GEOGRAPHY OF COASTAL ZONE MANAGEMENT
With Examples From Gujarat Coast

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C E R T I F I C A T E

Certified that the dissertation entitled "GEOGRAPHY OF COASTAL ZONE MANAGEMENT WITH EXAMPLES FROM GUJARAT COAST" submitted by Bijay Kumar in fulfilment of nine credits out of total requirements of twenty-four credits for the award of the degree of MASTER OF PHILOSOPHY (M. Phil) of this University, is his Original work and may be placed before the examiners for evaluation. This dissertation has not been submitted for the award of any other degree of this University or of any other University.

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C O N T E N T S

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CHAPTER I

INTRODUCTION

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INTRODUCTION

The coastal zone is a vital national resource area which is often beset by special interests and conflicts, coastal zone management presents a unified approach designed to clarify the issues and problems for those who either contribute to the managment function or benefit from it. Coastal zone management is an indispensable reference for all those concerned with the planning and use of this important geographical area, as this is the staging ground for use of marine resources. These problems stem from the multiple use of the coastal resources. Viewing as a geographer this coastal zone is a geographical conpact. It's predominant physical charactristic is the shoreline where land, sea and air join to form a triple interface. It is a continuum of geogrophical region. Each is characterized by its own pattern of economic social and political activities, which related to the distribution and availability of resources.

The present interest in the coastal zone is based on the fact that 80% of the marine food resources are available within this region. The next important economic aspect is that the sea bed in this zone could be a potential ground for petbolium and natural gas and other minerals. The third econonic aspect of the shelf region is it being the source region for sand and gravel. The fourth and new aspect is marketing beaches along the coast as tourist spots and recretion grounds.

The many and divert human activities involved in the use of the coastal zone constitute imposing, excessive, and competitive demands on the limited resources. Therefore they often critically affect regional ecological systems. It is essential that we sufficiently understand the threatened ecology as to determine what level of man's intervantion can be tolerated without destabilizing vital systems. Society has been ready to accept the environmental costs of economic benefits to a point. In recent years, however, it has become evident that environmental values have been destroyed out of proportion to the economic advantages derived from resource exploitation. For example, offshore drilling for oil and refining and transportation of petrolium products municipal and industrial effluents etc pose new threats to the coastal anvironment. For clear understanding one can take the case of Indian coast. The vast coastal zone of India is being utilized for the development of ports and harbours, fishries, beach resorts, land reclamation, location of shorebased industrial complexes, human settlement, agriculture, disposal of wastes etc. The coastal states of India are presently confronted with the problems of coastal erosion. Pollution in estuaries and nearshore waters is becoming a serious problem requiring scientifc solution. Due to the increase in population and industrialization the importance of coastal resource and its proper management has become important.

The main purpose of this study is firstly to indicate a national approach to regional management of the coastal zone

and to identify management's problem. Secondly to describe a rationale for planning that supports inovation by management, provides the optimal utilization of resources, and relate regional plane to national policy. Thirdly to provide an overview of the structure of the goals for multiple and consurvative use of coatal resources. And lastly to describe the management problem of conflecting goals.

Thus the coastal zone is subjected to multiple use leading thereby to conflicting demands for the exploitation of the various coastal resources by different interest groups and agencies. There is consequently a need for a comprehensive national policy and guidelines with requisite enforcing powers for managing the various coastal development activities in India.

In the present study a general geographical approach is being adhered to. All the survey and the problems have been seen with geographical point of view. That is why in the study of coastal zone such factors are being discussed intensively. Details are being interpreted with the available data and informations. It has been found that only developed contries are having lots of programme and iniciatives of the coastal zone management. Among the third world countries, although problem is severe but a little progress is being made in this regard as yet. The present study mainly emphesis on Indian coastal zone and a case study from Gujarat coast. First chapter sets the tone by introducing concepts and chapter second deals with review of

the literature on coastal zone management. Here history of the coastal study have been described first. For this a regional approach have been followed. A historical developmental sketch has been drawn for the countries having better coastal zone management programme and policy like the U.S.A. France, The U.S.S.R. Great Britain etc. After that some literature on coastal zone management put forth by different scholars have been discussed. These scholar suggested various tools and techniques of the coastal zone management. They pointed out the critical environmental threat, coastal water pollution, decreasing quality and quantity of coastal resources and some other problems related to geography and geology of the coastal zone. Some have suggested the better management scheme.

Chapter third is about geography of India's coastal zone and regionalization. Here firstly a regionalization schem has been described on the basis of different geographers view. In classification special imphesis has been paid only on the coastal zone of India because we are taking into account only the coastal region. After that a general geography of coastal zone has been written. Proceding with the geographical approach knoledge of geography of the said region is very much needed. That is why geographical defination of coast and coastal zone, topography, geology, structure and relief, etc have been discussed. Along with these the coastal erosionment and coast classification got special attention.

After knowing the geography we proceded in the fourth chapter on the resosurces of the zone. Here a possible resource inventary has been made with the help of above geographical discription. Firstly importance of coastal resources has been pointed out after that a classification has also been made for intensive study. It has been classified as living and non-living resources. Fishing, mericulture, aquaculture etc have been discussed becase for developing states like India these coastal resosurces have important position in relation to others. Non-living resources have been classified under three heads like Terrigenous, Biogeonous and Chemogenous deposits. Each has been discussed seprately. Exept these a discription has also been made about oil, natural gas and energy resources which are said to be the axil of the modern industrilised era.

Chapter fifth is exactly about problems management and development of the coastal zone with special refrence to India. Firstly various coastal problems have been pointed out. Afther that discription of exiting management programmes and policies regarding development of coastal resources and pollution control have been made. Some humble suggestionshave also been put forth to deal with the serious coastal pollution and degradition of coastal environment.

Chapter sixth deals with special refrence to Gujarat coast. Here discription has been made with viewing all parameters which have been looked into previous chapters. Starting with some special geographical & geological aspects

of the Gujarat coast, it has been classified on the basis of the nature of coasts. After that a brief resource inventary has been discussed. Although there are lots of coastal activities of Indian coastal zone but here some most important activities which are found in Gujarat coast have been discussed like Coastal fishing, Port management enviromental pollution and identification and understanding about other economic activities .

This chapter is being followed by conclusion showing summary of what is being discussed and pinpointing the issues and suggestion for future planning, monitoring of development activities and future uses etc. The present study is primarly based on the secondary data and information only. Field work is not possible as well as essential at this moment as their study is basically exploratory in character.

CHAPTER II

TRENDS IN COASTAL ZONE MANAGEMENT STUDY: A REVIEW

Chapter II

Trends in Coastal Zone Management Study: A Review

The study of coasts and coastal zone has been taking place since long back but under different chapter and contexts. So many papers on particular aspects of coastal morphology and regional discriptions of many areas of coast were published by European and American authors in the modern classical time. Since long back study of the dynamics and morphlogy of coastal zone followed various trends within the framework of several branches of Science and Technology. One such trend is to be found in the work of Leonardo Da Vinchi in fifteenth century. His work deals with the study of natural condition with a view to the selection of sites for the construction of ports and ship canals and assitance in thier planning. Subsequently coast defences become a part of the subject. French scientists Lanblaride (1789) and Emy (1831) and Italian Cialdi (1866) and Cronaglia (1889) studied many processes in the contert of the dynamics of the coastal zone. Longinov (1959) has recently published a historical review of this resourch.

By the beginning of the ninteenth century a number of empirical laws had been established concerning -

1. The depth and strength of wave action on the seabed and coast.
2. The coast and constructional fectures on it.

3. The movement of material along the coat.

In addition to direct observation, there was a great development of model experiments in wave tanks. Many conclusion of practical importance were derived from those exprisments, but they did not and could not make any contribution to the general theory of coast development. This could not be elaborated in isolation from the specific natural material of the coastal zone as a whole and from geographic comparisons of different districts.

An other trend is to be found in the work of hydrographers, who studied coasts for the purposes of navigation , the complication of sailing directions and navigational charts. Work of this type was widely developed in Russia in the eighteenth century. Outstanding Russian hydrographers, including Litke and Bellingshausen often showed interest in the origin of the coasts that they described. The genetic view in the description of coasts had not, however, developed at that time and it is only recently available sailing direction and maps have been subjected to analysis and critical evaluation. Among other scientist, major geologits including Lyell (1830) and Elie de Beaumont (1845) paid great attention to the work of the sea along coast. Many geologist subsequently studied the formation of plains of marine denudation, and become interested in the structure of coastal deposits formed in the course of marine transgression and regressions. The geological and geomorphological study of coasts was the widest and most

rewarding, since its aim was to study the general course of the erosion cycle in the development of relief, as well as contemporary processes in the alternation of coasts. Gilbert (1885) and Gulliver (1899) who examined general theoretical problems were pioneer in this trend.

The first classification of coasts and important general conclusion are to be found in the work of Richthofen (1901). Major summaries appeared in the early twentieth century, as Davis (1912) followed by Johnson (1919) in the United States, and Passerge (1912) and others in Europe. Johnson's book first published in (1919), remaine to this day the most complete theoritical study. Some of the work of Russian scientist has also found a place in the world literature. For example the works of Sokolov (1884) on dunes, the earlist work of Krendovikii (1884) regarding the problem of the origin of accumulation coastal forms, Obruchev's work (1908) on the longshore drifting of detritus and a number of regional studies by other geologists. Much regional work and theoretical research is still being carried out by the Department of Coastal Dynamic and Morphology at the Oceanography Institute.

In U.S.A. the Beach Erosion Board begen its work in the 1920's. Many universities now carry out research on coastal zone management and development. University of California and Chicago University are carrying out coastal research and publishing their results for many years. The state University of Louisiana has recently set up a special

institute of coastal study at Baton Rouge University of Miami (Florida) has set up a laboratory of coastal hydraulic engineerisng.

The organisation of research in France is reflected in the publication of the Central Committee for Oceanography and the study of coasts. Excellent model studies of coastal zone are also carried out at the hydraulic laboratories at Chatou, Grenoble and other places. Kuenen (1959) describes the profound research of Dutch authors. The wide scope of British work is apparent from King's book (1959). The criticals evaluations published abroad in the last twenty years include a langthy chapter in Shepard's Marine Geology. Guilcher has done highly compressed study of the geographic trend (1954).

The theme and system of coastal management is not new, but it has existed through out the Indian history also. Evidence of sea port system at Lothal (Gujarat) and at many other places highlight the existence of coastal management during Indus Velly Civilization. Ancient and medival man had simple and limited type of coastal management based on needs, experience and knowledge. It should be noted that the data and this literature on coastal management are meagre in the countries. The available materials on this subject are scattered and limited in scope and approach. Although the scholars from different fields have contributed much.

Schafer, M.B. (1970) has done a appriciable work on biological resources of the coastal zone. At first he tried

to define the coastal zone on the basis of human activities with marine and marine environment. He says, "Coastal zone is roughtly the sea and land adjacent to the interface, encompassing that region where terresterial activities importantly impinge on the marine environment, marine resources and marine activities, and where marine activities importantly impinge on the environment, resources and activities of the land". Although not a precise bondaries can be demarcated, but it is very ovious that coastal zone is rich biological province and keeps special importance in several ways. Schaefer pointed out that due to the rapid growth of population and the concomitant urbanization around the coastal zone in Californea a adverse condition for biological communities has been created. Similer situation has been existing in the eastern coast of U.S.A. The multiplicity of human activities in the coastal zone, for the production of food and other amenities, as well as for disposal of waste materials very much affect the coastal environment in multiple ways. Thus man is violently disruptive alement in the ecological regime of coastal zone. The author has view that with the increasing human activities in the coastal zone it is not possible completely to preserve the pre-existing ecological regime. The central problem there is to decide what ecological revisions and adjustment are desirable from the standpoint of the long range welfare of mankind and how they can be attained. So, the author's main purpose is to examine significant relationships of man

and living organisms of the coastal zone and the conservation of coastal biological resources. He suggested that for better coastal planning, the data of living resources, climatic condition of the zone and human activities is necessary. For this a regional authorities , for the management of the coastal zone is required according to different geographical unit.

Horting F.J. (1969), made a similer exercise as Schaefer. Horting emphasised on the conservation of the mineral resources. He also stressed on the importance of the coastal mineral resources and its development for the society. These should be an optimum development of offshore mineral resources for the nation. The author pointed out that there is a good administrative set up in the U.S.A. to Control the mineral resorces. For this coastal area are divided into many zone of juridiction. The development and consservation of the mineral resources are inextrivicably intertwined with the conservation of other non-living extractive resources such as geothermal energy; and with the dynamic of the ocean environment. Horting says that the optimum ressource allocation requires the most effective application of the principles of multiple use to a specific area to the maximum degree feasible.

David Sternlight (1971), discussed the planning of physical and organisation systems for the use of the coastal zone. This planning include systems structuring analysis and design, programming and subsequent feedback and evaluation.

The author also pointed out some issues related to conflicts and their resolution of the coastal zone. The coastal zone conflicts can be solved by serveying the social interest.

Many models and techniques have been presented by the author to solve the conflicts. He said that in the planning system and designing procese of coastal management there are five elements or stages to proceed as (I) Objectives (II) Alternatives (III) Cost and benefit (IV) Criteria and (V) Models. Here objectives are aims or goals in a particuler problem of choice. Alternative are different ways or systems for achiving objectives. Costs are the resources used up by each alternative. Criteria are rules for choice. With the establishement of Criteria the next step is the process at choice to construct a model or models. During planning process, design and analysis are used to select alternatives. The management will be effective only by good policy and implimentation of the policy. The author represented many diagrams to illustrate the ideals and planning model.

Schneidowind N.F. (1971), emphasised the importance and types of data needed for coastal development planning. Data can be divided into two groups (I) Environmental data (II) Inventory data. The author says, the major requirment for the development of a coastal zone data network is to provide some centralization of storage and processing within each zone. The data should be modified and simplified by advance technique (computer). Some of the measures which are needed to develop a coastal zone data network are the

following --

(I) Development and maintenance of an inventory of coastal zone data.

(II) Establishment of a control data centre and coastal zone data system.

(III) Development of a consistent method for indexing and storing the data.

(IV) Establishment of interzonal and intrazonal data format and transmission standards.

Peearson E.A. (1970), pointed out the environmental and ecological problems due to waste disposal in the coastal zone. He identified the types of waste disposal and also presented the solution of the problems. He classified waste disposal system in two groups. (1) The estuary-coastal discharge dilemma, and (11) the open coast desposal problems. The author is of the opinion that the treatment of this waste is very necessary for maintaining the quality of the coastal environment. Therefore, the environmental planning is necessary at the coastal zone management for the balanced development. Any impairment of environment of coastal zone directly affects the living and non-living communities and the hunman settlement of the coast.

Halliday, J.E. (1987) conducted a good study on coastal planning and management in England and wales. He used districtwise and the coastal zonewise records for this purpose. In England and wales, the district councils are

respossible for the coastal management and planning. The paper revels that in England and wales coastal management is very well developed for the purpose of Trading, Defece, Fishing, Agriculture, Residential area, Recreational and Industrial developments. There is a hierarchy of the system of coastai management with integration from top to bottom. Halliday discussed the coastal planning and management at local levei on the basis of data collected by postal survey. The key issues addressed were the identification of a coastal zone, the way of administration at district level, its ownerships and the exiting policies, management and plan for the areas. He suggested to give more power and decision making responsibility to the local level agencies.

Nordstrom, K.F. (1988), has discussed the changing environmental policy on the Oregon coast in U.S.A. due to the dune grading. So his study is an assessment of the effects of the new policy on the value of dunes for shore protection and implications of the policy for the future shoreline management. The Oregon initiative pointed out the need to re-evaluate and alter environmental control, according to public needs. It reprints a schift of policy from strict compliance with standerds of environmental compatibility to a more lemient approach that seeks to accommodate the land use rights of individuals property owners. The purpose of the study is to assess the implication of the new grading policy for future erosion hazards and to apply the finding of the Oregeon study for management of other coastal area of the

United State of America.

David Key (1988) pointed out that the coastal zone has become an important place of recreation in Britain. But huge discharge of waste material in coastal zone has created many ecological problems. He said that the essential Bacteria which are found in water and needed for human being are decreasing in the coastal zone. Some other problems of pure and toxicated water have also been discussed in his paper. The author says that the standard quality of water covers physiochemical and creithetic aspects of a bathing water as well as the more often dvoted enteric indicator species. So enggertion have been farmand to maintain the waste quality of the coastal zone for bathing and other purpose. The prevention of water pollution should be the integrated part of the environmental planning of the coaster zone.

Chrietersen, E.M. (1972), in his study said that pollutants are mixed within water masses due to turbulence generated by river currents and tides. The vertical mixing is inadequate to homogenize the vertical water column, while horizontal mixing may be very slow indeed. The result is that pollutants stay in well defined horizontal layers and that these layers may be horizontally discontionuous. The author found many veriabilities of water near Baston Harbour. He says the pollutant varies from two to one over times of the average. This variability and its occurence has been shown by histogram. He discussed many properties of water with the many combination of temperature and salinity in

water masses, formed by mixing of pollutants of harbour and the bay water. The author suggested that in order to get the variability and the actual transport mechanism for polluitants in coastal water, one almost has to chose the water masses around, rather than take data at well spaced stations. And one can do this by developing new tools for observation with the help of modern technology in data question, data handling and interpretation.

Palmer, H.D., (1972) focused on the importance of skilled manpower for coastal zone studies and the economic importance of the dynamics of ocean floor. Trained manpower is very necessary to make survey and studies of sea flooor. Although, the research of sea floor is very typical work. It needs knolwdge, courage and developed technology. At present very limited area of sea floor has been exploited. The author says that 90% of all activities of offshore occurs within a prism comprised of depths less than 100 feet and less than three miles to the coast that is why this coastal zone seems vital important region for resource development. The research submersibles now in operation. Several of the smaller models are well suited for coastal zone investigation. These information of the ocean is also very necessary for the economic use of the coast. Polcyn, F.C., (1972), emphasised the development of the technology for the coastal zone survey. At present, the remote sensing involves more than new instruments and collection platforms. He says that the information

geathering system involves not only the devices in their vehicles, but also the fields of computer data processing, information theory, display devices and large inforamtion networks. The needs to make a rapid assessment of changing conditions requires that the system available have the capacity to cover large areas in sufficiently within a short times. Although the science and technology has made a rapid progress, but the coastal floor exploring technique is not so impossible, according to authors view.

Twiss Robert, (1972) has paid emphasis on coastal planning of California in U.S.A. and pointed out some implication of land-oriented coastal planning that should be of concern to marine interests. According to Twiss, the balance use of marine and Land-oriented resource must be achieved if the coastal zone is to be maximum benefit to society. For the planning the information of environment and physical properties of the coastal zone is very essential. The inventory of coastal areas according to desirability for competing uses enables the planner to assess relative opportunities foregone if a use is allowed to occupy a coastal location. So the author outlined here an approach to coastal zone planning that would incrementally retionalize and environmentalize the planning process. The coastal zone planning system will be able to incorporate technical and environmental aspects of the marine sector.

Robert Ellies, (1972) discussed a combination of system techniques to organise, synthesize, analyse and apply

information for coastal zone management. He says that the coastal zone planning and resource management require an understanding of the complex melieu of interaction and activities talking place through out this region. Author says that "an integral objective of the programme is to develop a blueprint or conceptual framework that relates data, information, predictive techniques, environment interactions, methods of analysis and application into one system of producers tools and instruction for use of planners". Elis gave much importance to the coastal management information system for coastal zone management. He has suggested four basic objectives of the coastal studies as-

(I) To know the existing condition of the environment in time and space.

(II) To predict the influece of causal factors upon the condition of the environment in time and space.

(III) To assess the effect of the conditions on marine related activities.

(IV) To select from these alternative the combination of activities and conditions which best suited the mix of stated goal and needs.

The author presented many schematic diagrams to represent the data collection, storage of data, interpretation of data and the planning and management of the coastal zone. The author is of opinion that environmental planning is the integrated and essential part of coastal

planning.

John Pleasnts, (1972) says that one of the most aggravating problems for coastal zone managers is the aequisition and review of data. Pleasants pointed out that "making relevant data, properly organised and presented, available to advisors, managers and researchers is the needs of the marine environment and resources, research and management system". He thinks that the information and research needs is a continuing inventary of problems that require answer to permit successful management of the coastal zone in our area.

Whalen, H.,(1972) has discussed mainly the models and techniques needed for coatal management. Primarily a hydraulic model is utilized to predict physical parameters of the environment or changes to the environment as a result of dynamic processes. These quantities include current, wind waves, tides, salinaity, temperatures, edge waves, rip current, tidal flushing and so on. The author has also discussed the models and techniques for estuarine project studies, estuarine management studies, beach development investigations, harbor construction and artificial island and reefs studies. It is pointed out that the scale model studies are perhaeps the most valuable and versatile tool available for effecting a reliable evaluation of coastal zone management plans. It is author's view that although many technical problem remain to be resolved, the majority of problems encountered by coastal engineers can be effectively

solved within the present state of the art in conducting hydraulic scale model investigation.

Literatures available on the topic "Coastal Zone Management" are inadquate. And they are limited in their scope, magnitude and approach. But it has become very clear from the literature survey that, there is a great need of coastal planning for utilisation of immense source of resources of the ocean and ecology of the ocean. Very few countries of the world, particularlly the developed countries have well developed coastal management system. This system is totally lacking in developing countries. The coastal planning includes:-

I. Effective policy making and its implimentation.
II. A well effective administrative set up for coastal zone.
III. Planning for economic utilisation of living and non-living resources for the benefits of the mankind.
IV. Planning for environmental control of the coastal zone.
V. Manpower planning.
VI. Research and evaluation of the plan.

For this we need a advanced and modern technology. The collection, analysis and distribution of data of coastal environment and the prime requirements for coastal planning. The same coastal plan can not be universely applicable for all countries. Because the planning depends on coastal structures, relief, geomorphology, oceanic currents, waves, winds, available resources and the rate of erosion of the coast and deposion in the ocean.

Today, the ecological problems of coastal zones due to excess utilisation of coastal resources and due to industrial and municipal wastes have become a great concern for the coastal planners. Second concern is the economic utilisation of the resources because it needs technology, which is highly costly.

As far as Indian Coastal Management is concerned, it is not so developed. Although, Indian Govt. has been giving much importance to the ocean during plan periods. But the management is very limited in scope.

India has roughly 6100 KM long coastline. But in most cases, Indian coast is not suitable for utilisation due to indentation, narrow and deep coast. The Indian ocean not only keeps the resource important for India, but its importance is greater in the fields of defence, security and ocean transport. Indian population has been increasisng by lips and bound. This population problem forced India to look into the ocean, which is the vast store house of water, energy, minerals and biological resources. Therefore India should have a better coastal management to stregthened the coastal programme. For this at first Indian coast should be devided into different suitable zones for better planning and better exploitation of marine resources and environmental management.

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CHAPTER III

INDIA'S COASTAL ZONE AND REGIONALISATION

CHAPTER III

India's Coastal Zone And Regionalisation

Regionalization:

Regional approah in geographic studies has been long regarded as, inherently geographic or rather the focal Concept of all geographic work (Brock. J. 1965). It deals a particuler area of the earth and studies through geographical factors like physical, biotic and human. These factors work in union and intersecting among themselves and with other areas over a long period of time provide reletive homogenity or a distinctive chapter to it from the neighbouring aereas.

Like other geogriphical areas of the earth, Indian region are determined and further divided into individual units according to the degree of homogen ity of the various geographical phenomena. At present most of regional works and monograph divide the regions in different order of units and Sub-units, although no standard hierarchical scheme is followed. The earliest scheme of broad regional division was prepared by Mc Farlane in his volume, "Economic Geography". A very well known work has produced by Stamp, D. who drew up a marking scheme of the division of India during 1922-24. The factors adopted in this demacation of region, produced by stamp, are primarily phyiography and structure and secondly climate. He divided India into three macro level regions and twenty-two sub regions. The macro regions are -

a. The natural region of Mountain Walls.

b. The natural regions of Nothern Plain.

c. The natural regions of India Plateau.

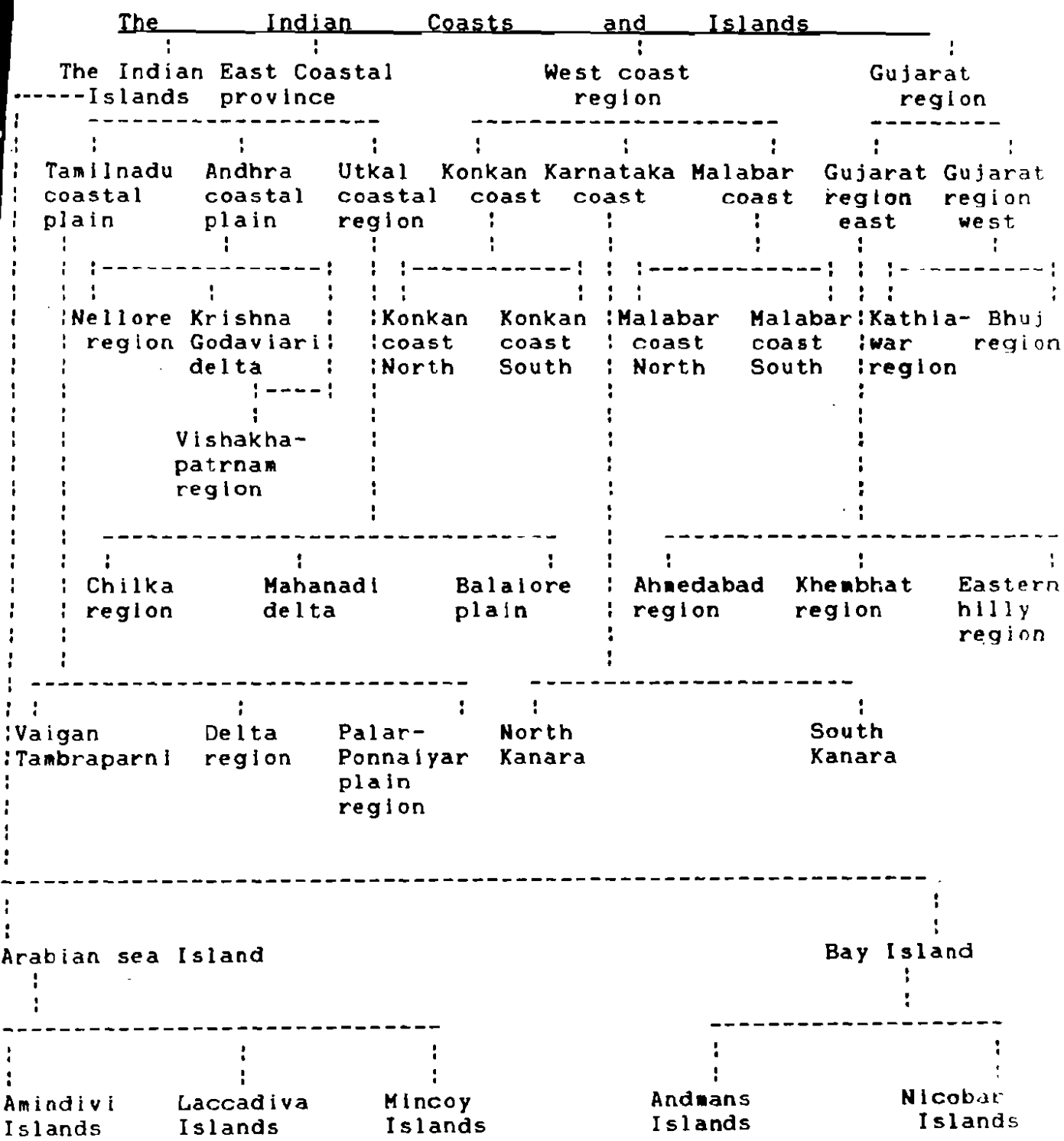
Spate, O. H. K. has brought forth, 34 regions of the first order under the three macro-region excluding islands, 74 of the second order with about 225 sub-diviriory. This view regarding regionalization is very flexible and dynamic. But there is much scope and a case for the fourth division i.e." the Indian coats and islands. This has been stated by Ahmad, K.S., Ahmad Planks in separating the coastal plains from the Dccan region and thus provids a four unit division. He states that relief and physiography of coastal area makes a separate identity, that is why four-unit division will be appropriate. Pithawala published a work on the regional division in the Journal of Madras Geographical Association in 1939. He adopted the factor of physiographic uniformity as a master principle running throughbout the hiararchy of regional devisions. Regarding the forth macro division Pithawala holds that the coastal low lands are more "Shore Facies" of the Deccan Trap and sorthern plateau provinces.

According to Singh R.L, "there is obviously no end to this sort of Fission what seems important here is not the detail of the two coasts differentiating them from each other but rather the more obvious fact that the coastal lowlands are basically different from the inner vast plateau complex". Concluding above study one can simply state that geology, structue relief and physiography together with the

positional factors provide a fairly clear-cut division of India into four units viz.

1. The Himalayan Mountain Region
2. The Grent Plains
3. The Peninsular uplands
4. The India coasts & Islands.

These are simple but effective macro division of the country in this study the researcher is more concerned about the forth macro divison i.e. Indian coasts and Island. It has been divided into 4 sub-divisions i.e. Gujarat Region, The West Coast, The Eastern Coastal Plains and The Indian Islands. The distinction between the Gujarat region and the west coast has been accentuated by the Gulf of combay and the core like situation of the Girnar hills. T schematic classification is as followed


The Indian Coasts and Islands
The Indian Islands
East Coastal province
West coast region
Gujarat region
Tamilnadu coastal plain
Andhra coastal plain
Utkal coastal region
Konkan coast
Karnataka coast
Malabar coast
Gujarat region east
Gujarat region west
Nellore region
Krishna Godaviari delta
Vishakha-patrnam region
Konkan coast North
Konkan coast South
Malabar coast North
Malabar coast South
Kathia-war region
Bhuj region
Chilka region
Mahanadi delta
Balaiore plain
Ahmedabad region
Khembhat region
Eastern hilly region
Vaigan Tambraparni
Delta region
Palar-Ponnaiyar plain region
North Kanara
South Kanara
Arabian sea Island
Bay Island
Amindivi Islands
Laccadiva Islands
Mincoy Islands
Andmans Islands
Nicobar Islands

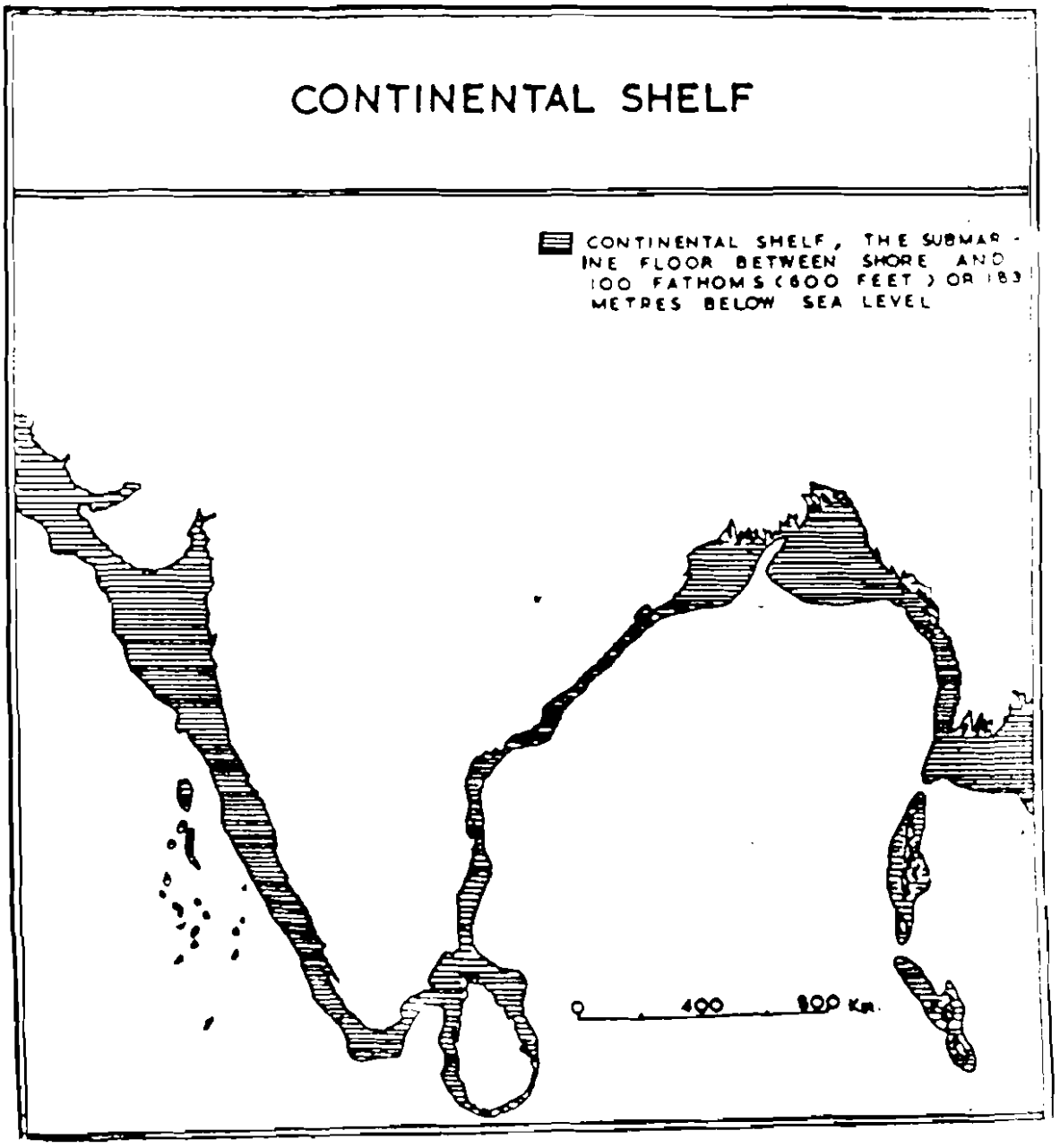
General Geogorophy of the Indian Coasts.

"The coast is a zone of varying width, including the shore and extending to the landward limit of penetration of marine influence. The crest of a cliff, the head of a tidal esturay, or the solid ground that lies behind coastal dunes lagoons and swamps", (Bird E.C.F. 1969). "Coast in the land zone immediately behind the cliff and 'coastline' as 'the cliff line or its edmivalent, the margin of the land ", (Wordridge & Morgon 1959). In other words according to Zenkovich 1967, The term coast will be used for a strip of land, the relief forms of which have been created by the sea at a given mean level. On cliff (implying districtive marine action) the inner limit of the coast runs along the upper edge of the cliff, on accummulation coasts it will lie along the inner margin of the contemporary terrace. The term coast will also be applied to the wider strip of land that retains relief forms created by the sea at high levels. If there are no morphological trace of elevation, the provisional limit of the coast is provided by a line connecting the heads of the bays. And geogriphical area sorrounded by the inner and outer margin of the coast is calied coastal zone. The land immediately behind the shore may be regarded as the coastal zone but its extent is difficult to define. It is obviously narrow where highlands formed by mountain and plateau stand immediately behind the shore zone. It is wide in area of low relief, eg,depositional coastal plains or plains of marine

abrasion or recently imergent marine floor of lowlands of desert levelling etc. No doubt it is possible to indicate in such general term the extent of the coastal zone but it extremely difficult to lay down in exact term to that exte and physical characteristics of this zone.

According to E. Ahmed if all the land ice of the present time would melt it would cause an eustatic rise of the sea level by about 50 metres. On this basis in Indian context 50 metre contour line may be taken as a very rough inner limit of the coastal zone. Following this concept the inner margin of the coastal zone would pass through the head of Ganga delta. On the Circar coast it would generally be within 30 km of the shoreline. In the Deltaic region of the Mahanadi, Godaveri and Krishna this line penetrates much deeper up to 100 km. This line would normally be 50 km from the shoreline on the Coromandel coast. The coastal zone reaches one of its narrowest point near Cape camorin where the 50 mt contour is only a few meters from the shoreline. On the west coans the inner margin of the coastal zone is approximately betwen 15 and 20 km from the shoreline on the Kerala and Karnataka coast and within 0 to 15 km from the water line on the Maharastra Coast. Further north in the Cambay region it is about 50-60 km from the shoreline. In Kathiwar, the coastal zone is variable. On the southeast rocky and cliffed area the inner margin of the coastal zone varies from 5 to 40 km from the shoreline. In S.W. Kathiawar from near Diu to Dwarka it is about 20-30 km inland. The position is similar

Map 1


CONTINENTAL SHELF
CONTINENTAL SHELF, THE SUBMARINE FLOOR BETWEEN SHORE AND 100 FATHOMS (600 FEET) OR 183 METRES BELOW SEA LEVEL
400
800 Km.

round the coasts bordering the Gulf of Kutch. Practically there is no coastal zone in the Laccadive group of island because the coral reefs are nowhere more than 10 m above the sea level. In the group of Andaman and Nicobar, the interior of most of the islands consist of disected high rocky ground. The highly dissected interior is steeper on the easstern side of the islands. Consequently the 50 m contour occurs over highly dissected densely forested rocky slopes and nearer the shore on the eastern side of the islands.

Topography

Alluvial monotonous dead level plains is the special characteritics of the intermediate coastal zone in gangatic delta region. Shoreward the coastal zone adjoins the mangrove tidal forests of sunderban. Approaching westward the monotony of the coastal plain in Balashore and Midnapore is broken, by sand hills representing in blown beach dunes. In the Mahanadl delta region the topography of the coastal region is marked by mangrove swamps towards the shore. Southwest of Vishakhapatnam the rocky interior approaches the shore. The topography of the coastal zone, in the Godaviri and the Krishna deltas, ranges from the tidal mangrove swamps near the shsore through alluvial tracts carrying some sand dunes. Further southward between the Krishna delta and Pondicherry i.e. up to about northern limit of Cavery delta, the coastal topography is very torne without any hills in the immediate background. Proceeding southward the coastal zone

is characterised by low alluvial plain country upto Cape Camorin. But in Rameshwaram penisula the dune belt is 3km wide. Around the cape there is highly dissected coastal zone marked by pronounced entrenched meanders of the stream like Tambraparni, Neyar Attingal and Attikara rivers. The Seaward margin of the coastal zone in formed by the steep hilly slopes that flank the coastal lagoons and lakes which are sometime cliffed. These characteristics prevail in the Kerala and Karnataka coastal zone. Near Karwar the shoreward margin of the coastal zone is dominated by high sea cliff and promontories which are frequently at the waterline. Here coastal interiar is worked by the highly dissected lower slopes of the Western Ghats and the coastal plain is generally very narrow. Northward near Kundalika river there is rising low coastal alluvial (18° 32' N) tract marked by a series of successive belts. The coastal topography in the camboy region is marked by low plain topography north of Bulsar and Bhaunagar. As a result of such topography the shoreward margin of the coastal zone adjoins the marshes which frequently 8 km in width. Within the marshes there are interfluvial patches of higher cultivated ground carrying settlements. Between Bhauvnagar and Diu the coastal zone is marked an irregular surface dotted with hills and swampy lowlands. The coastal margin between Diu and Dwarka adjoins narrow beach ridges. In the Kutch most of the hilly interier can be regarded as the coastal zone but on the north in the Rann of the Kutch one of the most prominent features of the

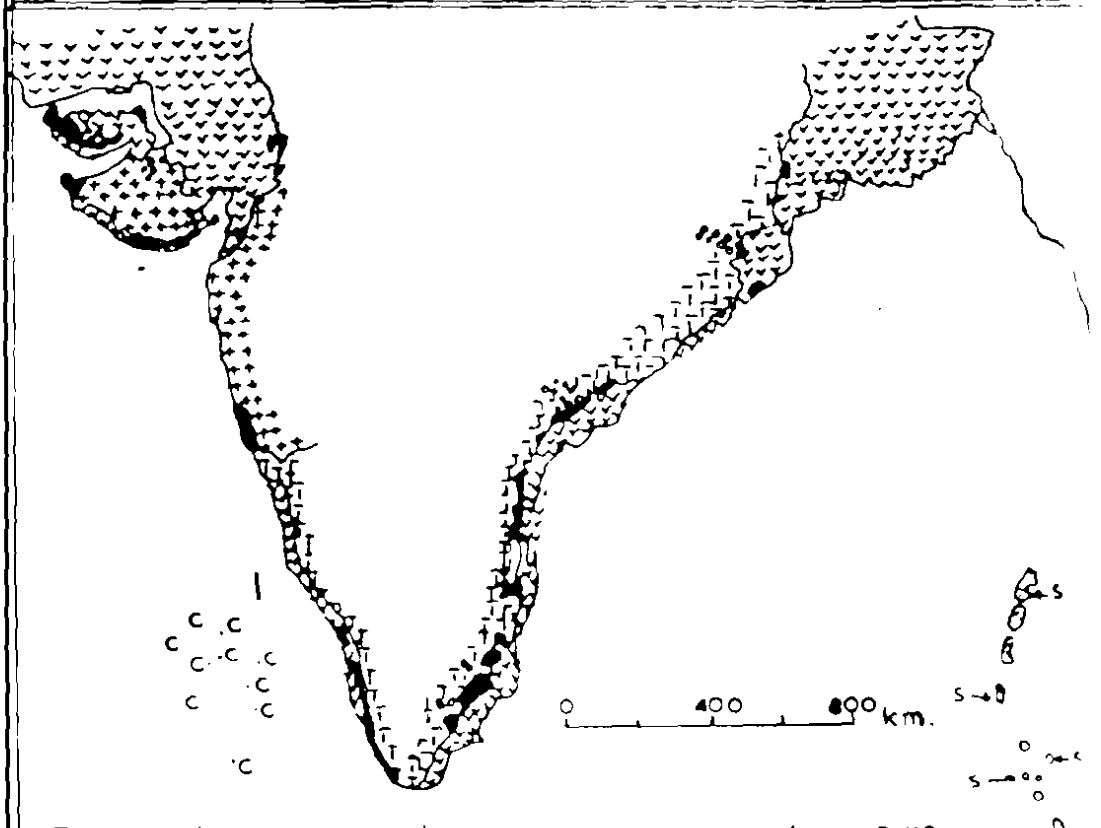
coastal zone is formed by the long line of dead but high cliffs.

Geology & Structure:

Geologically India's eastern coastal zone, from Ganga delta to Chilka lake, is of pleistocene and recent alluvium. Here a number of faults have been discovered which are additional evidence of tectonic instability of the alluvial formation. The coastal zone in the Ganga and Mahanadi delta is relatively unstable because of recent faults in the alluvium and recent to ancient fractures in the under lying basement (Morgan, M.1959). In the North Circar coastal region the geological formations are the gneisses and granites with frequent patches of Charnockite and Khondalites. In the region of Godavari and Krishna delta, the geological features are similer to those of the Mahanadi. The thickness of the recent alluvium gradually decreases from the shore to nothing near the delta heads, where the crystalline rocky interior appear. The Coastal region in this tract is underlain on its north-estern and south-western margins by Prmo-Carboniferus fractures that bordered the ancient Gondwana rift vallys. Southward between the Krishna delta and cape camorin there is a continuous belt of coastal allvium of varying width. Landward of this belt there is a discontinous belt of sedimentaries ranging in age from the upper Goudwana to pleistocene. The upper Gondwana occurs near Ongole, Madras, Madura and Ramnad. There are Crystalline

MAP 2

GEOLOGY OF COASTAL REGION



ANCIENT (PRE-CAMBRIAN) CRYSTALLINES : GNEISSES (INCLUDING KHONDALITES & CHARNOCKITES) SCHISTS & GRANITES OF COMPLEX STRUCTURE

UPPER GONDWANA SEDIMENTARIES (NON-MARINE).

CRETACEOUS

DECCAN TRAP (LAVA OF SIMPLE STRUCTURE WITH THIN INTER-TRAPPEAN SEDIMENTS, HORIZONTAL FLOW-STRUCTURE AND COLUMNAR JOINTS).

MARINE SEDIMENTARIES : CRETACEOUS TO PLIOCENE WITH GENTLE TILT TOWARDS THE SEA.

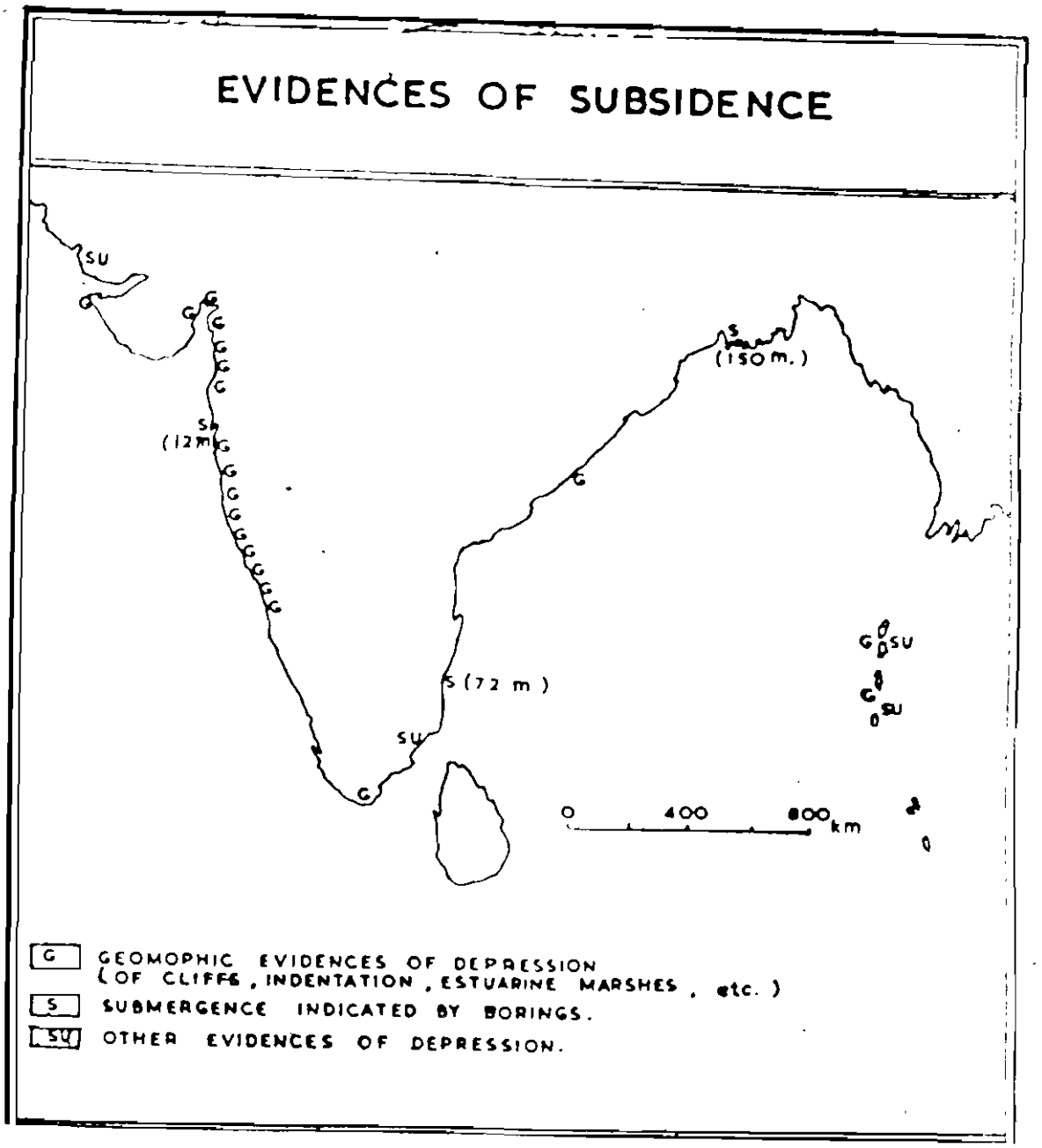
TERTIARY ; PLEISTOCENE & RECENT (NON-MARINE AND MARINE) INCLUDING RAISED CORAL REEFS, RAISED BEACHES AND PRESENT-DAY FRINGING REEFS

CORAL ATOLLS (PLEISTOCENE & RECENT).

COASTAL AND DELTAIC ALLUVIUM (PLEISTOCENE & RECENT) INCLUDING COASTAL DUNES, MILIOLITE OF KATHIAWAR & DESERT SAND.

gneisses of Cardamon hills near cape camorin. North of the Quilon, a belt of coastal allivium of variable width occurs in the coastal plain up to near Karwar. This belt of alluvium directly adjoine the gneisses and granites of Dccan massif. In western coast for a length of 350 km between Mahe and Quilon the laterite covered Warkalli and Quilon beds intervene between the coastal alluvium and the gneissic interior. Near Karwar and northward the coastal region is having granites and gneisses in Goa and further north up to 17^{o} with a few gneissic interruptions the rocks are laterite-covered beds in Ratnagiri district. Behind these marine coastal zone Tertiaries there are gneisses up to 16^{o} 15'N and further north we have the Deccan Lavas. The coastal Tertiaries in Ratnagiri are very thin deposits resting unconformably on the Deccan lavas. The lava has a number of geographical characteristics. It is marked by prismatic joints. Over most of the cambay coastal zone their is coastal alluvium. Eocene-Miocene exist concealed beneath the alluvium on either side of the Gulf. This has been proved by the discovery of petroliferous beds. In Kathiawar Peninsula Deccon lava forms the inner parts of the coastal zone. In the north it touches the shore line where the coastal and shore zone are formed of low plain and marshes as well as cliff. Eleswhere the coastal region is partly coastal alluvium and partly of tertiaries. According to Wadia, D.N. 1961, "It is believed that the Kathiawar peninsula stood 150 feet lower than at present and was probably in pleistocene

MAP 3


EVIDENCES OF SUBSIDENCE
SU
S (12m)
S (150 m.)
S (72 m)
SU
SU
SU
0 400 800 km
G GEOMOPHIC EVIDENCES OF DEPRESSION (OF CLIFFS, INDENTATION, ESTUARINE MARSHES, etc.)
S SUBMERGENCE INDICATED BY BORINGS.
SU OTHER EVIDENCES OF DEPRESSION.

time an island or group of islands". Dwarka beds of oligocene-pliocene is lying near Dwarka which is made up of clays and ferminiferous limestones. Kutch coastal region is formed by a belt of alluvium. It consists of windblown loam and sand underlain by clay 5 to 16 km wide. Solid rocks appear only at one points on the shoreline.

There is little of coastal zone in the coral atolls of the Laccadive groups where the reefs are only a few meter broad and rarely more than 5 meter above the sea level. In the Andamon group, particularly in the north Andeman island the entire coastal zone in composed of Eocene Conglomerates and sand stones. South Andmans are also more or less similar but here sandstones and clays are predominent in contrast with the N. Andmans where conglomerates predominate. Middle Andman represent geological transition between the two.

Erosion:

In the coastal zone of India erosional fectures may broadly be groupted under 3 heads: Cliffing, sheet erosion and gully erosion. The landforms of the coastal zone as a whole may be divided into erosinal and depositional features. Erosional features and processes generally characterise upstanding areas specially of marked slopes, while the depositional features occur in area of minimum altitude and of level topography. In highland coastal area cliff at the head and pocket beach or marshes at the head of bays and inlets, are important erosion at topography. The tracks

where the seaword margin of the coastal tract is a low land depositional features e.g. deltaic sedimentation, estuarine marshes, and dunes and river alluvium are the charateristic features.

According to Ahmad E, "In Indian coastal zone, Gully erosion and the formation of bad lands is developed to a high degree in the Gulf of cambay, in the valleys of the Tapti, Narmade, Mahe and Sabermati, particularly north of the Narmada". The Gulf of cambay coastal zozne is one of the most spectacular regions of India in respect of land and gully erosion. Ravines as deep as 2 to 3 metres scap practically the whole surface in the coastal zone between the Narmada and the Sabermati. Some gully erosion also characteries the coastral zone in eastern and southern Kathiawar, a few localities in the zone between the Godavari and the Ganga. However, sheet erosion is quite marked in all the above noted areas of gully erosion. Sheet wash of soil and sediments also occur to a marked degree in the region of the Western Ghats and North Circars.

When we look into the depositional features of Indian coastal zone than we see that the coastal zone from Midnapur to the Godawari is marked by coastal sand dunes. The coastal dunes are low in relatively protected sites e.g. Balashore and Midnapur coast falling on the lee of the Mahanadi delta. Casuarina trees growns in continuous clups arrest the landward March of the dunes in all the Indian coat and shore characterised by coastal dune. The sand dunes in the Circars

coatal zone are generally oriented as obolong ridges extending from S.W. to N.E. in conformity with the force of the prevailing wind i.e. the S.W. Monsoon. In comparision to N. Circars, on the caromandal coasts sand dunes are scarce. Near Cuddalore on its south there are sand dunes and hills about 20-30 m. high. Up to cape camorin the dune hills are more or less continous but lower i.e. 2 to 5 m in hight and occupy narrower zone, remaining close to the shoreline. In the relatively arid Tirunelveli area, falling in the rain shadow of Cardemon hills, notable series of round sand dumes, locally called "Teris", is found. But although they are features of the inner coatal zone they are not of coastal but inland origin. Here the ward-teri refere more appropriately to the upland, formed by sand dunes then the level sandy country. On the western coast particularly west of Cape Camorin near Trivendrum, there is dune belt occuring partly in the shore and in the coastal zone streches about 25 km. But this dune belt in more or less a featureless pile of sand. Such sands also occur between Cochin and Calicut. The dunes are totally absent, where the coatal plain is non-existant and the rocky surface plunges direct by into the sea or the lagoons and back-waters. On the western side of the Indian coast some dunes occur in the coatal area of Surat, Bharoach & Kutch coast. Another zone of dunes occur between Veraval and Dwarka on the south-western Kathiawar coast. By summarising the characterstics of the coastel dunes it can be concluded that they generally occur in the non-cliff, low

coastal plains, mostly on the east coast, being Scarce on the west coast. Concidering the orientation, Indian coastal dunes are quite complex but mostly the dunes run parellel to the shore line. Sometimes they are transverse to the coast as in the case of Godavari delta.

The other important depositional feature in the coastal zone is river alluvium. The topograhpy of the coastal low lands are responsible for such features. The east coast alluvium Consists chiefly of clay with Kankar. Gravels and sand also occur frequently. The thiknesses of the alluvium and the slopes of its surface in the coastal zone are related to the catchment, its geology, topography and precipitation falling within it. The rapid torrents of the Western Ghats plunging on the steep shopes discharge most of the sediments into the sea and the coastal plain is either very narrow or no-existent. In the east coast zone the large quantity of sediment is spread by widely socillating streams. The coastal zone is immediately behind the mouth of streams and is consequently characterised by deltaic esturine features of alluvial deposition. In India's many parts of the coastal zone, laterite (mostly low level laterite) forms an important depositional fetures. Here it occurs as an intrrupted fringe. In the north of Bombay it is almost absent but is seen between Bombay and Ratnagiri and then throughout large tracts of the low country separating the Western Ghats from the sea, as far as Cape camorin. On the east coast, laterite occurs almost everywhere rising from beneath the alluvium

which fringe the coast and sloping gradually upwards toward the interior. But it is generally much thinner deposit than on the west coast. (Pascoe E.H. 1970)

Classification of India Coastal Zone

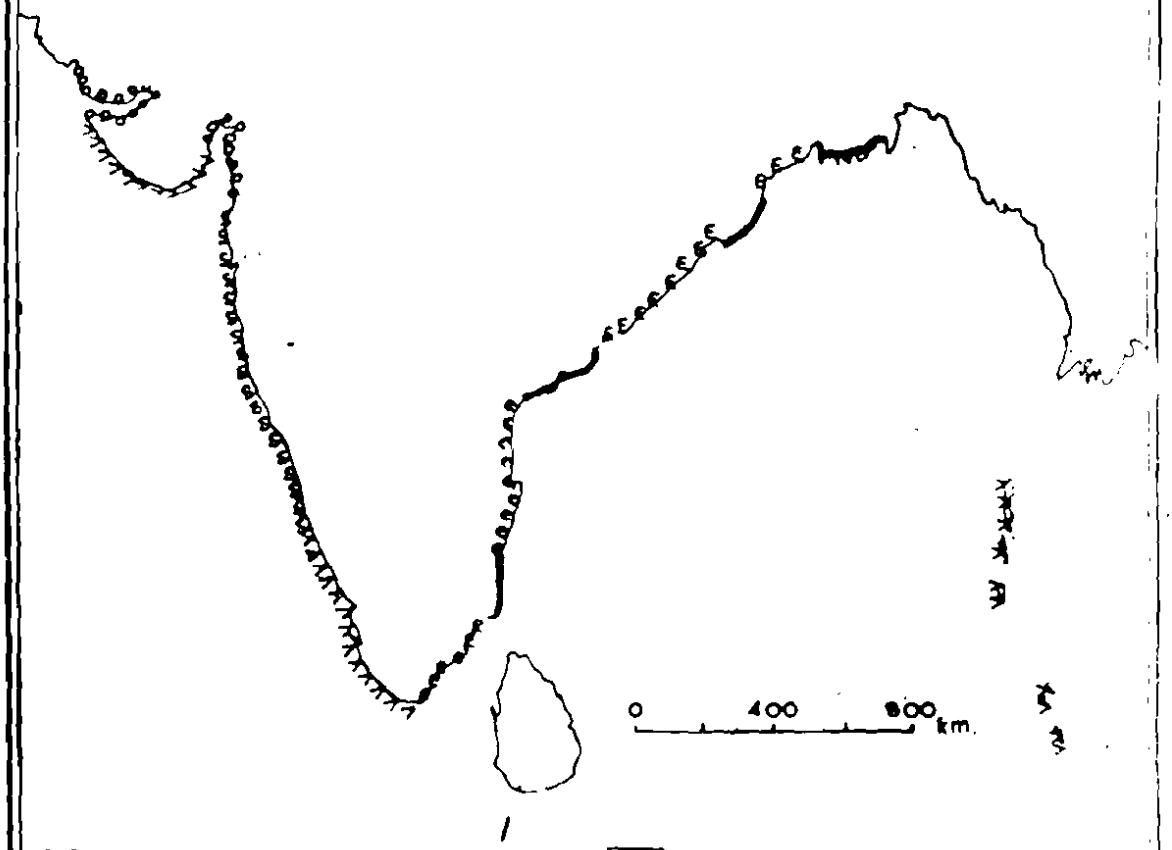
In a broad sense the very term 'Coastal zone' includs the coast and the shore. We defined the shore, coast & coastline for further classification of the coastal zone.

The shoreline is the junction of sea and land. This shore line is not static. It becomes longer and moves seaward at the low-tide. It moves landword at high tide. Thus there is a zone betwen which the shoreline migrates. The zone between these highest and lowest of shsorelines can be called the shore. According to Johnson D.W. "The shore zone, that lies between the ordinary low and high tide has been called foreshore and that above the same immediately at the cliff-foot as backshsore". Johnsons division of the littoral belt into three zones- off sh ores zone, shore and coast has been accepted by most of the scholar. Shepard has taken the inner edge of the wave-transported sand as the upper limit of the shore zone on the basis of the usage of the Beach Erosion board of the Army Engineers.

While the shore zone is bordered seaward by the offshore zone it is bordered landward by the 'coast' which is the belt of land immediately behind the shore zone. The coast includes the sea cliffs and elevated terraces or low lands adjacent to the shore (Shepard F, 1948). Thus the coastal

MAP 4

SHORELINE CLASSIFICATION



- — NEUTRAL (DELTAIC)
- E EMERGENT WITHOUT OFF-SHORE BARS.
- e e EMERGENT WITH OFF-SHORE BARS & LAGOON.
- >> COMPOUND (SUBMERGENT & EMERGENT ASPECTS CONCURRENT).
- SS SUBMERGENT (RIAS & CLIFFS).
- oo SUBMERGENT (ESTUARINE).

zone may contain the elevated or fossilarised shores and can contain coastal low lands. After above explanation for intensive study we shall look into the classification of Indian coastal zone in two heading.

a. Classification of Indian shoreline

b. Classification of India coast.

a. Classification of India shoreline:- According to Ahmed India is having following type of shore

I. The neutral deltaic shoreline- Such a shore is in the delta of the Gangga, Mahanadi, Godavari, Krishna and Cavery. It has gentle off-shore profile, being more akin emergent type. But according to Johnson it is neutral type because irrespective of emrgence or submergence such a shore continues to grow sea-word. According to Ahmed E, it is now an established fact that all major deltas such as the Indian deltas are submergent, but such sedimentation subsidence or isostatic subsidence do not alter the basic fact that deltaic shores prograde.

2. North Circars shore- North Circars extends from Ganga up to Krishna delta. Here emergent aspect is dominent except the deltaic shore. Its other important characteristic are straightness, universal development of beach dunes and spits, gentle profile of the shelf and a non-marshy shore zone. According to Guilcher, here sea action is important. Orientation of N. Circars shore is largely coincident with the prevailing winds.

3. Coromandal shore line: It sextends from Krishna delta

to Capa Camrin, and it is dominently emergent in character. Other important features are straightness, a very gentle profile both in the foreshore and backshore. Here off-bars are universaly occuring. According to Guilcher here marine action is main cause of topography formation.

4. Shoreline of Keral and Karnataka: This shore line is marked by a highly regular out shoreline representing the seaward margin of the off-shore bars. The inner shoreline of the legoons is often highly irregular and rocky and steep heaving a dominating submergent aspect. Such shore is termed as compouned. Because there is an outer straight shoreline representing the seaward side of the off-shore bars. Then there is an inner shoreline represented by the margin of the Khayals (the local name of such lagoons and lakes). The former has a dominantly emergent aspect while the latter has a dominantly submergent aspect. The Johnson suggested the term Compound shoreline showing concurrent existance of aspects of emergence and submergence. Guilcher has attempted only a morphological classification and the Mysore and Kerala shore line will fall in this type dominated by 'beaches' formed under marine action.

5. Shore line of Maharastra- It is very indented rocky and submergent coastline. The shoreline from near Karwar to Bulsar, roughly concident with Maharastra coast and Deccan lava region has a dominantly submurgent natural. Here high degree of indentation marked by ria like shore, and rocky promontories and headlands, mumerous cliff and rock plains,

stacks, sea-waves and bridges and a number of off-shore rocky islands are prominent feature. According to Guilcher this shoreline will largely fall under the head cliffs and rock platforms related to marine erosion.

6. Esturine Shoreline: In Gujarat state round the Gulf of cambay north of Bulsar up to near Bhalnager, the shoreline is indented with deep esturine inlets of the sea. Here submegent aspect is dominated. In this coast thre are a number of eturine islands and sand flats. Mud flats and marshes are very common in this zone.

7. Shoreline of Southern Kathiawar: Again it is identified as compound shore line. Here between Bhavnagar and Diu the shoreline is fairly indented. There are a number of rocky islands and cliffed points but like Maharstra shoreline, here submergent aspect is not so marked. In this shoreline the cliffs, islands esturies and inlets pointing to submergent aspect while off-shore bars and local straightening of shoreline relateds to the emergent aspect. That's why Johnson classed it as compound shoreline.

8. Shoreline of South West Kathiawar: It is compound shoreline because if would partly be classed as estuaries and marches and partly as beaches and coastal dune's. While the esturies and marshes suggest submegence of the bars, spilts and the remarkable straightness of the shore suggest emergent aspect (Johnson). Here close up study shows that the shoreline from Verval to about Dwarka in remarkably straight and has a dominently emergent aspect. There are bars and

spits on the mouths of several streams. But is marshy particularly near porbander or Maini near the esturine of streams.

9. Shoreline of Gulf of Kutch: It is classified as submergent coastline. Southern shore of the gulf of Kutch, is very indented dispite the low-level plain surface of the coastal interior and has a submergent aspect. It is proved by exiting topography like indentations, deep inlets, a number of off-shore islands and several estuarine river months.

10. Shoreline of Laccadive Archipelago : The Laccadive, Minicoy and Atolls islands are a series of costal atoue. In such area the shoreline is formed by the coastal organism. That's why Johnson indetified this shore line as neutral which means independent of submegence or emergence. Thus to determin the shore feature here coral reef building is the dominent process.

11. Shoreline of Andman and Nicobars: Again it is also identified as compound shoreline. Although the shoreline of this region are highly indented and shores marked by submergent aspect but there are a number of other characteristics in the favour of emrgent aspect. These are frequent cases of raised coral reefs and other types of raised beaches. These give definit proof of recent emergence. Alongwith many cases of sea cliffs carved out in different rock type. This shows recent submergence.

(b) Classification of Indian Coast: According to E. Ahmed

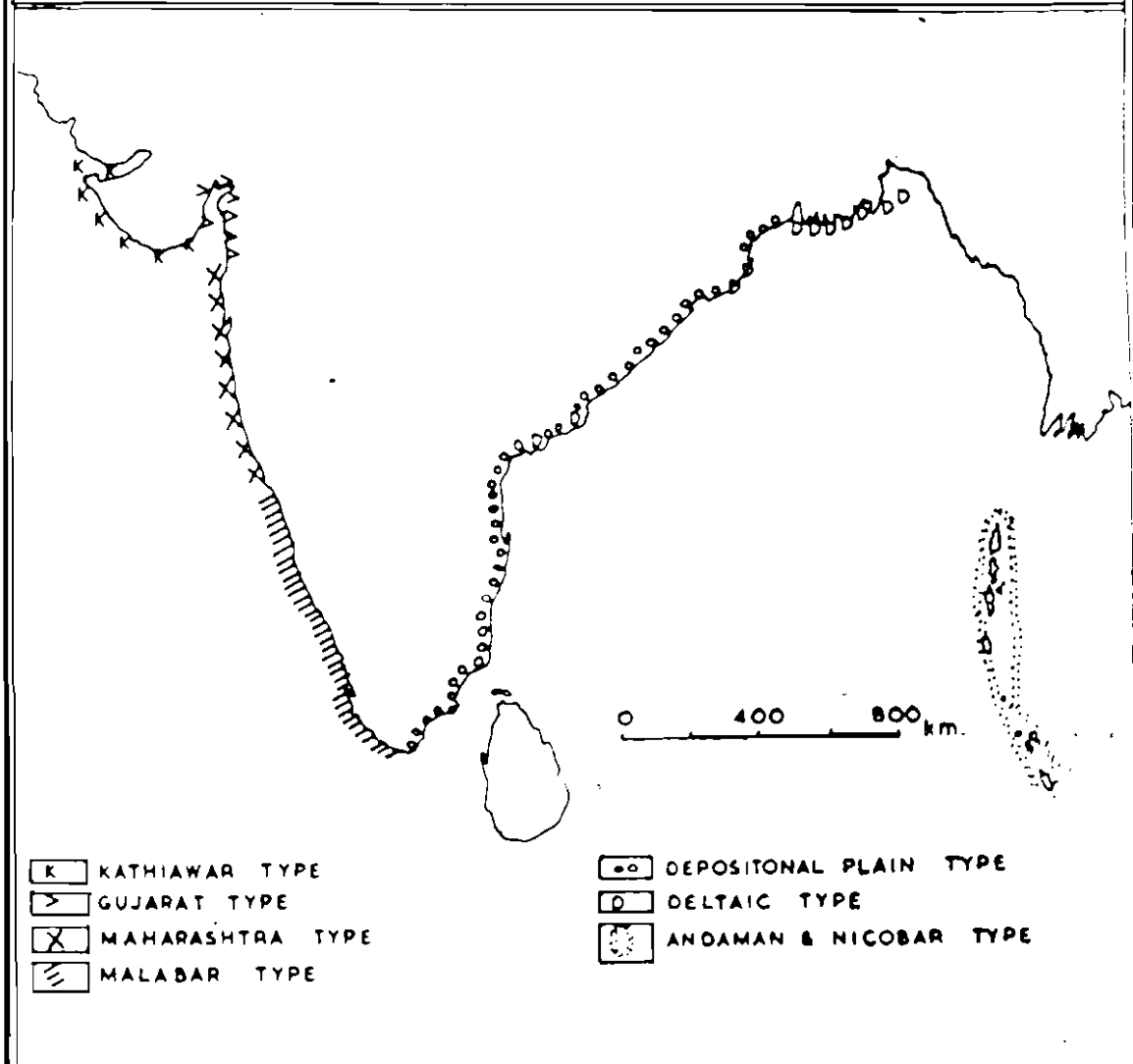
when we refer to a classification of the coast we are referring to the classification of that indeterminate ribbon of country which lies behind the shore zone i.e. behind the innermost limit of the sea during storms and highest tides. So here classification of the coast will not be overlapping with the shoreline type.

Earlier Richthofen has classified the coastal zone but due to various basis of classification it is very much overlepping on one another. For example according to Richthofen the eastern coastal zone of India is an area of regional alluvial coast', Considerisng only the shoreward section of the costral zone. But on the basis of the structural trends of the Eastern Ghats which are parallel to the coast, the estern coast of India can well be recognised on the longitudinal type of Richthofen. Further looking into the coastal Tertiaries and older sediments that dip uniclinally seaward then the east coast of India should be identified as transverse coasts. On the other hand considering the edges of Peninsuler plateau it can also be regarded a block coast. So without going into constroversies it will be wise attempt to make a general classification of India coastal zone on the basis of very common physical characteristics. On this basis Indian coastal zone can be classified into following heads:

1. Kathiwar coast
2. Gujarat type of coast zone
3. Maharashtra type.

MAP 5

COASTAL TYPES



4. Malabor type
5. The depositional plain eastern coast
6. Deltaic coasts
7. Andman & Nicobar type.

Kathiwar coast i.e. marked by a lava interior. In the north due to influence of the structure features of lava, besalt directly occurs on the shore. In other area a ribbon of coastal tertiaries and plestocene wind blown sediments occur. Here terrestrial deposition is dominant and has shaped the coastal feature. The coast is parallel to the structural trends of the interior in Kutch and in the Rann excluding western and estern end.

Gulf of Camboy is surrounded by Gujarat type of coast E. ahmed says that here the alluvial zone, Occuring above an esturine shore zone, is marked by gully eosion of the worst type probably due to recent local uplift behind the drawned shore zone.

Maharastra type coast zone extends between Goa and Gujarat. This zone is dominated by basaltic lava of cretacious period where there are no definite structure trends. The lower slopes of the western Ghat supposed to be due to faulting dominante the coastal zone. They occupy the larger part of the above the cliff or river and bays.

In Malaber type the coastal zone is having highly irregulaer terrain. It has been shaped by terreitrial erosion, techtonic disturbances, such as faulting during the tertiary era. Geology of this zone marks structural grains

of the ancient gneissic and cryetalline rocks being roughtly paraller to the coast.

The dipositional plain, eastern coast is identified between Ganga Delat and Cape camorin. This coastel zone is marked by a plain whose characteristics have been largely shaped by river deposition. Gentle sloping surface and largely land dominance are the special feature of the estern coastal zone.

In the delta of Ganga, Mahanandi, Godavari, Krishna and Cavery the coastal zone in marked by deltaic deposition and hydrography which overide other physical conditions of the area.

Andman and Nicobar type of coastal zone is dominated by a rugged terrain, North-South folded structure which is longitudinal to the eastern and western coast and transerves to northern and southern coasts.

Conducting the above study it is evident that coastal geomorphology of India is more than academic interest. Although the existing literature pertaining to the coastal geomorphology of India is very limited. It consists mainly of the work of the early poineers of the Geological survey of India. The physical features of the coastal area of India are a sort ot tarra incognita. In the absence of elementary and basic information it is too much to expect that we can understand the inter-relationship between the above-noted characteristic and causes with regard to India.

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CHAPTER IV

RESOURCE INVENTORY OF INDIAN COASTAL ZONE

CHAPTER IV

Resource Inventory Of Indian Coastal Zone

India is major coastal state in the Indian Ocean. It has a coastline extending to over 6000 Kms. Except this it possess a continental shelf covering 45 million hecters, an exclusive economic zone over 2 million square km., and a brakish water potential of 2 million hectare. During the next two decades, these, are the areas in which the most spectacular advancement are expected. Coastal and offshore activities are rapidly on the increase in India. Very large investments are being planned for the exploration and exploitation of various ocean resources such as food, chemicals, minerals, transportation, recreation and energy to improve the socio-economic condition of the vast population. Roughly 25 percent of the present population live in the coastal areas within a few hundred miles from the sea shore. It is estimated that about 170 million people are directly dependent on the sea for their living or livelihood (Qasim S.Z (1983). So a study of resource inventory in the Indian Coastal Zone is very much needed.

Resources of the Indian Coastal Zone can be classified under two heads:

A Living resource

B Non-living resource

A Living Resources: The zone of maximum importance to mankind today for the exploitation of natural living

resources is the uppermost layer of 100 m of the sea. Thu- in the zone where most of the photosynthetic production of organic water occurs. It forms about 1.8 persent of the world ocean. From this zone, more than 50 persent of the worlds fish catch is obtained presently. The region occupying this zone are either fairly close to the coast or in very fertile areas of the of the Coastal and offshore upwelling regions (Qasim s.z, 1983). With the 200 mile exclusive economic zone India has jurisdiction over the living resources in approximately 5,87,600 nautical miles of the Indian Ocean. Some important resources are capture fish, seaweeds, mangroves, coral reefs and mariculture etc.,

(1) Fisheries Resources: In India, marine fish production consists largely of capture of fisheries and for these the intensively exploited areas are found in the narrow coastal belt. India ranked as the eighth largest fishing nation in terms of fish landings and accounted for 46 persent of the total Indian catch (F.A.O 1986). But one can not say that the fisheries positions in India's coastal water is better. India's fish catch, for all practical purposes, is confined to offshore water. Only one persent of the catch is taken from the deep sea (Rahmatullah Khan, 1982). That is why in India's coastal resources there is very much importance of fisheries. About 60 persent of the total marine catch of India comes from the traditional fishing sector i.ethe fishermen operate about 5-10 miles from the coast.

Fisheries sector produces protein rich food of about 25 lakh tonnes of fish annually, earns foreign exchange worth about Rs. 400.00 crore per annum and provides direct and indirect employment to above five crore persons,monthly from traditional fisherman community. Fish production has shown an increase from 7.5 lakh tonnes in 1950-51 to 23.7 lakh tonnes in 1982-83. Overall fish production in 1984-85 was an all time high at 28.58 lakh tonnes. (Table I)

The growth of ovewrall fish production during the sixth plan was of order of +3.1 persent per annum. The level c production is likely to increase further considerably with steps now being taken for the exploitation of deep sea areas with the 200 nautical miles exclusive Economic Zone (EEZ). India's coastal fishing that comprises 1,50,000 traditional non-mechanised country craft and catamarans which account for about 60 persent of the total catch. There are also about 18,000 machenised boats which are capable of operating upto 10 Kms from the coast.

According to a survey undertaken by the Central Marine Fisheries Research Institute, there were a total of 1,435,000 marine fishermes of whom 322,532 (22.5%) were active fishermen. The distribution of the marine Fishing population in Coastal States of India, is evident from table II. According to table II, Andhra Pradesh has highest number of fishing villages followed closely by Tamil Nadu, Maharashtra, Kerala, West Bengal and Orissa, Gujarat, Karnataka, Goa and Pondicherry. These Coastal States have active fishermen

Table I

FISH PRODUCTION

(IN THOUSAND TONNES)

YEAR	MARINE	INLAND	TOTAL
1950-51	534	218	752
1960-61	880	280	1160
1977-78	1515	854	2369
1979-80	1481	855	2366
1982-83	1509	861	2370
1984-85	1769	1089	2858

(Source: Annual Reports of the Ministry of Food and Agriculture , India 1986)

TABLE II

DISTRIBUTION OF THE MARINE FISHING POPULATION IN COASTAL STATES OF INDIA

State	Approx. length of Coastline in Kms	No of Fishing Villlages	Total Fishing population	Active Fishing population
1.Andhra Pradesh	970	408	2,37,470	64592
2.West Bengal & Orissa	680	182	63,082	15076
3.Tamil Nadu	946	374	2,885856	68[illegible]7
4.Pondichery	14	21	16414	3785
5.Kerala	560	268	3,91,900	80898
6.Karnataka	270	145	98832	31740
7.Goa	110	40	14865	4067
8.Maharashtra	650	299	3,01403	41539
9.Gujarat	1500	179	1,24586	22518
Total		1913	14351[illegible]3	322532

(Source: Planning Commision, National Committee on Development of Backward area, report on development of [illegible] areas affected by Salinity, Nov 1983)

population of over 3 Lakhs, the highest being in Kerala (80,898) amd lowest in Pondichery and Goa i.e 3785 and 4067 respectively. In the Coastal areas of Kerala, West Bengal, Andhra Pradesh, Tamil Nadu, Goa, Maharashtra and Orissa, fish forms an important part of the diet of many people. Because, it is the most clearly produced form of protein food used with rice. Its particular importance arises because of the scarcity of animal foodstuffs. In India, fish enters into food mainly of the people living in the Coastal States where more than 80% of the population takes fish.

Pisciculture experts have classified the commercially important varieties of sea fish into 15 groups and fresh water fish into 8 groups. The sea fish group comparising marine and esturine fisheries includes eels, cat fish,.silver bar fish, herrings, anchories, Bombay Duch, makerals, perches, silverbellies, fat fishes, mullets, Indian Salmon, Jew fish crustaceans, shell fishes, and dorab . Some important caught on the west and east coast are:

Shark: Shark is found on the coasts of Sowrashtra, Maharashtra, Kerala, Southern and Northern parts of the east coast of Tamil Nadu and West Bengal in waters 45 to 55 metres deep. It is caught throughout the year. It is important for food and oil.

Oil Sardine: It ranks as one of the best known among commercially imoportant fishes in India. It is extensively used as food and in extraction of oil and Guano (used as

fisheries). Maximum abundance of this species is from Ratnagiri in the north to Quilon in the South. Kerala (83 persent) and Karnataka (16 persent) contribute the largest share of the catch of this kind. It constitutes about 24 persent of the total marine fish landings. Its yearly production is about 2.5 lakh tonnes.

Anchovis: Anchovies are caught along the Malabar Coast. More than 90 persent of the catch come from Maharashtra Coast.

Bombay Duck: It contributes on an average 8.3 persent of the total catch. It constitutes a major fishery confined within a distance of 6 to 8 KM in Gujarat, Maharashtra coasts from Bharuch to Ratnagiri. Along the east coast it forms only a minor fishery. But on the western coast Maharashtra (35.3 persent) and Gujarat (22.8 persent) together contribute as much as 58 persent of the marine fish catch of Bombay Duck type.

Ribbon Fishes: It contributs about 3.6 persent of the total catch. These are caught mostly along the west coast in Kerala. The season for fishing generally extends from July to March. They are used in fresh state as table fish and mostly cured with salt or sun-dried.

Miackeral: It is found practically all along the coast of India excluding the northern part of the west coast. It contributs 8.2 persent of the total marine catch. The main

fishing ground of this kind is restricted between cape Camarine and Ratnagiri. 95 persent of catchs comes from west coast. More than 60 persent of the catches are salt cured or pickled. The percentage contribution of different states to the catch is nearby 40 persent by Kerala, 16 persent by Karnataka 15 persent by Goa, 7 persent by Maharashtra, 3 persent by Tamil Nadu, 3 persent by Andhra Pradesh and 2 persent by others.

Pomfrets: They are mostly caught in northern parts of the Bay of Bengal, South Orissa, and north Andhra Pradesh coasts on the east and south Kanara and Malabar on the West. Pomfrets contribute about 2 persent of the total marine catch. They are one of the highly priced marine fishes with a great demand for both fresh and dried fish.

Some other important coastal fishing includes fly fishes, Indian Salmon, Soles, Cat fishes, Seerfishes etc. Fly fishes are confined to the east coast and are noted for their delicate flavour and high nutrition. Indian Salmon is caught on the east and the west coast. On the Coromandal Coast Trenqueber, pamban, Sippikulam and Idinthakarai ; and on the western coast N.Kanara, Kozhikode and Valapad are the important fishing centres. Soles fishery is one of the major fisheries of the west coast. It is cinfined almost exclusively to the Kerala and South Kanara. Silver bellies are confined to coastal belt with greater abundance along the coastline of Andhra Pradesh, Tamil Nadu and Kerala. They form about 3.8 persent of the total catch. Cat fishes

include a large number of commercial species and form about 3.3 persent of the total catch. They are abundant all along the Indian Coasts. Seerfishes are also found along the entire coastline of India. They contribute about 1.4 persent of the total catch.

Potential Distribution: India with a coastline of about 6100 KM has a large number of gulfs and bays creeks along with the extensive backwaters, esturies, lagoons and swamps along with the entire coast line. Thus India possess large potential fishery resources. Exploratory surveys indicate availability of 0.6. m tonnes of fish and prawns from the coastal belt upto 80 metres. The backwaters and esturies along the west coast are extensive. These are widely scattered and are estimated to cover an area of 75.0 lakh acres. The recent estimates are that 2 million hectares of low lying areas are available which can be used for agriculture.

As regards the type of fisheries potential the Demarsal fisheries upto 50 metre depth are rich in all states with Maharashtra ranking first (Table III). The potential yield of Demarsal fish resources from within 40 fatham is estimated at about 1.7.million tonnes ; however the present landing is about 0.64 million tonnes only. Here the following fish have been included within the tonnage of Pelagic fish: Chirocentrus, Oil Sardine, Sardines, Hilla , Flying fish, Ribbon fish Caranoids, Mackerel, Seerfish etc. Demersal: includes : eels, catfishes, Lizard fishes, Red mullets,

TABLE III

PLAGIC AND DEMERSAL FISH CATCH IN COASTAL STATES OF INDIA IN 000, TONNES

State	Plagic	Demersal	Total
West Bengal	6.42	4.32	10.74
Orissa	23.13	28.68	51.81
Andhra Pradesh	42.05	49.38	91.43
Tamil Nadu	112.92	122.08	235.00
Pondicherry	5.80	4.37	10.70
Kerala	228.27	102.24	330.51
Karnataka	97.89	28.50	126.39
Goa	15.83	9.56	25.39
Maharashtra	107.22	186.10	293.32
Gujarat	104.48	86.84	191.32
Andaman	1.14	0.58	1.72
Lakshadweep	3.20	0.65	3.85
	784.35	640.03	1388.38

Lectarine, Soles, Prawns,lobsters and chephalopode etc. The crustacean fisheries are rich in Gujarat and Maharashtra upto 50 metre depth, while they are impoortant between 50 metre and 200 metre depth in Goa, Karnataka, Kerala, Orissa and W.Bengal. The Chephaloped fishery has greater potential upto 50 metre depth, are richerst in Goa, Karnataka and Kerala, while between 50 metre and 200 metre depth they are richer in Andhra and Lakshadweep (Kundra P, 1984). Important constitutent of crustacean fisheries an Indian Coastal water are Prawns. The average annual catch, of prowns have been as :

West Coast -	Gujarat	4707	Tonnes
	Maharastra	80060	,,
	Karnataka	8192	,,
	Kerala	50659	,,
East Coast -	Andhra Pradesh	8643	,,
	Tamil Nadu	5770	,,

The catch of crustaceans other than prawns is meagre. The best prawn fishing is in Kerala. There has been considerable increase in prawn fishery off the Maharashtra Coast. The near coast fisheries have reached (for most fish) a maximum sustainable levelalong the Malabar and the Maharashtra Coasts. The productions of ,olluscs eg oysters, clams etc is primarily from brackish water adquaculture. The total landings of Lobsters in 1985 were 20,300 tonne . The tonnage expected of cephalopods was 15,000tonnes. There i.

some localised seasonal .loste fishery along the south west coast of Kerala and Southern Tamil Nadu. The fishery resources may be classified into following catagories:

1. Marine Fisheries
2. Fresh water Fishereies
3. Esturine Fisheries
4. Pearl Fisheries
5. Chank Fisheries

Sea fishing has been an occupati n with the coastal people of India from time immemorial, forming an integral part of the country's maritime heritage. Indian waters possess 12 rich fishing grounds in Coastal area viz.

1. West Bengal and Orissa Coast
2. Andhra Coast : South of Gopalpur to north of Visakhapatnam.
3. Andhra Coast: Vishakhapatnam to Masulipatnam.
4. Andhra Coast: South of Masulipatnam to north of Pulicat lake.
5. Coromandel Coast: Lake Pulicat to Cuddalore.
6. Coromandel Coast: South Cuddalore to Devipatnam.
7. Palk bay and Gulf of Mannar: South of Devipatnam to North of Cape camarine.
8. Kerala and South Malabar: Cape Camarine to Pannai River.
9. Malabar abd South Kana : North Ponnai to Mangalore.
10. Konkan Coast: North of Mangalore to South of Ratnagiri.

11. Maharashtre and Gujarat Coast: Ratnagiri to Broach Coast.

12. Kathiawar or Saurashtra Coast.

These fishing areas are rich in marine resources in the form of marine algae, fish and other edible animals. The marine fishereies are mainly confined to 16 KMS from the coast and is carried on within the depth of 20 metres in the sea. It is estimated that 74 persent of the fishing landings are from the west coast, and 26 present from the east coast. The fishing season in the west coast is from septeмber to february and generally extends upto march. The higher fish production on this coast is attributed to the broad continental shelf, the oceanic character of its water. Indian coastal zone waters have a more pronounced seasonal cycle and higher phosphate and nitrate containts, resulting in greater plankton productivity. The major fisheries like the Sardines, Mackeral and prawns are almost confined to the west coast there Kerala contributes about 36 persent of the total Indian catch. On the eastern coast fishing season starts from July to October on the Andhra Coast and from September to April on the Coromandel Coast. On this coast the north coast monsoon winds are moderate and of shorter duration that is why the circulation of water on this coast is less pronounced. Due to occurence of large rivers and coastal lakes such as the Chilka and Pliicat, has provided scope for esturaine fisheries. Here Tamil Nadu and Pondicherry contribute 16 persent of the total catch followed

by Andhra Pradesh (8 persent), West Bengal and Orissa (3%) and Andman and Nikhobar islands (0.1 persent).

Throughout along the entire coast and the coastal canal systems esturaine fisheries are confined to the esturaines, backwaters, brackish water lakes, tidal creeks, lagoons, inundated areas swarmps. The estuarines and backwater are highly productive areas because as enriched drainage from the land, influx of nutrients. The fishes constitutioning the estuarine fisheries in India are mostly marine species that can withstand variations in salinity. Important among them are: Milk Fish, Cat Fishes, Hilsa, Perches etc. The estuaries as an ecosystem, undergo dynamic stresses, mainly brought about by salinity changes and other physio-chemical factors. This is due to varying intensities of fresh water discharges in different seasons and tidal fluctuation throughout the year. That is why only a few species of high commercial value aree found.

Many species of pearls are found in Indian Coastal Zone Pearls of high value are obtained from pearl-oystems. Of these several species, *PRINCTADA VULGARIS*is by for the common and most important. This species is wicely distributed in the Gulf of Kutch, Gulf of Mannar and the Palk Bay. The Pearl-oysters of the east coast are more extensive and productive than those of the west coast. In east coast it extends from cape camarine to Kilkarai. The most productive region in the central zone near Tuticorin. Here excellent quality of Oriental Pearls or the Lingha Pearls is found.

Pearl-Oysters are usually found on the ridges of rocks & dead corals forming extensive pearl banks at a depth of 18-?? metres and a distance of 15 km from the shore.

Chanks are gregarious in nature. They are marine animals occurring in large numbers on muddy sand bottom upto 13 metres in depth in Tirunelveli, Ramanathpuram, Thanjavur, South Arcot, Chingleput and Nellore districts on the east coast and in Kerala and Sowrashtra on the west coast. The varieties of chunks commercially recognised are Tutikuddi from Tirunelveli, Duaui from Travancore, Ramessari from Rameswaram, Surati from Sawrashtra, Gharbaki from Point calimere to Madras and Dhola from different places. Chunk are widely used as a trumpet in temple. Shell is used in making of incense sticks and bangles and other ornamental articles.

(ii) Mariculature : There is vast scope for using the backwaters and estuaries along the coast of India for farming of aquatic plants and animals. The area under brackish water culture in India is estimated at about 12,000 hectare. The total area of coastal saline surface is 118 million hectare. The table IV gives the area of brackish water and estuaries. It is being practised on a small scale in the enclosed backwater and estuarine areas of Kerala, Karnataka and West Bengal. The culture is largely based on traditional method of trapping the jeveniles of prawns and fishes brought in by the tidal currents into the enclosed areas. The embanked brackish water fisheries in Malabar have been set up in the

TABLE IV

AREA OF BRACKISH WATER AND ESTUARIES

State	Brackish Water (in thousand acres)	Estuery (in thousand acres)
Gujarat	920	000
Kerala	500	100
Maharashtra	200	100
Karnataka	200	50
Goa	-	30

Source: Study on co-operation for Development in South Asia, Indian Council of World Affairs, New Delhi, February 1983.

low lying paddy fields known as Pakkali fields. Prawns, mullets and chromides are important here. The Chilka lake is an open shallow brackish water lake. Import nt catches are catla, rohan, mullet, etc.

The total production of fish and prawns from aquaculture practice is about 10,000 tonnes. Table V shows the brackish water areas under cultivation in four states of India and the total areas available for cultivation in nine maritime states and the existing annual production from mariculture . It is clear from Table that only a small percentage of the total area is being cultivated at present. The potential in this sector appears to be most promising and by the year 2000 the annual production of 4 million tonnes (2.5 from coastal and 1.5 from fresh-water areas) appears to be within reach.(Qasim S Z,1984).

Coarl Reef: In the process of making a resource inventory of the Indian Coastal Zone one should and must include the important living communities i.e. of course coarl reef. Coral reef are among the most biologically productive taxonomically diverse and aesthetically very important living organism. While their marine occurrence provides much needed protection for the coastline forms waves, their biologicaly productivity yields a multitutde of founa and flora dependent on the coral-reef eosystem. It also enhance the tourist inducting. Main sight of coral reef are the Atolls of Laccadives and on some of the island of Andaman and Nicobar.

TABLE V

AREA UNDER BRACKISH WATER AND CULTIVATION

IN COASTAL STATES OF INDIA.

State	Potential area available for culture (in hectre)	Area currently under culture (in hectres)	Annual Production (in tonnes).
Gujarat	376000	88	N.A
Maharashtra	81000	-	-
Goa	19000	-	-
Karnataka	8000	4800	1000
Kerala	243000	5700	6000*
Tamil Nadu	80000	-	-
Andhra Pradesh	200000	-	-
Orissa	299000	-	-
West Bengal	405000	20000	3000
Total	1711000	30588	10000

*includes Paddy-fields

Source : S.Z Quasim. A technological forecast of ocean research and development in India ,1983

(iv)Seaweeds: In Indian Coastal resources seaweeds are one of the important living resources. It is exploited by man for food, animal feed, fertilizers and for chimicals and pharmaceutical products. The total marine algal yield of the world have been estimated as 172,000 tonnes per year. Of this, India contributes only 1.09 percent of the total (Table VI). The demand for agarophytes and alginophytes by industry in India and abroad is increasing very rapidly. Table VII shows the total seaweed leveling in India. In India only during last twenty years seaweed based industries have been developed. Here natural regeneration in the weeds is not fast enough to meet the demand. That is why only way to generate extra resource is by cultivation of seaweed on ropes and wooden frames.

V Drugs from the Sea - In India the utilization of marine plants and animals as a raw material for effective and safe drugs and pharmaceutical is of recent origin. Of the 100 or more Organisms that have ben screened so far, forty two have given promising results. Studies in India indicate that all those species of marine algae that exhibit antifertility properties way also contain prostaglandings. Researches in this field and also on the cultures of marine bacteria, fungi, yeast etc., will advance considerably during the next two decades for the production of bioactive substances.

(B) Non-living Resources: There are mainly three kinds of mineral resources are found on the Indian Coastal Zone

TABLE VI

ANNUAL YIELD OF MARINE ALGAE FROM DIFFERENT COUNTRIES AS A PERCENTAGE OF TOTAL WORLD PRODUCTION

Country	Annual Yield (%)
Japan	62.26
Republic of Korea	10.63
Norway	9.27
Canada	4.37
Mexico	3.52
Argentina	3.09
United Kingdom	3.09
India	1.09
France	1.09
Spain	1.08
West African countries	0.45
Madagascar	0.04
Unites States	0.02
	100

Source : S.Z Qasim. A technological forecast of ocean research and development in India, 1983

TABLE VII

TOTAL SEAWEED LANDINGS IN INDIA

Area	Annual Yield (in tonnes)
Gujarat	3000
Maharashtra	6000
Goa	1000
Karnataka	Negligible
Kerala	Not known
Tamil Nadu	5000
Andra Pradesh	Not Known
Orissa (Chilka lake)	5
West Bengal	Not Known
Andaman and Nicobar Islands	Not Known
Laksha dweep Islands	Not Known

Source: S.Z Qasim ,, A technological forecast of ocean research and development in India , 1983

They are:

1. Terrigenous Deposit
2. Biogenous Deposit
3. Chemogenous Deposit

(1) Terrigenous mineral deposits: This deposit have been reported to be found in the beaches and the shallow offshore areas of Ratanagiri, Kerala, Tamil Nadu and Andhra Pradesh and also in Orissa coast. Terrigenous deposits are also known as placer deposit. A placer deposit in an accumulation of minerals grains concentrated in by sedimentary processes, commonly in the ancient beaches or steam beds. These grains are derived from the breakdown of solid rock by weathering and they may contain gold, titanium, and other important minerals. In simple words we can say that rivers and underground water carrying minerals as suspended water deposit those on the deltas or near the shore. From these, currents, wind and wave action spread them out. Such deposits are known as placer deposits. Mineral placers along the seashores, usually known as black sand, occur in many localities along the Indian Coast. Occurance of heavy mineral i.e black sand are reported from many localities of the Indian coast, which contain ilmenite, rutile zircon, magnetite, monazite, garnet, kyanite and tin in significant proportions for economic exploration.

Deposits on the west coast are largely concentrated as high-grade beach and low-grade dune deposits, extending from Kanyakumari to the Maharashtra coast with interruption in

between. These deposits mainly contains ilmenite, rutile zircon and monazite with varying proportions of magnetite and garnet (Qasim S.Z. 1984). Placer deposits of iron, titanium, gold etc have been located particularly off the Ratnagiri and the Kerala Coasts. Cassiterite (tin rich) sand has been located near the Lakshadweep archipelago. There are indications of deposits of diamonds and uranium off the east coast. Rare earths and Titanium have been extracted from many years. In India most of the terrigenous deposits occur along the coast of Kerala between Quilon and Cape Camarine. The terrigenous deposits in the black sands are estimated to contain, 17 million tonnes of ilmenite, 1 million tonne of rutile, 1.2 million tonnes of zircon and 0.2 million tonne of monazite. Along the coast from Ratnagiri to Vengurla (200 KM), there is heavy mineral content in sand, reckoned at from 7 to 81 persent of magnetite, ilmenite, hornblande, augite etc. Similar beach deposits with varying proportion of monazite, ilmenite, ziron and garnet have been reported fro Tirnelveli, Ramnad, Tanjore (Tamil Nadu), Vishakhapatnam, Yanada, Bhimunipatnam (Andhra Pradesh) and the Coastal area of Orissa. The total resources of ilemenite are estimated to be 139 million tonnes (1987) while the production in 19 thousand tonnes (Siddique, 1984). The 25 KM stretch along the coast from Neendakara to Kayankulam of Kerala is supposed to have the richest deposit of offshore minerals. The showed sand occured in the southern part, silty sand in the central part and a mixture of sand silt and clay in the north.

(Rao.P. 1968). Along the Konkan coast probable reserves of ilmenite is about 25 million tonnes. The extensive survey indicates that the onshore ilmenite placers are confined to a narrow coastal tract about a KM wide. The known reserves of heavy mineral placers are not as extensive on the east coast as on the west coast.

Sand and gravel are increasingly being exploited from the continental shelves for construction work. Worldwide offshore mining of sand and gravel currently exceeds offshore production of all non-fuel minerals in both value and volume, (camp.M.A. 1984). But sand and gravel being a low cost material, their mining from offshore has to compete with onshore deposits. This is likely to be posible in such coastal areas those have large urban centres and intense building activities. In India, such a demand of sand gravel has not arison. Such suitable deposits do not occur in the vicinity of Bombay, while heavy populated areas of Keral and the Urban centres of Cochin, Madras, Visakhapatnam and Calcutta have extensive sand deposits in offshore areas which may be useful for exploitation.

Mineral placers are also reported on the coastal tr[illegible] of many countries in the world. However, economically exploitable deposits are known only from the beaches and the shelf of Australia and India (rutile, zircon) , and Brazil (monizite and ilmenite). As time passes the importance and value of terrigenous minerals will go on increasing and by the turn of this century they will probably be exploited

extensively.

(2) Biogeneous deposit: The biogeneous group includes calcareous sands, coral reef oozes etc. The Indian coast preserves the corals on shallow banks and on the continental shelves. Oozes are found in the deep sea. Materials are continously formed, due to the prolonged biological activities of the Organism living in the oceans. After hundreds of years they are deposited in the mineral form. The coral and shell deposits are calcareous in the mineral forms of either aragonite or calcite.

Deposits of shell, corals and calcareous sands occuring in coastal areas have been utilised on a small scal from early historical times for working of whiting and lime for local construction uses. (Chaterji . G .1968). These days they are used on large scale for cement and chemicals. The best known deposits are in the Gulf of Kutch and in the vembanad lake of Kerala. The present production from the two areas is over one million tonnes. The reserves have been estimated to be 1.7 to 2.5 million tonnes in the Vembanad lake, 0.4 to 0.5 million tonne in the Kadarundi and about 1.0 million tonne in the lower reaches of the Pullet and Thathapatti rivers. Nodules of barium and phosphate and biogeneous deposits have been observed in the Lakshadweep region, Andaman sea, Gulf of mannar and Palk straits. Deposits of corals and shell sanads occuring in relatively shallow areas in the lagoons of the Laccadive island, in the Andman Island, and in the Gulf of Mannar and the Palk straits

appear to be promising.

In Indian coastal zone, relict oolitic and biogeneous sands, are found on the middle ad outer shelves. Western shelf extends almost as a continous middle strip from the Gulf of Kutch to the vicinity of Mangalore. On the eastern shelf only the occurance off Visakhapatnam consists of relict carbonate i.e. Oolitic and biogeneous sand (Siddique, 1979). Siddique and Ramjmanickam (1979) printed out that on the Kokan, Karnataka and Kerala lack limestone deposit, it would be convenient to use the biogeneous residuce in the Laccadive. Recently Venkataramanugam Santhanam and Sukumaran (1981) studying the coral resources off Tuticorin, identified 20 species along the reefs and offshore islands. Above 10,000 tonnes of lime is extracted annually from these reefs and their exploitation is already adversely affecting the islands and their local fisheries, but measures have been taken for their conservation (Venkataramanujam, K. 1981). Regarding ornamental and semi-precious stones. India is becoming increasingly important as a supplier of ornamental shells and the exports have risen many fold (Charlier 19[illegible]) In 1988 India become one of the leading exports of Jewels and stones.

<u>chemogenous deposits</u>: It formed due to rapid chemical reaction inside the sea. Of the sixty elements present in sea-water, only six are recovered commercially. These are sodium Chloride in the form of common salt, magnesium in the form of it. compound, bromine, calcium (Gypsum). Owing to

its low concentration, it is not considered economical. However, it is possible to recover potassium from bitterns. Efforts are being made to recover many useful element commercially, namely iodine, uranium and gold from sea-water. Recently, a commercial process for the recovery of uranium from sea-water have been reported. It is almost certain that research in this field will accelerate considerably and very large number of element will be recovered from sea-water in commercial quantities by the year 2000.

Chemogenous deposits is reported from the ocean floor in the vicinity of the Indian coasts, particularly off the west coast, and Andaman and Laccadive islands in the form of barium nodules. At present there is little interest in the exploration of barium nodules due to their being a low price comodity. The concretions are mainly composed of barium sulphate, with a small protion of calcium and strontium sulphate. Phosphate nodules are found on off North Andaman. With respect to production and reserve of phosphate rock, India is holding 13th position in the world with production of 0.6 million tonne; and an estimated reserve of 108 million tonnes. They occur in water depths ranging from 50 to 1000 meters. Sample of halogene phosphorites of the western continental margin of India consists of algal and oolitic limestones were recovered from depths ranging from 70 to 150 m, from Saurashtra to Kerala . In this group minerals present in order of abundance are high magnesium calcite, francolite, quartz, feldspar and aragonite. Gypsum crystals have been

found in the inner shelf silty clay, silt off the Mahashtra coast between Vengurla and Bombay. Generally these occur as euhedral single or twinned crystals of selenite. In the form of disolved minerals only common salt is very important. It is extracted from seawater in different coastal are Sodium and Chlorine are in the form of common salt.

Oil and Natural Gas: India has made a major effort to increase its Oil exploration and development capablities in the coming years. The effort is likely to increase rapidly. Though the present activities, related to offshore production of Oil and gas are confined to Bombay High area, the exploration activities are intensively going on, both on the east and west coasts of India.

The continental shelf around India upto a depth of 200 m with an area of around 452,000 km^2 can have a potential reserve of 1 billion tonnes of Oil and 271 bcm approximately of natural gas . The proven reserve of Oil, as of now is 510 MT which includes both onshore and offshore deposits. Upto 1985-86 the offshore and onshore Oil fields have yielded about 9.4 and 20.8 million tonnes of crude petrolium respectively (Table VIII). But it is evident form the table VIII that after 1984-85 the rate of production were reduced and in a very slow increasing order. Before 1980-81 only onshore drilling was important but after that off shore production have been dominating widely.

In Indian Coastal Zone on Gujarat Coast the probable reserves of petrolium has been estimated in 1985 at some 80

TABLE VIII

CRUDE OIL PRODUCTRION
(In million tonnes)

Years	On shore	Offshore	Total
1950-51	0.26	-	0.26
1960-61	0.45	-	0.45
1970-71	6.8	-	6.8
1975-76	8.4	-	8.4
1980-81	5.5	5.0	10.5
1981-82	8.2	8.0	16.2
1982-83	8.2	12.9	21.1
1983-84	8.6	17.4	26.0
1984-85	8.9	20.1	29.0
1985-86	9.4	28.8	30.2
1986-87*	9.9	26.6	30.5

* Provisional

Source : Economic Survey 1987-88 , Government of India

million tonnes. The potential reserve in Bombay high is supposed to be 230.53 million tonnes of crude oil. Out of which the 1980 production was 4.5 million tonnes, thus saving more than Rs.300 crores of foreign exchange per year (India Year Book, 1984). In terms of percentage from other sources Bombay contributes 48% to the total production in 1980 fallowed by Gujarat 40 percent (Hurwood, D.L, 1981). Recently ONGC have formed many new offshore oil bearing structures in South-southwest of Bombay, in Gulf of Cambay in Gujrat, coast of Portonova town. The new structure which yielded hydro carbons in the first well drilled was offshore Andaman and Nicobar structure where gas was found. ONGC obtained the service of Atwood Oceanics Ltd for drilling in its offfshore concession area in the coast of Orissa.

India is very fortunate to have discovered natural gas offshore at Andaman Nicobar islands, West Coast of the Gulf of Cambay and Kutch, in the coastal regions. From other source, the reserve potential of natural gas calculated on India amounts to 351.5 billion cubic meters out of which the offshore bring 270.56 bcm and onshore about 80.95 bcm in 1980. The real production in the same year amounted to 14.62 bcms. Viewing statewise it seems that Gujarat alone contributes the 48 percent of the total India production and Bombay 21 percent. In 1981 and 1982 total production of natural gas were 19.57 and 24.12 bcm respectively. But in 1984-85 the production of natural gas have gone upto 35.97 mcm. of which onshore and offshore production were 15.78 and

TABLE IX

EXPLORATION AND PRODUCTION OF CRUDE OIL AND NATURAL GAS IN 1984-85

Unit		ONGC	OIL	Total
1. Drilling (1000 meters		616.1	120.0	736.1
of which) onshore		369.5	106.5	476.0
	offshore	246.6	13.5	260.1
2.Crude Oil		26.6	3.0	25.6
(Production in million tonnes) of which				
	Onshore	6.3	3.0	9.3
	Offshore	20.3	-	20.3
3.Gas supply		26.5	7.32	33.97
(million cubic meters) of which				
	Onshore	8.46	7.32	15.78
	Ofshore	18.19	-	18.19

Source : Petrolium Economist Feb 1986, Vol L III

18.19 mcm respectively (TABLE IX). Recently ONGC discovered gas in the Dahej structure in the Gujarat State and Opens prospects in Shoal areas of the Gulf of Cambay.

Energy Resource: Ocean is a store house of energy due to solar influx. Exploitable energy exists in the form of salinity and temperature difference. Possibilities of power generation utilizing salinity or thermal gradients across the surface water - deepwater front have been studied theoretically, but no such power generation have yet been put into practice. There are many other cheaper methods, including the use of tidal energy. High tide builds up a head of water in a reservoir which, when draining out at low tide, gives rise to hydro-electric power. The method is economical if tides are paetty hight. In India, such tides (6 meters) occurs only near the Saurashtra Coast, and schemes are under study for using these. Tidal power plants can be utilized for with recreational facilities and aquaculture. A project is under investigation in this connection at the Central Water and Power Reaserch Station at Pune. At present electric generation is utilized in a generator off Madras Harbour for operating a marker light.

Thus with the above discription it is evident that India has vast coastal resources. But still many among them is not being used. Some are being used moderatly while some in negligeble amount. So there is a vast scope to develop appropriate management and development measures.

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CHAPTER V

COMPONENTS OF COATAL ZONE DEVELOPMENT AND MANAGEMENT

CHAPTER V

Components of Coastal Zone Development and Manamgement

In a region of coastal zone a very complex and fragile problem exists. Here issues and conflicts over environmental protection, urban development and utilization of resources for the satisfaction of basic human needs are involved. These issues and conflicts directly affect on a social, economic, techological and other levels of the nation as a political entity. Resolution of the problem situation requires an unified management approach and here an attempt towards a rational approach is being made.

The public awareness about the consequences of continuining mismanagement of vital resosurces has surfaced itself. The coastal zone is a major sector of the national environment with potentioal resosurces. It is particularly recognized by the public as a vital national resource requiring skilled management to solve the critical problems. These problems stem from the multiple use of coastal resources. The manner and rate of resource utilization may affect the stability of constituent geological, biologica and meteorological subsystem. The many and diverse human activities involved in the use of the coastal zone constitute impossing, excessive and competitive demands on the limited resources. Consequently they often critically affect regional ecological systems. The rational utilization of

natural resources must modify the environment to some degree.

Problems of the Coastal Zone: Many of the uses of th coastal zone and a large share of the issues and problems, involve the biological resources. Biologically, the coatal zone is unique and of spacial importance. It is a region of very high biological productivity due to a number of physical processes. Nutrient chemicals such as phosphate, nitrate and biologically important trace elements, reach the inshore margin of the sea from the land by rivers and other form of runoff. This coastal zone is a region of most intense interaction from a few Kilometers back of the beach to roughtly 15 to 25 Kilometers offshore. From a biological view point we can not regard this zone as isolated from the regions of either the land or the sea because of migratory nature of many of its organism. In this zone of natural process there are immence influences of the biotic activities.

The rapid growth of the human population in and immediately adjecent to the coastal zone is well known. Growing population demands more and more goods, services and amenities. The multiplicity of human activities in the coastal zone has been increasing day by day like production of food and industrial goods, services, recreation and others. Alongwith these, disposal of waste materials of our urban industrial establishments affect the organism of the sea and shore in multiple ways. To put it simply it can be stated that man is a new and potentially violently disruptive

element of the ecological regime of the coastal zone.

Thus the central problem is to decide what ecological revisions and adjustment are desirable from the standpoint of the long range welfare of mankind and how they can be attained. Some classification of man's uses of coastal resources will be helpful to understand the problems. In this context following classification have been suggested by Milner B. S. (1969).

1. Direct uses of living resources.

a. Extractive use for food and other marine products i.e. commercial fisheries and aquaculture.

b. Extractive use for recreation like sportfishing and hunting.

c. Non- extractive use : Observation for recreation, observation for science and education.

2. Other uses of the coastal zone that importantly depend on the biota.

a. Waste disposal biodegradable wastes

b. Biological extraction of inorganic materials.

3. Human activities that incidently affect or are affected by the biota.

a. Use of marginal lands.

b. Solid waste disposal and sanitary fill.

c. Building sites.

d. Airports

e Harbour Construction

f. Modification of shoreline for recreation.

g. Beach erosion and maintenance.

h. Waste disposal - nonbiodegradable wastes.

i. Ocean shipping.

j. Other forms of transportation as pip e line etc.

k. Power generation

l. Ocean mining.

I. Hard minerals and construction materials.

II. Petrolium and natural gas.

m. Communication

n. Military defence.

These kinds of coastal uses vary from state to state due to varying coastal population their needs, resource potentioal and level of economic and technological development. The over and under use of coastal resources leads to many problem.

In the Indian context it has been found that coastal problems are almost same as in other temperate countries. According to S.Z. Qasim and Sengupta (1980), 25 percent of population live in roughly 6000 Km long coastline of India. Rivers flow ing through the country add huge quantities of fresh water and polluted waters to the sea around India. As per the latest figure available, it may now reach 170 million persons. In India urbanization and growth of industries along the coast are increasing rapidly. This has become the cause for producing large quantities of waste

water. Detailed studies have been carried out at several place along the India coast by many agencies. It has been found that waste disposal varried from a few thousdand in case of some industries to a few thousand million literes per day as in the case of Bombay Municipal Corporation. In India there are roughly 31 medium and large urban centeres along the coast where some kind of organised water suply and sewerage systems exist (Table I & II). The total population in these area will be around 15 million and growing at an estimated rate of 3 to 5 percent per annum. According to the figure available (CUPS , 1980) the waste water generated mainly from the domestic side in around 1800 MLD with more than 2/3 being generated in around Bombay. The industries also contribute about 10% of the domestic water, bringing the total waste water flow around 2000 MLD. Samples of fish from the Bombay area have been found to contain mercury and salt concentration varying from 512-621 nenogrames per gram of fish. While as the acceptable safe limit for human consumption is 500 gms (illustrated weekly 1984). In 1973 Goa beach at Calva was inundated with shods of dying fish. Experts from NCERT confirmed that this has been caused by arsenic and other toxic chemical discharged from Zuari Agro chemicals 2AC. In the Bisso Reservoir, poisonous ammonia affluent flows without being treated. This in turn due to heavy seepage, pollutes rivers and creeks and kills fishes in them. Marine pollution around Bombay and Calcutta pose a major problem and say assume major proportions with

TABLE I

ITUATION OF WASTE WATER GENERATION, COLLECTION AND DISPOSAL IN COASTAL CITIES AND TOWNS

. o.	State/U.T.	No.of coastal cities*	No.of coastal town*	Total popu-lation (lakhs)	Waste Gene-rated MLD	Water Colle-cted %	Flow Treat-ed %	Mode of disposal
1	Andhra Pradesh	3	3	8.6	64	Nil	Nil	-
2	Goa,Daman and Diu	-	1	0.6	6	50	50	Estury
3	Gujrat	2	3	6.6	64	81	49	Estuarine and field
4	Karnataka	1	-	2.2	18	93	93	Estury
5	Kerela	5	4	17.4	176	30	2	Sea Shore and Estury
6	Maharashtra	3	-	89.1	1275	55	48	Sea Shore and Estury
7	Orrisa	1	1	1.9	11	Nil	Nil	-
8	Tamilnadu	3	1	35.2	183	90	26	Sea Shore and Estury
Total		18	13	161.6	1797	50**	37**	

Note : Estury includes the lower reaches of the river and river mouth regions.

*Cities - Population above One lakh Towns-Population between 0.5 and 1 lakh

**Taking into account industrial waste water also.

Source : The Oceans Relatives and Prospects, Sharma, R.C. (Ed) 1985 ,337

TABLE II

STATE-WISE DISTRIBUTION OF COASTAL CITIES AND TOWNS

State/U.T.	City	Population (lakhs)	Towns	Population (lakhs)
Andhra Pradesh	Vishkhapatnam	3.6	Vizianaparam	0.9
	Kakinada	1.7	Chirala	0.6
	Machilipatnam	1.2	Ongole	0.6
Goa,Daman and Diu	-	-	Panaji	0.6
Gujrat	Bhavnagar	2.3	Veraval	0.8
	Jamnagar	2.3	Valsad	0.6
			Cambay	0.6
Karnataka	Mangalore	2.2	-	-
Kerela	Cochin	4.4	Tellichery	0.7
	Trivendram	4.1	Cannanore	0.6
	Calicut	3.6	Kayamkulan	0.6
	Alleppy	1.6	Badagara	0.5
	Quilon	1.3		
Maharashtra	Greater Bombay	83.0	-	-
	Thana	2.1	-	-
	Ulhasnagar	4.0	-	-
Orrisa	Berampur	1.2	Puri	0.7
Tamil Nadu	Madras	31.7	Thiru Chedur	0.6
	Tuticorin	1.8	-	-
	Cuddalore	1.1	-	-
Total	18	153.2	13	8.4

Source : The Oceans Relatives and Prospects, Sharma, R.C (Ed) 1985 ,336

the increase in industrial activities. According to Financial Express (1974) the 140 mile Asansol- Durgapur Calcutta streach of the Damodar River is found to be one of toxic chemicals and hazordons substance. About 525 million gallone of polluted water enters the Ganga and Damoder river system from the Bengal industrial complex, every day (Competition Master, Jan 1977). The Maharashtra Prevention and Water Pollution Board had decelared 14 river basins, Creeks and coatal areas as water pollution prevention areas among which five are supposed to be badly polluted. The Mula-Mutha river near Pune, the Patal Ganga near Nasic, Kundalika and Ulhas creecks, and coastline off Bombay have been found to be the worst affected. The Thane Mahim and Mahal Cricks flowing through Greater Bombay are believed to be beyond redemption (The Times of India, June 17, 1978). According to Deinzing Aaron (1978), "It has been calculated from observations that the inorganic phosphate content in the water near shore areas of the Bombay city have increased about 50% during the last 20 years. But still in general damage caused by those sources has not reached alarming situation exept some place where it really has". Indian farmers are using about 34,000 tonnes of pesticide. There are about 100,000 tonnes of synthetic detergents which are being used by Indian people per year. About 25 percent of these chemical or their degradetion products are supposed to be find their way into the sea. The sea, especially the near shore zone which are mostly used for food, recreation and

coastal traffic, do not have an unlimited capacity for making pollution ineffective. The result is that the pathogenic organism, bacteria etc harmfull to human health are frequently found in coastal water. These harmful organism may have the following possible origin like food, paper tanning, textile, dairy, chemical, atomic palnts, power plants, animal husbandry and other industrial and agricultural activities. According to Indiancoucil of world affairs report on South Asia, (Feb 1983) pathogenic bacteria from cattle, sheep, pig etc, eg Salmonella or Disteria are parasites liable to contaminate coastal water. DDT waste passing from land to the sea cause contamination, producing marked effects on animal life. Nuclear energy plants and chemical industry, where wastes with or without treatment are passed out to the sea, can cause heavy metal and radioactive pollution. So research and development has to be carried out to determine human tolerance limits for the intake of contaminants in marine produce.

Another polutant is petrolium & its products. Dwivedi SN & Desai (1974) state that, "It may be inferred that the increase in the deposition of tar-ball on the beaches is due to an increase in shipping and because of increasing movement of crude oil along Indian coastline,". India has a good deal of international navigation engaged in the carriage of oil cargoes and other pollution passes near it shores. About 750 million tonnes of oil is tranported from the Gulf contries across the Arabian sea to far East, Japan and to western

countries. The average annual oil spill in the sea is estimated to be 3 million tonnes. Dissolved petrolium or hydrocarbon concentrates in the sea water. About 750- 1000 tonnes of this material are deposited every year during the monsoon months on the beaches along the west coast of India.

Coral ecosytstem are of vital significance for local coastal communities. In the coastal coral island region, repeated removals of corals for the production of lime is destroying local fishery. Haphazard construction of dams has blocked the the passege of migrating fish and destroyed some habitates of fish. Due to lake of required technological development fishing is restricted to mainly on shore area upto 10 fathoms of Indian coast. Over fishing population the same area is effecting the viability of the fishing industry under developed infrastructure, inadiquate fishing equipment and haphazard management systems are some important set back of India coastal fishing. Over fishing to the extent of near exhaution point has depleted many coastal areas. Much harm has been caused in coastal fishing by sewage from cities, industrial waste, hazards terrigenous materials etc. These materials pollute coastal water, kill the fish food like Planktone & Niketone and make water poisonous for fish hatching. Under developed port facilities are also a main negative aspect of the coastal fishing and other activities.

Coastal Erosion : Coastal erosion is an serious problem throughout the world both in developing and developed

countries. Some degree of coastal erosion is experienced in almost all of the more than 125 countries that have coastline. According to Amstrong & Kuretch (1979) "The social and economic consequences of coastal erosion can be substantial in many cases. It may come displacement of a whole community". The economic consquences of coastal erosion is loss of land and property. It creates quite severe problem in those countries where the coastal area contributes to a major part of the national income. As coastline becomes more and more developed, the erosion problems increase in magnitude.

In India it is a problem of great magnitude on the Kerala & Karnataka shore. In Indian coastal zone a vast arable land and settlements have crumbled into the sea. "Tradition tells of a church carried out to sea some hundred y ards west of Vypeen on the north bank of the Cochin river, there is no doubt that the sea now covers what was once the site of the tomb of the Arab Prist, Shaikh Mannu Koya" (Dist . Gazattears). On the all alluvial east coast also certain stretches of the shore and particulary subject to marine erosion by the strong N.E. Monsoon striking the shore transversly. As far example town of Mahablipuram is said to have been overwhelmed by marine erosion. According to Pascoe, E.H.A, (1964), "North of Karaikal, erosion of the beach at Tranqueber is well attested by old recrods, as well as the destruction of an old pagoda, whose eastern gate tower had been partially destroyed in 1859".

When we look into the problems of coastal erosion it very much require to know, what are the causes and factor behind it so that a prpoer control management can be suggested. The ultimate agents responsible for removal and deposition of coastal matarials are water and wind. Any variation in the working of these agents may lead to a difference in the rate of removal and deposition and there by to coastal erosion. Coastal erosion can be classified into two types i.e. natural and man induced erosion. Natural erosion is related with sediment supply and coastal processes like corrasion, abrassion, solution, hydrolic action etc. Excet these meterological and oceanographic conditions nature of waves, current and tides are also important factors of natural erosion. Any variation in one of these factors and processes cause the shoreline to davance or retreat.

On the other hand Man-induced erosion is caused by man's interference with natural coastal processes. According to a report of DIESA of UN (1982) human activities are classified under following headings in accordance with physical distance from the shore;

A. Upland actitivities

1. River dam construction
2. Sand and gravel mining from river beds.
3. Drainage system alteration.

B. On the shore activities

1. Devegetation and farming
2. Gand and gravel mining on the beach

3. Construction near the shore

4. Construction on the beach

5. Sludge disposal

C. Near-shore activities in the water

1. Offshore sand and gravel mining

2. Construction

3. Inlet Stabilization

4. Dredging

Thus sectoral activities in connection with agriculture, mining, industry, construction, transportation, power generation, trade and commerse, settlement etc may contribute to erosion situation.

Management and development:

Erosion - control of coastal erosion is an important issue in the context of efficient development and management of coastal areas. There are a variety of ways by which coastal erosion can be controlled or the unfavourable result of erosion contained. Except traditional technalogies some recent solution techniques have also been developed and being developed. A number of approaches have been suggested to deal with this problem.

A. General Coastal Environment Assessment Method: This approach is suitable for an overall coastal area development and management. It includes a wide variety of data inputs regarding the nature and distribution of natural environment, land and water capability and man's impect on

the coastal zone. This is a multipurpose exercise but exemplifies an efficient erosion determination methodology.

B. None Structural Method: Most of the non-structural methods are management tools primarily used to regulate or lesson the problem caused by erosion. This method is grouped as active ans passive methods. Active methods require physical alterations and engineering works like construction of moving structures and Vegetative measure of erosion control etc. On the other hand passive method require no physical alternation or engine ring works. It follows land-use control measurs. This is being done by permitting only those land uses requiring waterfront sites to occu py coastal lands. That land use can able to resist with erosion, coastal floodings and storm damage etc. This method also suggest that all new construction to be placed a safe distance from the shore-line. This shoreline here is technically called set-back lines.

C. Structural and Engineering Method: In this method the shoreline is to be made harden so that it may become more resistant to erosion. Some important examples of this structure are Sea-walls, revectments and bulkheads etc Other measur is Beach Nourishment. The most economical solution to problems of shore erosion may often by period transfer of sand. Beach norishment will also benefit down drift shore are as littoral transport carries sand to them. Dune construction and stabilization methad may be suggested to control erosion. By artificially developing plant

communities over dune, man can stabilize dunes and help retard erosion.

Benefit from the coastal erosion are as finicial, social and environmental. The financial benefit from control management are the income from economic activities protected. Such measurs also increase employment opportunities, and give protection from hazards to life and health. These will altimately helpful to increase environmental, cultural and aesthetic interest. Some Indian Institution engaged in information and research activities on erosional control are

1. Beach Erosion Control Board Central Water Commission, Govt. of India, New Delhi.
2. Beach Erosion Control office Govt. of Kerala.
3. Coastal Engineering Research Center, central water and power research station, Pune.
4. National Institute of Ocenography, Goa.

Waste Water Disposal and Management: One of the most important problem of the coastal zone is waste water disposal. The selection of disposal sites should be made insuch a way so as to minimise the interference with the other activities and adverse impact on environment. The physical characteristics such as density distribution and water movements of the marine environment influence the spreading, transport and dispersion of the waste. Hence, hydrographic studies with its seasonal variability become an important aspect. The meteorological data collection well

also be important for a proper interpretation of the physical oceanographic parameters and to asses the effect of wind draft. The chemical aspects are studied to establish base line water quality and to monitor the possible impact on the medium after disposal. The biological studies will give a clear understanding regarding the risk of potential research, such as biological productivity and fishery. biological study will indicate the quality of water and tolerance limits as apllicable to various organism. Thus considering the nature and behaviour of the waste from physical, chemical and biological points of view, it is possible to select a site for suitable disposal.

According to official specification, waste discharge of solid and untreated effluents in the coastal water, are prohibited except under certain conditions. Only treated liquid wastes keeping the prescribed limits can be released into the coastal marine environment. But existing pollution control law is not properly followed. Effective law and its immediate implimentation is very much needed to combct coastal pollution problem.

According to S.Z. Qasim & Sengupta (1980): At present India is having quite inadequate facilities to handle the large volume of waste. Practically no facilities are available in almost all cases for the safe disposal. Very often a major portion of waste water is being conveniently discharged into near by fields, streams, backwater or the sea without proper treatment. This has posed serious concern to

the Government.

Accordingly many steps have been initiated to improve and preserve the quality of water. It has been suggested that the cities producing large volume of waste water both industrial and domestic nature should be completely sewered and wastes should be treated and disposed suitably. In this context pioneer studies in India being conducted in and around Bombay. The best measure to conbat pollution is control of effluents and recycling of waste meterials. In scientific term such process is called rupology. Animal feeds, fertilizer composts etc can be produced from the processing of many agricultural and industrial wastes. Many organomatellies and organics can be disrrupted by bacterial filters to give useful byeproducts. Waste can be burnt as fuel and sewage can be converted to methane (CH_4) fuel. By action of suitable algae and becillietc sweage can be processed to give animal feeds, enzymes, sulfer and other chemicals. Marchent vassels may be legaly required to strilise the waste water by chlorine before releasing it into the sea. Effluents which are released into the sea should be away from fish farms. It is essential to monitor all city sewage and industrial effluents of nuclear assimilation capacity from the desired water quality criterion. Thus to develop suitable solution to pollution problems, investigations are to be undertaken. It is necessary to study the diffusion and disperssion characteistics of coastal water in which waste disposal is supposed to planned.

Linving Resources: The national demand for coastal living resources and their products has to be developed with proper perspective. There is a need to organise fish product development along with an effort to expand the internal as well as the external market. The catch can be expanded by with the halp of efficient managerial skills and availability of required infrastructure. The population structure and dynamic of fisheries have to be estimated from detailed knolwedge of life history, reproduction, migration and growth potential. There is urgent need for proper training, strengthening of national and regional research technology & institutions to develop coastal fishing. Development agency is required in coastal fishing villages for enthusing the people toward efficient methods of fishing , aquaculture and diversification. Political support is nessery for legal protection to marine fishing, aquaculture and ecosystem preservation in coastal zone.

Considerable knowledge exists in the country and an efficient extension service has been set up for the development of aquaculture and coastal mariculture. In many models cooperatives, through organisational improvements, the middle man has been eliminated. A Krishi Vigayan Kendra for mariculture (From service center) was established at Narakkal by the centeral Marine Fisheries Research Institute. The transfer of mariculture technology to farmers by the method of learning is the main objective of the center. At Kovalam a bending of sea-farming with capture fisheries has taken

place under the auspices of the coastal Marine Fisheries Reasrch Institute. A Bureau of Fish Genetic Resources has been set up in India for preservation of genetic materials for aquaculture and mariculture. In the light of India experience following suggestion can be advanced.

1. Suitable areas should be mapped out for cultivation of particular species.
2. Assessment and monitaring are necessary for regulation and conservation.
3. Overfishing has to be guarded and envirenmental protection should be assured.
4. Effective beach landing facilities are required along with infrastructure.
5. Effective systems should be established in all coastal states for distribution and marketing of fish catches.
6. Coastal aquaculture should be recognised or an industry so as to stimmulate rapid growth.
7. Polyculture as opposite to monoculture, can be attemped for compitable living animals.
8. Mariculture and brackish water aquaculture can be adopted in mangroves, swamps, salt pans, steam and open sea and can be integrated with agriculture and animal husbandary.
9. There should also be close cooperation between marine management bodies and authorities responsible for neighbouring areas because fresh water and coastal habitate are very closely related.

Non Living Resources: Among the coastal zone common salt has important position. It is extracted by evaporation all along the coast. In India chemical extraction of iodine and magnesium is carried out in Mahatastra and Gujarat coast. Now Iodi ne and magnesium can also be extracted by electro chemical means. The Salt Research Institute at Bhavnagar has carried out many successful extraction projects. Certain area in India like the drier parts of the Gujarat coast or some of the crowded coastal cities, might need abundance of fresh water, which can be had from sea water by cheper methods of desalination. The Salt Research Institute at Bhavnagar has developed desalination plants of various sizes.

In India losts of terrigenous , biogenous and chemogenous deposits are being found in the coastal zone. But still its new and appropriate method of solution mini ; is a awaited. There are often deposits o' sulfer, iron & phosphate which can be mined from the bottom of coastal water. When the deposits are very near to sh ore then mining can be done by tunnels from the land as in the case of iron mining in Japan. In India, there are known mineral deposits of sulpher, iron and phosphorits but the mining has not yet begun. Shallow sea nodules are not economically very important in Indian coast.

In Indian coastal zone possiblities of power generation, utilizing solinity or thermal gradients across the thermocline is being studied. But such study is still in theory . No such power generation has yet been put into

practice commercially. Since there are many other cheaper methods, including the use of tidal energy. So commercial uses of such energy will be very fruitful to India. Tidal energy can be developed on the line of hydroelectric project. Tidal power plan can be utilized for with recreational facilities and aquaculture. A project is under investigation in this connection at the Central Water and Power Research Station, Pune. Considerable research and development efforts are required in this frontier like data collection, analysis, environmental modeling, selection materials site etc.

India has mounted a major effort to increase its oil exploration and development capabilities. Over the coming years this effort is likely to increase rapidly. Present activities related to offshore production of oil and gas are mainly confined to Bombay high area. But the exploration activities are intensively going on both on the east and west coast of India. A large number of supply vessels and other multi-purpose support and production vessels, helicopter, Crew boat well edmiped harbour etc are required. Along with various development programmes, utmost care and preventive measures are necessary at the national level to combat polution due to oil.

Ports and Harbours: With the growing population use of coastal resources is increasing rapidly. It needs to increase the volume of seaborn traffic in petrolium and petrolium products, mineral & ores, coal, fertilizers, food

material, fishing etc. This has necessiated the development of new harbours, the expansion of existing harbour and port facilities in coastal area. Coastal shipping has become very important economically. It is therefore, necessary for India to reduce the unit cost of transportation by introducing large ships and cargo containerization. In Indian coastal zone many harbours need a regular dredging to maintain required depths for example on Tamilnadu coast. Congestion is becoming a serious problem particularly at large ports of India. It has, therefore, become necessary to divert ships to uncongated ports and develop others to recive the incresed traffic.

Recreation: Coastal zone has a great potential of recreation facilities which attract tourist from near and for. It enlarge employment oppertunities and getting more economic benefit. Sport fishing provides recreation and adds to food supply. Hotels and resturents can provide better facilities for sport fishing, aqualungdiving, swimming, sunbathing on beaches and enjoyment of fresh sea food. Aquarium, occanariums and coastal scenery, boating and yaching can greatly add to economic and social gains. India is planning to develop sport fishing in the Andman and nicobare. Tourist facilities are being developed through out the coast. Some important places of more attraction are Goa coast, Kovalom in Kerala and Caromandal, coast. A national park has been set up at Kargudi islands. Many places of pligrimage in India are located on the coast which need better management.

Thus the principle goal of coastal zone management should be to recover or preserve resources of value in the coastal area. But it should be without increasing the burden of natural and man-made stress to a point where either the physical enviranment or its users suffer serious lose. At present mainly following research programme are proposed.

1. Bathymetric Surveys: Meamurment of currents, waves and tides.
2. Study of erosion and accretion problem.
3. Harbour protection and development
4. Environmental monitoring along with coast and esturies.
5. Coastal Reserch Vessels are proposed to be acquired.

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CHAPTER VI

GUJARAT COASTAL ZONE: CHARACTERISTICS & PROBLEMS

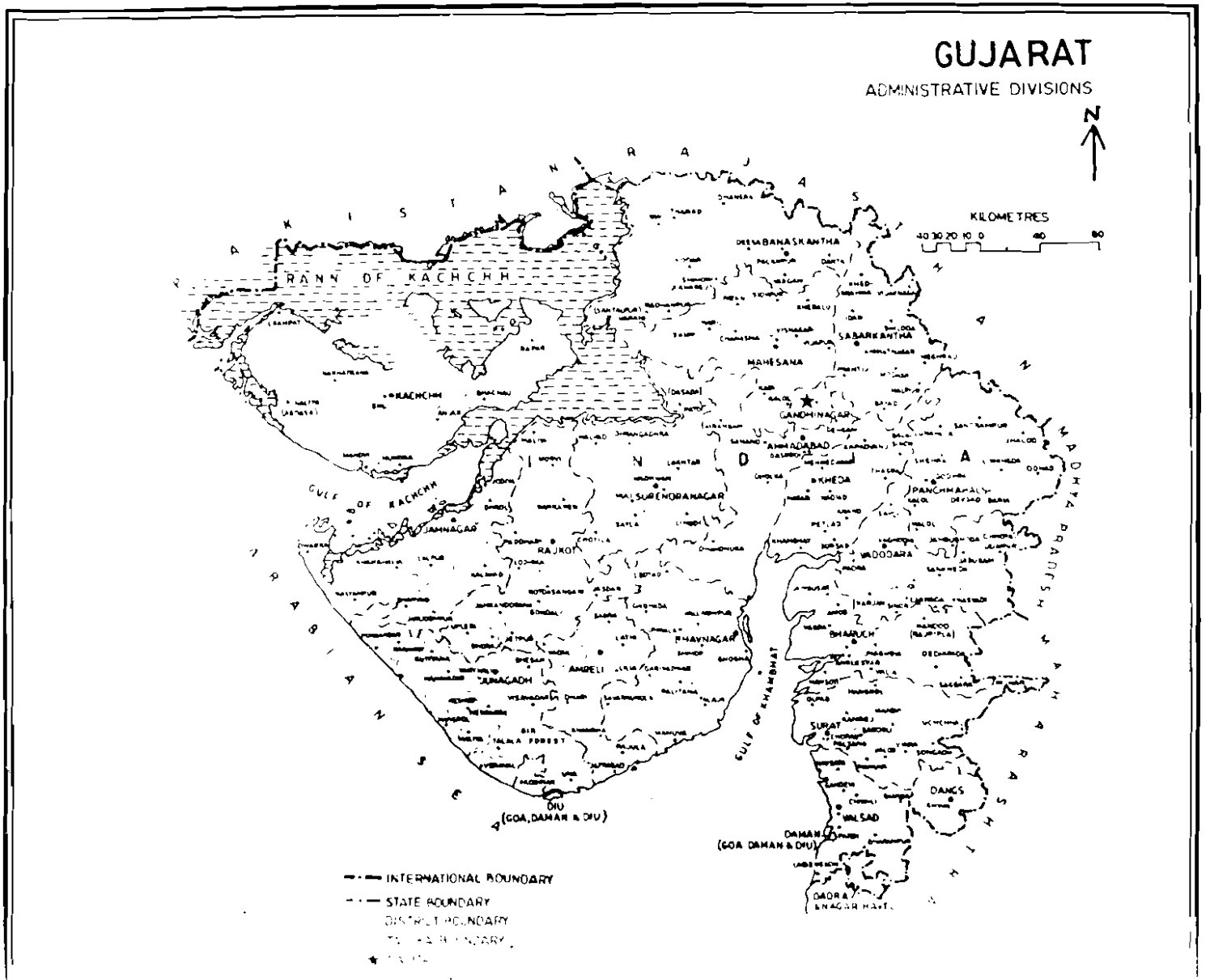
CHAPTER VI

GUJARAT COASTAL ZONE: Characteristics & Problems

Gujarat coastal zone has unique geographical extent. It includes twelve coastal districts. Gujarat has a very long coast line measuring about 1600 kms. In the cambay region coatal zone is about 50-60 km wide from the shoreline. It is variable in Kathiwar. On the south east rocky and cliffed area the inner margin of the coastal zone varies from 5 to 40 km from shoreline. In S.W. Kathiwar from near Diu to Dwarka it is about 20-30 km inland. The position is similar round the coasts bording the Gulf of Kutch. In the cambay region the inner limit of the coastal region lies in a plain and is highly wavy entering deep inland into the faulted basins of the Tapti and Narmada and remaining nearer shore on the western edge of the Satunra horst. Towards the north of this Gulf the limit lies over a much gentler plain surface. In Kathiwar it is irregular in the south east because of the nearness of the basaltic hill mass but it is rather even in the south and south west probably due to faulting. The eroded slopes of the basaltic interier make the inner limit of the coastal zone irregular in the north of Kathiwar and in Kutch.

General Topography: The coastal topography in the cambay region is marked by low plain topography north of Bulsar. As a result of such topography the shoreward margin

MAP 6


GUJARAT
ADMINISTRATIVE DIVISIONS
N
KILOMETRES
40 30 20 10 0 40 80
RANN OF KACHCHH
BANASKANTHA
SABARKANTHA
MAHESANA
GANDHINAGAR
AHMADABAD
KHEDA
PANCHMAHALS
VADODARA
SURENDRANAGAR
RAJKOT
JAMNAGAR
GULF OF KACHCHH
BHAVNAGAR
AMRELI
JUNAGADH
GIR FOREST
GULF OF KHAMBHAT
BHARUCH
SURAT
DANGS
VALSAD
DAMAN
(GOA DAMAN & DIU)
DADRA & NAGAR HAVELI
DIU
(GOA, DAMAN & DIU)
MADHYA PRADESH
MAHARASHTRA
INTERNATIONAL BOUNDARY
STATE BOUNDARY
DISTRICT BOUNDARY

of the coastal zone adjoines the marshes which are frequentl
8 km in width. Within the marshes there are interfluvial
patches of higher cultivated ground carring settleme
There are rocky residuals 15 to 30 m. high within thes
patches of cutivation and settlement at some places. Furth
inland the coastal zone is marked by one of the worst type c
gully erosion in India. Between Bhaunagar and Diu th
coastal zone is marked by an irregular surface dotted b
hills and swampy lowlands. Cliffs mostly 15 to 30 m hig
occur at the waterline. Further west the coastal zone is
more or less uniformly low plain. Shoreward the coast
margin between Diu and Dwarka adjoins narrow beach ridge
Landward of these sand hills a few rocky hill appear on th
plain tract and the surface rises imrreceptibly to the margi
of the main hill mass at a distance of about 15 km from th
shoreline. On the north, in the Rann of Kutch one of th
most prominent features of the coastal zone is formed by th
long line of dead but high cliffs ranging from 80 to 70 m
high.

Structure & Relief: North of Bulsar we have coastal alluvium
over most of the combay coastal zone. Nummulitic to Gaj
series which is of Eocene- Miocene age, exit conceled beneat
the alluvium of either side of the Gulf. This has bee
proved by the discovery of petroliferous beds. On th
Kathiawar side Perim island bears witness to this fact b
being composed of couglomerate (Miocene-pliocene) reach in
mammrian fossils. Tertiaries older than these conglomerate

and capped with laterite are found between Broach and Surat and consist of clays, sandstone, limestone and gravel. The limestones occupy the lower position in the series. These Tertiaries occur unconformably in traps.

Gujarat coastal region in one of the few regions of coastal India where the geological history is presented to great extent in the rocks of the region in Kathiwar Peninsula Deccan Lava forms the inner parts of the coastal zone . In the north it touches the shoreline where the coastal and shore zone are farmed of low plain and marshes as well as cliffs. Elsewhere the coastal region is partly coastal alluvium and partly of Tertiaries. It is believed that the Kathiwar peninsula stood 150 feet lower then at present and was probably in Plistocene time an island or group of islands. Near Dwarka there are clays and foraminiferous limestone known as Dwarka beds. These beds are of Oligocene-pliocene age. They form the coastal tracts and probably a belt of similar rocks occurs in the southern part of kathiwar pensiula. In Kutch the coastal region is formed by a belt of alluvium. It consists of wind blown loam and sand underlain by clay 5 to 16 km wide. Soild rocks appear only at one point on the shoreline. Between the alluvial belt and the trap there are two belts of tertiaries roughtly parallel to the shore. The older band consists of clays and limestone and is of Eocene age. The younger beds are sandstone and clays ranging in age from lower Miocene to Pliocene.

The esturies occuring in low-land areas particularly the

cambay region are characterised by mud flats and marshes. While ria shore is prominent on the west coat between Ratnagiri and Bombay. Esturies dominate on the south of Kathiwar coast, near Dwarka and Port Okha and Gulf of Cambay. The esturies become notably broad north of Bulsar in the cambay region. All the rivers e.g. the Tapti, the Narmada, the Dhader, the Ulhas, the Mahe, the Sabarmati, the Kim the Purna and the Ambika etc are marked by estuarine mouths, extensive mud flats and salt marshes and in some cases by esturine islands. Such mud flats also occur in the low-land stretch e.g. in Elephanta island and Mahim Bay . In some parts the marshes account for about one-forth of the width of the coastal plain. The swamps and mud flats are 6 to 8 km wide. Apaart from these area marshes occur on a large scale in the seasonally inundated Rann of Kutch.

Erosional and Depositional Aspect: There are mainly 3 types of coastal erosion in India ie. cliffing, sheet and Gully erosion. The topography can be grouped under two heads li erosional and depositional features. Viewing with example from Gujarat coast we have a very interesting picture. Gully erosion and the formation of bad lands is developed to a high degree in the coastal zone round the Gulf of cambay in the valleys of the Tapti, Narmada, Mahe and Sabermati particularly north of the Narmada. Eastern and northern part of the Gulf of cambay is one of the most spectacular regions of India as respects land and gully erosion. This type of excessive land erosion contribute to the shore zone

a large amount of sediments which might be partly responsible for the notable growth of mud flats and marshes in the combay region. Sheet erosion however is quite marked in all the above noted area of gully erosion.

In depositional features dunes, alluvium and latrites are important. The western coast of India from Cape Camorin to the Gulf of country in largely dune-free. Some dunes occur in the coastal area of Surat and Bharoach also. Another zone of dunes occurs between Veraval and Dwarka on the south-western Kathiwar coast. Some sand dunes also occur in the coastal areas of the Kutch. S.W. of Kathiwar coast the dunes are oriented roughly transverses to the prevailing onshore winds. At Sannand in Gujarat the alluvium was found to be thicker than 90 metres.

Isostatic Situation: (Emergence and Submergence) The submergence aspect is prominent in Gujarat shsoreline particularly round the Gulf of cambay north of Bulsar up to near Bhawnagar and southern part of Gulf of Katch. Here shoreline is very indented with deep esturine inlets of the sea. Mud flats and marshes are very common in the shore zone. Here esturies and marshes have been formed due to dominance of marine action. The shoreline of the Gulf of Kutch, particularly its southern shore is very indented dispite the low level plane surface of the coastal interior. This indicates the submergece aspect. Except this deep inlet (one occupied by the port of Kandla) a number of off-shore islands and several esturine river mouths are the proves in

the favour of the submergence aspects.

In the south east and south west part of the Kathiawar both emergence and sumbergence are important. That is why this port is known as compound shore line. Here the cliffs, islands esturies and inlets pointing to submergence while off shore bars and local straightening of shoreline related to the emergence aspect. Between Bhaunagar and Diu the shoreline is fairly indented from Verval to about Dwarka. It is remarkably straight and possess a dominantly emergent aspect. There are bars and spits on the mouth of several streams. There is marshy belt particularly near Porbandar or Navibandhar or Maini near the esturies of streams.

Continental Shelf on Gujarat Coast

Roughly speaking, continental shelf means the marine floor between the normal shoreline and the submarine contour of 100 fathom. Although some differ from such a definition, the 100 fathom contour has a simplicity and is suitable for practical purpose.

In comparision to the off the Gulf of cambay, the continental shelf near the shore in the Gulf of cambay is relatively deep. The 5 fathom contour interescts the coast near the mouth of the Narmada and Gogha on the Kathiawar coast. The sheet gradient in the combay region is long i.e. 7'. A higher significant fact in this region is the indifference of the shelf alignment to Kathiawar coast. In spite of the projection of this peninsula towards the sea the shelf margin maintains the same trend that it has been

following from near Trivendram to off Bombay. Consequently the width of the shelf off Kathiawar coast is only about 100 km and the gradient for the whole shelf is about 6', The Gulf of Kutch is a very shallow region like Palk strait but the Rann of Kutch is hardly a subsmarine surface or contimental sheet. It is a sandy desert or dry swamp for most of the year and is submerged only during the monsoons when the marine water is pushed into the Rann by the strong south west winds. Here shelf deposits are known to be gravel, sands, silts and muds. Among the littoral deposits we find silt flash in the Gulf of cambay. Near the shore mud flats are found in the esturies of Narmanda and Tapti river. The geology of the shelf is analogous to that which occurs nearest the shore on the adjoining land. The major part of the continental shelf between Ratnagiri and Kathiawar is Deccan leva. The lava extends right up to the shore in the entire region from Ratnagiri to Daman and on the other lava covers most of Kathiawar Peninsula. The geological formation on the shelf is expected to be oligiocuen and Lower Miocene sedimentary rocks like friable sandy shore and limestones, off Kori Creek and other tracts off Kutch and Kathiawar peninsules. As stated earlier it is believed that the Kathiawar peninsula 150 feet long than at present and was probably in pleistocsne time as island or group of island. Such a fact lands strong support to our conclusion that the shelf is formed of the same rocks that occur on the coasts In the continental shelf of the cambay region the low

appears to be over with later deposite. These consists of Nummulitic limestone inceeded by later conglomerate.

Gujarat Region: The maritime make-up of Gujarat gives it a geographical personality of distinct character. Its morphology, drainage, climate, desert, and Ranns, in harmony with human activities lead to design and to identify region of various orders. The Gujarat region is divided into tw , first order; Five, Second order; and Tweleve, third order region:

A. Gujarat Region West ;

a.	Bhuj Region	The Rann of Katch
		Kutch peninsula
b.	Kathiawar Region	Kathiawar North
		Kathiawar Core Region
		Kathiawar Southern Coastal Region

B. Gujarat Region East;

c.	Ahmedabad Region	Ahmedabad Region East
		Ahmedabad Region West
d.	Khambat Region	Khambhat Region North
		Khambhat Region South
e.	Eastern Hilly Region	The panchmahals
		The Narmada-Tapti Region
		The Dange Region.

In present study we are concerned with only Gujarat Region West. It consisits of coastal segment with density ranging betwen 50-100 person per sq. kmt. Over 80% of its inhabitants are rural. Kutch has reserves of 172.88 million tonnes of lignite, monthly in western part particularly Lakhpat and Mandvi taluka. Limestone (Res ever: 7765 million tonnes) occurs at Lakhpat taluka. Salt occurs at Padana, Kandla, Mundra and Jokhan.

Kathiawar region includes the districts of Jaminagar, Junagadh, Amreli, Bhavnagar, Rajkot & Surendranagar. The region has an irregular highland core. This hill masses covered with Deccan lavas are surrounded by the oligocene and pliestocene deposits. The peninsular configurati modifies the climate, especilly along the coast. The annual rainfall is betwen 40-60 cm. Dry decidious vegetation is found in Amreli, Junagadh and Bhavnagar. The region is primarily agriculture with NSA 62.7%. Minral resources are considerable. Limestone quarries are located at Jamnagar and Junagadh. Salt pane are found along the southern coast of the peninsula in Junagadh, Kutch, and Kathiawar. Both of them stand apart with their contrating characters. It emerges as Bhuj and Kathiawar Region. The emergence of land with the retreat of sea has resulted into Ronn, a huge stretch of naked tidal mud flats, isolated saline flecks and dead creeks bounded by salt. The highland core is engirdled with coastal alluvium and milliolites.

The region is hot and dry with very high temperatures in

its desert fringe in the north. Except the southern part (40-60 cm), The region receives less than 40 cm rainfall and the variability is over 60% . The Rann is barren but Kutch contains through scrub. Only 2.09% area is under forest. Bajara take the prime place among the agricultural crops. Other important crops being oilseeds, Jowar, cotton, groundnuts and wheat. This Bhuj region is neary sparsly populated. It exhibities three distanct unit: Practically unpopulated Rann, the central rocky core having a density of less than 50 persons per Sq.km

Textile constitute the main industry of the region. Cotton textile units are located at Bhavnagar (20) , Jetpur (2) and Rajkot (8). Woolen textils centre is at Jamnagar where as silk textiles have developed at Jamnagar, Amreli and Bhavnagar. Cement works have developed at Dwarka, Sikha and Porebander. Kathiawar region is next to Ahmedabad. Baroda Region has chemical industries.

The Kathiawar North is spastely populated with exception of Jamnagar, Rajkot and Surendranagar. On the other hand southern coastal regions is very densely populated in Kathiawar. The core region is on the whole moderately populated except Junagarh taulka which is comparable to Jamnagar in density.

Fishries:

Gujarat is well placed for development of marine fishries in the country . The state ranks forth in marine

fish production with approximately 15 percent of the tot marine fish production of the country. Gujarat has long coastline nearly one third of the country, broken by sever bays, inlets, road steads, esturies and marshy lands. Th area available for fishing extends from Lakhpat in Kutch district in north to Umbergaon in valsad district in south of the state. Important commercial varieties of fish namely Pomfrets, Jewfish, Bombay Duck, Pranws, Lobstars, Hilsa salmon, Mullete etc. are found in large quanties in their areas. Gujarat is having nearly one lakh square kilometer of the continental shelf with 11 intermediate, 28 minor and 19 marine fish landing centre.

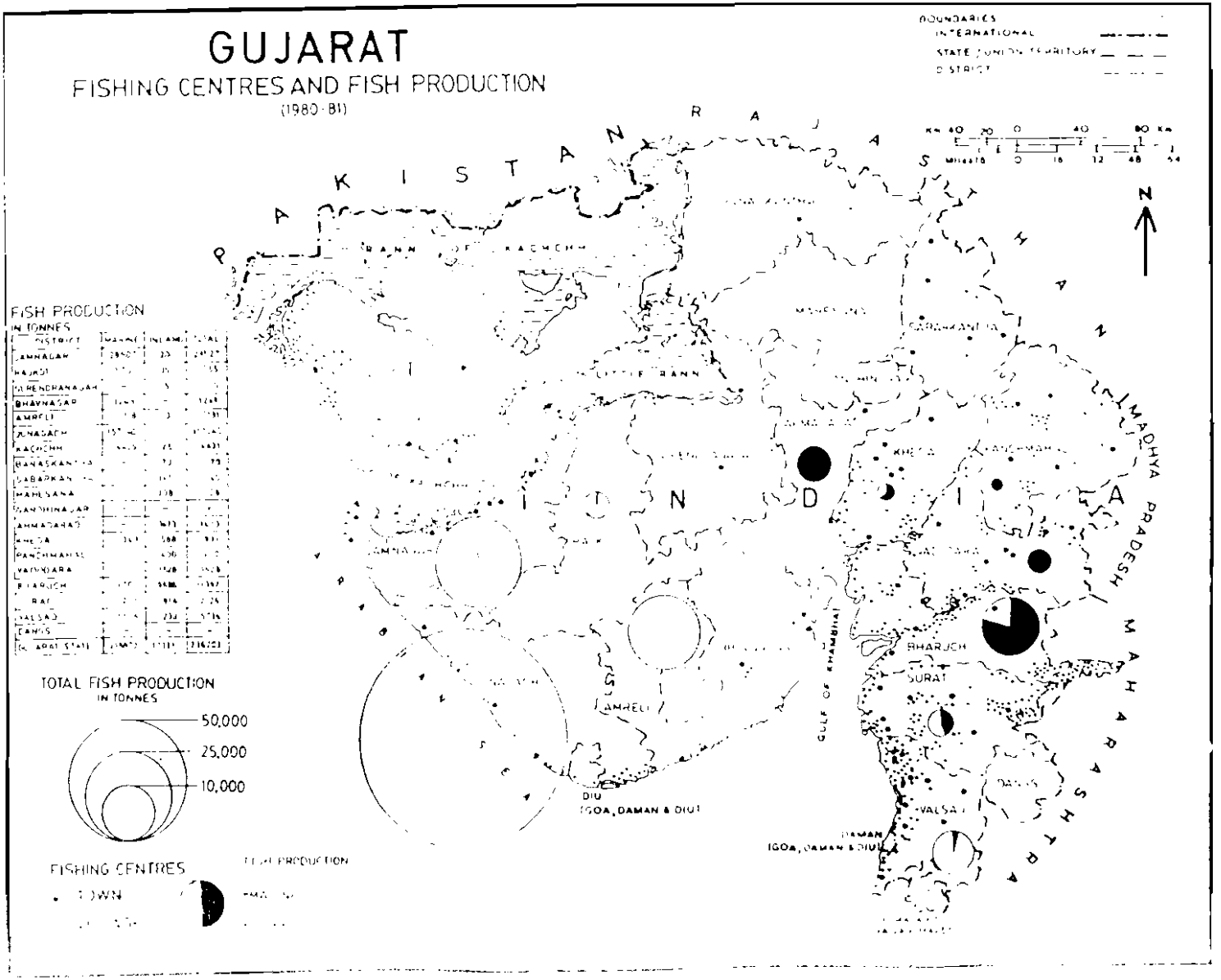
According to the final figures of the 13th livestock census 1982, there are 590 fishing villages in the state classified as 179 marine, 369 inland and 48 estuarine villages inhabited by fisherman population of 2.25 lakh. Out of this population, 0.8 lakh persons are active fishermen who are engaged in fishing, marketing of fish, repairing of boats/nets etc. As on 31st March, 1987 there were 13811 fishing boats registered in the state. Out of those 5311 boats were machanised boats. Besides marine fisheries and various resources, the state has considerable potential for coastal aquaculture and mariculture in over 3 Lakh hactares of the coastal base interspread with a large number of creeks and low lying mud-flats. Total active fisherman are further spelt out in various branches of fisheries as given in following table:

MAP 8

GUJARAT

FISHING CENTRES AND FISH PRODUCTION

(1980-81)



FISH PRODUCTION
IN TONNES

DISTRICT	MARINE	INLAND	TOTAL
JAMNAGAR	28450	23	28473
RAJKOT	175	35	210
SURENDRANAGAR	-	5	5
BHAVNAGAR	11651	-	11651
AMRELI	118	3	121
JUNAGADH	15[illegible]	[illegible]	[illegible]
KACHCHH	5[illegible]	93	6431
BANASKANTHA	-	93	93
SABARKANTHA	-	157	157
MAHESANA	-	178	178
GANDHINAGAR	-	-	-
AHMADABAD	-	1673	1673
KHEDA	343	588	931
PANCHMAHALS	-	436	436
VADODARA	-	1428	1428
BHARUCH	197	9686	9883
DANGS	-	914	914
VALSAD	1[illegible]	234	5[illegible]
GOA, DAMAN & DIU	[illegible]	[illegible]	[illegible]
TOTAL GUJARAT STATE	[illegible]	[illegible]	[illegible]

TOTAL FISH PRODUCTION
IN TONNES

50,000
25,000
10,000

FISHING CENTRES

TOWN

FISH PRODUCTION

Particulars Engaged in	Live Stock Census Year 1982
1. Marine fisheries	55,787
11. Fresh Water fisheries.	15,388
111. Esturine fisheries	7029
Total	80,204

Review of the progress: The fishery developmenmt programmes in the state were initiated in a very modest way by the former Princely State of Jamnagar (1933) , Vadodra (1942), Kutch (1943) and Junagarh (1946). After independence, the initial development activities of the Saurashtra region were carried out by the then Department of Marine Products. After the formation of the separate state of Gujarat in 1960 fisheries development recieved more attention of the State Government.

The full extent of marine and brackish water resources so richely available in Gujarat have not been fully assessed so far. They are far from being fully exploited or developed. Table below reveals that the fishing in the sea is generally confined to the coastal belt upto 25 fathoms and in certain areas up to 40 fathoms.

Depth Range (In Fathom)	Area ($In\ Km^2$)	Standing Stock (In Tonnes)
0 to 25	44,723	1,79,499
25 to 40	11,277	44,005
Total	56000	2,23,504

(Source: Development programme 1987-88 , Gujarat State Budget Publication No-31).

Gujarat has come quite close to reasonable utilization of the potential of demersal marine fisheries upto the depth of 40 F. The state has a large continental shelf of 165 lakhs sq. kms. of fishable potential. The coastal belt of Gujarat provides a large number of tidal creecks and low lying potential resources of about 3.68 Lakh hectares for tapping and lauching mariculture, brackish water and aquaculture programmes all along the coastline.

The marine fish yield which was 0.79 lakh tonnes in 1960 has increased to 2.19 lakh tonnes in 1980-81 and 3.07 lakh tonnes in 1985-86 (Table I). The contribution of the production from marine resources of the state in the total fish production is of the order of 3.16 lakh tonnes, constituting about 93 percent of the total fish production of the state.

The marine water of Saurashtra peninsula offer the richest fishing ground on the west coast of India. Most important commercial varieties of fish include Pomprets, Bombay duck, Dhowa, Indian Saleman, Hilsa , Goldera and Mullet, Lobster, Seer, Fish Perch, Prowm, Silver bar, Eel etc. Besides optimum condition prevail in the Gulf of Kutch for growth and sustenance of pearl oysters, edible oyster, window pane oysters, chanks and other shell fish, Turtel and sea weeds of commercial importance. The contribution of different district in the marine fish production of the state is evident from Table III.

From table II and III one can easily extract a clear

TABLE I

MARINE AND INLAND FISH PRODUCTION

(IN MILLION TONNES)

Year	Marine	Inland	Total
1960-61	0.79	-	-
1974-75	1.57	0.07	1.64
1979-80	2.06	0.16	2.23
1980-81	2.18	0.17	2.36
1985-86	3.07	0.24	3.31
1987-88 *	3.13	0.26	3.39

* (estimated)

Source: Statical Atlas of Gujarat Vol II.

Table II

FISH PRODUCTION IN GUJARAT STATE : IN MAIN COASTAL DISTRICTS

Sr. No.	District	Marine Fish Production (In percentage)		
		1978-79	1979-80	1980-81
1.	Jamnagar	9.48	11.97	19.02
2.	Rajkot	1.17	0.22	0.79
3.	Bhavnagar	0.18	0.40	0.57
4.	Amreli	14.50	10.41	7.85
5.	Junagadh	69.67	71.06	71.75
6.	Katch	2.74	2.76	2.01
7.	Kheda	0.12	0.12	0.16
8.	Bharuch	0.74	0.56	0.78
9.	Surat	0.36	0.39	0.55
10.	Valsad	1.04	2.11	2.52
11.	Gujarat State	100.00	100.00	100.00

Source: Statistical Atlas of Gujarat Vol II

TABLE III

FISH PRODUCTION IN THE COASTAL DISTRICTS OF GUJARAT STATE

Sr. No.	District	Marine Fish Production (in tonnes)		
		1978-79	1979-80	1980-81
1.	Jamnagar	21797	24755	28507
2.	Rajkot	26180	455	1731
3.	Bhavnagar	424	822	1249
4.	Amreli	33349	21529	17178
5.	Junagadh	160223	146921	157040
6.	Katch	6298	5706	4405
7.	Kheda	280	251	343
8.	Bharuch	1694	1158	1701
9.	Surat	844	797	1212
10.	Valsad	2382	4355	5506
11.	Gujarat State	229971	206749	218872

picture of marine fishing in the coastal district of Gujarat. Here such districts have been mention which have main contribution in marine fishing. Table I shows that Junagarh ranks first (71.75%) in the state. It keeps 20.6% of the total fishing population of state (Table V). Junagarh has 21 marine villages and 3 towns. (Table IV) Although Kutch possess 56 marine villages and 3 towns but having only 4.08 percent of fishing population, and accounts for only 2.01 percent of marine fish production of the state. District like Kheda, Bharuch, Surat, Rajkot and Bhavnagar produce less then one percent of the total marine fishing production of state (Table II). On the other hand Jamnagar and Amreli possess significant position i.e. 13.02 and 7.85 percent respectively in marine fishing of Gujarat. According to Table V. Junagarh and Valsad possess nearly 20 percent and 30 percent of fishing population of state but as regard to number of marine fishing village Kutch ranks first (56). Jamnagar ranks first in number of marine fishing towns (8). Due to variation of length of coast, levels of economic development there is great variation inproduction of marine fish. From Table IV it can be said that in marine fishing Kutch, Valsad, Bharuch, Surat and Jamnagar districts have significant position.

Various programmes for development of marine fisheries include mechanisation of fishing crafts, establishment of sevice station, providing incentive and financial assistance for improvement of traditional methods of fishing, supply of

TABLE IV

DISTRUCTWISE COVERAGE OF TALUKAS, FISHING VILLAGE AND TOWNS IN GUJARAT COAST 1982 CENSUS

Sr. No.	Name of District	No of Talukas covered	No. of Village			No. of Towns		
			Marine	Fresh Water	Estu-rine	Marine	Fresh Water	Estu-rine
1.	Jamnagar	4	12	-	-	8	-	-
2.	Rajkot	1	6	-	-	-	-	-
3.	Bhavnagar	5	3	5	-	2	1	-
4.	Amrell	3	6	-	-	1	-	-
5.	Junagadh	6	21	-	-	3	-	-
6.	Katch	7	56	-	-	3	-	-
7.	Kheda	9	-	30	7	1	5	-
8.	Bharuch	9	15	51	17	-	3	2
9.	Surat	12	13	118	5	-	5	2
10.	Valsad	8	26	39	1	3	7	2
11.	Ahmedabad	1	-	-	-	-	1	-
12.	Vadodara	11	-	37	8	-	7	-
	Gujarat State	100	158	320	41	21	43	7

Source: Bureau of Economics and Statistics Govt of Gujarat.

modern equipments and exploration of deep sea fishing grounds. The Gujarat Fisheries Aquetic Science Research Station at Okha has undertaken various research projects to contribute to the increase of fish production, rear pearl oysters, window pane oysters, sea weed culture and to develop exporatable and commercial varieties from various marine fish products. The co-operative movement is being recognised and an apex state level organisation, namely, Gujarat Fisheries Control Co-operative Association has been set up in 1956. Its function is to deal with different activities like fish processing, strange, freezing, trade and export of fish and its by products. The various schemes for the development of fisheries in Gujarat aim towards increasing production of fish, its by products and establishment of fish-based ancillary industry and thereby uplift the society and economically backward community of fisherman and tribals by providing them employment. Many training centres have been set up for imparting training in marine fisheries at Veraval, Porbander and Valsad. Marine fisheries research station at Okha has been stablished. After examining the potentialities of fishing ports in various maritime states all over India and looking to the vast potential resources of waters of Saurashtra Peninsula, an Integrated Marine Fisheries Project at Veraval and Mangral has approved by the world bank in 1977. This world bank assisted work prograssed instantially during the year 1986-87. The Fisheries Terminal Division at Mangral and Verval have come into existance on 23 April 1985

TABLE V

DISTRICTWISE FISHING POPULATION AND WORKERS IN MAIN COASTAL DISTRICT OF GUJARAT. 1982 CENSUS.

Sr. No.	Name of District	No of Towns and villages covered	Total Fishing Population		Persons engaged in fishing and related occupation	
			Persons	Percentage to total	Person	Percentage to total
1.	Jamnagar	20	11106	4.93	4527	5.64
2.	Rajkot	6	2456	1.09	1326	1.65
3.	Bhavnagar	11	2304	1.02	861	1.07
4.	Amreli	7	17457	7.74	6190	7.72
5.	Junagadh	24	46456	20.61	14002	17.46
6.	Katch	60	5160	4.06	3782	4.72
7.	Kheda	43	4223	1.87	1026	1.28
8.	Bharuch	88	20255	8.99	7850	9.79
9.	Surat	143	29336	13.01	11531	14.38
10.	Valsad	78	66388	29.46	24004	29.93
11.	Ahmedabad	1	722	0.32	350	0.44
12.	Vadodara	52	6226	2.79	1770	2.21
	Gujarat State	590	225440	100.00	80204	100.00

Source: Bureau of Economics and Statitics, Government of Gujarat.

and 13th September 1986 respectively.

An outlay of Rs 550 lakhs is provided for 1987-88 budget in Gujrat state. During the Sixth five year plan period state has conducted the survey of the Gujrat coastal belt and located 132 sites of possible location for launching coastal aquaculture programms. Out of these sites Mundra (Kutch), Sarthanpur (Bhawnagar) and Dandi Madhwad (south Gujrat) have been selected. The programme for applied studies had envisaged a small percentage of the Sixth plan allocation up to 3%. The important studies taken up were work on pearlculture, oyester culture, prawn hatching etc. According to governmental plan, on marine fishries side studies will be under taken on gear, fuel economy, fish preservation , fish transport, resource development , biological Bombay duck fishery, pollution effects pre-pollution survey to preserve rich fishing grounds. An outlay of Rs 8 lakhs is provided for 1987-88 for this programme. An outlay of Rs 23.2 lakh is provided for 1987-88 for training programme.

Gujrat fishermen have 12811 vessels /boats which includes 4858 machanised fishing vessels/ boats for which landing and berthing facilities are pre-requisites Porbandar as being developed is fishing harbour under centrally sponsored programme (50: 50%). Ten projects to provide landing and berthing facilities at Vansibarsi and Kosamba (Kutch district) Jafrabd, Rajpura, Madhwad Mil- dmarka, Amerli and Salaya-Sachena (Jamnagar district) are in progress as sanctioned by Government of India during Sixth

plan. An outlay at 69.50 Lakhs is provided in 1987-88 for this programme.

Ports and Harbours

Ports play a very important part in the development of trade, commerce and industries and act as a catalyst for the development of coastal area and the hinterland. The sea around Gujarat has got very favourable features for location of good ports. The various activities all along the coast line of Gujarat at different ports sustain large population employed in boat-building, handling of cargo, fishing trade & commerce. With a large coastline extending from Koteshwar in the north to Umbergaon in the south, Gujarat holds a prominant position in the development of maritime trade and economy in the country.

Gujarat is a principal maritime state in the country served by one major port Kandla, 11 intermediate ports and 28 minor ports. Each of the intermediate ports viz. Mandvi, Navlakisi, Sikha, Okha, Porbandar, Veraval, Jafrabad, Bhavnagar, Bharoach and Magdalla handle a traffic of more than one lakh tonnes in a year (Table VI). The 6 intermediate ports at Bhavnagar, Jafrabad, Porbandar, Okha, Sikka and Magdalla have direct berthing facilities and these ports are all weather ports. Except at Jafrabad and Magdalla which are used by a small coastal ships, large ocean going ships can berth at other direct berthing ports. The remaining 5 Intermediate ports are lighterage ports where facilities exist for handling cargo by lighters. The 28

TABLE VI A

TRAFFIC HANDED AT PORTS IN GUJARAT STATE

Sr.	Catagory of Ports	(In Lakh M. Tonnes)			
		1960-61	1970-71	1980-81	1981-82
1.	Kandla Ports	15.9	16.1	88.2	95.3
2.	Intermediate Ports	20.9	23.6	26.0	28.1
3.	Minor Ports	3.3	3.1	1.8	1.8
	Total	39.7	42.8	116.0	125.2

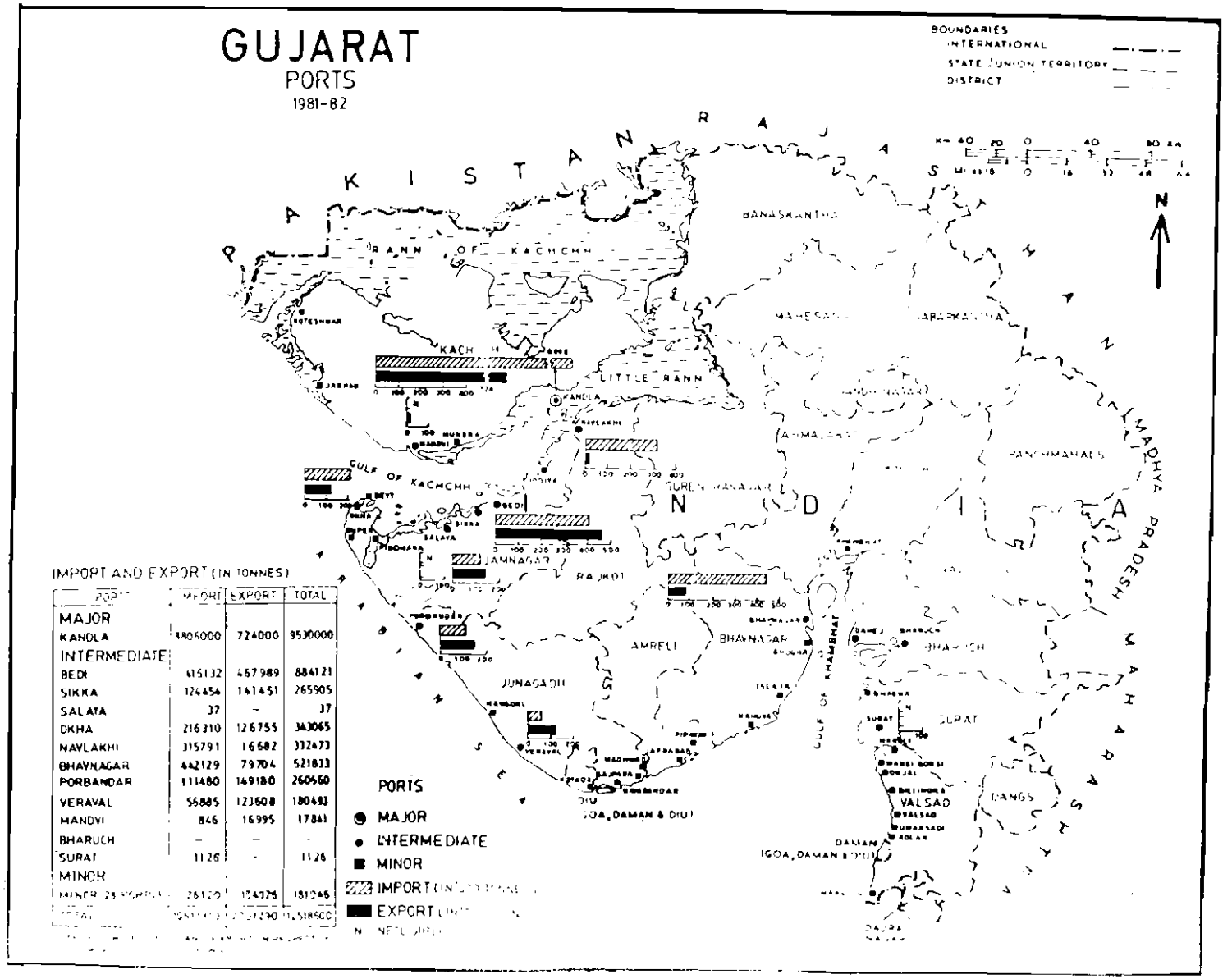
TABLE VI B

TRAFFIC HANDED AT PORTS IN GUJARAT STATE

Sr.	Catagory of Ports	(In Percentage)			
		1960-61	1970-71	1980-81	1981-82
1.	Kandla Ports	40	37.6	76.0	76.1
2.	Intermediate Ports	51.7	55.1	22.4	22.5
3.	Minor Ports	8.3	7.3	1.6	1.4
	Total	100.00	100.00	100.00	100.00

Source: Hand Book Of Basic Transport Statistics.

MAP 9



PORT	IMPORT	EXPORT	TOTAL
MAJOR			
KANDLA	8806000	724000	9530000
INTERMEDIATE			
BEDI	615132	467989	884121
SIKKA	124454	141451	265905
SALAYA	37	–	37
OKHA	216310	126755	343065
NAVLAKHI	315791	16682	332473
BHAVNAGAR	442129	79704	521833
PORBANDAR	111480	149180	260660
VERAVAL	55885	123608	180493
MANDVI	846	16995	17841
BHARUCH	–	–	–
SURAT	1126	–	1126
MINOR			
MINOR (9 PORTS)	28120	104478	1310246
TOTAL	[illegible]	[illegible]	11,518500

Minor Ports are Fair Weather Lighterage Ports or sailing vessels ports or ports having fishing activities. An autonomous Board namely, the Gujarat Maritime Board has come into existance on the 5th April 1982, on, National Maritime Day. The setting up of the Maritime Board is a big leap forward in the development of the long coastline and numerous ports in the State. The development, conservation and management of all the min and intermediate ports of the state is done by the Gujarat Maritime Board. Beside solving the financial constraints experienced in developing the ports, the Board will also help in providing the basic infrastructure facilities at the ports for the benefits of the shiping industry and effectively tap the marine resources of the state.

The major port (Kandla) is administrated by a port trust functioning adminitratively under the Ministry of Shipping and Transport Government of India. Gujarat ports handle a traffic of our 5 million tonnes in a year, consisting of sizeable exports to foreign countries, which earn foreign exchange of about Rs. 12,000 Lakh per year for the country. About 98% of the total traffic is handled at the 11 intermediate ports and 3 Minor ports i.e. Pipavav, Salaya and Mundra. The information on traffic handeld at major port of Kandla and intermediate and minor ports is given in the Table VI. It is evident from this table that the traffic at all ports has increased from 39.7 lakh tonnes in the year of 1960-61 to 125.2 lakh tonnes in 1981-82. It can also be seen

that the percentage share in total traffic at Kandla has considerably increased over the year. The phenomenal increase in the share of intermediate and minor port in the total traffic handled by all ports has accordingly gone down from 60% in 1960-61 to 24 % in 1981-82. When we look intensively then picture is some what different. Table VII shows that the total traffic handled by the intermediate and minor ports in 1981-82, the share of intermediate ports was 54 percent and that of minor ports was only 6 percent. Among 11 intermediate ports. Bedi port alone accounts for as large as 30 percent of the total traffic handled by the ports of Gujarat other than Kandla. The other ports handling significant quantom of traffic are Bhavnagar port with 17 percent and Navlakhi and Okha ports each with about 11 percent of the total traffic (Table VII).

It is seen that the coastal traffic handled at the Gujarat ports has gradually declined in terms or volumes as well as its share in total traffic (Table VII). The share of coastal traffic which was 57.5 percent of the total traffic in the year 1960-61 decrease to 22.42 percent in the year 1981-82. This is due to decreasing import of fertilizer. fuel oil Clinker salt and LDT of vessels at the ship breaking yards of Alang and Sachana. The main commodities of coastal import are mineral oil, coal and coke, building materials wood and timber. These six commodities share more than 80 percent of the total coastal imports. On the other hand Salt, Cement, Clinker, line and lime stone, groundnut seeds,

TABLE VII

TRAFFIC HANDLED BY INTERMEDIATE AND MINOR PORTS DURING 1981-82 IN GUJARAT

Sr. No.	Name of Ports	Traffic Handled (in tonnes)	Pecentage as Total
I.	Intermediate Ports		
1.	Mandavi	17841	0.60
2.	Navlakhi	332273	11.12
3.	Bedi	884121	29.58
4.	Sikha	265905	8.50
5.	Salaya	37	0.00
6.	Okha	343065	11.48
7.	Porbander	260660	6.72
8.	Veraval	180493	6.04
9.	Bhavnagar	521833	17.46
10.	Bharuch	-	-
11.	Surat	1126	0.04
	Total (I & II)	2807554	53.54
II	Minor Ports	181046	6.06
	Total	2988600	100.00

Sources: Hand Book of Basic Transport Statistics.

chemicals and food-grains are the main commodities of coastal export. Salt contributes nearly half of the total export traffic since the year 1975-76.

When we look into the foreign traffic of Gujarat coastal zone that it is seen from (Table VIII), that the share of foreign traffic to total cargo increased from 43 percent in 1960-61 to 78 percent in 1981-82. The main commodities of foreign imports are mineral oil, rock phosphate, food grains, fertilizer and sulpher. While oil cakes, cement, salt and bauxite are the main commodities of foreign export. They contribute nearly 50 percent of the total forign export traffic. Oil cakes alone claims for about 40 percent of the foreign export.

Government of India decided to develop Kandla as the sixth major port of the country. It is the first planned major port of the country after independence. Kandla is located inside the Kandla creack and protected from south west monsoon. The average tidal range is 5.9 meters which enables ships of deeper drough to come inside the harbour and unload its merchandise. During 1986-87 161.54 lakh tonnes of Cargo was handled by Kandla port constituting nearly 13 percent of the total cargo handled by all the major ports of India. Among imports of Kandla port, petrolium, oil and lubricants, food grains and fertilizer are important. Whereas Sugar, Gurgum, Crushed bones, rocks phosphate and bentonite constitute some of the important commodities exported. On 7th March 1965 the Kandla Free trade zone w

TABLE VIII

FOREIGN AND COASTAL TRAFFIC AT GUJARAT PORT
(IN LAKH TONNES)

Year	Foreign		Coastal		Total	
	Traffic	Percentage	Traffic	Percentage	Traffic	Percentage
1960-61	10.13	42.50	13.71	57.50	23.84	100.00
1965-66	15.21	46.61	17.42	53.39	32.63	100.00
1970-71	14.54	54.53	12.12	45.47	26.66	100.0
1973-74	16.80	59.54	11.42	40.46	28.22	100.0
1974-75	18.50	60.31	12.01	39.69	30.26	100.0
1975-76	21.36	68.86	9.66	31.14	31.02	100.0
1976-77	20.11	71.10	8.17	28.90	28.28	100.0
1977-78	12.21	59.73	8.24	40.27	20.45	100.0
1978-79	13.16	63.30	7.61	36.64	20.77	100.0
1979-80	18.85	76.61	5.76	23.39	24.61	100.0
1980-81	21.93	78.88	5.87	21.12	27.80	100.0
1981-82	23.18	77.58	6.70	22.42	29.88	100.0
1985-86					51.29	
1986-87					48.37	

Source: Directorate of Ports, Gujarat State.

inagurated with the objectives as

1. Industrial development and creation of employment oportunities in the backward area of Kutch.
2. Utilizing the facilities provided by the major port of Kandla.
3. Earning valuable foreign exchange.

Review of Progress: During the sixth plan port facilities were provided at Jafrabad and Magdalla ports for handling captive traffic of clinker. This first stage works of terminal facilities at Dahej and Ghogha for operating Tra. Sea-Ferry service between these two places were completed. The work on the project for providing port facilities at Pipavan, in the backward district of Amreli, was started during the last year of the Sixth Plan. Other important works were understaken at Navlakhi, Bedi and Bhavnagar. Additional Flotilla units and cargo handling equipment were purchased.

The targets envisaged for the Seventh plan include providing port facilities at Pipavan, Sikka, Koteshwar and Hazira. There are provisions of additional facilities at Navlakhi and at the ship breaking yards all along the Gachha and completion of the work of providing terminal facilites Dahej and Gogha. In addition programmes for augmenting the flotilla units the dredging capicity and the cargo handling equipments etc, will be undertaken and envisaged in the seventh plan. These programme will improve both the rate of

cargo handling and the volume of traffic handled at the ports. An outlay of Rs. 575 lakh has been provided for the Annual plan 1987-88 for the development of ports under state sector. The broad break-up of the outlay is shown by following table

Programme	Outlay for 1967-68 Rs. in lakh.
Development of Minor ports	485.0
Construction and Repaire	15.0
Dredging, Surveying and Investigation	60.0
Ferry Service	10.0
Total	570.00

In spite of the above development and management programmes progress is slow for want of proper marketing tie-ups, financial resources, managerial skills and some procedural difficulties. So a package of financial incentives, simplified and streamlined procedures, a efficient one window service etc will improve the better management programmes.

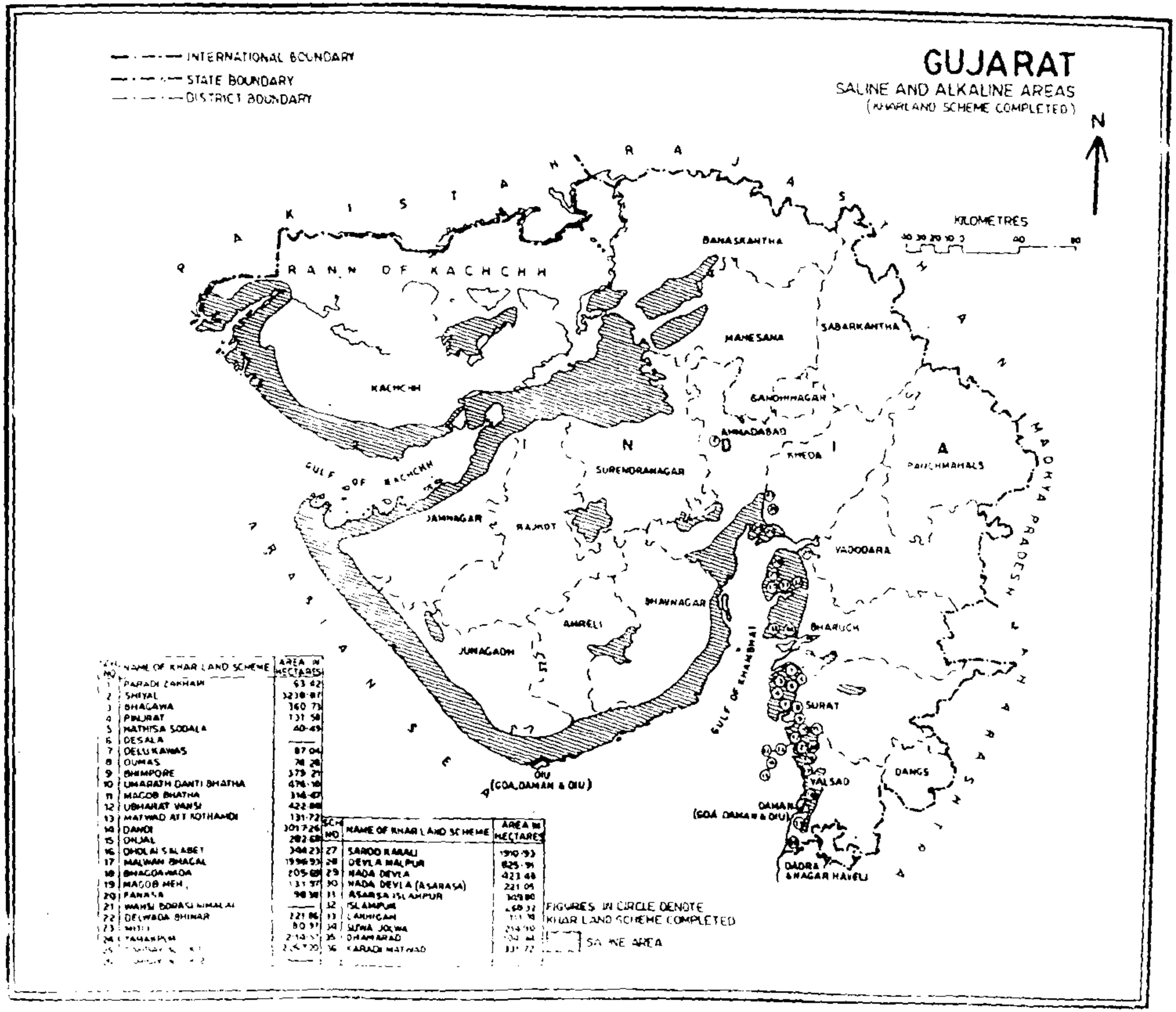
Environment and Pollution on Gujarat Coast: The last few years have witnessed on increasing awareness and concern for environment on Gujarat coast. Some results have been achieved in this concern, particulary in the field of control of industrial pollution through the introduction of sophisticated effluent treatment plants. But still a

systematic effort in needed to rectify the damage caused by denudation of coastal floras and founa, unabated coastal erosion, desertification, frequent tidal floods, exodue of people from the coastal cities and pollution of coastal water.

Many environmental problems arise from our attempts to develop for meeting the basic needs of growing population and for improving the standard of living. Development efforts lead to industrialization, urbanisation, over use and depletion of natural resources and consequent destruction of the natural ecosystem in the coastal region. Thus it is necessary to aim at development without destruction.

There is a problems of salinity increase in some parts of the state including coastal areas of Saurashtra, Rann of Katch and Sunderanagar district. Five desalination plants have been installed and other 17 plants are under various stages of installation and research and development. The serious implication of the salinity problem can be seen from the example of Jamnagar district. Most of the villages of Jamnagar district are adjoining sea coast, as a result of which the lands of this district have become saline. This factor has adversely affected the fertility of the land and the agricultural production of the coastal zone. To overcome this problem a scheme like reclassification of villages of Jamagar district was introduced in the year 1983-84. This programme has also been extended on the other affected areas. Upto September 1986, 12965 villages have been covered in the

MAP 10



SCH NO	NAME OF KHAR LAND SCHEME	AREA IN HECTARES
1	PARADI ZAKHAM	63.42
2	SHIYAL	3230.87
3	BHAGAWA	360.73
4	PINJRAT	131.58
5	MATHISA SODALA	40.49
6	DESALA	—
7	DELU KAWAS	87.04
8	OUMAS	78.28
9	BHIMPORE	379.21
10	UMARATH DANTI BHATHA	476.10
11	MAGOB BHATHA	314.07
12	UBHARAT VANSI	422.88
13	MATWAD ATT KOTHAMDI	131.72
14	DANDI	3017.26
15	ONJAL	282.68
16	DHOLAI SALABET	394.23
17	MALWAN BHAGAL	1996.93
18	BHAGDAWADA	205.68
19	MAGOB MEH	133.97
20	FANASA	98.38
21	WANSI BORASI MIMALAI	—
22	DELWADA BHINAR	221.86
23	MITI	80.97
24	TAHARPUR	214.57
25	[illegible]	[illegible]
26	[illegible]	—

SCH NO	NAME OF KHAR LAND SCHEME	AREA IN HECTARES
27	SAROD KANALI	1910.93
28	DEVLA MALPUR	825.91
29	NADA DEVLA	423.48
30	NADA DEVLA (ASARASA)	221.05
31	ASARSA ISLAMPUR	309.80
32	ISLAMPUR	[illegible]
33	LAKHIGAM	[illegible]
34	SUNA JOLWA	[illegible]
35	DHAMARAD	[illegible]
36	KARADI MATWAD	[illegible]

TABLE IX

DISTRICTWISE NUMBER OF PROBLEM VILLAGES IDENTIFIED IN GUJARAT COAST. AS ON 1.4.1980

Sr. No.	District	Those not having an assured source of drinking water within resonable distance (1.6 K.M) or within a depth of 15 meters		Those which suffer from excess of Salinity, iron of fluorid or other toxic elements hazardous to health.		Total	
		No.	Population (in thousand)	No.	Population (in thousand)	No.	Population (in thousand)
1.	Jamnagar	388	368	20	24	408	392
2.	Rajkot	418	470	66	59	484	529
3.	Bhavnagar	361	291	35	41	396	332
4.	Amreli	310	310	32	49	342	359
5.	Junagadh	516	550	103	151	619	701
6.	Katch	523	247	86	61	609	308
7.	Kheda	70	31	374	430	444	461
8.	Bharuch	205	153	69	65	274	218
9.	Surat	526	218	81	86	607	304
10.	Valsad	354	187	252	207	606	304
11.	Ahmedabad	389	147	128	128	517	275
12.	Vadodara	502	284	61	123	563	407
Gujarat State		7053	5129	1985	2059	9038	7188

Source: Gujarat State Water Supply Sewarge Board, Gandinagar.

first round, 12709 villages in second round, 4175 villages in the third round and 74 villages in the fourth round. In addition 6305 villages in Sauratra and 948 villages in Kutch area are also covered. Saurastra Coastal Prevantion of Salinity Ingress Projects have been accepted to assistance by the World Banks. During 1987-88 the total provision made for Research and Development in desalination was 5 Lakh Rs.

Important inorganic resources presently being expolite along the foreshore zone of coastal tracts of Gujarat includes salt and marine chemicals, construction material etc. Construction materials are found in the form of beach sand and gravel. Extraction of salt from sea water is mainly done with the application of solar energy and the beach sand mining along the lower coastal tract. But these activities also pose environmental hazards in the long run. This has brought into focus by geo-environmental appraisal which has carried out along the Gujarat coast. It has been pointed out that several environmental hazards, both geologic as well as man-made is going on. It adversely affect the shoreline equilibrium and salt extracting industries and thereby the socio-economic structure of the region. As the sea water is spread and retained in the salt pans the seapage and leakage increases the soil salinity in the coastal area of Gujarat. This tends to encrochment over the agricultural land. In Gujarat coast a severe impact of coastal water pollution has been seen by chemical industries on salt pans. Pollution of esturine regime and creeks because of toxic industrial

effluents may become a serious health hazard in this coast. For example alarming incidents of Cadmium (10 ppm) Chromium (125 ppm) Copper (15 ppm) and mercury (30 ppm) has been detected in water samples from Mumba, Thane and panvel Crecks (GSI report, 1985). It is found that large-scale expansion of salt pans take place along such creacks and such contaminated coastal waters are utilised for salt making. So it is possible these lethal elements may find their way in the extracted salt. Similar critically dangrous zone along Gujarat coast are Kantiajal - Olpad and Navasri - Auranga tracks.

The direct urban sewage disposal into the intertidal zone is practiced along the major part of the south Gujarat coast. Such activities have polluting effect specially during high tide surges to the marine life as well as salt industry. The problems is particularly acute in Khambhat-Palaj and Umbergaon-Sanjan sectors of Gujarat coast.

There are many coastal villages in Gujarat which suffer from excess of salinity, iron of fluorid or other toxic elements hazardous to health. Table IX gives a clear understanding of this major coastal problems. In Gujarat there are 1985 villages which are suffering from this problem. Out of this total 1307 villages are of coastal districts. Problem is very serious mainly in the district of Ahmedabad, Bharuch, Junagardh, Valsad and Katch where total 943 villages are affected. Roughly 14 Lakhs people of the coastal villages of Gujarat are being toxicated directly with

this hazard. That is why such problem should be looked into sincerely.

Due to rapid urbanisation and industrialisation of southern Gujarat coastal tract the demand for sand and gravel is increasing day by day. This leads to deplation of the best and most suitable located reserve on the beaches and barrier bars. The uncontrolled beach sand mining activities along the coast have disturbed the shoreline equilibrium and aspect of beach nourishment. For instance, it was observed that the coastal areas under recent marine erosion such as Kolak, Udwada, Surwada, Deheri, Tithal, Umergaon, Nargal in Valsad district are also the areas that are being mined for sand and gravel. Secondly most of the major coastal streams and rivers of Gujarat are being trained and deemed upstream for multipurpose projects. It causes a drastic decrease of terrestrial sediment influx in the littoral zone of Gujarat. Therefore, such unplanned sand/gravel mining of the beach will cause destruction of natural defence system on the shoreline against wave action. Ultimately it endangers the safty of coastal hamlets. Thus in view of above problem it could be advisiable to restrict the sand mining activities all along the beaches in Gujarat coast.

Thus salt extraction and beach sand exploitation might be matually exclusive activities on the Gujarat coast, but they create geo-environmental hazards to the entire ecosystem and human habitat. In Gujarat, particularly southern coastal area is very much affected by untreated industrial effluent

and direct urban sewage waste disposal to the inter-tidal zone. Such activities not only affects the marine life but also human being, through consumption of contaminated salt and water as extracted from such toxic coastal and estuarine regimes. Beach sand mining has a direct impact on shoreline equilibrium and the natural defence system. The magnitude of the problem can well be imagined, if the entire process of degradation and uncontrolled resources deplation is believed to be in operation all along the whole Indian coast. Here there is a need of systematic and quantitative study on these aspects, so that a proper and rational management can be made. Any work in this direction will be ultimately helpful to the people and the country.

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CHAPTER VII

CONCLUSION

CHAPTER VII

Conclusion

A spectrum of human needs depends upon many uses and activities in the coastal zone. Some are basic and critical to survival of mankind while others are desirable options. So important task of the coastal planner is to identify resource uses and attendent activities with the urgency and importance of needs. For example worldwide expanding population has a particular impact on coastal zone develdopment. The increasing coastal population density is directly related to the intensity of the negitive effects of urbanization. This is a strong signs of growing unstability in the coastal ecology. It is often the basis of constraints on coastal resources accessibility.

The issues and problems are arising from multible use of the coastal zone. These can be resolved most effecientl'y through a balanced master development regional plane. In this connection important consideration in the development planning process may be as folows:

1. The economics of profit-oriented competition for access and use of coastal zone resources.
2. Sociological and economic factors bearing on issues of environmental degradation and resource conservation.
3. Opportunities for technological innovation.

This dissertation addresses a wide range of resource

uses, conflicts and problems of coastal zone management. It will be helpful in its approach to the subject to gain an early appreciation of the interdisciplinary perspective. Selected cases of typical goal conflicts, issues and problem has been cited.

Waterfront industrial establishments are heavy producers of waste products which pollute the Esturies, harbours and nearshore water. Suitable sites for heavy industrie requiring deep water port facilities and back shore accesses are diminishing with respect to increasing national economic need and level of demand. Increasing pollution has damaged the breeding grounds of important marine life species in the coastal region. These include the need for converting specific coastal areas to exclusive commercial or housing development. This will be helpful to regulate the advese impact on biological resources and natural environment in the coastl region. Other required measure are technology of waste management and pollution control, zoing constraints on critical uses of coastal areas etc.

With continued attempts to petrolium resource development and damaging oil spills exceed tolerance levels for commercial fishing in many location. Indeed it is fact that petrolium products have over-whelming value to the national economy, but commercial fishing also represent an essential component of the economy. Therefore these two should not inadvertently succumb to competition of use of the coastal zone. A more balance and rational attempt is needed

in this regards with viewing the tolerance limit of population fishery , development of petroliums potential, receation, aesthetic requirements and coastal economy.

We have considered the nature and scope of the coastal zone management. It is necessary to understand the issues, conflicts and environme within which workable solutions must be developed and implemented. For adequate plann g and management implementation need a national policy guidlines. Furthermore, national authority generally does not have sufficient apreciation and intimate knowledge of regional problem situations to mitigate the local conflicts and environmental resources. For this, development planning fo the coastal zone should be performed with local interests, needs, constraints, and opportunities. These things should be carefully considered within the framework of national policy and objectives. The essential management function of planning implementing, and controling operation must be provided for in a unified management system linking national state and local jurisdictions.

The most significant aspect of this study is the management and development of Indian merketing zones. A country like India having long coast line and a large population to feed, a tremandous task ahead as a pioneer among the developing countries. Although it has vast resources on the coast, the management is not upto the mark to compete with the advanced countries. Considering the exploitation of mineral and energy resource and management of

the coastal environment, Attention have been given mainly to the development of living resources. The coastal zone o India contains the junction of land and sea where the major part of the international trade gravitates. The continantal shelf contain s vast fishries and unexplored minerals. The importent salt industry and coconut cultivation are features of the shore zone. For these and several other reasons coastal geomorphology of India is of more than academic interest.

On the terrigerous deposits, the beaches on the western shelf of India have placers of ilmenite, rutile, zircon magnetite and garnet. However little exploration and exploitation work has been carried out till now. There is no doubt that the heavy minral places on the beaches and offshore area of India are perhaps for more widspread and richer than on the beaches of the other oceans. The biogenic sediments both calcareous and siliceous are low priced comodities. It is doubtful in the Indian case wheather any of the deposits in the deep sea would be of economic interest in near future. The increasing demand for construction material in India coastal or urban centres have led to the exploitation or comparatively large scale of calcureaus deposits. Island like And-man and laccadive in India whose economics are becoming increasingly dependent on tourism, restraint would have to be exercised for their exploitation. Sytematic exploration of Indian coasts for the phosphorits, the most useful chemical for fertilizer, is very important in

near future. The Ocean Economics and Technology Breach of the United Nation Department of International Economic and Social Affairs has Introduced a Marine and Coastal Technology programme. This technologies for coastal erosion control has been selected as the topic for such technology review. On the basis of this review in this study anlysis has been made about forces and machanisms responsible for coastal erosion. The natural and manmade cause of erosion have been identified. A description has been made in detail about the alternative technologies available for the control of coastral erosion. Among the suggested measures a little is working out on Indian coast. So these should be looked into seriously. Although coastal erosion problems is not found throughout Indian coasts, but at some selected patches the problem is very serious for example Gulf of Cambay coast, Orissa and Andhra Pradesh coast etc. At these required places immediate coastal erosion protection programme is needed. In the same way problem like silting is also serious. In this field also proper management programmes is required. Sectoral activities in connection with agriculture, mining, industry, construction transportation, power generation, trade and commerce, settlement etc may inhence the erosion problem situation. So a unified management and development initiative is required. Thus coastal zome development and management efforts have become necessary to take into account the man-induced cause of erosion.

India has developed a varied infrastructure for development of coastal resources, along with some areas have to be estengthened. While enguaged in such development India is also in a position to enlarge co-operation with nighbouring countries in a number of directions. There is need for extensive as well as intensive survey over the continental shelf for mineral oil and gas resources, as well as pollution generated by these activities. There is a need for planned development of fishing, especially in the less fished areas of Gujarat, Mahrastra and East coast. Infrastructure and training are limited for longline fishing the major bottlencks for national or regional development are financial, sociological and managerial. Maragerial skills are needed to organise the fisheflock and to motivate public service and techniciane and entrepreneurs. Some other areas in which more have to be made are machnized fishing craft, development of infrastructure, handling and transportation facilities, fish forecaste and oceanographic and fisheries research. For the purpose of agaculture and rearing of small fish, specific nutrition studies are necessary. More production is possible through mariculture. A special studies are required on fishbehaviour and fish diseases in the coastal zone.

Monitoring of physical data should be looked into intenisively. For example oxidation-reduction potential of the bottom silt, Ph of sea water, salinity, trace metals, light penetration, dissolved oxygen and major ions should be

regularly determined at the surface and at the bottom. Chemical trace element analysis is important for pollution as well as intrition studies. State dams have to be enacted for pollution control, for industrial city effluents as well as against waste discharge by ships. Estuarine hydrography has to be studied in most of the esturies for planning esturine fishery development. The quality of river water can be optimised through controlled organic pollution (with DDT or PCB or radioactive pollution within safe limits) and with planned points of entry of sewage and treated industrial water. Planner should thinnk about planning nuclear energy plants or oil refineries on ofshore on barren islands in order to avoid pollution of populated coastal area.

Beside control of pollution, the presservation of the ecosystem is essential. The beaches have to be preserved ar kept clear and safe. The seashare must provide for useful infrastructure and essential services like harbours, acquaculture, boat sheds, wet basins, marine sprots and scenic view. Any reclaimed land must not be put but to uses like setting up shops and factories, that could be place further inland. Stability of aquatic environment is determined by the diversity and abundence of animal species. Intimate knowledge of food chain structure is needed for the efficnet management of coastal waters where most production occurs.

India will have to make a such greater effort toward accomplishing each of the above plane of work. So that a new

era of exploration, exploitation and betterment of our vast coastral resources will come. These efforts will boost the economic and social development of the country.

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