean and coastal management, 1992, p.113-110.
 7. Kahawita, B.S., Concepts and Tools for Coastal Zone Management in Srilanka, in Vulnerability assessment to sea level rise and wastal zone management : proceedings of the IPCC Eastern Hemisphere Workshop, Tsukuba, Japan 3-6 August 1993, R. Mchlian and N. Mimura, Editor, p.249-255.

especially hard to define the coastal zone about two- third of the country goes under water each year with the river floods, and thus most of the nation might be considered coastal. In case of the Maldives, where there is almost no land above 3m above high tide level, it is certainly necessary to incorporate the entire country into CZM.⁸

Problems of definition become still more difficult where there are conflicting claims. Thus although Bangladesh was one of the first nation to claim the 200 miles EEZ, it did so from a base line which look into amount the retreat of its tidally - dominated deltaic coast. The base line which it choose to declare in 1974 was not recognised by its neighbour (esp. India).⁹ Same problem of defining base in and coastal zone exist in ASEAN region (e.g. Malaysia and Thailand in Joint Development Area; Malaysia and Philippines over the separately Islands (which

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8. Clark J.R.J. Sorensen and G. Schultink. 1993, Integrated Coastal Zone Management Strategy. Tropical Resources and Development inc. Gainesville. Report, to UNDP and Phoning Commission of Bangladesh, Dhaka, 62 pp.
 9. Prescott, J.V.R. Maritime Political Boundaries of the World. 1985, London : Methven.

are claimed by China, Vietnam, Brunei and Taiwan). Malaysia and Indonesia over Pulav Sipadam).¹⁰

The atolls of Maldives being true coral atolls, there exists no continental shelf. The atolls reefs end in sharp plunging reefs below which are after sandy submarine terraces sloping to greater depths.¹¹ Thus the coastal zone can only be defined with the ocean current regime, immediate to the drop - off. The coastal zone has not been defined in legislation or in any official papers. However it is generally accepted that the sea ward limit of the outer extent of the country's Exclusive Economic Zone.

Tidal fluctuations influence the fresh water table throughout the islands, whose freshwater levels is small in keeping with the Ghyben - Herzberg principle relating island size to lens size. Salt intrusion is common on many of the inhabited islands. Thus the whole island is with in the coastal zone as the effects of coastal processes directly influence the whole land area. Thus that is no land ward limit to the country's coastal zone.

10. Burbridge P.R. and Koesoebiong, 1981. Coastal zone management in South East Asia In : South east Asian Seas ; Frontiers for Development Mc Graw Hill P.P. 110-135.

11. Hulbergen, C.H. and Schoden P.C. (Ed.) 1989 : Republic of Maldives : Implication of sea-level Rise. Report on Identification Mission. Ministry of Economic affairs, the Netherlands. UNDP.

While in India, coastal zone has been defined as region between sea ward margin of the EEZ and the inland limit of the coastal plain.¹² In other word, it is a region between 20 km distance from landward to the extension of EEZ towards the sea.

Coastal zone Management Issue in South Asian Countries.

Coastal Zone Management in Sri Lanka

Sri Lanka has a land area of 64,000 sq.km, coastline of 1585 km and a resource base of 120000 ha of brackish water lagoons, estuaries, mangroves, and salt marshes.¹³ In the last 5 centuries following foreign occupation, the country's development has been closely related to maritime activities. Population centres were established along the coast and exploitation of coastal resources to provide sustenance to these communities were intensified. The opening of coastal railways and highways accelerated this process.

12. Zingde M.D. (1996) : Coastal zone management in India, in a workshop held in Madras, Coastal zone Management, Megicities and Globalisation. By Madras institute of Development Studies, Madras, at 21-23, 1996.

13. Amarasinghe, R.S, H.J.M. Wickremertere and G.k. lowry, sr 1987: coastal in Sri Lanka 1978-1986. In coastal zone'87, vol.III, mer. soc. civ. eng., newyork. pp.2822-2841

During the four decades following independence (1948) the economic importance of coastal areas has grown further with the increase of population pressure on the resource base of the coastal zone increased. Development in the coastal zone within the last few decades has resulted in many problems increasing conflicts over coastal uses, the depletion and degradation of coastal resources. Sri Lanka, therefore is presented with serious problems with respect to the management and utilization of 18 millions people.¹⁴ Population pressure exerts a strain on coastal habitat. The narrow and fragile coastal zone supports one third of the population. As Sri Lanka approaches the status of newly industrialized state, two thirds of the industry is located in the coastal belt.

Early Initiatives: Interest in coastal problems in Sri Lanka dates from the 1920¹⁵. Efforts in this field were primarily directed towards seeking engineering solutions to curb immediate coastal erosion problems by the construction of protective structures mainly to provide protection to coastal highways and railways.

14. CCD, 1990 Coastal Zone Management Plans, Sri Lanka coast conservation department, Colombo Sri Lanka pp.110

15. 1 bid I

The major development of tourism sector since the mid-sixties, with its main focus on the beach oriented tourism gave a premium value to coastal land. An initial step in adopting this policy was the drafting of supporting legislation directed towards coast conservation. In Jan 1978, a new division was created within the ministry of fisheries, esp vested with the responsibility for coast conservation. The main function of the department was to look after the activities going on coastal zone.

Coastal Zone Management Plan (CZMP)-- The formative years (1978-1983) the establishment of the division of coast conservation gave an opportunity to those involved in the programme to adopt a more dynamic approach to coastal problems. It also allowed them to view the problem of coast erosion in the broader context of coastal zone management. It was necessary that the need for adoption of management practices be given a local basis. Hence the preparation of coastal zone management plan, was made a mandatory requirement of the law and provision was included for regulation of the law and provision was included for regulation of all development activities within a specified coastal zone. The law was passed by Parliament in September 1981 and became operational from 1st October 1983.

The Coast conservation Act:

The coast conservation act which provides the legal basis for coastal zone management came into operation in 1983. It has five parts:

Part 1.-Administration

Part 2.-Coastal Zone Management

Part 3.-Permit Procedure

Part 4.- General

Part 5.- Amendment & Modification of Central Law

In 1984, Coast Conservation Department (CCD) prepared a statement of basic planning principles which clarified the Philosophy of Department as it relates to the CZMP and served to give direction to CCD staff in the preparation of the CZMP. these basic planning principals were adopted by the coast conservation advisory council established under the coast conservation Act and comprising of representative of almost all government agencies with an interest in the coastal zone and representative of the Universities, The non-governmental organisations involved in the environmental matters and fishery interests.

The CZMP was completed in 1986. The Coast Conservation Act has set out a figures review procedure for the plan prior to its adoption as national policy.

In 1990, the government of Sri Lanka (GOSL) approved a national coastal zone management plan to address the problems of coastal erosion, coral and sand mining, degradation of coral reefs and other sites of interest to ecotourists and historians. This plan has been referred to as a "first generation plan" and it provided the GOSL with the opportunity to collect Bodleian data on many significant ecological points of interest and import. Two important features of these plans include the "revolution" of decision making to provincial/local authorities and the requirement of environment impact assessments (EIAs).

The Government of Sri Lanka also has taken foreign aid and projects to promote the coastal zone management. One of the important is United States AID through the University of Rhode Island. In 1993, Curtis Limited, a Canadian Company, in cooperative with Sri Lanka Joint Venture Parties, the Mc Callum group, the design and implementation of a community-based seaweed aquaculture program. It is basically a community-based Co-Management approaches to natural resource management and havestesting have potential as an alternate approach to development. The Ministry of Fisheries and aquatic Resources and Material Aquatic Resource Agency have noted that this project is unique in that it is one of the

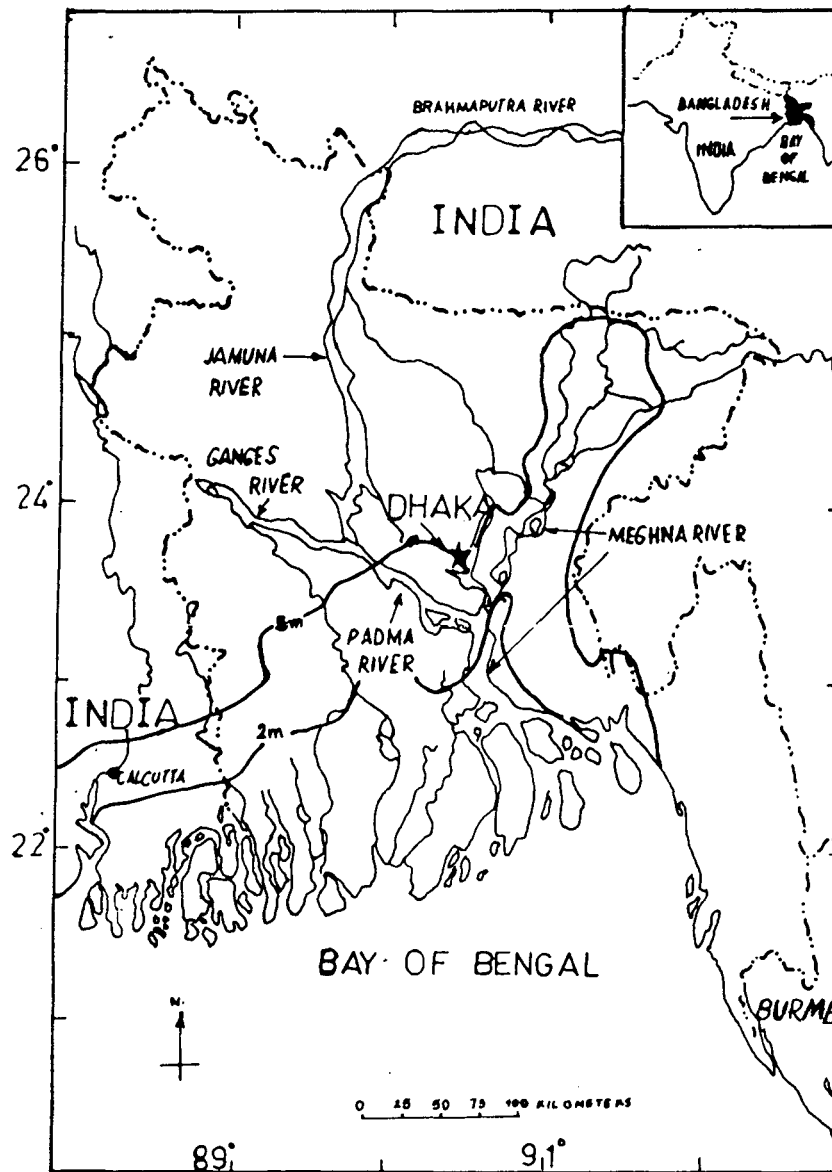
first sustainable economic projects which work with communities as partners and Co-managers.

Decentralisation

The 1990 coastal plan refers to a "second - generation coastal resources management program(which) must be implemented simultaneously at national, provincial, district and local levels". CCD has begun the process of delegating authority for issuing "minor" permits to local authorities and has organised an extensive program of training local officials to implement a minor permit system. This devolution process also requires the development of monitoring system for ensuring that permit procedures imply with Coast Conservation Act1. A major criterion of success for the decentralization effort is the success of sharing of authority between national and local level of Government.

The 'bottom up' approach of decentralization by CCD involves the ore of situation management; specifically, the designation of special area management planning areas, as they are called here, in which residents become actively involved in both design and implementation of the Coastal Zone Management program.

Lowry and Wickremeratne concluded after detailed examination of Sri Lanka's program that its strength and vigour are due in large part to the following:



Bangladesh, showing 2-m and 5-m sea-level transgression scenarios
 Source: Adapted and modified from Milliman and others (1989).

- (a) strong orientation of the country;
- (b) widely shared agreement about what the coastal problems are;
- (c) a law that provides a strong legal basis for management;
- (d) strong program leadership;
- (e) adequate development of the planning and management program.

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Coastal Zone Management in Bangladesh

Coastal Region of Bangladesh

The coastal line of Bangladesh is 480KM long extending from a tiny coral island called the St. Martin's island located in the south eastern corner to the Hariabhangra river mouth in South Western tip. Three mighty rivers namely, the Ganges, the Brahmaputra and Meghna discharges their combined flow into the Bay of Bengal. This zone which is the central part of the coast line is extremely dynamic and coastal line is constantly changing. Severe cyclones and associated surges strikes the Bangladesh Coast frequently bringing about colossal damage and destruction. Management of any kind, therefore, is challenging. The situation can be greatly worsened by the rise in the sea level due to the Green House Effect. Infact, Bangladesh will be one of the worse hit countries if corrective measures are not taken.

Bangladesh has an area of 1,44,000 Sq.Km with a population in excess of 100 million. This makes Bangladesh the most densely populated country in the World. The Coastal geomorphology in Bangladesh is mainly characterized by the following:

1. vast network of rivers;
2. enormous discharge of the river waters heavily laden with silt and sand;
3. large number of islands formed in the coastal zone;
4. presence of the 'Swatch of No Ground' (a submarine canyon) running Northeast-Southwest particularly across the continental shelf about 24Km South of Bangladesh Coast;
5. strong tidal and wind action.

Atleast 30% of the total population live in the Coastal area depending upon agriculture and fishing for their livelihood.

Coastal Hydrology, Channels and Islands:-

The three major rivers, namely, the Ganges, the Brahmaputra and the Meghna account for 85% of the total dry season flow passing through Coastal Zone. The surface flow varies from maximum of $102,000\text{m}^3/\text{s}$ in August to a minimum of $7030\text{m}^3/\text{s}$ in February with occasional flood flow exceeding

140,000m³/s. Twenty big to medium size channels which are connected with a large number of Criss-Cross streams and stream lets are spread along the coast line.

Tides in Bangladesh are almost semi-diurnal and occur once in every twelve hours. Tides in the Bay of Bengal are quite strong and range between 1.83m at neap tide and 4.83m at spring tide near Sagar Dwip. Topography of the coastal zone and the tides play a very important role in the economy of the area. During the lean period (April-May) the tide reaches upto 170Km in the North and 340Km in the North-East region. Along the east coast tidal action is observed upto 0-50Km depending on the topography and presence of channels in the area.

Management of The Coastal Zone:-

Because of heavy population pressure on land, large number of people mostly agriculturists, fisherman and assorted labour move towards the coastal areas in the hope of finding new land where they can settle down along with their families.

Although the management of Coastal zones is very difficult in Bangladesh but a number of Government Agencies are engaged in activities which are directed towards bringing about changes in the life of the people who live in

these areas and also to manage resources that are available.

These agencies are:

- (A) The Bangladesh Water Development Board (BWDB)
- (B) The Bangladesh Inland Water Transportation Authority (BIWTA)
- (C) The Bangladesh Inland Shipping Company (BICS)
- (D) The Bangladesh Forest Department (BFD)
- (E) The Directorate of Fisheries (DOF)
- (F) The Bangladesh Meteorological Department (BMD)
- (G) The Bangladesh Space Research and Remote-Sensing Organisation (SPARRSO)

The Bangladesh Water Development Board (BWDB) is charged with responsibility of developing and managing water resources of the entire country the BWDB has a very important role to play in the management of the coastal zone. In the 1960, this organisation started building coastal embankments in order to protect coastal agricultural lands from salinity intrusion. Recently assisted by the Royal Danish Government BWDW has constructed a dam across the Muhuri river. Another most important department which taking care about coast is Bangladesh Forest Department (BFD). In Bangladesh forested area has rapidly declined due to population pressure and is only 14% of the total area of Bangladesh is under Forest. Of this 9% is government owned

reserved forest. The important Sunderbans located along the Bay of Bengal Coast has an area of about 3265Sq.Km. determined recently by Bangladesh Space Research and Remote-Sensing Organization on the basis of recent Landsat imagery and aerial photographs.

In 1966, a Coastal afforestation program was undertaken by the Bangladesh Forest Department with the objective of protecting the coastal embankment, constructed by the Water Development Board, from erosion due to tides and storm surges. During 1980-85 a large afforestation programme was undertaken with World Bank assistance, and an additional area of about 40,000 hectare was planted with the following objectives:

- (i) to create a forest belt in the tidal flats;
- (ii) to stabilize land from erosion;
- (iii) to increase forest wealth for domestic and industrial use;
- (iv) to improve socio-economic condition of the coastal population.

Recently a British team of forestry experts conducted an inventory survey of the Sunderbans financed by the Overseas Development Administration (ODA) of the United Kingdom.

Bangladesh Space Research and Remote-Sensing Organization is another important tool for Managing the country's coastal zone. In this Japanese Geostationary Meteorological Satellite is helping a lot to detect about the Cyclones as soon as they form and another information regarding the Coast.

Coastal Zone Management in Pakistan

Geographical Characteristics of Coastal Zone:

Pakistan bordering the northern Arabian Sea has a coastline of about 990Km extending from Jiwani near Iranian border in the west to the Sir Creek in the Indus Delta, adjacent to the Indian border in the east. The maritime area of Pakistan extends upto EE2 of 200nm covering an area of about 240,000Sq.Km.

The Coastal Zone of Pakistan has two main parts,

- (i) Sind Coastal Zone
- (ii) Baluchistan Coastal Zone

The coastline of Sind Province is about 320Km along extending from Hub River in the west to the Sir Creek in the east and cover the entire delta of Indus River. The total area of the Sind Coastal Zone is estimated to be about 83,400Sq.Km. Coastal area along Baluchistan is mostly rocky frequently with a sand dunes.

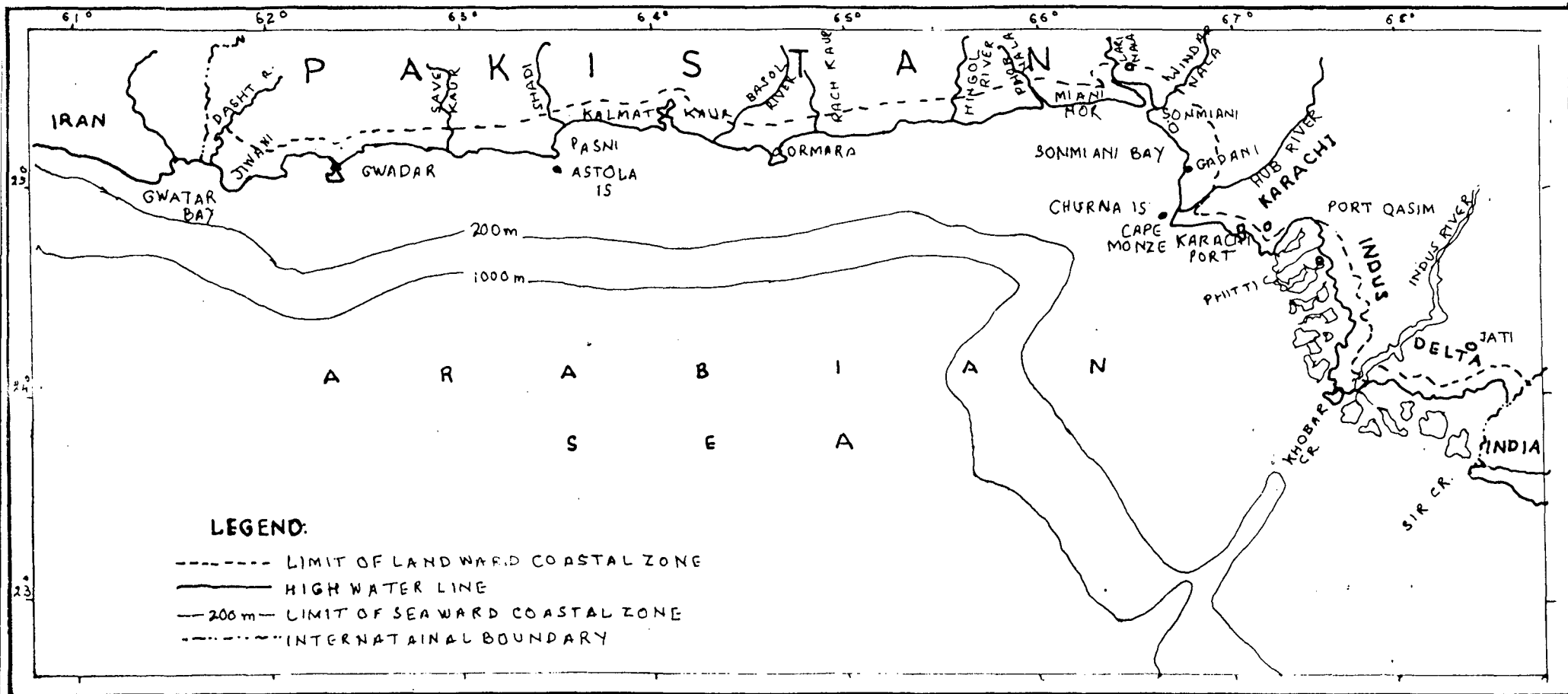


FIGURE : COASTAL ZONE OF PAKISTAN

SOURCE : S.H. NIAZ RIZVI (1993) : COASTAL ZONE MANAGEMENT IN PAKISTAN, IPCC REPORT.

Coastal oceanographic features of the Pakistani Coastal Zone is much under influence of the oceanographic characteristics of Arabian Sea. The unique oceanographic features of the northern Arabian Sea such as the high salinity, low precipitation, high evaporation rates, reversal of seawater circulation during monsoon periods, the upsloping of the oxygen minimum layer, and high primary production rates, prevail all along the coastal waters within the coastal zone.

The mean annual sea surface temperatures for the open sea along the coast range between 20 degree Centigrade to 30 degree Centigrade while the sea water temperature at about 10 metres depth in the coastal belt range between 18 degree Centigrade to 29 degree Centigrade. The sea surface salinities range between 33/000 to 37/000 per year while at 10 metres depth the range between 35-37/000.

The data on the Mean Sea Level (MSL) over a period of 150 years within the Coastal areas indicates a raising trend with an average rate of 1.1mm per year. The wave height in the Coastal waters are usually 1.5-2.5mts. while during the South-West monsoon periods waves upto 4 metres.

In the landward side of the coastal zone, the average annual rainfall is less than 200mm. the area is mostly without vegetation except deltaic area of Indus basin and

other small rivers. The total mangrove forest area of Pakistan is about 612,370 hectare, out of which 605,370 hectare belong to Indus Delta and only 7340 hectares along Sind coast.

Pakistan coast can be divided into four regions having unique physiographic features and environmental problems.

They are:

- (1) Indus deltaic region
- (2) Karachi Metropolitan Area
- (3) Lasbela Coast
- (4) Makran Coast

The natural resources of Seaward Coastal zone of Pakistan includes about 0.369 million metric tons of annual fish landing, about 612,000 hectare of mangrove forest, considerable resources of minerals, seaweeds - and sea salt, and estimated a few billion barrels of ore and a few billion cubic foot of gas, industrial use and potential of the coastal belt.

The natural resources of landward coastal zone include placer minerals, construction material such as sand, wild life, mariculture potential, recreational potential of beach development and tourism, housing, jetties/parts and coastal industries.

Legislation for Coastal Zone

The Seaward Coastal Zone upto 12nm from the coastal line is under the Jurisdiction of the two provinces viz., Sind and Baluchistan. The coastal zone beyond 12nm upto 200nm is under the Jurisdiction of the federal. The legislation and its enforcement for coastal resource management such as fisheries, mangrove forest etc., is the responsibility of the provincial governments. However, the protection and conservation of coastal resources is the responsibility of the federal government. The federal government also has authority for legislation and its enforcement within the 3 mile limit of the parts and within 12 to 200nm of EE2. Several federal and provincial agencies are relevant to coastal. A coastal environment management plan for Pakistan was prepared by the Environment and the Urban Affairs Division, Ministry of Environment and United Nations ESCAP. The preparation of Coastal zone management plans for the Sind and Baluchistan coasts are the responsibility of the respective provincial governments. However, the federal ministries of Environment and Science and Technology have the national expertise to provide technical help to the provincial governments for preparation of Coastal Zone Management Plans.

The tribal/federal system of Politics is in practice in the entire Coastal zone except in Karachi city and in a few coastal towns where Urban system is being followed.

Coastal Zone Management in Maldives: An Informal Approach

Geographical Characteristics:

The Republic of Maldives archipelago ranges between latitude 7° 6' North to 0° 42' South, and between longitude 72° 33' to 73° 44' East. The natural formation of Coral islands multiple shaped atolls provides the basis for their division into 20 administrative units. These atolls, consisting of a double chain which tapers off into single atolls in the North and South, are spread by deep waters with depth about 10m or more. Atoll lagoon depths are generally 50 to 60 meters deep in North and increasing to about 80 to 100 meter depths in South. Strong ocean currents exist in the inter atoll channels. The Republic of Maldives lies 600Km to the West-South-west of Sri Lanka in the Indian Ocean. In total it is estimated that there are about 2000 of these small low lying coral line islands in the Maldivian chain (Woodroffe, 1989, 24).¹⁶ The number varies as islands are submerged, over washed and disappear.

16. Woodroffe, C.D., (1989): Maldivies and Sea-level Rise: An Environmental Perspective, Department of Geography, University of Wollongong.

Approximately 80% is less than one metre above present mean sea level.

The area of the Country is about 90,000Km², but only about 298Km² is land. The largest island is only 6Km² in area, and most of the islands have an area less than 1Km². Monsoonal climate experienced revolves around North-Easterly winds from November to March, and South-Westerly winds from May to October. The Monsoonal Climate strongly affects wind directions, tide currents and sea state both within and outside the atolls. Monsoons and effects of storms are felt more strongly in the North: The Mean Wind speed is 8 knot with one day per month on average on which the wind speed gusts exceeds Force 7 on the Beaufort scale, Precipitation exceeds 2000 mm per year in the South, where in North is about 1800mm.

Tides are semi-diurnal. The tide range in 'Male' is between 0.2m (neap tide) and 1.0m (spring tide). Highest Astronomical tide is about 0.6m above mean sea level. Tidal currents are generally weak and follow the monsoonal climate pattern with off shore speeds ranging from 0.3 to 0.7m/s. Current Velocities close to islands are reported to reach

2m/s.¹⁷ Average wave heights vary between 1-2m with extremes of 3-4m from the prevailing monsoon directions. Swells are generated by storms in Antarctic Ocean and by tropical storms. Tropical storms and monsoonal winds are the sources of the waves.¹⁸

Beach Morphology

Maldivian beaches are extremely mobile and dynamic. The ancient volcanic basement rock of chain overlain by loose or cemented coral debris or sand of indeterminate depth. A thin layer of dark topsoil is evident inland on most islands. There is much diversity in beach formation. Relative size of the calcareous forms which provide beach nourishment material range from fine particles of sand, to coral aggregate to large pieces of aeropora fingers. The beach sand shifts seasonally to the lee side of prevailing wave and wind direction during each monsoon. Swell waves also affect the mobility of the beach sand leading to slight variations in the general pattern of the sand circulation described earlier. However, the greatest influence on the natural sand cycle is by man-made structures such as

17. Hulsbergen, C.H. and Schroder, P.C. (eds), 1989: Republic of Maldives: Implications of Sea Level Raise, Report on identification Mission, Ministry of Economic Affairs, the Netherlands, United Nations Development Programme.

18. *ibid* - 1.

jetties, groins, causeways, sea-wells and offshore break waters which are becoming increasingly common around the inhabited islands of the Maldives. These islands show many examples of the unforeseen adverse side effects that human interference in the natural processes can have on the coastal zone.

Population Pressure on The Coastal Zone

The influence these factors on settlement patterns and other resource uses is minor compared to the influence of population increase. The population growth rate between 1985 to 1990 was 3.4%, 90.2% increase from that between 1977 and 1985. The 1990 census enumerated that total population of the country at 213,215 (MPE, 1992,1998) the population forecast for the Year 2005 is 357,000 (MPE, 1993). This increase in population has led to increasing population pressure on land and coastal areas. Boat houses, residential plots and houses, public buildings, structures valuable coconut palms etc., increasing under threat as human interferences with the natural coastal process increase. The increasing encroachment of settlement on to the beach proper and the resultant loss of the natural prompt live vegetation along the beach has meant that the dynamic, seasonal cycling of beach material is being increasingly felt in terms of loss of investment and labour. The lack of knowledge leads

to much human intervention in the coastal processes which leads to unforeseen adverse side effects such as exacerated erosion downdrift of the coastal structure.

The adverse impacts of coral mining from the house reef have become a major concern of the government over the past few years. It has passed a ban on coral mining on the house reefs of same. A recent reduction of import duty on construction imports in one of the economic incentives the central government could undertake for promoting a more sustainable use of resources.

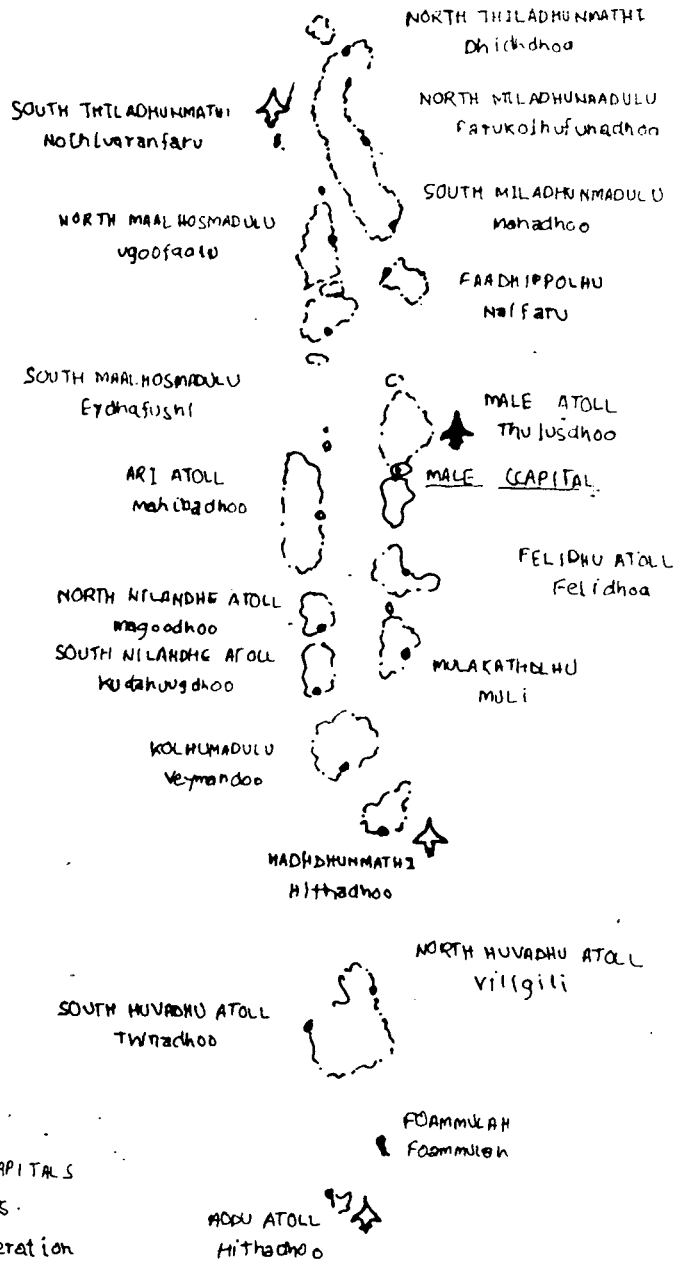
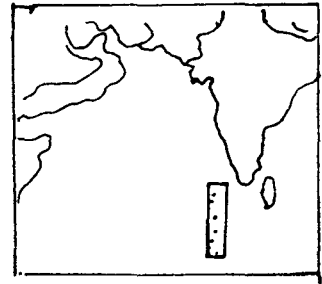
Coastal Zone Management Approach in Maldives

In Maldives an informal traditional and non-innovative approach to coastal management seems to exist already, but it could be strengthened. Many islands rely on natural coastal defence such as self for protection, but as has been noted this has been seriously undermined by coral mining on the reefs. The natural protection afforded by the front line vegetation and setback has also been undermined with encroachment of settlement on the beach. Retreat or accommodation strategies are not options open to many islands where land is scarce.

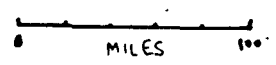
The legislative basis for resource management is inadequate and existing laws are piecemeal. Under the country's newly satisfied Environmental Protection and



REPUBLIC OF MALDIVES



- ATOLL CAPITALS
- ✳ AIRPORTS
- ✳ In operation
- ✳ Under construction



Preservation law of the Maldives, the Ministry of Planning and Environment (MPE)'s functions include environmental policy making, the setting up of procedures and guidelines for sound environmental management of resources on the coastal zone. However, this law is vague on principles and policies such that neither nor its Environmental Research Unit (ERU) has a clear mandate upon which it can react to environmental problems.

MPE's Environmental Research Unit (ERU)'s role is to act as a facilitating organisation for co-ordination of all relevant information and data while also undertaking appropriate research and for monitoring.

No government agency has a clear mandate for coastal zone management. The coastal zone management has only been initiated in the country after environmental studies undertaken following the high wave experience in 1987. This experience highlighted the lack of research and planning in coastal management.

The Marine Research Section (MRS) of the Ministry of Fisheries and Agriculture is active in the management of coral reef resources and marine resource management and coastal zone management. Despite this, the existing framework may not be operating as effectively as is necessary for two main reasons. First, a local,

appropriately educated government cadre does not exist to distinguish between significant and insignificant issues. Making such a distinction has not helped the country to develop. Second, people tend to accept deterioration of their environment as the cost of improving another living standards. For example, poor groundwater quality and other population pressure - related effects on Capital City (Male) are accepted as the cost of better education and medical care.

The government has commissioned several studies by international experts into the implications of sea level rise in the Maldives. The draft study by Hulbergen and Schroder (1989,1993) recommendations include the following:

- design and implementation of an action plan to create public awareness of the implications of sea level rise in terms of water management, coastal erosion, population restriction and population growth.
- design programme from training in water management, coastal ores (surveying and standards) coral reef management and conservation.
- institutional strengthening in planning, monitoring, control and enforcement capabilities.

These recommendations were incorporated into the National Environment Action Plan formulated in 1990, which

designated the areas for priority action from 1990 to 1992.

The work programme included the following:

- assessment of the health of Maldives Coral reef.
- assessment of the coastal erosion problems throughout the country.
- the management of land/lagoon/reef ecosystems to maintain its health and condition, including the development of coastal zone management schemes for individual atolls and islands.
- development of guidelines for the construction and location of coastal structures such as seawalls, groynes, harbours, jetties, piers, gabions and causeways.
- improve monitoring of the coastal zone through the establishment of a hydrographic unit capable of monitoring sea level, tidal; and wave patterns, extension of weather monitoring, marine ecosystems and coral reef surveys, coastal geomorphology and sedimentology.

Thus consideration assumes that the adaptation of existing systems is impractical because these systems are inappropriate but cannot be adopted quickly enough. It also assumes that innovative mechanisms can be assimilated quickly or that they can be imposed.

CHAPTER - IV

Tools and Techniques of Coastal Zone Management:

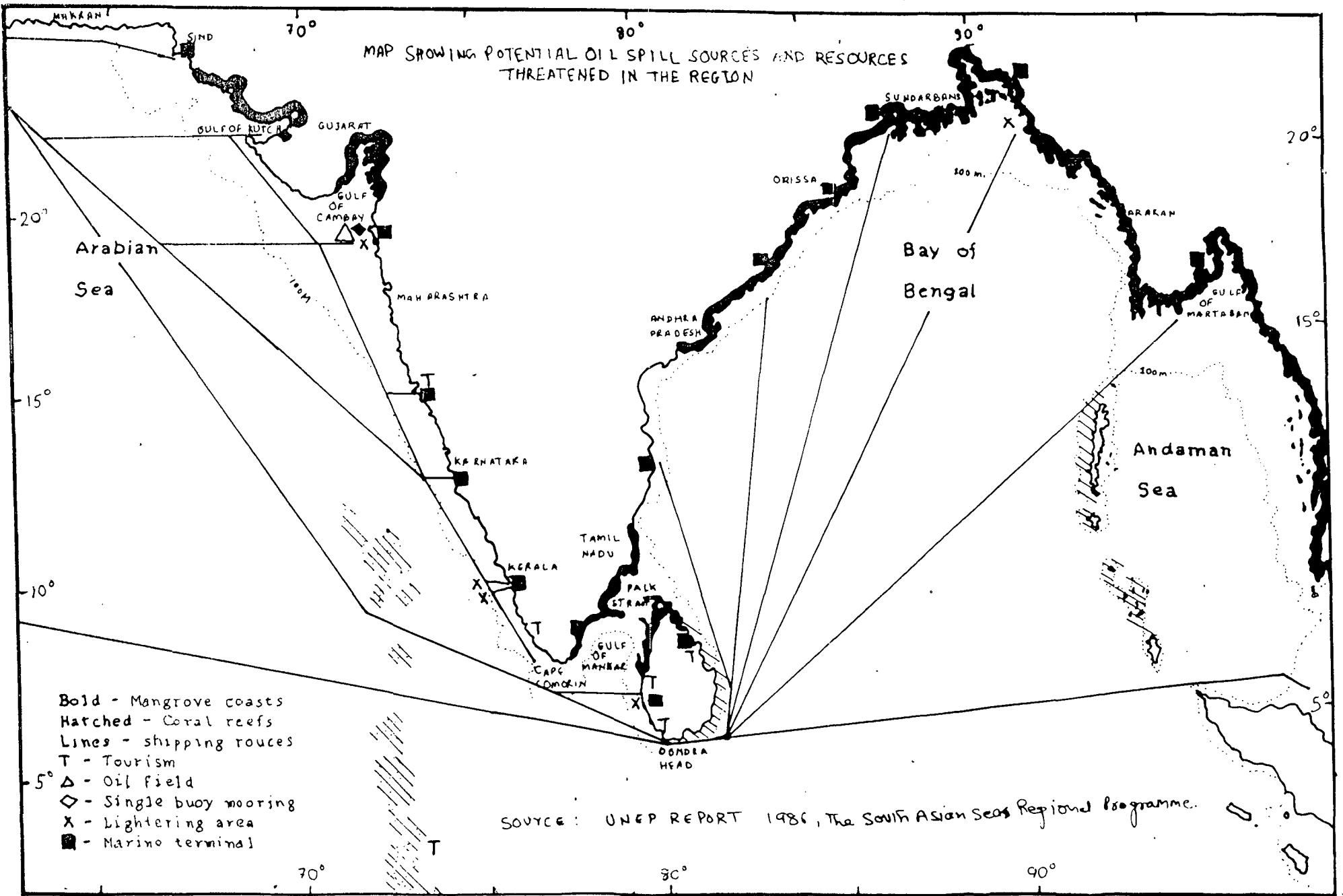
A Case Study of India

Out of the many gifts that nature has provided to India, three require special mention. These are the monsoon, which is unique phenomena for this region influencing the weather and climate of our country and on which the livelihood of millions of people depends, second, the Himalayas, which are young mountains and provide us a wealth of resources. They regulate the monsoon, give us our water supply, energy and a variety of other resources, many of them still untapped, the third important is the sea-coast to us, which is not only utilised for shipping and fishing but for various other activities. It is said that but for these three gifts, India would not have been able to sustain such a large population. If, these gifts are effectively used by us, the large increase in our population even in the future will not remain short of the life sustaining resources.

Marine environment in India has a great potential with a vast coastline of 7516 kms, 6th largest in the world, main land coastline accounts for 5422 kms. Lakshadweep's coast extends 132 kms, while Audaman and Nicobar Islands have a coastline of 1962 kms. India has an Exclusive Economic Zone

(EEZ) of 2,013,41089 kms, the main land including Lakshadweep accounting for 14,18,193 sq kms and Andaman and Nicobar Islands for 595,217 sq kms. India's total land area is a little more than that; Just above 2.9 million sq. kms. Fourteen major rivers discharge a huge quantity of fresh water along with about 12 billion tonnes of silt and nurture into the sea along the coastline. These conditions nurture the most-productive coastal ecosystems such as coral reefs, mangroves and sea grasses in our country. These ecosystem in turn nurture the sea, protect the land, stabilise the shore lines, maintain water clarity and provide the 'home' for fin-fish. If properly managed, shell fish, birds and other wildlife. These ecosystems could produce a huge annual yield of fish, shrimps, crabs and molluses of commercial importance.

The coastal main ecosystems are disturbed and threatened, encountering several produces like pollution, erosion, storm surges siltation and anthropogenic pressures. The crisis is mainly due to human activities. Nearly 60% of the human population which occupy the coastal zone, exploit the coastal resources. One serious problems today is the fast expanding prawn culture practices by sacrificing extensive paddy field and coastal ecosystems. It is feared that most of our shorelines will be denuded by the turn of



this century. We have already lost 50% of mangrove area of what existed a century ago. Some information is available on what is happening to sea-grasses and coral reefs along the vast Indian coastlines. The National Remote Sensing Agency has recorded a decline of 70,000 ha of mangroves in India within a six year period from 1975 to 1981. The fast depletion of mangroves has already caused soil erosion and significant fall in fishery resources.

4.1 Department of Ocean Development :-

With the enactment of the Maritime Zone Act 1976 and the Coast Guard Act 1978 and rapidly emerging new rules governing the Oceans, a persistent need was felt to have some continuing framework or institutional mechanism at the highest levels of the government that would enable us to intelligently organise our responses to and to chart out our strategy for, any questions arising in the realm of the law of the sea. The idea was to have within the nation. The ability to manage Ocean interests in an organized manner to ensure the best utilization of our national assets - that is, the navy, merchant marine, fisheries, and so on. With this avowed objective, two options were suggested: either to set up a full-fledged Department of Ocean Management under the Cabinet or the Prime Minister's Secretariat to deal with both the legal and policy aspects of all law of the sea

matters; or alternatively, to established a cell responsible for coordination, formulation and development of Ocean policy as a whole. In order to dispel any possible misapprehension or allay any reluctance on the part of the existing ministers or departments concerned with Ocean affairs, it was emphasized that the new department or the coordination cell would not take over any of the functions being performed by them but that the new set up could be a high powered body manned by experts to out as a think tank for various ocean related activities and to assist the ministries and departments in more effectively carrying out their functional responsibilities. The Cabinet Ultimately decided in July 1981 to set up a Department of Ocean Development Charged with the responsibility of determining policies regarding Ocean development, framing appropriate laws and regulations, overseeing technological developments, collaborations concerning living and non-living resources and soon.¹

Over the years, the programmes of the Department were formulated based on the Ocean Policy Statement of the Government the Allocation of Business Rules and activities

1. The Times of India, New Delhi editor Sept. 19, 1978.

specifically assigned by the Government. The main thrust areas identified in the Ocean Policy statement are:

a. Survey and exploration of living and non-living resources.

b. Sustainable exploitation of these resources

c. Harnessing of renewable energy from waves, tides and temperature differences in water column;

d. Technology development relating to instrumentation, material development, ocean data collection and anti erosion capabilities;

e. Protection and preservation of marine environment

f. Human resource development in scientific and technological programmes;

g. Institutional and infrastructural support like research vessels and reliable data and information systems.

The UN Convention on the law of the sea which came into force in 1994 provides for extended area of national Jurisdiction in the sea and increased based for exploration and exploitation of living and non-living resources even beyond Exclusive Economic zone in the continental shelf. The UN conference on Environment and Development of 1992 envisages integrated approach towards environment and

development as well as integrated coastal and marine area development and management. Consequent to the above, the Department has augmented and oriented its activities towards exploration and exploitation of marine living and non-living resources for the socio-economic benefits, protection of the marine environment and development and the use of the Ocean Science and Technology with the active participation and support of national R&D laboratories, education institutions and industries. The activities in the thrust areas relate to, one, developments with direct application to the welfare of the society such as integrated coastal and marine area management. Coastal community development Ocean information services, etc., second, developments in technologies relating to survey and exploration seated mingly and basic research in the Ocean Sciences Technology, human resource development Creation of Centre of Excellence in academic institutions and public awareness of the potential and uses of Ocean.

The major programmes and projects, implemented by the Department during the year 1995-1996 relating to a. Antarctic Programme, b. Polymetallic Nodules Programme, c. Coastal Zone and Island Programme, d. Marine Research and Manpower Development, e. infrastructure and ships and f. international co-operation.

4.2 Marine Area Management Scheme

The Department of Ocean Development (DOD) has launched a scheme for integrated coastal and marine area management, particularly in the context of the proposal to make it the nodal Department for the implementation of the Ocean Regulatory Zone (ORZ) notification.² A sum of Rs. 9 crores has been allocated in the union Budget for 1997-98, for the programme under which financial and technical assistance would be provided to coastal states for building up facilities and manpower training for the implementation of the ORZ notification. The scheme would include projects for assessment of the waste assimilation capacity of selected coastal areas and development of comprehensive guidelines for off-shore and coastal structures, ports and harbors, process industries, marine waste water disposal, tourism, berth and shallow water mining and agriculture activity.

A major benefit of the project is expected to be gain of an additional area of 1.5 million square km outside Economic Exclusive Zone (EEZ) for the country. It would be used for various purposes, such as exploration and exploitation of living and non-living resources, and has also proposed to launch a programme for assessment of marine

2. The Hindu, New Delhi Edition, March 26, 1997.

living resources beyond 50m depth in the EEZ and correlate fish abundance with ecological aspect, with a view to promote sustainable development and management of the resources and augmenting the sea food production.

4.3 Coastal Zone and Islands Programme

The programme on coastal zone and islands was started in India in 1985 with the objective of

- developing and maintaining data bases for assessment and of coastal zones, islands, exclusive economic zone and its resources including harnessing of wave energy,
- Conducting regular environmental assessment of the state of the environment of coastal and marine areas;
- developing marine resource potential of islands;
- technology demonstration in selection fields.

The programme has been structured into the following projects, with a sphere on development of relevant technologies.

- Marine Satellite Information Service (MAESIS)
- Coastal Ocean Monitoring and Prediction System (COMAPS)
- Wave Energy - integrated Break water system
- Island Development
- Sea level Monitoring and Modelling (SELMAM)
- International Geosphere Biosphere Programmes (IGPB) including Joint Global Ocean Flux Studies (JGOFS)

(i) Marine Satellite Information Service (MARSIS):

MARSIS programme, initiated in 1990 to develop capabilities for utilizing remote sensing technology for generation of useful Ocean and coastal data products and to disseminate them to the end users on an operational basis, was contained. Application Centre and Centre of Mathematical Modelling and Computer Simulations are participating in the programme. Five MARSIS Centres have been set up on the east coast and the west coast for interacting with down stream users achievements of this programme are:

- Generation of daily sea surface temperatures for Arabian sea, Bay of Bengal and Indian Ocean.
- Dissemination of potential fishing zone information of 174 fish landing centres.
- Development of wet land maps for Karantaka, Goa, Maharashtra and share - line Change maps for Goa, Gujarat and Andhra Pradesh.
- Completion of modelling on internal waves using the IRS and ERS - 1 data.
- Completion of a pilot project on the development of coastal zone information system (CZIS) for Rameswaran talk and Mahanadi Estuary mangrove region.

(ii) Coastal Ocean Monitoring and prediction system (COMAPS)

COMPAS is a continuing programme since 1991 for monitoring the health of our seas. Data Collected through this programme are essential to formulate remedial measures to protect the health of our marine environment. Depending upon the level and source of pollutants, 77 sampling station have identified, of which 32 have been classified as Hot-Spot Stations. Data on 25 environmental parameters including heavy metals and pesticide residues are being monitored. The institutions involved in the programme include National Institute of Oceanography (NIO) and its Regional Centres at Bombay, Cochin and Visakahapatnam etc. The details of state-wise locations where the levels of pollutants were monitored are given below with the intensively monitored areas as potential hotspot identified.

The results obtained have indicated the pollution was minimal. In general sea beyond one km from the coast was observed to be clean except of Bombay, where the sea beyond 2 km from coast was found to be free from pollution

(iii) Sea Level Monitoring and Modelling (SELMAM)

This programme was started in 1992 with an objective to areas variations in the sea level due to climatic changes and its impact on the coastal belt of India. The main aim of the programme were:

- Installation and commissioning of Modern tide gauges at Bombay, Porbonder, Goa, Cochin, Tuticorin, Madras, Machilipatnam, Visakhapatanam, Baradip, Calcutta and Kavaratti, for more aaurately measurement of tides.
- Establishment of tide data centre of survey of India, Dehradun.
- Networking of tide gauge stations using NICNET. .
- Preparation of 0.5 m Contour Internal Coastal maps of the stretch from Nellore to Machilipatnam.
- Development of predictive models on sea level variations, storm -surge, etc.

Major achievements of this programme that a new design of stilling well for tide gauge stations was fabricated and installed at Madras Port. A modelling project entitled "Sea-level analysis was conducted at survey of India, Dehradun, in collaboration with Intergovernmental Oceanographic Commission.

(iv) Joint Global Ocean Flux Study (JGOFS India)

The JGOFS is an established core programme of the International Biosphere - Geosphere Programme (IGBP) designed to determine carbon flux in the world oceans with a view to establish the role of ocean in governing atmospheric CO_2 , Content, in relation to climatic change. The Indian component of JGOFS was launched in 1993, to assess the

carbon flux in the Arabian Sea and to determine whether Arabian Sea acts as a source or sink for atmospheric Carbon dioxide. Under the programme four multi-disciplinary cruises were proposed to be conducted in the Arabian Sea, covering both South-West and North-West monsoon seasons.

The important findings of the programme were the surface primary productivity rates in the Arabian sea were high compared to other open ocean water. Nitrous oxide and Methane Concentrations in Surface water exhibit an increasing trend from South to North in the Arabian Sea. And sources of for atmospheric dust in Arabian sea are largely from the Indian sub-continent and Thar desert.

Other programmes taken up by the Department of Ocean Development for Coastal zone were

- Share to fishing vessel communication system.
- GPS - Cum - Fish Finder.
- Pearl Culture
- Island Development Programme.

In share to fishing vessel communication system under the Marine Instrumentation programme during 1992-93 with main objective of providing a communication for then safety at the sea. Without appropriate marine instrumentation for navigation in the sea and finding the fish schools, it will not be possible for the fisherman to judge the distance from

the shore and also to locate the fishing ground. The most important instruments required for this purpose are Global Positioning system (GPS) Navigator and a Fish Finder.

A societal programme for the production of cultured pearls by the local community, jointly with the Central Marine Fisheries Research Institu., Kochi, in eight coastal districts of Tamil Nadu and Kerala was initiated with a view to promoting commercial marine pearl system and supply them to Farmers regularly and provide technical assistance for growing the Oysters in the on-shore facilities. In order to have a good knowledge on the resources, ecology and environmental aspects of coastal and marine echo-system of the Andaman & Nicobar Island Groups, the Department of Ocean Development has been supporting a multi-disciplinary project-executed by various institutions. For co-ordinating these efforts and providing the working and instrumental facilities for Island based oceanographic studies to the scientists, a centre called Andaman & Nicobar centre for Ocean Development (AHCOD) has been set up at Port Btan.

4.4 The Role of Remote Scusing in Coastal Zone Management

The effective management of coastal zone requires information on extent and condition of coastal wetlands, coastal processes and water quality of coastal waters. Orbital remote seeing data have proved to be immensely

useful in generating information on these components. In India, Satellite data has been used wetland mapping, change detection, plant community identification, brackish water aquiculture site selection, coral reef mapping, shoreline change land term mapping, coastal salinity, impact of projected sea level rise on tidal wetlands and suspended sediment dynamics, widely.

The monitoring of coastal environment is very important as it influences various industrial, engineering, commercial and recreational activities taking place in this dynamic coastal zone. This environment is difficult to manage because of the complex variety of data required for decision making. In India, coastal zone is squaring an increasing importance in view of the pressure of population, exploitation of natural resources, viz. fisheries aquiculture, sea weed harvesting, sand mining, increasing load on labours due to depending Import-export trade, location of waste effluent disposal sites, development of various chemical, petrochemical, fertilizer and allied industries and above all petroleum exploration activities in this are. Important factors which influence these activities area the extent, condition and production potential of wetland, geographic processes viz. erosion

deposition and sediment transport, and degree of pollution in coastal waters.

Data generated remotely may be recorded in either digital or photographic form. Remotely sensed data that are not camera based are usually in digital form and typically are stored in computer compatible tapes. These are processed through the use of image processing systems which are particularly used in conjunction with satellite imagery. In India it is IRS series of satellite and Landsat TM dates are used widely for coastal wetlands coastal processes and temperature/Salinity (Water quality).

For nation wide mapping of coastal wetlands IRS LISS II and landsat TM data were Found to be extremely useful in discriminating between categories. viz. between mangroves and sea weeds and improved delineation of high and low water lines. These study helped in standardizing classification system, methodology, map representation scheme and image interpretation key (Nayak et al, 1991).³ At the instance of the Ministry of Environment and Forest, the Development of space had launched a nation wide mapping inventory of

3. Desai P.S., A Nariain etc. IRSIA applications for coastal and Marine resources. Current Sciences. 61 (384), 204-208.

coastal wetland rising land sat TM/IRSIISS II data on 1:250,000 scale.

Major Findings of Coastal Characteristics I

Coast	Categories. Characteristics of Coast
Gujrat Coast	extensive mudflats
Maharashtra Coast	rocky cliffs & Pocket beaches
Goa Coast	wide beaches
Karnataka coast	long beaches and spectacular spits
Kerala Coast	backwaters/Kayals
Tamil Nadu coast	extensive duenes
Andhra Coast	mainly delatic in nature
Orissa coast	partly deltic and has an extensive lagoon
West Bengal Coast	mangroves
Lakashdweep islands	mostly atolls
Andamans and Nicobar's	both mangrove/extensive fringirteets's

Coastal Land use mapping of Brackish water Aquiculture site selection

Recognizing the prawn exports have tremendous potential, the Ministry Agriculture, Govt. of India, requested the Department space to undertake preparation of coastal land use maps on 1 : 50,000 scale Using IRS LISS II data for brackish water aquiculture site selection for the

entire country's coastline. Wetland features indicating presence of flat, creeks, lagoons, estuaries, salt pans, aquiculture ponds and other land use categories like barren area agriculture, forest plantations etc have been democrated. The land use/wetland information has been used for evaluating water quality of the surrounding coastal waters as this information was not available in most of the cases.⁴

Coral Reef Mapping :

At the instance of Dept. of Ocean Development Govt. of India, the Dept of space has taken up preparation of Thematic coral reef maps on 15,0000 scale for the Indian coast. The knowledge about extent and condition of coal reef will help to plan preventive and conservative measures to protect this fragile system. IRS LISS II and SPOT data was visually analyzed to map coral reef features such as type of coral reefs, and sand/beach vegetation, algae, sea grass, Bea Weeds type low water lines. This mapping has been carried out in the Gulf of Kachch, Gulf of Manner, Lakshdweep islands and Andamans and Nicobar Islands.

4. Mayak. S, Bahuguna A. (1992), Application of IRS data for Brackish. Water Site Selection. In the Proc. of the National Synp. On REMOTE Sensing or sustainable Development ISRS, Lucknow, pp. 395-399.

Major findings of this programme were as followings.⁵

- a. Gulf of Karhehh Characteristics of coral reefs. Mostly fringing reefs with a few platform Patch, and atoll reefs and Crol Pinnacles. In degraded conditions.
- b. The Palk Bay has a single fringing reef with narrow and barren reef area. Reefs destroyed on account of their areas construction material. The reef flat is extensive and with dense reef vegetarian.
- c. Lakshdweep Mostly atolls with few coral pinnaches.
- d. Andaman & Nicobar Island Mostly finding reef with narrow area. New Coral growth mapped near the Wandoor National Park. Mud deposit found on reef area near Port Btain, Navy bay, Flat Bay etc.

Plant Community Identification :-

Various digital enhancement techniques were attempted for identifying different plant communities using satellite data in the Navalakhi - Kandla, Sikka, Alibet areas on the Karnataka coast (Sahav, 1985).⁶ It was possible to

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5. Sahai B, 1985. Coastal Geomonophology: A case study in the Gulf of Khambhat (Combay) Inter. J. Remote Sensing 6(384) : 559-568.
 6. Nayak. S. and Manikiam B. 1992. IRS-IA applications for coastal zone management in the Natural. Resource Management - A new perspective NHRMS, Banglore pp-181-189.

distinguish mangrove from marsh' vegetarian. The combinations of red, vegetation index and infrared bands also helps in distinguishing between mangroves, swamps and other vegetation in the wet land zone. For example on the Karnataka coast edge enhancement FCC Green, red, infrared) was found to be useful for wetland studies.

Land Form Studies and Coastal Salinity:

The study of land forms gives due to the processes operating in an area. They are best studied on area areail photographs in conjunction with topographical maps. Coastal landform map of the Gulf of Khambhat on 1:250,000 scale using landsat TM/IRSLISS II FCC was prepared. It was possible to delineate high tide flats, intertidal slopes, substidal zone, mangroves, dunes relict, alluvium area etc.⁷

The coastal belt around the Gulf of Khambhat, covering park of the district of Bhavnagar, Surendranagar, Ahmedabad Vadodara, Kheda, Valsad, is severely affected by Salinity. The salinity is ether inherent in nature or due to tidal ingess. This work was carried out for the export's committee appointed by the Govt. of Gujrat to study problem of coastal salinity and to suggest measures to deal with

7. Chauhan H.B. 1985. Monitoring of Wetland and shore line on the part of Gujrat coast unusing landsat data in the Proc. of the 6th Asian Conf. on Remote Sensing Hyderabad pp.348-353.

these problem using pre and post monsoon images of Land Sat TM (1986). The salt encrustations and saline areas, slightly saline areas and non-saline areas correlated well with soil having. Ec more that 2 mm hus, 1-2 mmhou and less than 1 mm hus (1:2 soils : Water extract). It was observed that 0.9 M ha area has been affected by Salinity. The classification accuracy of there maps was 90%.⁸

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8. Bapat, M.V. 1987 application of landsat data for mapping the coastal Saline belt around the Gulf of Khambhat in the proc of the National symp on land Transformation and Management, ISRS. Hyderbad pp.59.64.

CHAPTER - V

COASTAL REGULATION ZONE (1991) IN INDIA : A CRITICAL REVIEW

The environment in Developing Countries has to be understood in the context of overall development and well-being of the people. Development should not be viewed as being anti-environment. A proper symbiotic relationship should be built between environment and development. If a development scheme does not meet the environmental standards, the proper answer is to look for alternative approaches and not to give up the scheme altogether. While it is recognised that the organised industry is slowly disciplining itself in following proper environmental standards, it is the effluents from unorganised and small scale industry in sectors like chemicals, leather, textile etc. and the huge quantity of domestic wastes from municipal corporations and other local bodies which are posing a threat to the coastal and marine areas. There is need for adequate political and administrative will to enforce discipline in these sectors.

The coastal zone, which constitutes some of the world's most productive areas providing valuable marine resources is very important to the national economy. The increasing population is imposing considerable stress on the coastal

and marine environment. A proper approach to effectively manage the coastal and marine environment requires detailed information with regard to water quality, sediment quality and biological characteristics of the intertidal and near shore coastal water.

In 1981, then Indian Prime Minister Mrs. Indira Gandhi declared a distance of 500 metres from the coastline as a no development area'. This directive was generally ignored and unregulated development was allowed all along the coast. But we have several regulations and notifications aimed at the management of the coastal zone. The important ones are:

- general standards for discharge of waste waters in marine coastal area (1993)
- notifications declaring certain coastal localities as marine sanctuary or marine national park,
- notification declaring coastal stretches as Coastal Regulatory Zone (CRZ) and regulating activities in CRZ (1991, 1994)
- environmental impact assessment notification (1994) and
- Indian parts Acts (1963).

5.1 A Brief Review of Coastal Regulation Zone 1991 :-

Recognising the importance of the coastal ecosystem which has received international significance and finds place in Agenda 21 of the Rio convention, the Government of

India, by a notification dated 19.02.1991, laid down parameters for the development that is permissible in coastal areas up to 500 metres from high-tide time. Thus, the Coastal Zone Regulation is nothing more than a piece of legislation passed in the year 1991.

There were three important parts of this notification:

- Coastal Regulation zone Notification
- Coastal Area classification and development Regulation
- Guidelines for Development of Beaches Resorts/Hotels in the Designated Area of CRZ III.

But the important, here, are first two.

The first part

- is divided into four parts i.e. a notification,
- prohibited Activities,
- Regulation of Permissible Activities and
- procedure for monitoring and enforcement.

The important thing in Notification is the defining the no activity zone within the 500 metres from High Tide line (HTL) as defined by Ministry of Environment & Forests :

"... and all other powers resting in its behalf, the Central Government hereby declares the coastal, stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by Tidal action (in the landward side) up to 500 meters from the High Tide line and the HTL as coastal

Regulation zone, and imposes with effect from the date of this notification, the following restrictions on the setting up and expansion of industries, operations or processes etc. In the said coastal regulation zone (CRZ). For the purpose of this Notification, the High Tide Line will be defined as the line up to which the highest high die reaches at spring tides...".¹

This statement is the basis for the preparing the coastal zone management plans. The following activities were declared as prohibited with the coastal regulation zone i.e. setting up of new industries, and expansion of existing industries, manufacture or handling or storage or disposal of hazards substances as specified, setting up and expansion of fish processing units including warehousing, dumping of city or town waste for the purposes of landfilling or other wise, the existing practice mining of sand, rocks and other substrata materials, except those rare minerals not available outside the CRZ areas harvesting of drawl of ground water and construction of mechanisms therefore within 200 m of HTL, in the 200 m to 500 m zone, construction activities etc.

1. Coastal Regulation zone Notification, 1991, Ministry of Environment and Forests, Govt. of India, New Delhi - India.

In the Regulation of Permissible Activities it is the authority of minister of Environment and forests, Govt. of India, to give the clearance for any prohibited activity. Even clearance will require can construction activities related to Defence requirements. Very special cases, like operational constructions for posts and harbours and light hourse thermal power plant, have will also require the permission from govt. of India.

Another important aspect of coastal Regulation zone Notification is that it directs the coastal states and UT Administrations, which shall prepare, within a period of one year from the data of this notification coastal zone management Plan identifying and classifying the CRZ areas. The ministry of Environment & Forest and the Government of state or Union Territory and such other authorities at the state o Union Territory levels, as may be designated for this purpose shall be responsible for monitoring and enforcement of the provisions of notification within their respective jurisdictions.²

Second part of Notification deals with the classification of Coastal Regulation Zone the first part of Coastal Regulation Zone is CRZ = I - is environmentally

2. Ibid. I

sensitive areas, such as National Parks, Coral/Coral reefs etc. and the area between the low Tide line and the High Tide Line.

Category - II of CRZ deals with the Urban/built up areas, and category III of CRZ is areas that are relatively undisturbed and those which do not belong to either category I or II. i.e. rural area.

Category I or II. i.e. rural areas.

Category - IV of CRZ is coastal states in the Andman, Nicobar, Lakshadweep and small islands.

Then, there certain norms for Regulation of Activities in each category of CRZ for CRZ-I, it is the no new construction shall be permitted within 500 metres of High Tide Line. The important one is of CRZ-III, the area up to 200 metres from the High Tide Line is to be earmarked as 'No Development Zone' and development of vacant plot between 200 to 500 metres of High Tide Line in designated areas of CRZ-III with prior approval of Ministry of Environment & Forest permission for construction. Another aspect of norm is that the building permission for construction will be subject to the conditions that the total numbers of dwelling units shall not be more than twice the number of existing units, total number of dwelling units shall not be more than twice the number of existing units, total covered area on all floor

shall not exceed 33 percent of the plot size, the overall height of construction shall not exceed 9 metres and construction shall not be more than 2 floor (ground floor plus first floor).

While the CRZ IV for Andman and Nicovar Islands and Lakshadweep Islands the norms remains same as in the CRZ - III except the total covered area on all floors shall not be more than 50% of the total size and corals and sands from the beaches and coastal waters shall no be used for construction and other purpose. No blasting activities in and around the coral formation.

Where as in August 16, 1994 there was slightly modification in the Coastal Regulation Zone by Ministry of Environment and Forest at two points.

- The demarcation of High Tide Line.
- Construction with in 200 metres of Coast.

In the First point it says that,

"... for the purposes of this notification, the High Tide Line means the live on the land upto which the highest water line reaches during the spring trade and shall be demarcated uniformly in all parts of country by the demarcating authority so authorised by the central

government in consultation with the Surveyor General of India...."³

Another aspect which is also differ from the earlier is that the distance from the High Tide Line shall apply to both sides in the case of rivers, creeks and back waters and may be modified on a case by case basis for reasons to be recorded while preparing the Coastal Zone Management Plans. However, this distance shall not be less than 50 metres or less and in earlier export this distance was 100 metres.

On the second point, where earlier there was 'No Development Zone' within the 200 metres But it was slightly changed in this report saying.

"Provided that the central government may after taking into amount geographical features and overall Coastal Zone Management Plans and for reasons to be recorded in writing, permit any construction subject to such candidates and restrictions as it may deem fit."

And there were slightly addition that live fensicing and barbed wire fencing with vegetation cover around private properties, no flattering of sand dunes, no permanent structures for sports facilities and construction of

3. The Gazette of India, Part II, section 3, subsection II Aug. 16, 1994, Ministry of Environment and Forest, Govt. of India, New Delhi, India, pp.3.

basements may be allowed with a no objection certificate from the ground water Authority.

5.2 The Problem of Implementation of Coastal Zone Regulation

As from above, Coastal Status/UTs are required to prepare Coastal Zone Management Plans (CRZMPs) as per the provisions of the Coastal Regulation Zone Notification (1991) identifying and categorising the coastal zones for different activities and submit it to the ministry for approval. The ministry has constituted a Task Force and needed to be modified. The Govt. of Orissa has submitted a partial plan covering only a part of coastal area. By West Bengal, a partial plan covering only a part of coastal area. By West Bengal, a preliminary concept document of the CZMP has been submitted. Revised CZMP/Clarifications have been received from the state of Goa and UTs of Daman and Diu, Lakshwadweep and Andaman & Nicobar Island.⁴

Even the implementation of CRZ Plan Notification is having problem in the states and Uts. An Amendment made in 1994 made it even less effective. In April 1996, the Supreme Court has stuck down some of the amendments and in final judgment it scrapped the 1994 amendments. Thus it is only CRZ notification of 1991 is valid now.

4. Annual Report 1995-96, Ministry of Environment and Forest Government of India, New Delhi, India, pp.58.

There are two views hanging around the future of CRZ Notification in almost all coastal states and UTs Andhra Tamil Nadu and Kerala. One view is that the restriction on setting up of industries in the coastal zone mentioned in the coastal Regulation Negative. Infact, all the states feel that CRZ itself is negative. They feel that its focus should be more on planing and development. However, environmentalists and others feel that negative laws are also essential. Case of Tamil Nadu and Kerala states can be analysed in implementation of CRZ Notification.

State of Tamil Nadu : The state of Tamil Nadu has prepared and submitted its Coastal Zone Management Plan (CZMP) which is now pending with the Ministry of Environment and forests for approval, as reported in its Annual Report 1995-96.⁵ Various NGOs Consumer Action Group (CAG), Madras, the Campaign Against Shrimp Industries. The Human Rights Foundation, Madras, Legal Resources, for social Action (LRSA) and other concerned citizens, culminated in formation of the Coastal Action Network (CAN) which decided to address the various short comings of the Plan to the Ministry of

5. Ibid. I

Environment & Forest. Various shortcomings according to them were;⁶

a. The entire Tamil Nadu CZMP made no mention of the problems caused by aquaculture on the Tamil Nadu Coast.

"While it openly supports the establishment of aquaculture farms thus displaying insensitivity to the problems caused by aquaculture.

b. Demographic data provided in the plan also did not reflect to villages in the interior.

c. Plan also made no mention on check on letting out their effluents of several industries and refineries along the coast no special prescribed measures.

d. The plan did not suggest any steps for tackling erosion caused by developments such as construction of ports, Jetties etc.

And in spite of this Govt. has permitted large projects to come up from 1991 within the Coastal Zone Regulation Area. This shows Govt. lacunas weakness in knowing the ground realities. At the very minimum the government should conduct a physical verification and provide comprehensive data as to what developments exist as of today on the coast and provide such information in the plan.

6. Ibid. I

CRZ in the State of Kerala:

The Coastal Regulation Zone Notification in Kerala has drawn opposition from certain political parties and interest groups in the state. There is, in fact, intense lobbying now for scuttling the rules by vested interests in the state. The present move by a section of the business lobby in Kerala to do away with the CRZ rules should be viewed seriously taking into account the state's ecological, economic, and political background. The arguments for exempting Kerala from implementing the relevant provisions of the coastal regulation zone are predictably based on the perceived curtail in the 'construction sector' in the coastal, backwater and river side areas and the resulting loss of employment to the coastal people. The adverse consequences of a freeze on multistory building and other commercial structures within the 500 metre zone are projected by many of the 'Kerala model' of developers as devastating. They have dubbed the move as anti-coastal, anti-touristic, anti-developmental.⁷

While Division Bench of the Kerala High Court on March 25, 1997, stayed the operation of some parts of the CRZ, all of which related to backwaters and rivers influenced by

7. Korakandy R. (1997) : Coastal Zone Management A Must For Kerala, Southern Economist Vol. 35, No. 18, pp.25.

tidal action.⁸ In the petition, the petitioners have challenged the inclusion of backwaters and rivers in the CRZ notification. Actually, when the draft notification was published, rivers and backwaters had not been included in the CRZ. However, the Central Government had later incorporated rivers and backwaters in the final notification in 1994. Which had scrapped by the Supreme Court of India in 1996. They are pointing out that as far as Kerala was concerned, the CRZ notification had far reaching consequences because of its peculiar geographic position, which is quite distinct from the rest of the country. Had it been that the land on either side of tidal rivers and around backwaters in the state were going to be included in the CRZ, the state and many affected persons could have highlighted the difficulties arising out of such inclusion. It had been pointed out that if the notification was implemented, no activities would be possible in the islands in the state like Thanthanni, Vypeen, Kadamakkudi etc. because no place in these islands would be beyond 500 metres of the HTL. Besides, they said, the people would not be able to put up even a shed in these islands.

CRZ is facing similar kind of problems in other state like Andhra Pradesh, Orissa, Goa. They have also challenged CRZ Notification in courts and are trying to make it dilute.

8. The Hindu, New Delhi Edition, March 26, 1997.

CHAPTER - VI

CONCLUSION

The coastal zone constitutes a complex ecosystem. It is viewed as a unique resource which is of great importance to humanity. The multiple use of resources on the coastal zone has leading there by to conflicting demands for the exploitation of the various coastal resources by different interest groups and user agencies all over the world. 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 environment. Thus, there is consequently a need for a comprehensive coastal planning and management for better and effective utilisation 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.

The governance arrangement for the management of coastal zones can be classified according to their focus, strength of national control and policy orientation

(Sorensen and Mc Creary, 1990).¹ Such classifications help advance the practice of CZM by allowing comparative assessments of natural coastal management efforts, there by aiding the identification of the pre-conditions for adoption of programme components that have met with significant success. There can be two more categories more than Soresan and Mc Creary classification. First, the policy of sustainable management of coastal assets, such as is embodied in Coastal Regulation Zone Notification (1991). Second, the strength of environmental concerns being manifest in the 1990s, including the 1992 Earth Summit, have resulted in increasing commitment to creation of cross-sectoral environmental management units. Such units coordinate the development and planning initiative of existing sectoral government agencies, Bangladesh have in 1992 recommended the establishment of such units.

Analysis of the administrative systems for the management of coastal zones in the region give an indication of the extent to which integrated approaches have been adopted, or the potential for adoption. However, such

1. Sorensen, J.C. and Mc Creay, S.T. (1990), "Institutional Arrangements for Managing Coastal Resources and Environments" 'Renewable Resources Information Series No I, University of Rhode Islands, Marragansett., 2nd ed., 194pp.

effective methods for managing coastal zones in a regionally and nationally applicable manner. Specifically, a coastal nation or territory may have comprehensive national strategies for coastal zone management, but because of implementation problems, these strategies are ineffective. There are three main categories on which analysis of the effectiveness of a nation's CZM strategy should concentrate. These are:

1. Administrative efficiency;
2. Implementation effectiveness; and
3. Variance Potential

Administrative efficiency and effectiveness is influenced significantly by the governance arrangement. Of the three factors listed above, the effectiveness of CZM strategy implementation is often the most difficult to determine. But its considerable variation from country to country makes such comparative studies worthwhile. The reasons for the lack of policy effectiveness include:²

- lack of clear political mandate;
- lack of local community consultation;

2. IPCC (Intergovernmental Panel on Climate Change) Coastal zone management subgroup (1992) 'Global Climate Change and the Rising Challenge of the Sea', Ministry of Transport and Public Works, The Hague the Netherlands, 35pp.

- poor linkages between national and regional local/or community level decision making; and
- ineffective policing and monitoring of policy implementation.

Take the case of Srilanka and India in South Asian Countries. The Government of Sri Lanka has emphasises on "Community understanding and support of the management programme is essential for effective implementation. Hence, the means for effective community participation in the design of management strategies and in implementation activities. The means of community participation in the design of management strategies and in implementation activities. The means of community participation are likely to take different forms depending on the resource management issues and the degree of community interest".I And the other part of coastal zone management plan says that,"the coastal zone is the common heritage of the nation to which every citizen has right of access". So it is state as well as individual responsibility to know these limits while using coastal zone. Thus the Sri Lankan Government is seeking public participation first and moving towards making laws to protect. An effective strategy indeed.

While in India, the implementation of Coastal zone Regulation 1991, the Government is finding difficulty, as

discussed in chapter 4. What Indian policies regarding coastal zone management lacking is effective community participation or organising the local public in effective management. This can be done by providing them environmental education programmes through seminars, workshops, publications papers, reports, films etc., or, Most effective these days, through NGOs.

Another aspect which seems to be most important in Indian case is its vast and diversified size and needed a broad classification of coastal problems and defining them properly. This task can be done by recent geographical information system etc. By making different maps then going to the site, and properly analysing the depth of problem and then making proper specific treatment for specific coastal area.

Here are the prominent areas of ecological stress in India are:

- (a) Gulf of Kutch and the coast of Gujarat face the problems of the natural sedimentation due to erosion of the coast, deposition of wind born sand, dredging of the soil for industrial ore, pollution from salt pans, destruction of mangroves for firewood and fodder.
- (b) West Coast of India from Bombay to Kerala face disturbances due to oil drilling, oil spill from

tankers, pollution from industries, run off from up lands, invasion of "Salvinia" as in Kerala, destruction of Mangroves, exploitation of fossil and living bivalves and dredging for deepening the navigation channel.

- (c) Gulf of Mannar and Palk Bay along the south-east coast
Quarrying of corals for industrial ore has resulted in partial to total destruction of fringing reefs in the area. At present the area is declared as a Marine Park and total ban on quarrying of corals has been imposed.
- (d) Maldives, Tamil Nadu, Andhra Pradesh, Orissa and Bengal Coast face problems of severe cyclonic destructions, erosions, pollution, Mangroves destruction etc.
- (e) Lakshadweep: Excessive siltation in lagoons. Blasting of the lagoon reefs and dredging of lagoons. Construction along the coast. Deforestation in Minicoy.

Here, what my humble submission in this study is that each state in India has its own peculiar geographic position and characteristics which are quite distinct from each other hence, they need a specific management program or even bytaking each coastal district by going in detail. Here it becomes clear that you cannot impose a general law on each state.

In Kerala, for example, the provisions of the coastal zone Regulation (1991) has drawn opposition from various political parties and interest groups because they have dubbed the more as anti-coastal, anti-touristic and anti-developmental land perceived curtailment in the 'Construction Sector' in the coastal backwater and riverside areas and the resulting loss of employment to the coastal people. While in the Andhra Pradesh and Tamil Nadu it is the Aquaculture and shrimp farming which are creating problem between the Government, rules and the local people which again are mixing with the section of business lobby and then challenging the rules in the courts. And hence making the task more complex.

In Pakistan, the task of managing the coastal zone is still far away. The main problem is lack of relevant data and information and policy making. The existing political system such as feudal and tribal system along Baluchistan and Sind coast are resisting changes in their living conditions and styles. Lack of funds is another aspect which comes in the way to the management plans.

Bangladesh and Maldives propose has been slow in almost all areas of coasts due to the lack of expertise and funds for implementation and lack of infrastructure and

institutional framework. While in Sri Lanka the management work is in excellent progress. They have taken care of coastal zone with the help of World bank, IMF, Private agencies, People participation, Government agencies, NGOs.

10. Coastal zone management

Thus, in the context of the large and increasing population living in the coastal zone, and the addition of large areas in the form of the EEZ, there is obvious need for integrated coastal zone management (ICZM).

However, many authorities have jurisdiction in the coastal zone including the EEZ. In India, there is the Central Government, 10 States (Gujarat, Maharashtra, Goa, Karnataka, Kerala, Pondicherry, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal), 2 island territories (Andaman and Nicobar, and Lakshadweep) and a host of local authorities including panchayats, municipal corporations and port authorities. Besides, functionally, the work in all these authorities is fragmented into various ministries and departments.

ICZM thus faced many problems of an institutional nature. To meet this problem the following measures are suggested.

- * A Commission or Task Force should be established by the Central Government in consultation with the concerned States to hold dialogue with all concerned and thereafter make recommendations regarding the institutional and other steps necessary to optimise development of the coastal zone and the EEZ. The recommendations of the Commission could thereafter be considered by the National Development Council.
- * A National Institute for Coastal Zone Management could be set up to continuously develop ideas based on the oceanic, technological, managerial and other research being carried out in the country.
- * We should have a national registry of events like accidents which happen on the Oceans and the Coastal Zone.
- * Long stretches of the coast could be placed under one authority so that strategic planning for the concerned zone takes place.
- * A National Coastal Mapping Agency should be set up to bring out standard maps of coastal zones, including EEZ, regarding topography, resources etc. The Agency

should coordinate the work of Survey of India, Geological Survey of India, National Institute of Oceanography etc.

- * Strategic planning is necessary for coastal zone as a unit. Projects should be considered together for a zone and not individually.

Finally, one should keep in mind that :

*We must remember that
we are not the creators of the oceans,
we are mere users of these resources.*

BIBLIOGRAPHY

- Agarwal, A. and S. Narain (eds.) 1985; The State of India's environmental 1984-85. Centre for Science and Environment, New Delhi, 398pp.
- Ahmad, Y.J. and G.R. Sammy. 1985. Guide lines to Environmental Impact Assessment in Developing Countries. Hodder and Stoughton, London. 52 pp.
- AID/NOAA: Coastal Resource Management Assessment, 1983, Sri Lanka, Unpublished Sector report, November 28, 1983, 12pp.
- Alam, M. 1990-91; Geotectonic and subsidence of the Ganga-Brahmaputra Delta of Bangladesh and accompanied drainage sedimentation and salinity problem. In J.D. Million and S. Sabhasie (eds.) Sea level rise and coastal subsidence: Problems and strategies, John Wiley & Sons, New York.
- Amarasinghe, S.R., H.J.M. Wickremeratne, and G.K. Lowry, Jr. 1987. Coastal zone management in Sri Lanka 1978-1986. In: Coastal Zone '87. Vol. III. American Society of Civil Engineers, New York, Pp. 2822-2841.
- Amarasinghe, S.R. and H.J.M. Wickremeratne. 1983. The evolution and implementation of legislation for coastal zone management in a developing country-The Sri Lankan experience. In: Coastal Zone '83, Vol. III. American Society of Civil Engineers, New York. Pp. 2822-2841.
- Amaratunga Carol: Coastal Zone Management in Sri Lanka A case study, Second International Conference on Science and the Management of Protected Area (SAMPAA), Coastal Conservation Advisory Council of Sri Lanka 23-25th April, 1994.

- Annual Report (1995-96): Department of Ocean Development, Government of India, New Delhi, India.
- Annual Report (1995-96): Ministry of Environment and Forests, Government of India, New Delhi, India.
- ASPO. 1972. Regulations for Flood Plains. Am. Soc. of Planning Officials, Advisory No.277.
- Bascom, W. 1974. The disposal of waste in the ocean. Scientific American. Vol.231, August 1974.
- Bigford, T.E. 1991, Sea-level rise, nearshore fisheries, and the fishing industry. Coastal Management, vol. 19. Pp. 417-437.
- Biswas, A.K. (1987); Environmental Concerns in Pakistan, with special reference to water and forests. Environmental Conservation 14(4): 319-328.
- Brown, B.E. and R.P. Dunne (1988); The Environmental Impact of Coral mining on coral reefs in the Maldives. Environmental Conservation 15(2): 159-166.
- Burbridge, P.R. and J.E. Maragos. 1985. Analysis of Environmental Assessment and Coastal Resources Management Needs (Indonesia). International Institute for Environmental Development, Washington, D.C. (Draft report)
- Burbridge, P.R. and Koesoebiona. 1981. Coastal zone management in Southeast Asia. In: Southeast Asia Seas: Frontiers for Development. McGraw-Hill. Pp. 110-135.
- Burbridge, P.R.N. Dankers, and J.R. Clark. 1989. Multiple-use assessment for coastal management. In: Coastal Zone '89 Vol. I, American Society of Civil Engineers, New York. Pp.35-45.

- Burgett, J. 1991. Diving deeper into Hanauma: identifying conceptual barriers to effective management. Resources Research & Development Institute, Newport, Oregon, USA. Pp. 100-105.
- Cambers, G. 1985 An Overview of Coastal Zone Management in Six East Caribbean Islands. U.N. Educational, Scientific and Cultural Organization office for Science and Technology, Montevideo. 69 pp.
- CCD. 1990. Coastal Zone Management Plan. Sri Lanka Coast Conservation Department, Colombo, Sri Lanka. 100 pp.
- Chapman, C. 1983. Freshwater discharge. In: Coastal Ecosystems Management: A Technical Manual for the Conservation of Coastal Zone Resources. J.R. Clark (Ed.), Robt. E. Krieger Publishing Co., Melbourne, FL. Pp. 634-639.
- Chaverri, R. 1989. Coastal management: the Costa Rica experience. In: Coastal Zone '87, Vol. V. American Society of Civil Engineers, New York. Pp.5273-5285.
- Chong, K.C. and I. Manwan. 1987. Incorporating integrated rural development into coastal resources use and management. In: Studi Kasus Penelitian Agro-ekosistem. KEPAS. Badan penelitian dan Pemegambang Pertanian, Jakarta. Pp.131-169.
- Choudhury, A.K. 1987. Climatology of the estuarine region of West Bengal. U.N. Educational, Scientific and Cultural Organization training course (Calcutta). Wildlife Institute of India, Dehradun. Pp. 63-73.
- Chua, T.E. 1986. Managing ASEAN coastal resources. Tropical Coastal Area management, Vol. 1. No. 1, International Centre for Living Aquatic Resources Management, Manila. Pp.8-10.

- Chua, T.E. and A.T. White 1988. Policy recommendations for coastal area management in the ASEAN region. ICLARM Contributions, No. 544. Pp. 5-7.
- Chua, T.E. and L.F. Scura. 1992. Integrative Framework and Methods for Coastal Area management. International Centre for Living Aquatic Resources Management, Manila. 169 pp.
- Claridge, G. 1988. Assessing development proposals. In: Coral Reef Management Handbook, Kenchington, R.A. and B.E.T. Hudson (Eds.). UNESCO Regional Office for Science and Technology for Southeast Asia, Jakarta. Pp. 131-138.
- Clark, J.R. 1983. Coastal Ecosystems Management: A Technical manual for the Conservation of Coastal Zone Resources. Robert E. Krieger Publishing Co., Melbourne, Fla. (First edition by John Wiley-Interscience, New York, 1977). 928 pp.
- Clark, J.R. 1990. Evaluation of Khulna Embankment Rehabilitation Project. Report submitted to UNDP/Asian Development Bank, Dhaka, Bangladesh. 41 pp. plus Figures and Annexes.
- Clark, J.R. 1990. Management of environment and natural disasters in coastal zones. Paper presented at Colloquium on the Environment and Natural Disaster Management, World Bank, Washington, D.C., June 1990. 20 pp.
- Clark, J.R. 1992. Carrying capacity and tourism in coastal and marine areas. Parks Magazine, Vol. 2, No. 3. Pp. 13-17. (Reprinted in Marine Parks Journal, 95, Mar. 1992, Tokyo).
- Clark, J.R. 1992. Integrated Management of Coastal Zones. FAO Fisheries Technical Paper No. 327. United Nations/FAO, Rome. 167 pp.
- Clark, J.R. (Ed.). 1985. Coastal Resources Management: Development Case Studies. Coastal Management Publication No. 3, NPS/AID Series, Research Planning Institute, Columbia, S.C. 749 pp.

- Clark, J.R. (Ed.). 1991. The Status of Integrated Coastal Zone Management: A Global Assessment. CAMPNET, University of Miami/RSMAS. Miami, Fla. 73 pp.
- Clark, J.R.J. Sorensen, and G. Schultink. 1983. Integrated Coastal Zone Management Strategy. Tropical Resources and Development, Inc., Gainesville, Fla. Report to UNDP and Planning Commission of Bangladesh, Dhaka 62 pp.
- Clark, J.R. 1985. Recommendations for a Combined Coastal Management and Protected Areas Program for the Saudi Arabia Red Sea Coast. Summary Report submitted to the International Union for the Conservation of Nature, Gland (Switzerland) by the National Park Service (USA), Washington, D.C. 63 pp.
- Classen, D. B. van R. and P.A. Pirazzoli. 1988. Remote sensing: a tool for management. In: Coral Reef Management Handbook, Kenchington, R.A. and B.E.T. Hudson (Eds.), United Nations, UNESCO Regional Office for Science and Technology for South-East Asia, Jakarta. Pp. 69-88.
- Coetzee, M.D. 1991. The importance of public participation in coastal management. In: The Status of Integrated Coastal Zone Management: A Global Assessment, Clark, J.R. (Ed.). CAMPNET/University of Miami/RSMAS, Miami, Fla. Pp. 29-30.
- Dahuri, R. 1991. The Need for Integrated Coastal Resource Management. In: The Status of Integrated Coastal Zone Management: A Global Assessment, Clark, J.R. (Ed.). CAMPNET/University of Miami/RSMAS, Miami, Fla. Pp. 108-111.
- De Silva, M.W.R.M. (1985); Status of the coral reef ecosystems of the Sri Lanka. pages 515-518 in proceedings of the 5th international coral reef congress, Tahiti, Vol.6

- Dixon, J.A. 1989. Coastal resources: assessing alternatives. In: Coastal Area Management in Southeast Asia: Policies, Management Strategies and Case Studies, Chua, T.E. and D. Pauly (Eds.). ICLARM Conference Proceedings 19, International Centre for Living Aquatic Resources Management, Manila. Pp. 153-162.
- Dobbin, J. (ed.) (1983); Sri Lanka Coastal Zone Management Plan: Evaluation needs and a proposed action plan. Prepared for Coast conservation Division. Ministry of Fisheries, Colombo, Sri Lanka, USAID/Srilanka contract No. ASB-044-C-00-3089-00; 34pp.
- Freestone, D. 1991. ICZM: The problem of boundaries. In: The Status of Integrated Coastal Zone Management: A Global Assessment, J.R. Clark (Ed.). CAMPNET, University Of Miami/RSMAS. Miami, Fla. Pp. 75-77.
- FRRL. 1994. Tree and Palm Plantation Project in Cyclone-prone Areas of Bangladesh (The Coastal Greenbelt Proposal). Main Report. ADB TA No. 1816-BAN. Fountain Renewable Resources Ltd., Brackley, Northamptonshire, U.K., for Asian Development Bank. 109 pp.
- Geritsen, F. and S.R. Amarasinghe: 1977; Coastal Problems in Sri Lanka. Pages 3487-3505 in Proceedings of the 15th Coastal engineering conference, American Society of Civil Engineers.
- Goldobor, J. and Grobov (1970); The Fishery investigation of Azcher NIRO in the Northern part of the Arabian Sea (Summary account of the specific research done of the exploitation in the water adjacent to Islamic Republic of Pakistan from January to December, 1969), Part I and II, 252pp.
- Hamilton, L. and S. Snedaker, 1984. Handbook for Mangrove Area Management. East/West Centre, Hawaii. 123 pp.

- Hayes. M.O. 1985. Beach erosion, In: Coastal Resources Management: Development Case Studies. J.R. Clark (Ed.). Coastal Publication No. 3. Research Planning Institute. Columbia. S.C. Pp. 67-200.
- Healy, R.G. and J.A. Zinn. 1985. Environment and development conflict in coastal zone management. Journal of the American Planning Association. Vol. 51, No. 3, Pp. 299-311.
- Hilderbrand, L.P. 1989, Canada's Experience with Coastal Zone Management Oceans Institute of Canada, Halifax. 118 pp.
- Holl, K., G. Daily, and P.R. Erlich. 1990. Integrated pest management in Latin America Environmental Conservation, Vol. 17, Pp. 341-350.
- ICLARM. 1986. Tropical Coastal Area Management Newsletter. Vol. 1, No. 1. International Centre for Living Aquatic Resources Management, Manila.
- Jhingran, A.G. and P.K. Chakrabarti. 1990. An Approach to Coastal Zone Management and Planning in West Bengal. Inland Fisheries Society of India. Cochin India 53 pp.
- Joliffe, I.P. and C.R. Patman. 1985. The coastal zone: the challenge. Journal of Shoreline Management. Vol. 1, No.1. Pp. 3-36.
- Kana, T.W. 1991. Treating the coast as a dynamic system. In: The Status of Integrated Coastal Zone Management: A Global Assessment, J.R. Clark (Ed.). CAMPNET. University of Miami/RSMAS, Miami, Fla. Pp.60-61.
- Kapetsky, J.M.L., McGregor, and H. Nanne. 1987. A Geographical Information System and Satellite Remote Sensing to Plan for Aquaculture Development. FAO Fisheries Technical Paper 287. U.N. Food and Agriculture Organization, Rome 51 pp.

- Kay, R.C., Paul, S. and Mirza (1993): "Bangladesh Coastal Management in 1993 and Beyond", In Magoon, O. (ed.) Proceedings of Coastal Zone' 93. American Shore and Beach Preservation Society.
- Kay, R.C. Paul, Hassan, M.K. and Zaman M.A. (1993): Climatic change and Sea-level Rise: the case of the Coast' Bangladesh Unnayan Pridshad, Dhaka, Centre for Environmental Resource Studies, University of Waikato, New Zealand and the climatic Research Unit, University of East Anglia, England. Woodroff, C.D. (1989) Maldives and Sea Level Rise: An environmental Perspective, Department of Geography, University of Wollongong.
- Kenchington, R.A. (1985): Report on mission to the Republic of Maldives, UNESCO Unpublished technical report, 87pp.
- Kiravanich, P. and S. Bummpapong. 1991. Coastal area management planning: Thailand's experience. In: The Status of Integrated Coastal Zone Management: A Global Assessment, J.R. Clark (Ed.). CAMPNET. University of Miami/RSMAS. Miami, Fla. Pp. 97-104.
- Knecht, R. W. 1979. Policy issues for coastal area development/management: legislation, agencies programs. In: Proceedings of the Workshop on Coastal Area Development and Management in Asia and the Pacific. N.J. Valencia (Ed.). East-West Centre, Hawaii. Pp. 119-127.
- Lincer. J.L. 1983. Toxic substances. In: Coastal Ecosystems Management: A Technical Manual for the Conservation of Coastal Zone Resources. J.R. Clark (Ed.). Robert E. Krieger Publishing Co., Melbourne. Fla. Pp 740-749.
- Lowry, K. 1993. Coastal management in Sri Lanka. Coastal Management in Tropical Asia, No. 1. Coastal Resources Centre, University of Rhode Island. Pp. 1-7.

- Lowry, K. and H. Wickremeratne. 1989. Coastal management in Sri Lanka. In: Ocean Yearbook 7. University of Chicago Press. Pp. 263-293.
- Mahtab, F. U. 1989. Effects of Climate Change and Sea-level Rise on Bangladesh. Sponsored by Commonwealth Secretariat for Expert Group on Climate Change and Sea-level Rise. Prokaushaki Sangsad Ltd. Dhaka. 302 pp.
- Marchand. M. 1991. Introduction to the ecology of the coastal zone. Coastal Zone Management Seminar. Delft. Netherlands.
- McConchie, D.M. 1990. A Short Course in Delta Morphology and Sedimentology with Particular Reference to Coastal land Stability Problems in Bangladesh. Southern Cross University. Centre for Coastal Management. E. Lismore, Australia.
- McNulty, J.K. 1983, Discharge of sewage. In: Coastal Ecosystems Management: A Technical manual for the Conservation of Coastal Zone Resources, J.R. Clark (Ed.). Robert E. Krieger Publishing Co., Melbourne, Fla. Pp. 604-610.
- Ministry of Planning and Environment (1992): Statistical Year Book of Maldives, 1992, Ministry of Planning and Environment, Male'
- Nair, M.M. (1987); Coastal Geomorphology of Kerala. Journal Geological Society of India: 29:450-458
- Niering, W. A. 1983. Salt marshes. In: Coastal Ecosystems Management: A Technical Manual for the Conservation of Coastal Zone Resources. J.R. Clark (Ed.). Robert E. Krieger Publishing Co., Melbourne. Fla. Pp. 697-702.
- NOAA/CZM. 1980. Coastal Management Program for the Commonwealth of Puerto Rico. National Oceanic and Atmospheric Administration Office of CZM, Washington, D.C. 168 pp.

- OECD. 1990. Integrated coastal zone management and marine living resources. AGR/FI/ENV, 90 (I). Committee on Fisheries, Organization for Economic Cooperation and Development, Paris. 13 pp.
- Ohta. P. 1991. Development in Hawaii. In: Case Studies of Coastal Management: Experience from the United States, B. Needham (Ed.). Coastal Resources Centre, University of Rhode Island, Narragansett, R.I. Pp.97-106.
- Olsen, S., L.Z. Hale, R. DuBois, D. Robadue Jr. and G. Foer. 1989. Integrated Resources Management for Coastal Environments in the Asia Near East Region. Coastal Resources Centre, University of Rhode Island, Narragansett, R.I. 77 pp.
- Olsen, S. (ed.) (1986) The Management of Coastal habitats in Sri Lanka. Report of a workshop, May 1986, held at the Sri Lanka Foundation Institute, Agency for International Development, University of Rhode Island, Coastal Resources Management Project Technical Report, 1-36pp.
- Olsen. S. 1987. Sri Lanka completes its coastal zone management plan. CAMP Newsletter, August 1987, P.7.
- O'Brien, R.J. 1988. Western Australia's nonstatutory approach to coastal zone management: an evaluation. Coastal Zone Management, Vol. 16, No. 3. Pp. 201-214.
- Pauley. D. 1988. Some definitions of overfishing relevant to coastal zone management in Southeast Asia. Tropical Coastal Area Management. Vol. 3. No. 1. Pp. 14-15.
- Paw. J.N. and T.E. Chua. 1991. An assessment of the ecological and economic impact of mangrove Aquatic Resources Management, Manila. Pp. 201-212.

- Pheng, K.S.J.N. Paw, and M. Loo. 1992. The use of remote sensing and geographic information systems in coastal zone management. In: Integrative Framework and Methods for Coastal Area Management. T.-E. Chua and L.-F. Scura (Eds.). International Centre for Living Aquatic Resources Management, Manila.
- Premchand, K. and C.M. Harish (1990-91): Rising Sea level - Concern along south-west coast of India in J.D. Millman (eds.), Sea Level rise and Coastal subsidence: Problems and strategies. John Wiley & sons, New York.
- Ramakrishna, K. (1989): Legal regime for environmental protection in the south Asian Seas Region. Paper presented at the Joint annual convention of the British International Studies Association and the International Studies Association, London, March 28 - April 1, 16pp.
- Rizvi, S.H. and Quraishie, G.S. (1989): Environmental Data Survey Technical Report No. 1: Karachi Coastal Zone Management and Planning. Sponsored by UMCHS and Master Plan and Environmental Control Department, KDA, National Institute of Oceanography, Pakistan, 220pp.
- Saenger, P. 1993. Land from the sea: the mangrove afforestation program of Bangladesh. Ocean and Coastal Management, No. 20. Pp.23-29.
- Samsuddin, M. and G.K. Suchindan (1987): Beach erosion and auction in relation to seasonal long-shore current variation in the norther kerala coast, India, Journal of Coastal Research 3(1): 55-62
- Singh. H.S. 1994.. Manager, Gulf of Kutch Marine Park. Gudjarat. India. Personal communication.
- Smith, H.D. (Ed.) (1992): Advances in the science and Technology of Ocean management Routledge, London and New York.

- Snead, R.F. (1988): Man's response to change in the coastal zone of Pakistan, Pages 521-551 in K. Ruddle, W.B. Morgan and J.R. Pfafflin (eds.); The Coastal Zone - man's response to change, Harwood academic Publishers, Chur Switzerland.
- Snedaker, S. C. and C.D. Getter. 1985. Coastal Resources Management Guidelines. Coastal management Publication No. 2. NPS/AID Series, Research Planning Institute. Columbia, S.C. 295 pp.
- Sorensen, J. 1993. A conceptual framework for integrated coastal zone management. OECD, World Coast Conference 1993.
- UNEP, (1986): Environmental Problems of the marine and Coastal area of Maldives. National Report, UNEP Regional Seas Reports and Studies No. 76, 31pp.
- UNEP (1986): Environmental Problems of the marine and Coastal area of Bangladesh. National Report, UNEP Regional Seas Reports and Studies No. 75, 47pp.
- UNEP (1986): Environmental Problems of the marine and coastal area of Pakistan National Report, UNEP Regional Seas Reports and studies No. 77; 55pp.
- UNESCO. 1984.. Comparing Coral Reef Survey Methods. Report of a regional UNESCO/UNEP Workshop. Phuket Marine Biological Centre. Thailand, 13-17 December 1982. UNESCO Reports in Marine Science. U.N. Educational Scientific and Cultural Organisation, Paris. 170 pp.
- UNESC. 1987. Development of marine areas under national jurisdiction: problems and approaches in policy-making, planning, and management. United Nations Economic and Social Council, New York. 22 pp.

- United Nation (1992): "Agenda 21". In: The Outcomes of the United Nations Conference on environment and Development Rio de janerio, Brazil, 3-14 June, 1992.
- URI. 1986. The Management of Coastal Habitats in Sri Lanka. Report of Workshop, May 12-15, 1986. Coastal Resources Centre, University of Rhode Island, Naragansett, R.I. 36 pp.
- Vannucci, M. 1991. Saving a crucial ecosystem. In: The Hindu Survey of the Environment. 1991. Madras. India. Pp.. 157-161.
- Wafar, M. 1992. Management and conservation options for Indian coral reefs. In: Tropical Ecosystems: Ecology and Management, K.Singh and J. Singh (Eds.). Wiley Eastern Ltd., New Delhi. Pp. 173-183.
- White, A.T. and J.I. Samarakoon. 1994. Special area management for coastal resources: a first for Sri Lanka. Coastal Management in Tropical Asia. No. 2, Columbo, Sri Lanka. Pp. 9-11.