Extra

COASTAL RESOURCES MANAGEMENT PLANNING

SOUTH ASIA CO-OPERATIVE ENVIRONMENT PROGRAMME

Report of the SACEP/ESCAP/CEA Workshop on Coastal Resources Management Planning in the SACEP Region

10 - 14 June 1991
Colombo, Sri Lanka

Extra

SOUTH ASIA CO-OPERATIVE ENVIRONMENT PROGRAMME

(SACEP)

REPORT OF THE SACEP/ESCAP/CEA WORKSHOP ON COASTAL RESOURCES MANAGEMENT PLANNING IN THE SACEP REGION

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SOUTH ASIA CO-OPERATIVE ENVIRONMENT PROGRAMME
SACEP/ESCAP/CEA WORKSHOP ON COASTAL RESOURCES MANAGEMENT PLANNING IN THE SACEP REGION
10 - 14 JUNE 1991
COLOMBO - SRI LANKA

REPORT

1. INTRODUCTION

A Workshop on Coastal Resources Management Planning in the SACEP Region funded by the Economic and Social Commission for Asia & Pacific, hosted by the Central Environmental Authority of Sri Lanka and convened and organised by the South Asia Co-operative Environment Programme was held in Colombo, Sri Lanka from the 10 - 14th June 1991.

2. ATTENDANCE

This Workshop was attended by the Representatives of the three Marine Member States of SACEP, namely Maldives, Pakistan & Sri Lanka and of the United Nations Economic & Social Commission for Asia & Pacific. The List of Participants is given in Annex I.

3. INAUGURATION

The Workshop was inaugurated by Hon. Vincent Perera, Minister of Environment & Parliamentary Affairs, Sri Lanka. Hon. Dr. Wimal Wickremasinghe, Minister of Environment, Sri Lanka and Hon. M E H Maharoof, State Minister of Ports & Shipping, Sri Lanka, were also present. The Agenda for the Inauguration is found in Annex II.

The Chairman and the other members of the Consultative Committee of SACEP as well as Mr. Robert England the Resident Representative of UNDP in Sri Lanka were also present at the ceremony.

The address made by Dr. Rezaul Karim, Chief, Environment Section, Division of Industry, Human Settlements and Environment, ESCAP is reproduced in Annex III.

4. **WORKING SESSIONS**

The work programme drawn up by the SACEP Secretariat, in consultation with the Resource Persons is shown as Annex IV; the Country Reports and Case Studies as Annex V and the abstracts of Guest presentations as Annex VI.

5. **IDENTIFICATION AND DISCUSSION OF COASTAL ZONE MANAGMENT ISSUES WITHIN THE SACEP REGION**

It was agreed that identification and discussions of Coastal Zone Management issues in the South Asian Region should be according to the following format.

A) Institutional Mechanisms
   * National
   * Provincial

B) Legal Mechanisms
   * National
   * Provincial

C) Common Concerns

D) Ongoing Programmes

E) Recommended Regional Actions

The discussions centered mainly round the three countries represented namely Maldives, Pakistan and Sri Lanka.

A) INSTITUTIONAL MECHANISMS

* NATIONAL

COUNTRY	LEAD AGENCIES	RESPONSIBILITIES
MALDIVES	* Ministry of Planning & Environment	Environmental matters including Environmental Impact Assessments
	* Ministry of Public Works & Labour	Dredging; Coast Protection; Ports etc.
	* Ministry of Defence & National Security	Coast Guard Service; Policing the Exclusive Economic Zone (EEZ)
	* National Commission for the Protection of the Environment	Advisory Body

COUNTRY	LEAD AGENCIES	RESPONSIBILITIES
PAKISTAN	* Ministry of Communication, Ports & Shipping Wing	Shipping; Pollution (Specially Oil Pollution); Ports Authority.
	* Maritime Security Agency	Marine Pollution in the Exclusive Economic Zone (EEZ) and other Coastal Areas outside the jurisdiction of the Ports; Illegal fishing by foreign vessels.
	* Ministry of Environment & Urban Affairs	Preparation of National Standards for effluents; Oil Spill Contingency Plans; Environmental Impact Assessments; Marine Pollution
	* National Institute of Oceanography (NIO)	Research & Development work in the Coastal Zones and the Exclusive Economic (EEZ) covering all aspects except legal

COUNTRY	LEAD AGENCIES	RESPONSIBILITIES
PAKISTAN	* Ministry of Food & Agriculture	Activities in the Marine Fisheries Department & fish resources management within the Exclusive Economic Zone (EEZ)
	* Ministry of Tourism	
	* National Oceanographic Commission (NOC)	Surveys and Research

COUNTRY	LEAD AGENCIES	RESPONSIBILITIES
SRI LANKA	* Ministry of Ports & Shipping - Coast Conservation Department	Coastal Zone Management including Coast Protection
	* Ministry of Environment & Parliamentary Affairs / Ministry of Environment	Overall control of environmental aspects of Development, Policies, Programmes & Projects
	* Central Environmental Authority (CEA)	Planning, Implementation, Enforcement & Monitoring of Development, Policies, Programmes & Projects
	* Urban Development Authority (UDA)	Management of activities in declared urban areas
	* Ministry of Fisheries & Aquatic Resources/ National Aquatic Resources Agency (NARA)	Research & Development relating to aquatic resources

INSTITUTIONAL MECHANISMS

* **PROVINCIAL**

COUNTRY	LEAD AGENCY	RESPONSIBILITIES
MALDIVES	-	-
PAKISTAN	* Baluchistan Development Authority	Development works relating to Ports, Jetties, Infrastructure, Water Supply falling within the jurisdiction of the province.
	* Sindh & Baluchistan Provincial Departments of Fisheries	Management of Coastal Fisheries within the two provinces.
	* Sindh & Baluchistan Forestry Department	Management of Coastal Forests within the two provinces.
SRI LANKA	* Provincial Councils	Control of Provincial Land & Local Water Resources

B) LEGAL MECHANISMS

MALDIVES	PAKISTAN	SRI LANKA
* Environmental Law (Now in draft stage)	* Environmental Protection Ordinance of 1983 * Forest Act of Sindh * Forest Act of Baluchistan * Fisheries Act of Sindh * Fisheries Act of Baluchistan * Shipping Act * Harbour Act * Sindh Wildlife Act * Local Bodies Acts of Sindh & Baluchistan * Maritime Security Act (Now in draft stage) * Baluchistan Wildlife Act	* Coast Conservation Act (57 of 1981) & Amendment (1988) * Maritime Zone Law (22 of 1976) * Urban Development Authority Law (41 of 1978) * Control of Pesticides Act (33 of 1980) * Forest Ordinance * Fauna & Flora Protection Ordinance * National Aquatic Resources, Research & Development Agency Act (54 of 1981) * Natural Resources, Energy & Science Authority of Sri Lanka Act (78 of 1981) * National Environmental Act (1980), Amendment (1988) and Regulations made under this Act * Fisheries Act * Greater Colombo Economic Commission Act * Marine Pollution Prevention Act

C) COMMON CONCERNS

Several concerns of common interests to the South Asian countries emerged from the discussions. The following are some of these main concerns.

a) POLLUTION

The disposal of sewerage and solid municipal waste posed a major problem in the coastal municipalities of all countries. A major concern was voiced about high pollution on the coast of Pakistan and the coast of Sri Lanka, whilst industrial pollution was a concern in Sri Lanka and the Sindh coast in Pakistan specially around Karachi. The discharge of heated industrial effluents into coastal waters is a problem of some concern in Pakistan.

b) HABITAT DEGRADATION AND DESTRUCTION

i) MANGROVES

Degradation and destruction of mangrove forests in the Indus Delta through salinisation, human destruction and camel grazing is a serious concern in Pakistan. In Sri Lanka the major threat to mangroves are conversion to other uses such as "Reclamation", Overexploitation and Aquaculture development.

ii) CORAL REEFS

The mining of coral reefs and extraction of living organisms from coral reefs is of serious concern in the Maldives and Sri Lanka. The presence of Acanthaster planci (Crown of Thorns Starfish) poses a serious threat to these coral reefs. Destructive fishing methods pose another serious threat to coral reefs in Sri Lanka.

iii) COASTAL EROSION

Coastal Erosion is a serious concern in the Maldives and Sri Lanka. In Pakistan, coastal erosion is not generally perceived as a serious problem. Mining of beaches and coral reefs were considered major contributory factors towards coastal erosion in the Maldives and Sri Lanka. Sand mining in estuaries in Sri Lanka is also a major concern.

iv) LACK OF POTABLE WATER SUPPLIES

The lack of potable water is a serious concern in some islands of the Maldives and the coastal areas of Pakistan.

v) FISHERIES

Concern about poaching of fish by foreign vessels were voiced by the participants from all three countries. Concerns were expressed about over fishing for shrimps in Pakistan and for spiny lobsters in Sri Lanka. Decline in the turtle population is a concern in Pakistan and Sri Lanka. The turtle is declared as an endangered species in Sri Lanka. The reduction in the number of certain marine mammals is a serious concern in Sri Lanka.

vi) SEA-LEVEL RISE

All delegates express concern about the impact of sea-level rise. For Maldives this was the priority concern whilst in Pakistan the impact of sea-level rise is a concern especially in the Indus Delta. Sri Lanka is concerned about impact of sea-level rise on coastal ecosystems and the heavily populated coastal regions.

vii) **NATURAL HAZARDS**

Damage and destruction caused in coastal areas by natural hazards is a common concern of all three countries.

viii) **INADEQUACY OF RESOURCES FOR PLANNING AND IMPLEMENTATION OF COASTAL MANAGEMENT**

* TECHNICAL EXPERTISE

Lack of technical expertise is a common concern in all three countries and is particularly acute in the Maldives.

* DATA FOR PLANNING

Concern was expressed about the inadequacy of data for planning by all three countries.

* FINANCIAL RESOURCES

Inadequacy of financial resources is reflected in the overdependence on foreign aid for coastal zonè managment activities in all three countries

D) ONGOING PROGRAMMES

MALDIVES

TITLE	ACTIVITIES
* National Environmental Action Plan	* Crown of Thorns eradication programme * Identification of areas where coral and sand could be mined with the least negative impact * Survey of all resort islands regarding construction of jetties already built and their impact on the beaches * Banning of construction of solid jetties and coral mining * Prevention of environmental degradation in Addu Atoll * Providing substratum for coral growth * Setting up of EIA guidelines * Use of Mooring buoys in place of anchors

PAKISTAN

TITLE	ACTIVITIES
* Fisheries Development Programme by FAO	* To reduce fishing pressure on shrimp fishery * Converting of shrimp trawlers to gill nets * Development of fisheries harbour and ancilary facilities * Development of fisheries harbour / Korangi Fish Harbour * Turtle conservation programme * Rehabilitation and restoration of Mangroves in the Indus delta
* Karachi Special Development Project	* Upgrading existing effluent treatment facility * Feasibility study for marine outfalls for sewage disposals after primary treatment * Upgrading existing water supply to Karachi * Expansion of Karachi Fisheries Harbour * Research & development programmes for Coastal Zone Management measures * Water supply projects for coastal areas of Baluchistan

SRI LANKA

TITLE	ACTIVITIES
* Coastal Zone Management Programme	* Implementation of coast erosion management measures * Preparation and Implementation of the Coastal Zone Management Plan * Regulation of development activities within a defined coastal zone through a permit procedure * Enhancement of coastal areas (beach parks coastal replanning programmes) * Environmental Education * Training of provincial, district and other agency staff in Coastal Resources Management * Conduct of Survey/Studies of relevance to Coastal Resources Management

E. RECOMMENDED REGIONAL ACTIONS

The following activities were identified as prime areas for regional / subregional co-operation.

i) Exchange of expertise on :
   - coastal habitat management
   - Marine pollution monitoring and control
   - Legislation

ii) Enhancement of monitoring capabilities
   - Water quality
   - Conditions and trends in the use of natural resources

iii) Regional Contingency Plans :
   - Pollution Combating
   - Natural Disasters / Early warning system

iv) Development of Standards for Effluents and Guidelines for Environmental Impact Assessments

v) Sharing of Training Opportunities

vi) Exchange of Data

The participants felt that a significant contribution to coastal zone management in the South Asian Region could be made if early initiatives are taken to finalise and implement the Action Plan identified under UNEP's South Asian Regional Seas Programme.

6. CONCLUSION

The participants agreed that progress in the implementation of the recommendations of this Workshop should be assessed at the next Governing Council Meeting of SACEP or at some other appropriate meeting.

It was decided that the SACEP Secretariat should formulate a draft Action Plan for Coastal Zone Management in the SACEP Region on the basis of the recommendation made by this Workshop and that this would need to be discussed at an early follow up meeting.

The Course Director in his final comments thanked the participants for their valuable contributions and wished to place on record the deep appreciation of all concerned to ESCAP for having kindly agreed to fund this Workshop, the Government of Sri Lanka for having provided host facilities, the Resource Persons and Guest Speakers for their contributions. He commended the SACEP staff for the excellent secretariat facilities they provided.

Annex I

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Ms. Shelaan N De Silva	Staff Assistant
Ms. Bushra Ismail	Receptionist
Ms. Ruchirani Kariyawasam	Analyst/Programmer

Annex II

SACEP/ESCAP/CEA WORKSHOP ON
COASTAL RESOURCES MANAGEMENT PLANNING
IN THE SACEP REGION
10TH JUNE 1991

INAUGURATION CEREMONY
AGENDA

08.45	-	Invitees take their seats
09.00	-	Lighting of the Traditional Oil Lamp
09.05	-	Welcome Address by Mr. G K Amaratunga, Chairman, Central Environmental Authority, Sri Lanka.
09.15	-	Address by Dr. Rezaul Karim, Chief, Environmental Co-ordinating Unit, Economic and Social Commission for Asia & Pacific, Bangkok, Thailand.
09.25	-	Address by Mr. B S Kahawita, Director, Coast Conservation Department, Sri Lanka.
09.35	-	Address by Hon. Dr. Wimal Wickremasinghe, Minister of Environment, Sri Lanka.
09.45	-	Keynote Address by Hon. Mr. Vincent Perera, Minister of Environment & Parliamentary Affairs, Sri Lanka.
10.00	-	Address by Mr. Mervyn Wijeratne, Workshop Course Director,
10.15	-	Vote of Thanks by Mr. A M S Hoque, Director, South Asia Co-operative Environment Programme.
10.20 - 10.45	-	Tea

Annex III

INAUGURAL ADDRESS BY DR. REZAUL KARIM
CHIEF, ENVIRONMENT SECTION
DIVISION OF INDUSTRY,HUMAN SETTLEMENTS & ENVIRONMENT
ESCAP

Distinguished Participants, Ladies & Gentlemen,

It is a great honour and privilege for me for being with you in this important Workshop on coastal Resources Management Planning in the SACEP Region. It is also satisfying for me to be able to witness the successful holding of the Workshop for which SACEP has worked so hard. We are gratified to be part of it with our support in the preparation of this Workshop and bringing together the experts from member countries of SACEP. I must acknowledge the strong support provided by the Government of Sri Lanka which was a great boost for this activity.

Coastal areas are amongst the most productive on earth and constitutes an enormous wealth of resources, both living and non-living, renewable and non-renewable. Dependant on a complex symbiosis of biological and natural elements, coastal ecosystems are also amongst the most fragile. Over exploitation, disturbance of natural habitats, pollution and the dumping of wastes have upset the delicate balance, and many coastal resources, especially in the most productive tropical regions are threatened with annihilation. There is now a pressing need to formulate management plans for the utilisation of coastal resources based on the concept of environmentally sound and sustainable development.

ESCAP has for the past several years been co-ordinating the development of coastal environmental management plans for several countries in the region. The first such plan, or CEMP as it has been popularly known, was developed for the west coast of Sri Lanka. Later that year, the CEMP was prepared for Thailand. Subsequently, with funding from the government of Norway, CEMP's were developed for Bangladesh, Pakistan and Tonga.

The CEMP for Sri Lanka, which became the model for subsequent studies, examined the demographic and socio-economic characteristics of the west coast and recommended an institutional and legislative framework that needed to be established. The plan was based on in-depth studies of the coastal geomorphology and land use pattern, the ecosystems of the lagoons, corals and mangroves, the prospects of developing marine fisheries, aquaculture and tourism, the impact of coastal erosion, sedimentation and pollution, and the imperatives of improving environmental health and sanitation as well as pollution control, while establishing the mechanisms for environmental monitoring and assessment. Recognising the need to increase awareness amongst the public as well as the decision makers, audio-visual modules were produced for Thailand, Bangladesh and Pakistan. The modules for Bangladesh and Pakistan are available for viewing in this Workshop. It is perhaps the time to make an assessment to what extent the findings and recommendations of CEMP were implemented.

Ladies and Gentlemen, I must reiterate that ESCAP is firmly committed to protecting the environment, particularly the coastal areas where great numbers of the region's poor strive to eke a precarious and often hazardous livelihood. As portrayed in the report of the state of the environment in Asia and the Pacific 1990, the environment in our region continues to deteriorate.

These were discussed in the Asia-Pacific Ministerial - level Conference held in October 1990 resulting in a declaration in support of ESSD. Steps must be taken immediately in line with this declaration to reverse not only the degradation of resources of the coastal environment, but also to undertake the activities in support of Environmentally Sound and Sustainable Development in the coastal region.

In this task, particularly for the coastal environment, the capability of the developing maritime member and associate member countries of ESCAP is not uniform. Some of the countries have reasonable well developed institutions and trained personnel to promote programmes for dealing with the coastal environment, while there are others where even the institutional responsibilities for this task are not well defined. Trained manpower and institutions are not adequate. The capability for monitoring and assessment of the coastal environment is lacking in many countries of the region. National programmes attach little priority in coastal areas compared to other development activities. The networking of the institutions of oceanography and marine environment in the form of a working group offers possibilities of developing natural capabilities and regional co-ordination.

ESCAP has already proposed to organise the working group to develop a core institutional group to provide support for the development of guidelines for CEMP and for the implementation of various recommendation for the management of coastal resources and the environment. We would like the regions oceanographic and marine environmental institutes to be part of it.

The destruction and deterioration of the coastal environment poses a direct threat to people living in the coastal areas, particularly for the poor, resources of the coastal areas are essential for maintaining a living. Fishing communities in the coastal areas are usually the poorest and most disadvantaged (as mentioned in the CEMP study of Pakistan), and face the maximum impact due to the depletion of resources. The hazards of cyclones and storm ravages are always there.

The Ministerial-Level Conference on Environment and Development in Asia and the Pacific, while recognising the importance of the coastal environment for the region's poor, recommended that management plans for the coastal environment of the countries of the region should be developed on an accelerated basis. Programmes should be undertaken for preparedness against the natural calamities. Despite all preparations and early warning, we had to witness to the recent catastrophic cyclone devastating the coastal areas of Bangladesh.

While ESCAP's long-term objectives in the coastal areas are to produce environmentally sound policies, practices and conservation methods for the protection of the environment and enhancement of the quality of life, the immediate aims to :-

a) promote regional co-operation for the development of coastal environmental management plans;
b) strengthen national capabilities in the consolidation and integrating of CEMP findings and recommendations into programmes and projects for implementation; and
c) promote public awareness and people's participation for the protection of the coastal environment.

Ladies and Gentlemen,

The purpose of stating the development at the regional level is to stress the need for further strengthening of regional/sub-regional co-operation, and to catalyse actions at national level in support of these initiatives. I would also like to make reference to the Regional Strategy for Environmentally Sound and Sustainable Development endorsed by the member countries of ESCAP at their annual session at Seoul this year. Implementation of this strategy would go a long way towards sustainable management of the coastal resources. In our endeavor to save the environment, we are also looking towards the preparation of the UNCED which has generated a lot of enthusiasm since the work of the World Commission on Environment and Development.

Therefore, in the context of the prevalent situations in the Asian and Pacific Region and elsewhere, this Workshop on Coastal Resources Management Planning is of great importance to the countries that SACEP serves.

I hope efforts would be made to come up with concrete suggestions. The programme should also devote more time for discussion to get the best out of the participants.

THANK YOU.

Annex IV

SACEP/ESCAP/CEA WORKSHOP ON
COASTAL RESOURCES MANAGEMENT PLANNING
IN THE SACEP REGION
10 - 14TH JUNE 1991

WORK PROGRAMME

DAY 1

Monday 10th June 1991

08.30 - 09.00	-	Registration
09.00	-	Lighting of the Traditional Oil Lamp
09.05	-	Welcome Address by Mr. G K Amaratunga, Chairman, Central Environmental Authority, Sri Lanka
09.15	-	Address by Dr. Rezaul Karim, Chief, Environmental Co-ordinating Unit, Economic and Social Commission for Asia & Pacific, Bangkok, Thailand
09.25	-	Address by Mr. B S Kahawita, Director, Coast Conservation Department, Sri Lanka
09.35	-	Address by Hon. Dr. Wimal Wickremasinghe, Minister of Environment, Sri Lanka
09.45	-	Keynote Address by Hon. Mr. Vincent Perera, Minister of Environment & Parliamentary Affairs, Sri Lanka
10.00	-	Address by Mr. Mervyn Wijeratne, Workshop Course Director
10.15	-	Vote of Thanks by Mr. A M S Hoque, Director, South Asia Co-operative Environment Programme
10.20 - 10.45	-	Tea
		* SESSION I - CHAIRMAN - Dr. D Nesiah, Secretary, Ministry of Environment & Parliamentary Affairs;
10.45 - 11.30	-	Presentation on 'Coastal Zone Management in Developing Countries - Current Status and Problems' by Mr. S R Amerasinghe, Chairman, International Coastal Organisation, Massachussettes, USA.
11.30 - 12.30	-	Presentation on 'Coastal Zone Management; Why a Special Initiative' by Mr. H J M Wickremaratne, General Manager, Lanka Hydraulic Institute Ltd., Sri Lanka.
12.30 - 14.00	-	LUNCH
		* SESSION II - CHAIRMAN - Mr. K A H Ranaweera, Director-General, Central Environmental Authority, Sri Lanka.
14.00 - 14.45	-	Country Paper - Bangladesh
14.45 - 15.30	-	Country Paper - India
15.30 - 15.45	-	TEA
15.45 - 16.30	-	Country Paper - Maldives
16.30 - 17.15	-	Country Paper - Pakistan

Day 2

Tuesday 11th June 1991

		* SESSION III - CHAIRMAN - Mr. B S Kahawita, Director, Coast Conservation Department, Sri Lanka.
08.30 - 09.15	-	Country Paper - Sri Lanka
09.15 - 10.00	-	Presentation on "Coastal Erosion Hazards and its Mitigation in Sri Lanka" by Mr. D Godage, Project Manager, (Master Plan Implementation) Coast Conservation Department, Sri Lanka.
10.00 - 10.15	-	TEA
10.15 - 11.00	-	Presentation on "Environmentally Sound Preparations Against Natural Disasters" by Dr. Rezaul Karim, Chief, Environmental Co-ordinating Unit, ESCAP, Bangkok.
11.00 - 11.45	-	CASE STUDY 1 - BANGLADESH
11.45 - 12.30	-	CASE STUDY 2 - INDIA
12.30 - 14.00	-	LUNCH
		* SESSION IV - CHAIRMAN - Dr. Upali Jayasekera, Director-General, National Aquatic Resources Agency, Sri Lanka.
14.00 - 14.45	-	CASE STUDY 3 - MALDIVES
14.45 - 15.30	-	CASE STUDY 4 - PAKISTAN
15.30 - 15.45	-	TEA
15.45 - 16.30	-	Presentation on "Elements of a Coastal Zone Management Programme" by Ms. D. Sadacharan, Manager, Coastal Resources Development, Coast Conservation Department, Sri Lanka.
16.30 - 17.15	-	CASE STUDY 5 - SRI LANKA

DAY 3

Wednesday 12th June 1991

		* SESSION V - CHAIRMAN - Mr. S R Amerasinghe, Chairman, International Coastal Organisation, Massachussettes, USA
09.00 - 09.45	-	Presentation on "Impact of Mean Sea Level Rise in the SACEP Region" by Mr. S H Niaz Rizvi, Principal Scientific Officer, National Institute of Oceanography, Karachi, Pakistan.
09.45 - 10.30	-	Presentation on "Coral Reef Resources of Sri Lanka" by Mr. Arjan Rajasuriya, Scientific Officer, National Aquatic Resources Agency, Sri Lanka.
10.30 - 10.45	-	TEA
10.45 - 11.30	-	Presentation on "Environmental Impact Assessment in Coastal Zone Management" by Ms. Shiranee Yasaratne, Acting Director, National Resources Management Division, Central Environmental Authority, Sri Lanka.
11.30 - 12.15	-	Guest Presentation on "Down Stream Impacts of Upstream Development" by Mr. N. Karunakaran, Chief Research Engineer, Lanka Hydraulics Institute Ltd., Sri Lanka.
12.15 - 13.45	-	LUNCH
13.45 - 15.30	-	Discussion on "Identification and Discussion of Coastal Zone Management Issues within the SACEP Region.
15.30 - 15.45	-	TEA
15.45 - 17.00	-	Discussion (contd.,)

DAY 4

Thursday 13th June 1991

* Field Trip to Galle and back.

07.30	-	Leave Hotel * Moratuwa Coast Protection Project * Sand Mining * Kalu Ganga Estuary
10.00	-	Bentota Resort
11.00	-	Leave Bentota Resort * Coral Mining Sites * Coast Protection Projects
12.00	-	Hikkaduwa * Tourism Development * Proposed Marine Sanctuary
12.30	-	Leave for Galle
13.30	-	Lunch at Closenberg
15.00	-	Leave for Colombo * Pass through Galle Fort

DAY 5

Friday 14th June 1991

		* SESSION 6 - CHAIRMAN - Mr. M S Wijeratne, In-Country Project Administrator, Coastal Resources Management Project, Sri Lanka and Course Director.
09.00 - 09.45	-	Presentation on "The Mangrove Environment in Sri Lanka" by Mr. A N S Baminiwatte, Assistant Conservator of Forests, Sri Lanka.
09.45 - 10.30	-	Presentation on "Coastal Zone Management Initiatives as a Response to People Needs" by Mr. H J M Wickremaratne, General Manager, Lanka Hydraulic Institute Ltd., Sri Lanka.
10.30 - 10.45	-	TEA
10.45 - 12.30	-	Discussion on Draft Report on Coastal Issues in the SACEP Region, its Adoption and Closing Session.
12.30	-	LUNCH

Annex V A

COUNTRY REPORT - MALDIVES

The chain of coral islands lying peacefully in the Indian Ocean called the Republic of Maldives consists of 26 coral atolls lying along the 73 degree meridian between 7 degree 06'N and 0 degree 42'S. The atoll chain is about 870km long.

There are about 1300 islands of which 200 are inhabited. Although there are about 26 natural atolls. The Republic is divided into 19 atolls mainly for administrative purposes. Each of these administrative atolls or units are headed by an Atoll Chief who is supported in his work by an administrator in each different island called an "Island Chief".

According to the 1990 census preliminary results the population of Maldives is 213215 of which 55130 live in the capital city Male' and the remaining 158085 are distributed to the other 200 inhabited islands.

The Maldives boasts of a rich culture, their own language and script 'Thaana' written from right to left. Archaeological evidence states that these islands have been inhabited for upto 2,500 years. Researchers suggest that early settlers were from the Hindus Valley civilisation and linguistic evidence suggests a common ancestry with the Sinhalese. The people who were originally sunworshippers, later buddhists were converted as Muslims in 1153. Limited information is known about the geology of the Maldives. The thickness of the coral limestone of the submarine ridge on which the Maldives sits is about 2000 metres.
The Maldivian economy is based on fisheries, tourism, agriculture and international shipping of which the last two sectors have a fairly minimum contribution to the economy.

Being the principle foreign exchange earner for the country tourism plays a very vital role in the economy. Tourist resorts are developed on uninhabited islands which contributes a great deal to the unique attractiveness the Maldives offer its guests. Tourism accounts for some 17.47% of the GDP in 1989. The main attraction of Maldives can be listed as the white sandy beaches, vegetation, unique and wondrous reefs of the archipelago and especially the presence of these combined assets in crystal clear waters. It can also be stated that the diving conditions in these indian ocean islands are the best in the world.

The fact that none of these islands exceed 13sq km in size and do not rise more than 2m above mean sea level makes it very fragile to all coastal problems. It is therefore a well known fact that due consideration should be given to coastal planning and problems in the development of these islands.

Fisheries being the other major sector of the economy accounting for 15.73% of the GDP (1989) employs about 20.5% of the workforce.

Export of fish products have more than doubled over the last decades. The principle export is frozen skipjack. Next in the importance are canned fish, dried fish. Marine products include dried shark fins, shark oil, sea cucumber, fish meal, live tropical fish and coral.

One of the major problems that the Maldives is facing today is that of beach erosion. This can be linked to several different development activities which are in their own sense a must to the betterment of human life. The small major unique islands of the Maldives entirely consists of fine to divine to coarse coral side which lies on top of loose or cemented coral debris or cmented coral sand. Thus the beaches consisting of loose sand particles are very mobile under the force of waves and currents which impinge upon them. The fact that the beaches are of this very mobile material makes the island vulnerability to change in waves and currents.

It is therefore clearly known that each human interference with the existing hydraulic regime will result in a change of the island's dynamic behaviour and of the islands average equilibrium shape. Development activities which are essential to the life of Maldivians such as building of groynes, jetties, causeways and sea walls can be stated as such interfering activities. Basic knowledge with respect to the prevailing physical processes which control the coastal dynamics is lacking among most local constructors resulting in expensive errors, wastage of money and a lot of trouble for the future. Probably the biggest disadvantage is that such errors cause inconvenience and frustration to the people, thus absorbing much of their energy which otherwise could have been spent on other development activities.

It can be clearly seen that our beaches are a dynamic pact of our life, in relation to the mainstay of the island and also to tourism our principle foreign exchange earner, Stating the seriousness of the problem of beach erosion, next in step we also should keep in mind that activities such as jetty construction, sea wall, causeways etc. are in essential to our way of life. One of the defences to these incredibly low lying states from the threat of sea level rise is a sea wall. A jetty is most essential for sea transport in these interdependent islands. Hence it is believed that a compromise between these in planning of these resources should be met, as setting up of an effective coastal engineering.

Maldivians use coral mined from their own reefs for housing. Due to steady changes in demand for housing arising from the increasing population, we now have to face the inevitable problem of reef damage and coral bleaching the basement upon which we live. Both current and waves are essentially altered by any change in the related topography of the reefs. Lowering of the reefs' surface elevation inevitably leads to higher wave attack on the sandy beach; due to smaller wave energy absorption over the reef. This is a matter of concern since the rate of longstre sediment transport and the required weight of stable break water stones increases with the third power of the affecting wave height.

The most important thing to note here is that a one decimeter of reef lowering by mining or any other activity is risky as a one decimeter rise in sea level, as far as wave attack is concerned. It is evident that mining of corals from the reefs should be discouraged very effectively. But along with this there also rises the question of a substitute for the corals which we use for building. Cement blocks has been introduced recently. But this option still faces the usage of sand which is mined from the beaches and lagoons. Regulations are been enforced to forbid the mining of coral from the house reef Areas are being identified by the Ministry of Planning & Environment for sand mining. The mining of aggregate is also being limited by regulations. The import tax levied on sand & aggregate has been reduced considerably.

As population increases the need for a strategy to distribute the population to uninhabited islands rises. The capital island Male' accommodates 1/4 of the population of the Maldives mainly due to the living standard in Male'. Hence diversion of the population to other lesser compact islands is a very urgent and important question. The Government has launched a new redistribution policy in order to meet the demand of the increasing population.

According to this development scheme several selected islands are to be developed as new growth spheres. Development of these new islands require coastal activities to be carried out within the island itself. Careful planning has to be done to lessen coastal problems.

One of the major positive steps the Government has taken in this regard is the EIA process.

All development projects are subject to an environmental impact assessment before they are implemented.

To meet the increasing demand for housing land from the increasing population, minor reclamation has been carried out through out the archipelago. Male' the capital island has been reclaimed subtantially during the 70s & the 80s. But it has to be reasoned out that reclamation of land reduces the coastal defense ability of the isalnd.

Given the low altitude of the island it is clear enough that the whole nation is at risk in the event of sea level rise. It is also important to note here that one of the coastal defensive measures that we can take is the construction of sea walls. But as understood this is a very expensive alternative for a developing country such as the Maldives.

When taking into consideration the vulnerability and fragileness of these islands a very major step the country has taken is the drawing up of an environmental law which is in the latest stages of formulation now. It is assumed that this law will contain all relevant regulations regarding the problems of sand mining, coral mining, standards regarding building of groyns, causeways etc.

Several extract studies have been done about the various environmental problems of the Maldives. The recommendations of the exports are being implemented by the Government. But the most important it should be noted that Maldives lacks trained personnel in relative fields to address these problems. Hence making the training of personnel in all environmental related fields. The most urgent and important question to be addressed at the moment. Scholarships are being awarded to the staff of the presently understaffed environment section of the Ministry of Planning & Environment. A National Environment Action Plan has been drawn up which includes 19 projects including setting up of an environmental database, strengthening the managemnt capability etc.

It is hoped that the implementation of these 19 projects along with the other projects and strategies will minimise to a great extent the current problems we face in the field of coastal management planning and the whole environment itself in the near future.

Annex V B

COUNTRY REPORT - PAKISTAN

ENVIRONMENTAL MANAGEMENT OF COASTAL AREAS IN PAKISTAN

EXECUTIVE SUMMARY

The paper describes the state of the environment versus various development projects in the coastal areas of Pakistan. The focus has been on the environmental issues relating to the socio-economic development of the area. The coastal areas of Pakistan constitute one of the most under-developed areas of the country and as such, require special attention to build infrastructure and basic facilities to bring these areas at least at par with other fast developing towns of the country.

The main objective of the study is to propose management measures to keep environmental health and socio-economic development projects in harmony with each other. The paper examines the current state of the coastal environment, basic socio-economic structure, the development work so far carried out and to identify the basic priorities and environmental considerations in the existing and future development projects in the coastal areas.

The paper describes the features of coastal environment and associated Oceanographic characteristics of the Indus Deltaic areas and of the Balochistan coast. The potential of the major coastal resources of the coastal areas have been assessed and the need for their environmental management is stressed.

The various recommendations made in the paper basically focus on five main areas: 1, management of the coastal environment for sustainable development of resources such as forestry, fisheries, non living resources and future expansion. 2,development of projects for water supply and sanitation, disposal of sewage and marine pollution with reference to the current situation, future expansion and basic health services. 3, the development of communications such as coastal highway, inland links,fish landing jetties and mini ports, regular sealink service between Karachi and other coastal towns and better telephonic and postal services; 5, development of infrastructure for industries particularly fisheries and tourism. The Karachi coastal areas have been described separately from the rest of the coastal areas because of the special problems inherent with this developed part of the Pakistan coast.

Based on the available information recommendations have been made to provide guidelines for an environmental management plan for rational exploitation of coastal resources and development of essential civic amenities, communication and infra-structure for sustainable development. The priorities for the various development projects incorporating environmental considerations / safeguards have also been indicated to achieve sustainable socio-economic development of the coastal areas.

1. INTRODUCTION

There is a growing awareness about the health of our environment throughout the world. The level of awareness for the environment in Pakistan is also increasing significantly despite its low literacy rate and generally underdeveloped economy. The lesson we receive from the developed countries that it is essential to generate environmental awareness before starting industrialisation and socio-economic development. Therefore, it is essential for the developing countries which are at the verge of development to ensure that the environmental considerations and safeguards are built in all the development plans and development projects in harmony with the health of the natural environment.

The concept of sustainable development without altering the natural environment has given rise to the idea that with the present level of understanding, awareness, and technological advancement, the engineers, scientists, managers, and policy makers should focus their efforts to devise means and ways to manage the entire human activities in the ambit of sustainable development to keep the health of our environment within acceptable limits. The environmental management thus,is a challenge to all the managers and scientists/engineers.

The environmental management primarily centers around preserving the natural environment in ambit of sustainable development throgh adopting such techniques and processes which are in harmony with the natural processes. It does not imply that development works for infra-structure and basic/advanced industrialisation should not take place, instead it only means that due environmental considerations and environmental safeguards be incorporated as part and parcel of all development projects.

1.1 Need and Purpose of the Study

The coastal areas of Pakistan, with the exception of Karachi, are one of the most under-developed areas of the country. In addition, there is a total lack of integrated approach to coastal zone management. However, the development works in the coastal areas are now progressing at a faster rate as compared with the last 2 decades. It is, therefore, very pertinent that all the development projects relating to any sector of economy must be reviewed in order to determine their compatibility with the overall objectives within the spheres of socioeconomic development and environmental management.

A number of small development projects are in operation in the coastal areas of Pakistan. A Management Plan based on environmentally sustainable principles is necessary for the two provincial governments (Sindh, Balochistan) for the development of the coastal areas. With the new concepts of development and management such a plan could be part of an Environmental Management Plan for the coastal areas. An effort has been made in this paper to prepare guidelines for framing an Environmental Management Plan for the socio-economic development of the coastal areas of Sindh and Balochistan.

1.2. Statement of Problem:

Pakistan is a maritime country bordering the northern Arabian Sea. It has a coastline of about 990 Km extending from Jiwani near the Iranian border in the west to the Sir Creek in the Indus Delta, adjacent to the Indian border in the east. There are a number of small towns and fishing villages are located along the coastline which totally lack basic infra-structure. In addition, the environmental degradation and socio-economic conditions are very poor. Karachi - the biggest city and main industrial and trading centre is also located within the coastal belt and is confronted with severe pollution and environmental degradation problems. There are a number of environmental problems within the coastal belt of Pakistan, which are linked with the development of infrastructure, and projects for the socio-economic uplift of the coastal area.

The socio-economic conditions of the coastal belt with the exception of Karachi are very poor and need immediate attention of the planners and policy makers. The paper examines the main environmental and socio-economic issues, and development problems, and suggests recommendations / plans for their possible solutions, and ongoing and possible future projects for developing infra-structure for the various development schemes. The projects for the socio-economic uplift must take into account the principles of sustainable development of the coastal areas with full consideration to environmental safeguards required to protect and preserve the natural environmental management concerns with managing the environmental problems and allowing development schemes without or with minimum alteration to the environment.

Karachi city and adjacent areas on the coast are distinctive with a large and growing population and industries. It has many inherent problems of acute water shortage, poverty inadequate roads and communication systems, improper disposal of the urban and industrial waste, etc. There is need to develop an environmental management for Karachi exclusively.

The main issue for environmentally sound and sustainable the human problems needs to be focussed in order to improve the standard of living through protection of the deteriorating environment in terms of improving human health, better sanitation, clean air and water and socio-economic conditions. Thus the safety and prosperity of humans have been given top priority in the suggested recommendations for the environmental management of the coastal areas. In order to achieve these the resources of the country and required to be utilised economically and in well planned stages.

There is a great potential for the development of tourism as the city has large hotels for the tourists and recreational spots on the beaches and shores. There is a large space for development of new townships and establishment of coastal industries as all the necessary industrial infrastructure is available. All these resources require proper management.

The main objective of the study is to propose management measures to keep environmental health and socio-economic development projects in harmony with each other. The approach does not intend to impose restrictions on the development of basic infra-structure which is essential for any development.

In the first phase, all the deteriorating changes need to be protected such as, environmental changes due to sanitation, control on industrial and marine pollution, protection of coastal ecology, particularly in the region of the mangroves forest, control on biocides, protection of coastal structures, sea encroachment etc.

The secondary objective is proposed to be devoted to the improvement of the coastal environment to meet the basic standard for a happy and healthy life. In general, this phase requires actual development such as in modernising fisheries, setting up of new fisheries industry, deep sea fishing, fish farming, new fish harbours and fish landing jetties, fish storage and marketing facilities, etc. In the field of non-living resources offshore exploration and exploitation of minerals, oil and gas resources etc. In the field of conservation of resources and economic development of the coast: land and water development projects, establishment of new harbours, roads, communication and extending coastal industrial infrastructive facilities, new industrial complexes inland water transport, and development of tourism, etc.

The second phase should focus on the consolidation of all the projects which were developed uptill now. This will ensure sustainable development of the coast. The proper management of the coastal environment will generate substantial revenue which will contribute to the overall economy of the country.

1.3. Methodology:

The data/information on the coastal environment of Sindh and Balochistan was collected through a survey of published/un-published relevant scientific literature. Most of the required literature was available in the published and unpublished reports at the libraries and files of the National Institute of Oceanography, Marine Fisheries Department, Fisheries Departments of Sindh and Balochistan. The relevant data was also collected during a recent visit to Fisheries Harbours, Power Plants, Water supply projects in Gwader, and Pasni along Balochistan coast. The data on the sanitation and water supply schemes of coastal Balochistan was obtained from Public Health Engineering Department, Government of Balochistan, Quetta. The data on the sanitation and water supply schemes for Karachi and other parts of coastal Sindh were obtained from KWSB, KDA, Planning & Development Department, Government of Sindh in Karachi and from WAPDA, and irrigation department, Hyderabad. In addition, the relevant reports of UNEP, UN-ESCAP, US-AID and in daily DAWN were also studied to get the relevant information. The bibiliography listed at the end of this paper cover all the reports, etc., which were

consulted for the preparation of this paper.

A synthesis has been made of all the data/information collected and the extracted information along with the interpretation, has been presented in this paper to describe the current situation of various environmental and socio-economic issues and suggestions have been made to manage these problems in the ambit of environmental management and sustainable development. In the light of the data information made available , it was possible to identify a set of proposals as recommendation for the action plan of the Environmental Management.

In the preparation of the report, various coastal environmental problems and major issues involved there in were identified. An effort was made to obtain authentic information through reliable documents listed in the Bibliography.

2. THE COASTAL AND MARINE AREAS OF PAKISTAN

The coast may be defined in broad terms, as the area which comprise shore lines, beaches, estuaries, and partly shelf area. The hiterland adjacent to coastline upto 30 - 50 Km, generally constitute the coastal belt or coastal area. On the seaside the natural physical processes and water mass dynamics in these areas profoundly affect biological, chemical, geological, and meteorological conditions and play dominating role in maintaining the health of the environment. The shoreline and the landward part of the coastal belt is under the influence of natural as well as human activities, the latter have a profound effect in shaping the environmental conditions. Both, the natural as well as human activities have a direct and definite bearing on the development and management of the coastal region. The importance of a coastline is determined from its (1) potential resources of its hinterland; (2) strategic location and (3) the inherent capacity of the coast for development. The potential resources of the hinterland are considerable. The inherent capacity for coastal development can be judged by its potential of selected promontories and sheltered areas for development into Ports and landing jetties and from prospectus of development of coastal industries and tourism.

Pakistan has a coastline of about 990 Km and an adjacent Exclusive Economic Zone (EEZO is about 240,000 Sq Km. The development of the coastal area and marine areas, require (1) careful planning; (2) substantive investment and (3) technical know-how. The coast being the land-sea boundary is an important region to extend the land development to the sea. The development and management plans for the area require special considerations.

2.1. Coastal Region

Pakistan Coast can be distinctly divided into two regions having unique physiographic features and environmental problems. These are (1) Indus Deltaic Region, (2) Karachi Metropolitan Area, (3) Lasbela Coast, (4) Makran Coast. Characteristics of these coastal regions are described below :

1. INDUS DELTAIC REGION

The Indus Deltaic Region is located in the eastern part of the country which is drained by the Indus River. The Indus River is one of the world's largest in terms of drainage, river discharge and sediment load. The freshwater discharge to Indus Delta has been drastically reduced during the last 6 decades (Milliman, et al, 1984). The coastal morphology of Indus Deltaic Coast is characterized by Network of tidal creeks formed due to changes in river courses; Variation in Indus discharge and sediments due to natural and man-made events. A large number of small islands in the tidal channels. The problems of sea encroachment are common due to Rise in Mean Sea Level.

2. KARACHI COAST

The coastal belt of Karachi is about 60 miles long. On the west, it is bounded by the Hub River and on the east by the mangrove swamps and creeks network of the Port Qasim area. Karachi receives only about 6 inches of rainfall during monsoon season. As a result most of the coast, with the exception of mangroves, is devoid of vegetation. The Lyari River and Malir River which flows during S.W. Monsoon rainfall, drains in the Arabian Sea in the west and east of Karachi respectively. These rivers also carry the Urban and industrial wastes which are only treated, insignificantly to about 5 Percent. The coastal morphology of the Karachi Metropolitan area is characterised by a large number of shallow lagoons, sea cliffs, sea stacks, terraces and dune fields which subjected to changes from man-made and natural events; the western coast and the sandy beaches like at Manora Island are eroded during SW Monsoon; reserves of gravel and sand in the coastal area, drained by Malir and Lyari rivers which have been heavily exploited as construction material. The eastern zone has tidal creek environments, with mangrove and mudflats and creeks of the Indus Delta.

3. LASBELA COAST

The Lasbela coastal belt is extended from the Hub River in the east to the Hingol River in the west. Most of the coast is located in a moonshaped Sonminai Bay. The coast borders the two districts of Baluchistan viz. Bela and Lasbela. The coastal morphology of the Lasbela Coast is characterised by erosion of sandy beaches by the S.W. Monsoon waves and cutting of the cliffs near Gadani. The sea encroachment at Gadani during S.W. Monsoon is very severe and damages the residential area. The Miration of sand dunes occur in different seasons. A group of mud volcanoes exist in this region known as 'CHUNRAGUP.' The coast between the Hub River and Miani Hor has two offshore islands; Churna and Kiou. There are many beautiful sandy beaches and small bays such as Monze Bay, Khalifa Bay, Gadani Bay, etc. Further South of these bays, there is a large oyster bed and corals near Churna Island.

The Hub coastal area being closed to the Karachi Metropolitan area has a high potential for development. The basic infra-structure for the industries being established and or extended from Karachi. The Government of Baluchistan have programmes to build power station, water supply units, communications and the establishment of industrial estates. An industrial estate of Hub has been established near Winder River. The Sonmiani Bay is characterized by upwelling and sea fronts creating ideal conditions for high fish catch. The lagoon is a traditional shrimp fishing ground with a high quality of shrimp. River Windar and River Polali drains into the lagoon in the east west respectively.

4. MAKRAN COAST

The coastline is about 700 Km long and mostly mountainous in character except for certain strips which are situated in the valleys and neglected courses of small rivers. The coast is drained by small rivers, Hub, Hingol, Basol, Shadi Khor, and Dasht. Although the rainfall is very limited (150 mm/year) but the large encachment areas of the rivers causes flash floods during rains. The Makran coastal belt, as a consequence of scanty rainfall, highly saline nature of the soil constitute desert conditions. The coastline faces considerable erosion and due to shortage of promontories and sheltered areas most of the littoral material is lost to the sea. The sand dunes migration by winds is very common. The coastal morphology of makran coast is characterized by torrential rain high discharge in the rivers and inundation of dry water courses. The coast is liable to be attached by Tsunamis.

2.2. COASTAL ENVIRONMENT

1. COASTAL ZONE

The coastal zone of Pakistan lies in the north-eastern corner of the Northern Arabian Sea. The coastal oceanographic feature of this coastal zone are therefore, very much under the influence of the oceanographic characteristics of the Northern Arabian Sea. The unique oceanographic features of the Northern Arabian Sea such as the high salinities, low precipitation, high evaporation rates, reversal of seawater circulation during the two monsoon periods and the upsloping of the oxygen minimum layer,high primary production rates, prevail all along the coastal and nearshore waters of the Karachi coastal belt. However, due to the shallow depths of the inshore and backwaters, certain factors such as turbulence, turbidities, high suspended solids, littoral drift, and organic and inorganic pollutants are more pronounced in the coastal waters within the coastal zone of Pakistan.

The coastal belt, with the exception of Karachi is among the most backward areas which are very sparsely populated. The land-sea boundary of Pakistan coast differs distinctly in various parts of the coast as such the definition of the coast varies. The coast along the Indus Delta where tidal creeks penetrate inland to about 30 km is defined to be the coastal limit. Beyond this limit, there is a distinction in crops interalia mangroves forest changes into agricultural land. In order to protect this land from the sea water penetration several bunds have been constructed and moe and being constructed. The bunds more or less form the limit of the coast. On Balochistan coast raised beaches of the geological times are taken as the coastal limit. These beaches are about 20 km from the sea. Beyond these raised beaches hills and mountain ranges differentiate the coastal belt from the main land. The whole Karachi Metropolitan area which is in between Sindh and Balochistan coast is considered as a coastal city which is 60 km long and variable width ranging between 30 to 60 km. With these definition of the coast, and the coastal belt, the Environmental Management Plan has been prepared.

The coastline of Sindh province is about 300 km long extending from Hub River in the west to the Sir Creek in the east and cover the entire delta of Indus River. There is a coastal belt of Sindh covers about 300 x 25 sq. Km area which extends upto 25 Km offshore from the coastline. This coastal belt two distinct units - the northwest coast and the southeast coast. The northwest coast with rocky shores, sandy beaches, backwaters and estuaries extends from Hub River Fall upto the Karachi Harbour area. The southeast coast consists of creeks of the north-western Indus Delta and inshore waters with tidal mud flats and creek channels extending upto Sir Creek area.

The coast at Karachi on the west has the influence of Makran Coast and on the east the influence of Indus Deltaic region Karachi is a big city with population about 8 million, and has huge industrial complexes of Singh Industrial Trading Estates (SITEO, Landhi Industrial Trading Estate, oil refineries, Steel mill etc. there are two large ports located on Karachi coastal area; Karachi Harbour and Port Bin Qasim. KANUPP is also located on the coast. The coast from Hub River entrance to Port Qasim entrance is about 50 Nautical miles. The coast west of Karachi Harbour entrance upto Buleji consists of Sandy beaches: Manora, Sandspit and Hawkesbay beaches, which are separated from each other by rocky protruding points. From Buleji to Cape Monze, the coast consists of hard conglomerate and/or shale cliffs which are being slowly eroded. Many small, normally dry rivers supply sediments to the coast in rainy periods. These rivers and the eroding coast are the predominant sources of sediment to the sandy beaches west of Karachi harbour entrance. The littoral drift on the coast, west of Karachi entrance is in the easterly direction. The material consists of coarse and brown sand and contains no mica. The coast at Clifton is very flat. The sand is very fine and very different from the sand of the beaches at manora. A significant accretion takes place at the Clifton beaches. This coastline has been for 100 years reported to advance on the average 30 ft./year (Rizvi and Quaraishee, 1989).

The littoral drift is negligible with a tendency towards eastward movement. These sediments consist of very fine silt with varying contents of coarser mica flakes. The annual rate of sedimentation within Karachi Harbour is about 800,000 cubic meters per year. Lyari River flows through the Karachi harbour carrying a part of urban waste, partly treated, and industrial waste of the SITE area. A fish harbour is also located within the Karachi harbour.

The data on the ground water resources within the coastal belt indicate presence of limited amount of slightly saline waters and a possibility of extracting ground water for the household works and other consumers.

2. OCEANOGRAPHIC CHARACTERISTICS

The mean annual seasurface temperatures for the open sea along the coast range between 20 C to 30 C while the seawater temperatures at about 10 meters depth in the coastal belt range between 18 C to 29 C. The seasurface salinities range between 33 ppt to 37 ppt per year while at 10 meters depth the range is 35 ppt to 37 ppt. The seawater salinities at the surface may drop to 28 ppt in the near-shore area for a few days during the rainy season. The seawater surface temperatures in the backwaters and creeks range between 16 C to 31 C during the year. The seawater surface salinities in the creeks are usually high (36 ppt to 40 ppt for most of the year except during rainy season when it drops to below 30 ppt.

The data on the Mean Sea Level (msl) indicate changes over a period of 150 years within the coastal areas indicate a rising trend with an average rate of 1.1 mm per year. The waves height in the coastal belt are usually 1.5 - 2.5 meters while during the south-west monsoon periods waves upto 4 meters significant heights are common with a maximum of 5 meters. The tides in the coastal belt are semi-diurnal with a tidal amplitude of about 4 meters. The tidal streams are very prominent in the circulation of water in the backwaters and creeks. The currents in the ebb tide are stronger than during flood tides thus help in the flushing of backwaters and creeks over an average of 5 to 10 tidal cycles. The seawater currents along the open coast have an average speed of less than 1 meters per second and westerly direction during southwest monsoon while easterly direction during northeast monsoon period. The littoral drift along the coastal belt has been assessed to be very high particularly during southwest monsoon period. It is estimated that on the average about 3 to 5 million metric tons of fine to coarse sand moves from one end of the intertidal and nearshore area of littoral zone. An average of about 0.1 to 0.5 metric tons of fine sand and silt gets eroded/deposited per meter square per year at some places along the coastal belt. The mean direction of littoral drift on the western coast is from west to east while on the southern coast is from east to west. The surface drift follows the pattern of prevailing wind direction. The siltation and erosion problems are severe along the open coast have been marked. The severe erosion is taking place at some places along the open west coast (Hasan Point to Pacha, and Paradise Point to Western Buleji) and at various places along the deltaic creeks particularly along Budo Island. The siltation rates are very high in the area. It is about 3 million metric tons per year in the Port Qasim approach channel area and approximately 1 million tons per year in the western coastal areas. The possible coastal hazards in the area include the possibility of the occurrence of moderate earthquake and the risks involved with the sea level rise in the area and the local erosion and siltation problems (Quraishee, 1988).

3. FORESTRY

3.1. COASTAL FORESTS IN BALOCHISTAN

1. MANGROVES VEGETATION:

The mangrove forest area along coast of Balochistan is limited. Different estimates have been reported; Khan (1986) have reported that the area under mangrove forest is 20 ha, Amjad and Khan (1983) have reported an area of 2,000 ha. While Mirza et al (1988) have estimated an area of about 7,340 ha (18,350 acres) under mangrove forest along Balochistan coast using remote sensing techniques. This seems to be the most likely estimate for Balochistan coast.

Nasir and Ali (1972) have reported eight species of mangroves from Pakistan. Avicennia marina is the most common species. Other species have been reduced considerably if not lost completely. Rhizophora apiculata occupies a large area in Miani hor. Ceriops tagal also occurs in scattered forms in Miani Hor as does Aegiceras corniculatum. Bruguiera gymnorrhiza and Ceriops tagal, which once occurred in Hub River delta (Champion et al. 1965) can no longer be found (Kogo, 1985).

1) Distribution

The distribution of mangrove forest along Balochistan coast is restricted to three main sites namely Miani Hor, Kalmat Khor and Gwatar Bay. Table -1 presents the details of the area under mangrove vegetation.

TABLE -1. DISTRIBUTION OF MANGROVE VEGETATION ALONG THE COAST OF BALOCHISTAN

SITE	AREA		PERCENTAGE
	Acres	Hectares	
Miani Hor	7,750	3,100	42
Dense	4,100		
Normal	2,700		
Sparse	950		
Kalmat Khor	5,400	2,160	30
Gwatar Bay	5,200	2,080	28
Total	18,350	7,340	100

Source: Mirza et al (1988)

2) Threats

i) Grazing and Browsing

The unrestricted browsing by the camels in mangrove forest from year to year has completely denuded the tree growth. Herds of camels enter the mangrove forest area during the winter months to graze and browse on mangroves.

ii) Overfellings:

Due to the arid conditions and absence of any irrigation arrangements there is no other tree growth along the sea coast with the result that communities living near the mangroves have been cutting the trees for their domestic need.

iii) Environmental Changes

Due to the environmental degradation coupled with human exploitation is believed to be the major cause of diminishing area under mangrove. Several factors may be implicated. Migrating sand dunes kill mangrove trees, and they fail to thrive where deposition of fine alluvium is restricted; winter temperatures are too low and the seasonal range too wide for optimum growth.

It has been estimated that the mangrove forest along the Makran Coast in estuaries of rivers, deltas, bays and sheltered coasts was more extensive in the past but now practically all the mangroves have disappeared due to environmental degradation (Macnae, 1974). Miani lagoon is also filling slowly with sediment (Snead 1966), and numerous changes in channel width and position have occurred in recent historical time.

2. OTHER VEGETATION

Except for mangroves and a few scattered clumps of date palms, the vegetation is the same throughout the coastal plain. Immediately behind the beach, where sand flats or coastal dunes occur, salt-tolerant shrubs and vines are found the shrubs.

3. AFFORESTATION

1) Status

The moving sand dunes have been the source of disruption in the communication and social life in the fishing towns of Ormara, Pasni and Pishukan. In Pasni the sand dunes occur from the seashore, some 35 km. west of Pasni near a palace called Chur, a fishing village. In Gwadur the drifting sand dunes emerge from the western coast. The sand dunes in Pishukan, a major settlement of fishing families, about 50 km. from Gwadur, are similar to those in Pasni, but the area occupied by the sand dunes is about 80 sq.km. The Balochistan Forest Department has drawn up a project titled "Dand dunes stabilization along Makran Coast". The project costing US $ 4 million aims at controlling and stabilising sand dunes over an area of 19,430 ha. along the Makran Coast. The project has been drawn up after successful sand dune stabilization and afforestation of 2 1/2 km. long and 100 meter wide sand strip along the sea coast near Pasni with brackish water.

The objectives of the project are to control soil erosion by establishing vegetation cover, provide fuel wood and small timber to local communities and create jobs. The project, to be executed over a period of five years, is in the approval stage and will be implemented when sanctioned.

4) RANGE MANAGEMENT

There is the possibility of scientific range management in all areas that are free of sand. Range management practices include construction of small embankments and spurs to hold water and planting of xerophytic trees, shrubs and grasses. The Range Management Projects, are expected to provide fodder for cattle and fuel wood for the local population.

5. MANAGEMENT ASPECTS

The main objective of the management of Forestry along Balochistan coast should be the protection of forests, fisheries, wild life and sand dune stabilization along the coastal belt. Over 80 per cent of Balochistan's coastal population is dependent on fisheries. The forestry practices along the sea coast in Balochistan should be of protective nature catering to the needs of the local communities. The main emphasis has to be on conservation of the existing mangroves and their extension, where ever possible, to providing spawning and nursery grounds for the many marine species of fish and shrimp. Moreover, the particles of vegetation (detritus) and nutrients exported out of the mangrove ecosystem form the food base of a complex marine ecosystem, which in turn supports valuable estuarine and nea-shore fisheries.

The sand dune stabilization, dry zone afforestation and range management practices in the coastal zone will meet the fuel wood and fodder needs of coastal communities. It will not yield income to the government, but it will help improve socio-economic conditions in terms of production of fuel wood and fodder and other amenities.

The prospects for the introduction of exotic species of salt tolerant grasses and trees needs to be given a serious consideration. In this context Prosopis juliflora (mesquite) has been successfully grown along the sea coast with brackish water. it is a tree, which once established never dies and keeps on coppicing and growing again and again. It is a hardy tree.

3.2. COASTAL FOREST IN SINDH

1. MANGROVE VEGETATION AND GRASSES

Mangroves are the plants which are characteristic littoral Mangroves not only dominate the habitat and characterise the ecosystem, but also serve as an economic resource. This resource has been widely and variously used by coastal people of the tropics for thousands of years. Mangrove ecosystems are reservoirs of species of plants and animals bound together over a long evolutionary line, and still imperfectly known and understood. Some historical background on the forest resources of the indus delta is provided by the "Gazetteer of Sindh (1907)" which mentions three specific species.

The Avicennia trees are slow growing, reaching maturity at 60 years or os. The average yield from a dense crop has been calculated at 7.5 cubic meters per hectare (Qureshi, 1985). Dense Avicennia crop does not cover large areas, however, and is confined to strips along the banks of creeks. The standing stack of mangrove (wood) has been estimated at 16,000 cubic meters per hectare (Ansari, 1986).

The grasses are common in the areas of the Indus Estuary particularly along the banks of the Indus River. The Elephant Grass (Typha elephantina, "Pan") which grew further upland also bound the soil with far reaching roots and prevented erosion. "The Gazetteer of Sindh (1907) reports that the natives were well aware of its environmental function and although they used it in the manufacture of matting and baskets they were careful to cut the plants close to the soil without disturbing the roots".

1. STATUS

1) Mangrove Forest in Indus Delta

The area under mangrove forest in Sindh has been estimated during three attempts made since the independence in 1947. The recent attempt is made using Satellite remote sensing techniques in 1983 (Mirza et al, 1983). The total area of the Indus deltaic region (tidal zone area) was estimated to be about 0.60 million ha. out of which about 0.26 million ha (i.e. 44 %) are under mangrove vegetation (Table -2).

TABLE - 2. MANGROVE VEGETATION IN INDUS DELTA
(Based on LANDSAT Data)

Mangrove Categories	Area (million ha)	Percentage of Total Area	Percentage of Total Covered Area
(1) Mangrove Vegetation			
a. Dense	0.05	9	11
b. Normal	0.21	35	48
c. Sparse or no vegetation	0.14	22	32
	0.40	66	91
(2) Sand	0.04	7	9
	0.44	73	100
(3) Area under water channels	0.16	27	
	0.60	100	

Source: Mirza et al (1983,1986)

2) Mangrove Forests in Karachi District:

All above details of mangrove forests pertain to the area east of Karachi up to the Pakistan-India border. These mangroves fall in Thatta district. In Karachi district also, there are small islands carrying mangrove forests consisting of Avicennia marina. The area has not been surveyed and the estimates are that the total area is about 500 hectares. These forests are also with the Board of Revenue.

3) Ownership and Legal Position:

An area of 344,870 ha was transferred to the Forest Department in the year 1958 and declared "Protected Forest" under "The Forest Act of 1927" with the provisions that:

A. All trees in the mangrove were declared as reserve trees; and

B. a) cutting, conversion or removal of trees;
b) cutting or removal of all other vegetative growth & grass;
c) cultivations of all types;
d) breaking of the soil and removal of soil or stones;
e) all grazing or browsing, and
f) all other works inside the mangroves were prohibited.

The listed activities could, however, be done with the permission of the Sindh Forest Department.

In 1973, an area of 64,400 ha. was transferred by S.F.D. to Port Qasim Authority. However, the areas with Port Qasim Authority continue legally to be "Protected Forest." The remaining mangrove area is with the Board of Revenue, a Government body owning all those Government lands which are not owned by any other government organizations. This mangrove is listed by the Board of Revenue as "Waste Land" (Qureshi, 1985). The mangrove forests are thus under the control of the organisations are given below:

	Organisation	Area in hectares
i)	Sindh Forest Department	280,470 hectares
ii)	Port Qasim Authority	64,400 hectares
iii)	Board of Revenue	260,500 hectares
		605,370 hectares

With the revised estimates for the mangrove forest area (605,370 hectares) the Indus Delta ranks as one of the largest single mangrove forest in the world (Draft, CEMP, UNESCAP,1989).

Dense mangroves are present in Korangi, Phitti, Wadi Khudi Khai, Patiani, Dabbo, and Say-so Creeks of northern area and Kajhar, Pakhar and Sri Creeks of southern area. Traditionally fewer camel grazers come to these areas.

2. MANGROVE AND COASTAL PRODUCTIVITY

1) Coastal Productivity:

Mangroves are open-ended ecosystems with an overall transport of matter and energy from land to sea. Biological cycles are completed in a short span of time, the turnover rate is intense, microbial degradation is fast. The coastal mangrove creek systems are shallow and nutritionally rich, providing an ideal habitats as nursery and feeding grounds for a variety of marine animals in addition to commercial fish and shrimp. The mangrove forests have been extensively utilized by coastal people not only as a place to live, but also as a resource for a variety of products. These include fuel wood, timber, salt, drugs and fodder. Local Communities regularly gather mangrove leaves for cattle, buffalo and donkey fodder. Herds of camels are also brought from the interior and left to browse on the many mangrove islands along the coast. The mangrove system also supports a wide variety of other wildlife of conservation importance. The mangrove forest thus is meeting the energy requirements of the local coastal settlements/towns (Ansari - 1986). Most of the coastal population around Indus Delta is mostly dependent upon mangrove forests for fodder, fuel, timber and fishing for their livelihood.

2) Village Economy (Fodder, Fuelwood, Construction):

The mangroves in Sindh contribute directly or indirectly towards the economic development of the village communities by :-

i) Protecting inland cultivated agricultural lands, ii) providing a sustained supply of fuelwood and timber to the entire population residing along the sea coast, iii) providing living/resting sites for many aquatic animals, birds and fishes, iv) helping to present a balanced ecosystem which provides livelihood to the coastline population through fish and shrimp catches within its system. Fuelwood is the most important product and one that is used by the entire coastal population. v) camel grazing : Professional grazers own large numbers of camels which graze on coastal lands mainly during the flood season. They come from the interior of Sindh province.

3. PRESSURES ON MANGROVES

1) Reduction in Fresh Water Flow

The construction of a number of barrages and reservoirs on the Indus and its tributaries for hydro-electric power generation and irrigation. This has decreased the fresh water flow to the Coastal mangrove forests. Although mangroves are tolerant of saline water but depend upon a steady supply of fresh water to keep the salinity levels within certain limits. Under this condition, the mangrove trees are failing to survive in many areas and the ecological balance of the system is being influenced. The mangrove of the Indus Delta is thus under stress from the high seawater salinities resulting from gradual but drastic reduction of fresh water input to delta from the Indus River (Milliman et al, 1984). As a consequence, the loss of

estuarine conditions, and drastic reduction of sediment nutrient input from the Indus River. The mangrove forests and its associated ecosystems are therefore adversely affected. The growth of mangroves is arrested and they appear to be rapidly disappearing. These conditions are expected to worsen overtime because of the future plans to use Indus water for irrigation and power generation upcountry.

2) Over Cutting, Grazing, Browsing and Lopping

The local people have been cutting the trees adjacent to their habitations, with the result that the areas near the habitations have been denuded of tree growth. There was no control on the cuttings whatsoever up to the year 1958, when some areas of mangroves were transferred to the S.F.D. Since then dead, dying and moribund trees only are permitted to be cut for meeting the domestic requirement.

The Sindh mangroves play an important role in providing animal feed. Mangrove lands serve as range lands. Cattle, camels, goats and buffalo are the domestic animal, which graze on mangrove foliage. The damage to the mangrove forest on account of grazing is not extensive and serious and it is localised to areas that are in close proximity to the coastal villages. Normally the people keep cows and buffaloes, which develop the habit of eating Avicennia leaves. Sometimes, the buffaloes swim across a small creek to an island adjoining the village in the morning and spend the day on the island eating Avicennia leaves and swim back in the evening to the village.

The damage on account of browsing by camels is serious and extensive. During flood season in river Indus the camels from the interior of Sindh migrate to mangrove forests in herds. These are owned by the professional grazers or by Waderas and Zamindars. Camels bred and raised in Thatta District are favoured in Sindh and exported to Arabia.

According to the locals the camel browsing on mangroves does not affect the growth of mangrove trees seriously as the mangrove growth compensates for this loss. The rough estimates obtained during recent surveys of the coastal areas of Sindh suggest that the total number of such camels grazing at any time is around 5,000. This demonstrates that the camel browsing pressure on the mangroves is only in localised areas where this could cause a significant denuding pressure on mangrove trees.

4. MANAGEMENT OF MANGROVE FOREST

The main objective of a management plan for Mangrove forest in Sindh Coast (Indus Delta) should be the protection of the forest from the threats of environmental degradation as well as from the human exploitation. It will be easier to control human exploitation by local communities through strict conservation practices. However, it would require a policy decision at a very high level to protect Indus Delta from the environmental degradation caused by the reduction of freshwater supply through Indus River. However, some restoration plans have been made keeping in view that freshwater from Indus River may and may not be available for discharging into the Indus Delta.

1) RESTORATION PLANS

The restoration plans for Avicennia marina the main species in the coastal areas must take into account the facts that there is no large-scale commercial utilization of mangroves, and 5 year rotation for Grazing, browsing and lopping confined to small pieces of land already earmarked for the purpose. The efforts for the natural regeneration, complemented by artificial regeneration have not been very successful so far.

i) Current Working Plan:

The current Working Plan titled "Working Plan of Mangrove Forests" for a 20-year period from 1985 to 2005 has been prepared (Qureshi, 1985). Some of the main objectives are:

a) To provide sustained quantities of forest products viz. fuelwood, small poles for construction of huts and fodder to meet the demands of the local communities.

b) To introduce commercially valuable exotic species in order to improve the economic viability of the present mangrove forests.

c) To protect the coastline from erosion and to protect the cultivated fields behind the coastal region from severe winds and storms.

In order to achieve these objectives two working circles viz. Selection-cum-Improvement working Circle and Fodder working Circle have been prescribed (Ansari-personal communication).

i) Selection-cum-Improvement Working Circle:

This Working Circle includes the total area of the mangrove forest under the charge of Sindh Forest Department, which at present is 280,470 ha. Of this, the stocked area is 109,946 ha. and the rest of the area is wither blank or under water. The existing forests contain either mature, mixed or young crop. Some of the areas had heavy incidence of grazing but have a chance of recovery, while other areas are above the tidal inundation limit where the trees are generally top dry and need to be removed or replaced. In this Working Circle improvement fellings for removal of dead, dying and fallen trees have been prescribed to meet the demand of fuelwood and timber for local people. No fellings on commercial basis will be carried out.

Natural regeneration will be encouraged under natural conditions and environment without any interference. This will be achieved by exercising strict control over grazing, browsing and lopping. Artificial regeneration will be carried out in areas where dead, dying and fallen tree are removed. The soil of those patches that have become hard will be worked. Planting regeneration areas, grazing, browsing and lopping shall be prohibited. Subsidiary silvicultural operations such as weeding, clearing, thinning and pruning will be carried out.

ii) Fodder Working Circle

This working circle overlaps the Selection-cum-Improvement Working Circle but includes those areas where grasses cover large areas such as near Keti Bunder and Shah Bunder villages. These are open pasture grounds with or without Avicennia trees or with stunted growth or dry land where the soil has been rendered barren in places due to excessive salt depositions. Common salt bushes and other inferior quality fodder is already present in the designated areas on a 5-year rotation, so that each area gets periodic rest to recover. A great deal of experimental work will be carried out during the working plan period.

2) REHABILITATION OF MANGROVE PLANTATION

The proposed World Bank Project titled "Environmental Protection and Resource Conservation Project" includes sub-project titled "Rehabilitation of Mangrove Plantation" to be executed over a 7-year period (draft, CEMP, UN/ESCAP, 1989). Some of the main objectives of operational project are given below.

1. To preserve and improve the existing vegetation of mangrove ecosystem.
2. To estimate the productivity of mangroves so as to harvest the wood and other products on sustained yield basis.
3. To investigate effect of increasing salinity, pollution, decreasing flood water from river and grazing and browsing on mangrove vegetation and to work out the methodology to minimize their effect by proper control and management including possibility of introducing other suitable mangrove species.
4. To determine better uses for the wood and leaves (for cattle feed) of Avicennia marina.
5. To work out model for planting blank areas. The project includes planting 62,000 hectares of blank areas of mangrove.

The mangrove area with the Board of Revenue can be afforested in the same way as the Sindh Forestry Department (S>F>D>) mangrove area. Although the mangroves with the Board of Revenue are degraded they have not reached a stage where recovery may not be possible. If transferred to the S.F.D. these areas can be declared as "Protected Forest" under the Forest Act of 1927 and all activities including grazing, browsing and lopping can be controlled and cuttings stopped. The mangrove can be brought under scientific management and rehabilitation.

It is preferable that all mangrove forests both in Karachi and Thatta districts be managed by one agency. Further all those mangrove forests, which have not been declared "Protected Forest" and the "Forest Act of 1977" should now be declared as such, so that legal cover is given for the protection and preservation of this important natural resources and ecosystem.

3.3 WILD LIFE AND NATIONAL PARKS

1. HINGOL NATIONAL PARK

At present there is only one National Park, viz. Hingol National Park. which includes a portion of seacoast in lasbela. Hingol National Park was created in December 1988. Its total area is 165,004 hectares. On the sea Coast it starts from Malan Bunder through Ras Malan to about 25 km west along the sea.

An earlier "Lasbela Wildlife Sanctuary" created in December 1980 over an area of 1,687,579 hectares has been abandoned. It was unmanageable and the present N. P. has been carved out of it. The fauna of the park include ibex, urial, leopard, chinkara (gazelle), and crocodile (Draft CEMP, UNESCAP, 1989).

2. TURTLE NESTING HABITATS

There are five species of marine turtles are reported from coasts of Balochistan and Sindh. The sandy beaches are limited along Sindh coast but are very common along Balochistan coast.

In Balochistan long stretches of suitable beaches exist along Balochistan coast but the total length that is well-suited to turtle nesting is somewhat limited. Large numbers of green turtle (Chelonia mydas) are known to visit its beaches for nesting. Almost all sandy beaches are known to be visited by marine turtles. Most important beaches that are used as nesting beaches are Ormara (Taq at Kamgar Hills), Astola Island and Jiwani. Nesting has be observed to take place throughout the year with peak activity in the months of October and December for green turtles while July and August for olive Ridley turtles. Most of the "turtle beaches" are located in inaccessible and remote beaches and therefore are not disturbed (Ansari - Personal Communication). The marine turtle nestings have been reported from a number of sandy beaches from Balochistan coast (Groombridge et al, 1987)

The Balochistan nesting populations have been the subject of intense exploitation; At Ormara and Haft Talar in some seasons every female that emerged to nest was slaughtered. The level of damage caused to the turtle population is not known but it is believed that the turtle population is recovering slowly.

In Sindh, the sandy shores are limited. However, along the coast of Karachi the sandy stretches from Hawkesbay to Pacha provide ideal habitats for the nesting of marine turtles (green turtle - Chelonia mydas). With the promulgation of the Sindh Wildlife Protection Ordinance 1972, marine turtles were declared protected species and therefore it was made illegal to exploit or to harass the marine turtles, their eggs and hatchings. In the conservation area, which are the beaches of Hawkesbay and Sandspit, legal protection has been implemented and a hatchery programme begun where endangered nests were transferred to protected enclosures.

3.4 IMPACT OF DEVELOPMENT PROJECTS ON WILD LIFE AND FORESTS

1. COASTAL ROADS

An international coastal highway is being constructed linking Karachi with Gwadur and Iran. This highway will run along or near to the sea. The highway will pass through Hingol National Park, the richest in wildlife in the whole of Balochistan. The highway will adversely affect the wildlife and disturb the ecology and environment.

2. RESERVOIR ON HUB RIVER

The construction of a reservoir at Hub River is a spectacular example of how decrease in supplies of fresh water can destroy mangroves. The reservoir was constructed about twenty-five years back. Catchment area of this reservoir is such that the reservoir hardly gets filled up. Since its construction there has been no flow of water downstream. The average annual rainfall is 120 mm. Mangrove forest with Avicennia marina, Rhi zophora mucronata, Aegiceras Spp. and Ceriops tagal has completely died and there is no longer any mangrove forest.

3. FISHING HARBOURS

The first fisheries harbour of balochistan is at Pasni which has a population of about 20,000. The harbour has the general cargo handling facility for small ships. About 450 fishing vessels operating on the Makran Coast can be handled. Pasni port has a general cargo jetty handling cargo ships upto 1,200 tons dead weight. A fishmeal plant, shrimp processing plants, ice plants, cold storage, boat repair facility, fuel stations, a thermal power plant, power lines and other infrastructure will be established. The port will thus be the future industrial base in modernising the once inaccessible terrains of the province. The construction of fish harbour at Gwadur has started. It is estimated that somewhat its impact would be somewhat similar to that of Pasni Harbour on forests and wild life of the area are expected.

4. SHIP-BREAKING YARDS

The only ship-breaking yard of Pakistan is located about 40 km. northwest of karachi at Gadani coast in Balochistan. it employs a workforce of more than 30,000 (mostly immigrants). The sandy and rocky inter-tidal zones at Gadani are smeared with oil, which flows from the oil tanks of numerous ships being scrapped at the yard. Oil beached on the shore has penetrated into the sediments.

5. DAMS ON THE INDUS RIVER

A number of major dams and barrages have been built on the Indus River which have reduced the water flow from Indus to the Indus Delta. This has resulted in the loss of estuarine character of the delta and thereby degradation of the delta to the extent that the numerous intertidal areas and island once densely populated with lush green mangrove forest are now rapidly being changing into sand dunes. The mangrove forest is rapidly disappearing, the growth rates of the existing vegetation has become very slow. The wild life associated with mangrove forest has also disappeared from the affected areas. The estuarine fauna and flora have almost disappeared.If the current trend of environmental degradation of the delta continues the mangrove forest will disappear altogether. This will also badly affect the fisheries resources of the area resulting in a much reduced catch of fish and shrimp from the Sindh coast.

4. TOURISM IN THE COASTAL AREAS

The coastal areas of Pakistan have the potential for development into a modern Tourism Industry provided investment is channeled to develop essential amenities and accessibility to the beaches and areas with interest features.

4.1. POTENTIAL IN THE COASTAL AREAS

Pakistan has a considerably large coastal zone with a coastline of 990 km and adjacent belt of land sea. Most of the coastline is beset with rocky and sandy beaches except the Indus Deltaic coast which has numerous islands and harbours world's 5th single largest mangrove forest. There are spectacular coastal cliffs, mountainous terrain with small rising mountains and site of the triple junction of the three continental plates. There are several hundred small and large beautiful islands with network of creeks for grat potential for holiday resorts and a variety of water sports, boating, sport fishing and developing Holiday Resorts. The beautiful and clean beaches with brown sand are abundant along Pakistan coast and offer the potential of best recreation. The rocky beaches offer sites for jetties, marinas and sport fishing. The deep sea fishing is possible almost all along the coastal belt.

There are some interesting features such as mud volcanoes, green turtle beaches, beautiful marine life, shark landings, etc. The archaeological sites of interest are Bhimbore - and old forts used by the forces of Mohammad Bin Qasim. The coastal areas of Pakistan have the distinction of being the return road for the forces of Alexander the Great.

4.2 PLAN FOR DEVELOPING TOURISM

The entire coastal zone of Pakistan can become as a site for tourist industry. It would be necessary to give the tourist site a status of commercial importance. In the super structure of the industry it is therefore suggested that a term of 'Commercially Important Tourist Sites' (CITS) be adopted and identified areas should be commissioned by the Ministry of Tourism CITS. The site should be commissioned by the Ministry of Tourism irrespective of their ownership, control and management as CITS. This charter of commission needs legal definition and would become obligated to a code for maintenance, mass accessibility, security and preservation.

a) The manual of industrial management for tourism may be committed to Provinces for adoption strictly for the purposes of revenue gains and fiscal budgeting.

b) All commercial and industrial enterprises in Pakistan have a contribution to make to this national industry. Possible tax relief upto 5%, as for charity, for tourism promotion could well be an incentive to begin with.

c) Foreign investment and investors should be given an open hand with a status equivalent to that of a local investor,Constitutional guarantees though protecting foreign investment should sweeten the deal for initiatives.

Economic Objective: The economic objective principles have to be geared on a self financing methodology. This in fact means that the private sector must take the lead and with more degree of assistance from preferably non repatriable foreign collaboration investments.

a) With identification of CITS, instant deregulation of public sector holding must be taken up at hand so that facilities which exist are passed out to the private sector on lease for fixed revenue to the government.

b) Communication being at the root of economic development for any industry, it is suggested that communicational projects supportive to transport, telecommunication, television and air/sea crafts be freely committed for the support of tourism.

c) The Industrial Investment Schedule must hence incorporate all tourism enterprise as an industry. This should be in form of tax relief and participational commitment which each industrial plan must incorporate.

4.3. SUGGESTED ACTIVITIES

The suggested remedial measures in the present report are strictly the views and policy objectives. The details of the suggested remedial measures are given below.

1. HOTELS,INNS & MOTELS, YOUTH HOSTELS & HOLIDAY VILLAGES (CITS - PRIVATE SECTOR)

Within the coastal zone establishment/building of Hotels, Inns, Motels and the like should completely be deregularised into the private sector but with rigid laws regulating standards. This is a major support facility for tourism but at the same time it is essential to keep strict laws on quality of hygiene, service and food as pre requisites.

2. SANCTUARIES & WILD LIFE RESERVES (CITS PUBLIC SECTOR)

These areas are of prime importance to environmental control ecological planning. The tourism receipts which support the activity notwithstanding reserves and sanctuaries must be set up wherever possible throughout the coastal zone in the country with special laws for their security from poachers and preservation.

3. CAMPING SITES (CITS PRIVATE SECTOR)

Camping sites all along roads and in exclusive areas along the coast and adjacent wilderness should be marked and leased out. These sites are aimed to support group tourism by schools and colleges and should offer the simplicity of nature, survival with it, and in conditions which can offer exposure to real camp life or coastal village living. Basic amenities of security against criminals, first aid, drinking water, and W.Cs are about the only prerequisites.

4. AQUARIUM (CITS PRIVATE SECTOR)

Much like the zoos and zoological sites aquariums have a special place as a potential tourist attraction all over Pakistan. The Arabian Sea and the indus delta have a lot to offer for public display. Open or natural aquarium sites to see the green turtle and the blind dolphin apart, aquariums should be set up in all micro zones for public education and tourist revenue.

5. COMMUNICATIONS (LEGISLATIVE)

The role of communication is primary to the pace of optimizing tourist revenue. Telephones, roads, air & rail links and vehicles thereof are basic areas of concentration and it is suggested that master plans to reach all C.I.T.S. should be made with the help of local and foreign consultants and financial plans be so devised that in ten years the entire CITS network is accessible with public help of labour & money.

6. AIR/SEA TRAFFIC (CITS PRIVATE/PUBLIC SECTOR)

The laws on chartering & owning air & sea crafts to ferry in tourists from T.G.C.S' and the region are very important. The private & public sector both should be given an equal set of open laws to own and bring to the country tourists from wherever they possibly can. We can even enter into bilateral agreements with countries of the SAARC & OIC to allow us free transport facility too and from their countries of foreign tourist if they spend encash a minimum of US$ 50/- a day in Pakistan for five days.

7. PARKS AND MARINE PARKS (CITS PRIVATE/PUBLIC SECTOR)

Urban populations are robbed of their character and their peace if parks are absent. Parks play a major role in environmental control and it is their greenery and natural habitation which is all important. Parks when retained as parks not camp sites and eating places and or barren plots of land stand to their definition and need.

Similarly, there are several interesting areas along Pakistan coast where Marine Parks can be established with the objectives to attract tourists as well as to conserve some of the rare and endangered marine species found along the Pakistan coast. The coral reef areas along Karachi, the Mangrove forests of Indus Delta, Miani Hor and Kalmat Khor, the mussel and clam beds along Pasni and Gwadur coasts, the star fish areas along jiwani coasts, the turtle, dolphins and sharks along most of Balochistan coast are a few examples.

8. BEACHES (CITES PRIVATE SECTOR)

The entire Makran coast is littered with patches of top class beaches. With water based sports near absent such as water skiing, surfing, yachting trolling, fishing, crabbing, sailing, water scootering and ski flying these beaches are non productive almost altogether. All beach sites need identification and they aught to be leased out to the private sector for development into tourist villages with strict laws on pollution and environmental control. A five star hotel on the Sonminai beach may seem absurd but is well worth. Beaches are a major national asset and for expensive tourism about the most in potential.

Tourists entering Pakistan must all be covered by accident & medical insurance and their security of movement and stay by world standards must be developed on war footings.

Free of duty import of tourism support equipment to all CITS Licenses should be allowed on N.R.I. licenses.

5. FISHERIES IN COASTAL AREAS

The coastal and marine fisheries is the main economic activity along Balochistan coast and in general an important economic activity in coastal Pakistan. Despite low contribution of fisheries in GDP (0.5%) the employment export earnings from this sector are substantial. Export of fish and fishery product have yielded a sum of Rs. 2.244 billion in 1988. The production and exports are critically dependent upon environmental sustainability.

A considerable size of fishery is supported by coastal waters of Pakistan. Most of the fishing fleet in Sindh and a major part of the fleet in Balochistan is also mechanised. However, the fishing fleet is ill-equipped and without any navi-gational aids. The fishing is mostly carried out in the coastal waters within 15-30 km of the coastline. Thus the fisheries activities in Pakistan are concentrated in shallow coastal waters, the Indus Deltaic areas and to a lesser extent, in the deeper part of the ocean.

5.1. FISHERIES RESOURCES

Based on the results of various cruises so far conducted in Pakistan waters, Abildgaard et al (1986) have reported a value of 330,000 m. tons for demersal fish stocks in the waters between 10 to 200 meters depth. Brandhorst (1986) has enumerated the results based the available data and after extrapolation of the results to area between 0-10 meters to estimate total stocks of demersal fish in waters of Pakistan (Table - 3).

TABLE - 3. STOCKS OF DEMERSAL FISH IN PAKISTANI WATERS.

AREA	STOCKS
Demersal fish stocks between 10-200 meters	330,000 m.tons
Demersal fish stocks between 0-10 meters	100,000 m.tons
Demersal fish stocks in creek areas and mangrove swamps	57,750 m.tons
TOTAL	487,750 m.tons
Roughly to	500,000 m.tons

Source: Brandhorst (1986)

Based on the little data available, the size of the area and the present landing of the pelagic fish the biomass of small pelagic fish in the coastal and offshore areas of Pakistan are estimated to be 706,520 m.tons (Table - 4).

TABLE - 4. STOCKS OF PELAGIC FISH IN PAKISTANI WATERS

AREA		BIOMASS
Small pelagic fish biomass Between 10-200 meters		500,000 m.tons
Small pelagic fish biomass Between 0-10 meters		129,520 m.tons
Small pelagic fish biomass in creek areas and mangrove swamps.		77,000 m.tons
TOTAL	Roughly to	706,520 m.tons 700,000 m.tons

Source: Marine Fisheries Department.

The landings of large pelagics in Pakistan waters are about 20,000 m. tons annually. No estimates of stocks are available but it is believed that biomass of large pelagics is about 3 to 4 times the present production level (upto 50,000 m. tons/year). Similarly, the stocks of the sharks are estimated to be about 24,000 m. tons/year.

Out of the total (336,000 m. tons) fish harvested from the marine environment, about 26,000 is contributed by shrimp whereas large pelagics contributed 25,000 m. tons, small pelagics about 160,000 m. tons and demersal fish about 140,000 m. tons.

5.2. FISHERIES IN PROVINCE OF SINDH

1. CURRENT SITUATION

The coastline of Sindh province is about 300 km long. It is marked by innumerable creeks and the Indus Delta. The continental shelf is broad, extending upto 110 km in some areas, with muddy easily trawlable bottom. Fisheries activities are at present concentrated at Karachi Fish Harbour, and to a lesser extent, at Korangi. Major fishing settlements along the Sindh coast are Karachi, Korangi, Shams Pir, baba Island, Saleh abad, Baba island, Bhit Island, Adamabad, Buleji, Bungalow, Garrison, Bhit (Khori), Manjhar, Gizri, Ibrahim Hydari, Rehri and a number of small fishing centres in the Indus Deltaic areas.

It is estimated that about 90,000 m. tons of demersal fish are harvested in the waters of Sindh. Demersal fish resources of Sindh are harvested using trawling, bottom set gillnetting, beach and boat seines and by stake net fishing. A major part of the demersal fish species is directly used for human consumption.

Shrimp, which is the most important commodity that is caught from waters of Sindh, is predominantly harvested from shallow coastal waters (upto a depth of about 30 meters). The exports of shrimp earned an estimated amount of Rs. 1.6 billion in 1988. It is estimated that about 1,600 trawlers are engaged in shrimp fishing; more and more are added every year. The average landing for shrimp are about 30,000 m. tons/year.

The landing of small pelagic species are estimated to be about 100,000 metric tons annually 9M.F.D.). Most important species that are caught in shallow coastal waters and creek areas are sardinellas and scads, etc.

The Fisheries statistics (M.F.D.) demonstrate that out of a total marine catch of Pakistan about one third of the fish catch comes from the coastal waters of Karachi and shelf adjoining creeks near Karachi. The fisheries industry in Karachi coastal belt is developed to some extent because of the existence of infrastructure facilities such as a fish harbour, processing industries and availability and maintenance facilities of fishing gears and boats, etc.

2. INFRA-STRUCTURE:

The infrastructure such as all weather roads, electricity, freshwater supply, health and educational facilities and landing jetties are lacking in most parts of the coastline of Sindh except Karachi and Korangi. The Karachi Fish Harbour and Ibrahim Hyderi Landing Jetty in Korangi are the largest fishing centre for fisheries activities in Sindh. Due to rapid growth of fisheries the facilities at these centres have become inadequate.

1) Karachi Harbour

The Karachi Fish Harbour Project started in 1953. It was designed and constructed for 400 fishing boats but now over 2,000 fishing boats have congested it and the facilities have become quite inadequate. With a view to solving this problem, the government, in 1986, has prepared a plan to develop and to rehabilitate this harbour. A project costing Rs. 285 million has been approved by the government for the purpose. The European Economic Community has provided a grant of 12 million ECU for this project. The new harbour will handle 40,650 tons of fish, 26,700 m. tons of shrimp, annually: ABOUT 200 GILLNETTERS, 100 trawlers and a large number of artisanal boats (M.F.D). For the shrimp trawlers there is a provision of 9 berths, for gillnetters 10 berths and 79 meters for artisanal boats. The project has not yet started.

2) Ibrahim Hyderi Landing Centre

It is a major landing centre for small pelagic species including sardinellas, anchovies, thryssas and mullets. Small quantities of shrimp are also landed at this centre. A few years back, the local administration (Town Committee) constructed a small landing jetty at Ibrahim Hydari. No infra-structure facilities are available on the jetty. All requirements for fishing vessels have to be brought from other areas especially oil, ice, and general provisions. Adequate facilities for auctioning are not provided. The required draft for bigger vessels is not available even at high tide. As majority of the fishmeal plants are located in Korangi area, this centre is of great importance. This harbour is being used by a large number of vessels; 'Katra' boats and 'horas' using 'tukri' nets.

Considering the pressing requirements in this area, a plan was made to contract a new fisheries harbour in the vicinity. This new harbour (Korangi Fish Harbour), will provide facilities to about 1,000 vessels. By the year 2000, this harbour will cater to the needs of about 1,500 fishing vessels. By the completion of the Master plan in the year 2010, Korangi Fish Harbour will handle a catch of about 162,000 m. tons annually. There is provision of a cold storage of 300 m. tons capacity and an ice factory of about 100 m. tons (Draft CEMP, UNESCAP, 1989).

In addition, there is a growing need to construct new fish landing Jetties in other parts of coastal Sindh to provide basic facilities for fisheries. This is needed particularly at Keti Bunder and other fishing centres on the Delta on the left bank of the Indus River.

3. FISHERY OF INDUS RIVER ESTUARY

The Indus estuary used to provide livelihoods to a large number of fishermen living around the Indus Estuary (i.e. Keti Bunder etc.,). There are still about 2,400 (small and large) operating boats (M.F.D.) that catch a wide variety of fish and shrimp species. The shrimp caught in the creek area is brought to Karachi either by the fishing boat in the ice holds or by carrier boats that ply between fishing grounds and Korangi. a major part of shrimp from Keti Bunder and Gahro area is transported on pickups which carry an insulated box. Small pelagic and trash fish is first dried on the fishing stations are then transported either by carrier boats or by pickups/trucks.

A sizeable fishery could not be developed in Indus estuarine area due to lack of infra-structure and basic facilities for fish industry. Metaled road is absent in most of the coastal areas of Sindh. Similarly, there is no electricity, freshwater and landing jetties in these areas.

As estuarine areas serves a nursery ground for commercially important species such as shrimp, management measures is required to protect juveniles. A ban should be imposed on use of all nets having a mesh less than 1 cm in the creek area. Similarly a ban should be imposed for trawling inside creek system.

5.3 FISHERIES IN COASTAL BALOCHISTAN

The fisheries is the main economic activity in the coastal towns/settlements of Balochistan. The population is very low and scattered along the coast in small fishing villages. The entire population of coastal areas of Balochistan is estimated to be about 1.5 million at present. There are about 32 fishing settlements along Balochistan coast. The major towns/settlements include Gaddani, Sonmiani, Ormara, Pasni, Gwader, and Jiwani. The fisheries is the main economic activity in all the coastal towns/settlements. The total fish catch from the Balochistan coast is about 90,000 metric tons per year. There are 3,000 fishing boats but no fish/shrimp trawlers.

The gillnetting is one of the important fishing activity along the Balochistan. This is done in the deeper offshore waters along the coast. About 250 gillnetters based at Gadani, Damb, Ormara, Pasni, Gwadur and Jiwani are engage in fishing for large pelagics. Among the large pelagics, tuna, sailfish, dolphinfish and sharks are of major importance. Gillnets made up of nylon twine or multi-monofilament are used for the purpose.

Shark species are represented in the drift gillnetting catch throughout the year with a peak in May to September when their contribution to total catch may be as high as 75%. The sailfish and marlins are predominantly represented in the catch during March and May and during September and November. Mackerels are also represented throughout the year especially during September and December.

Lobster fishery, though small provides an important resource which is exploited by local fishermen in the shallow subtidal and intertidal areas. The main centres for lobster are Churna Island, Ormara, Malan, Taq, Sakoni, Pasni, Astola Island, Sur, Gwadur, Ganz and Jiwani. The catch is also sold by number and after beheading transported to Karachi in chilled form by airlifting. Spiny lobsters are most common in the landings.

1. FISH RESOURCES OF BALOCHISTAN

These are based upon FAO/NORAD sponsored research Project Fridtjof Nansen during the year 1977 and their subsequent evaluations (Anonymous, 1978) by the international experts. The estimates for the fisheries resources in Balochistan waters are:

1.	Cartilaginous fishes	65,000 metric tons.
2.	Large Pelagics	14,000 metric tons.
3.	Small Pelagics	2,50,000 metric tons.
4.	Demersal	2,28,000 metric tons.
5.	Crustaceans	15,600 metric tons.
	Total Fin fish and shrimp stocks.	5,72,600 metric tons

Source: Fisheries Department, Govt. of Balochistan.

A large potential exists for the expansion of fisheries in Balochistan. The estimated maxima of sustainable yield estimated by Fisheries Department, Government of Balochistan is given below:

1.	Cartilaginous	32,500 metric tons
2.	Large Pelagics	7,000 metric tons
3.	Small Pelagics	1,25,000 metric tons
4.	Demersal	1,14,000 metric tons
	Total	2,86,300 metric tons

2. INFRA-STRUCTURE

The lack of infra-structure for fisheries is one of the constraints that limits the growth of fisheries along the Balochistan coast. The area stands isolated from the rest of the country with and the services of communication, telephone, telegraph, roads, and coastal shipping not reliable and absent in most parts of the coast.

1) Landing Facilities:

There are no facilities for fishlanding all along the coast with the exception of Pasni Fish Harbour built recently. The smaller boats are beach landed while larger boats are anchored in shallow waters from where the catch is brought to the beach in smaller boats.

i) Pasni Fish Harbour:

A small fishing harbour has recently been constructed in Pasni at a total cost of Rs. 350,000 million with the financial and technical assistance of the Asian Development Bank. This harbour has started functioning recently (April 1989). It has all the essential facilities. This harbour has the capacity to provide services to about 750 fishing boats. A fishmeal plant of 25 m. tons per day capacity has also been established in the area.

ii) Gwadur Fish Harbour and Mini Port:

Recognising the lack of infra-structural facilities along Balochistan coast, the Federal Government has started construction of a fish harbour and mini Port at Gwadur. The harbour will consist of a 500 meter long jetty. The vessels up to 900 DWT will be accommodated in the harbour. There is a provision of establishment of one ice plant and cold storage with a capacity of about 50 m. tons per day within the harbour area. There is a growing requirement for landing jetties/mini harbours at Sonmiani Damb, Gadani, Ormara, Kalmat and Jiwani.

2) Communications:

Gwadur District has very limited and unreliable roads. There is a need for all weather roads in the district and, except for Gadani, Bundewari and Damb, the fishing settlements along Lasbela coast also lack good roads. The coastal town and settlements are not linked together with jeepable tracks and in case of rains, these towns and settlements become isolated. An all weather coastal road linking all major settlements along Balochistan coast and its continuation to RCD Highway is being constructed and is expected to be completed in the next two years. The Telephone, telegraph and postal service are very poor along the Balochistan coast. Gwadur, Pasni, Ormara and Jiwani are linked with Karachi by an air service. These flights are being used for airlifting shrimp from Pasni and Gwadur to Karachi. No coastal shipping service is currently practised.

3) Salt, Ice and Other Fisheries Implements:

The poor quality sea salt is being used for curing and preservation of fish along the Balochistan coast. Ice plants are in both public and private sectors. In Gwadur there are 3 ice plants in private sector; in Pasni there are 3 plants, one under public sector; in Jiwani there is one plant under private sector; in Ormara there is one plant under public sector whereas there are two plants under private sector in Sonminai. Some of the ice plants also have cold storages but none of them are in use. The fishing implements, nets, engines, nylon twines, etc., are available in the market. The fisheries department provides fisheries implements on subsidised rates.

3. MAJOR CONSTRAINTS:

The major constraints in the development and growth of fisheries along Balochistan coast have identified and given in the following:

i) Lack of marine infrastructure and onshore facilities.

ii) Lack of Communications, Coastal Highway through Ormara Hingol and Lyari requires priority for quickening marketing time. All weather roads should link all fishing townships of Balochistan coast, especially the proposed coastal highway.

iii) Lack of community hygiene and proper town planning to develop hygienic habits for better fish handling and distribution practices.

iv) Lack of Potable water for Kalmat areas, Pishukan, Gunz, Jiwani, Hingol and Sur, for establishing ice plants and thus increasing fresh fish trade. Available water supplies are totally untreated. Treated potable water should be available to improve community.

v) Lack of marine engines and fishing equipments.

vi) Lack of electricity.

vii) Reduced debt paying capacity of the fish industry.

viii) Lack of qualified extension staff.

6. WATER SUPPLY AND SANITATION IN COASTAL AREAS

The water supply and sanitation situation in the coastal areas of Pakistan vary according to the geographical location, nature, type and size of the settlement, available water supply source and facilities for waste water disposal.

6.1. BALOCHISTAN COAST

1. WATER SUPPLY

The drinking water supply for the settlements on the Balochistan coast, west of Karachi, is provided by the surface and groundwater sources. The Hub River provides water for settlements of Bunderwari, Gadani and Sonminai Damb. Ormara receives its water from Basol River. Pasni gets its supply of water from Shadi Khor (river) and Akra River provides water for Sur and Gwadur. Jiwani gets its supply both from wells and bunds filled during rains and surface water from the accumulated rain water. Other than these almost all of the coastal settlements receive their supply of water from 18 to 20 feet deep shallow wells, dug, within a radius of 1 to 2 km. from the shore. No water treatment facilities are available for the fishermen villages. Most of the wells have polluted water due to improper sanitary practices. Table-5 shows the situation of drinking water supplies for major coastal settlements in Balochistan.

A small desalination plant was established in Gwadur to convert sea water into sweet water. The plant has remained out of order most of the time, due to operational difficulty, as a result of accumulation of the continuously blowing desert sand on the solar energy collector system.

1) Existing Situations:

Geographically, the coastal Balochistan falls into hot and tropical regions. The coastal region comprises Gwadur, Pasni,Ormara and its adjoining fishing stations and towns. The whole coastal region is in the rainshed area. Average annual rainfall is around 50 mm/ year. Barring the sources of water supply to Pasni and Ormara, the rest part of the region is overwhelmingly in the salt ranges from where the sea had withdrawn recently or in the recent past. Consequently, the available water, including sub-soil water, is brackish and unfit for human consumption. Gwadur nad its adjoining townships and villages are in this range.

Gwadur is getting water from Dasht River and Akara Kaur (River), rain water from hills, blocked by the Saji Dam, the small Akara reservoir. The Saji Dam, a small storage facility financed by Senator Mohammad Ishaq Baloch from his development funds, has not received any rain since it was completed last year. At the end of April,1988 Gwadur was getting a net supply of 123 million gallons instead of the required 0.5 million gallons per day. The situation in the nearby settlements of Ganz, Sur Bunder, Pishukan, Palleri, Cheb Rekani, Gurki Dot was even worse. This has triggered mass migration, from the outskirts and surrounding areas of Gwadur towards Pasni which is not facing any water shortage.

The Gwadur-Suntsar Water Supply Scheme was completed in 1970's for a population of about 35,000. Now, Gwadur alone require about 0.5 million gallons of water/day. Similar pressure formed in Pishukan and other villages where population registered a net increase of five per cent.

Ormara and Pasni towns do not face water scarcity as the perennial sources of water are substantial. Pasni gets water from Shadi Kaur. The Pasni Mini-fort Project has a parallel water supply scheme capable of meeting future industrial needs. Pasni has a population of about 20,000. Following the improvement, water supply increased from original 50,000 gallons to 0.2 MGD.

The ormara water supply scheme was completed in 1979. It has its source in the Basol River, about 34 kilometers from the main town. It is supplying about 0.2 million gallons per day which is considered sufficient for the next decade. The Health Engineering Department, Government of Balochistan has also completed 16 other minor schemes ensuring fresh water supply to the villages and the towns adjoining Gwadur, Pasni and Ormara. Out of the total population of 1.3 million of coastal areas of Makran the Public Health Engineering Department has so far provided potable water to about 0.42 million population.

TABLE - 5. WATER SUPPLY IN MAJOR COASTAL SETTLEMENTS OF BALOCHISTAN

SL. NO.	NAME OF SETTLEMENT	CLASS	TYPE	QUAN-TITY	SOURCE	COMMENTS
1.	BNDERWAI	V	P	SW	K	HUB RIVER SOURCE
2.	GADANI	T	P	SW	K	"
3.	SONMIANI/DAMB	T	P	SW	K	"
4.	BERA	S	C	B	G	SHALLOW WELL
5.	PHOR	S	C	B	G	"
6.	SAPAT	S	C	B	G	"
7.	HINGOL	V	C	B	G	"
8.	MALAN	S	C	SW	G	"
9.	BALARA	S	C	SW	G	"
10.	HAD	V	C	B	G	"
11.	ORMARA	T	P	SW	R	BASOL RIVER
12.	SAKI ON I	S	C	SW	G	SHALLOW WELL
13.	SIKRI	V	C	B	G	"
14.	KIWARI	V	C	B	G	"
15.	KALMAT	T	C	B	G	"
16.	ISPHIHAK	V	C	B	G	"
17.	PASNI	T	P	B/S	R	SHADI KHOR RIVER
18.	CHUR	V	C	B	G	SHALLOW WELL
19.	KAPPAR	S	C	B	G	"
20.	SUR	T	P	B/S	R	AKRA RIVER
21.	GWADUR	T	P/C/D	B/S	R	AKRA RIVER/ DESALINATION PLANT
22.	PISHUKAN	T	C	B	G	SHALLOW WELL
23.	GANZ	V	P&C	WW	G	RAIN WATER
24.	JIWANI	T	C	SW	G	SHALLOW WELL
25.	BINDRI	V	C	B	G	SHALLOW WELL

NOMENCLATURE: Classification: S=Settlement; V=Village; T=Town; M=Metro City. TYPE OF WATER SUPPLY: C:Community Well; P=Piped Water; D=Desalination Plant. Quantity of Water Supply: SW=Sweet water; B=Brackish Water; B/s= Brackish/Sweet Water; Source of Water: G=Ground Water; R=River Water Source; K=Karachi waters.

2) Dams and Reservoirs

i) Akara Dam

For solving the perennial water problem in the area, the Balochistan Government has prepared a scheme for constructing a major Dam on the Akara River. The scheme has been approved. After implementation of the project, an assured supply of water equal to 3 cusecs (1.6115 million gallons) per day of water will be made available. Out of which 2.5 cusecs (1.346) MGD) of treated water will be provided for house holds, industries, public institution, defense installations, where 0.5 cusecs (0.269) mgd) of raw water will be allocated for the agriculture land around Nigore Village.

ii) Mirani Dam

Mirani Dam is proposed to be built at short distance below the confluence point of Dasht River and Kech Kaur. The system will irrigate around 80,000 to 90,000 acres of most fertile land between Turbat and Gwadur. The total discharge of water will be 125,000 acre feet per year nd the total storage capacity will carry over the water in a cycle of four years.

The total cost of the Mirani Dam project is around Rs 435 million. The Dam at Mirani will also generate electricity, about 600KW, with three generators installed with a capacity of 200 KW each. Mirani Dam is expected to bring an economic and social change in the area and develop the whole region in coming years.

iii) Hub Dam

The Hub Dam has been built on the Hub River in the Las Bela District basically to provide a part of water supply to Karachi city and the Hub Industrial Estate. It is however, supplying water to parts of the Lasbela District. The catchment area of Hub Dam is about 3,400 sq km with a storage capacity of about 0.85 million acre feet. Hub Dam supplies 89 MGD to Karachi. It also supplies 110 cusecs to Las Bela District of Balochistan for irrigation.

2. SANITATION

The majority of the settlements along the coast of Balochistan, do not have any sanitation facilities except in a few government, public, and private buildings, where occasionally indian style squat type latrines are provided mostly without flush tanks. Most of these buildings have private enclosure for use as toilets. Normally the human excreta and other wastes are pushed out of the building through a pipe, which discharges into an open ditch which finds it way into the sea. There are no garbage disposal facilities available in most of the coastal settlements. Incidences of worm related diseases are quite common in the fishermen settlement areas.

In majority of settlements the health conditions are further aggravated due to non availability of basic health care facilities and necessary medications. Qualified doctors and hospital facilities are rarely available.

6.2 WATER SUPPLY AND SANITATION IN COASTAL SINDH

Generally, majority of the coastal areas in Sindh have sweet water available. However, some settlements like Chasma Goth, Rehri, Lat Basti, Patiani, Dubbo, Hajamro, Chan, Ghora, Khobar etc., have brackish water. The water obtained from most of the shallow wells is contaminated. No treatment is done to water supply in cities such as Karachi and Hyderabad.

The drinking water supply for the settlements along the Sindh Coast is obtained both from surface and groundwater sources. Extensions from Karachi water supply system provide water to many coastal towns such as Ibrahim Hydrai, Gharo, Mirpur Sakro etc. Water supply for most of the other towns and villages is obtained from shallow and deep wells.

1. EXISTING SITUATION IN COASTAL AREAS

1) WATER SUPPLY

The current situation of water supply to various coastal settlements in Sindh are summarised in Table - 6. In the early '70s, the government initiated piped water schemes for large coastal settlements like Keti Bunde and Shah Bunder as the Indus mouths on which these settlements were situated had long since become saline. Water was pumped from perennial canals to surface tanks in the settlements via many miles of pipeline. Most of the settlements along these pipelines have also acquired water connections and many villages have shifted their locations so as to be near the pipeline. However, no more than 15% of the coastal people receive water from such piped water schemes. These schemes are managed by the District Councils or the PHED. UNICEF has also been involved in the water sector in the delta. The present water line to Keti Bunder and Shah Bunder were added to by the UNICEF in 1986. However, these piped water schemes do not function efficiently and when they break down people revert to their traditional sources. Even while they function, water from the schemes is inadequate.

TABLE - 6. WATER SUPPLY IN MAJOR COASTAL SETTLEMENTS OF SINDH

NO.	SETTLEMENT	CLASS	TYPE	QUALITY	SOURCE	COMMENTS
1.	JATE GOTH	S	C	SW	G	GROUND WATER
2.	KUN	S	C	SW	G	SHALLOW WELL
3	KODARI	S	C	SW	G	"
4.	BAM BHATIA	V	C	SW	G/R	RIVER INDUS
5.	SHAH BANDAR	V	C&R	SW	G/R	"
6.	JANGISIR	V	C	SW	G/R	"
7.	KARO CHAN	V	C	SW	G/R	"
8.	RAJWARI	S	C	B	G	"
9.	KHOBAR	S	C	B	G	SHALLOW WELL
10.	GHORA	S	C	B	G	"
11.	CHAN	S	C	B	G	"
12.	HAJAMARO	S	C	B	G	"
13.	HABARIM	S	C	B	G	"
14.	KANGRI	S	C	B	G	"
15.	KETI BANDAR	T	C	B	G/P	"
16.	DUBBO	S	C	B	G	"
17.	PATIANI	S	C	B	G	"
18.	JOHAR MALAK SHAH	S	C	SW	G	"
19.	JAT	S	C	SW	G	"
20.	MOHAL/SHOLANI	V	C	SW	G	"
21.	BHOARO	V	C	SW	G	"
22.	DEH PAT MARO	V	C	SW	G	"
23.	MIRPUR SAKRO	T	P	SW	K	KARACHI WATER
24.	GHARO	T	P	SW	K	"
25.	LAT BASTI	S	C	B	G	SHALLOW WATER
26.	REHRI	V	C	B	G	"
27.	CHASMA GOTH	V	C	B	G	"
28.	SALT FACTORY	V	P	SW	K	KARACHI WATER
29.	IBRAHIMHYDRI	T	P	SW	K	"
30.	KARACHI	H	P	SW	K	"
31.	BABA ISLAND	T	P	SW	K	"
32.	B I T ISLAND	T	P	SW	K	"
33.	SHAMS PIR	V	P	SW	K	"
34.	MANORA	T	P	SW	K	"
35.	SALE ABAD	V	P	SW	K	"
36.	SANDSPIT	V	P	SW	K	"
37.	BULEJI	V	P	SW	K	"
38.	PASHA BANDAR	V	C	B	G	SHALLOW WELL
39.	BUNGALOW	V	C	B	G	"
40.	MANIJI	V	C	B	G	"
41.	SUNARI	V	C	B	G	"

Classification: S=Settlement; V=Village; T=Town; M=Metro City.
Type of Water Supply: P=Piped Water, C=Community Well, R=River
Water Quality of Water Supply: SW=Sweet Water, B=Brackish Water, B/S=Brackish/Sweet Water,
Source of Water: G=Ground Water, R=River Water Source, P=Piped Water, K=Karachi Water.

2) SANITATION

There is no sanitation in most of the coastal Sindh. The people use the old traditional methods. There is no electricity, no communication etc., in areas such as Keti Bunder. The conditions are a little better in the areas which are near some coastal towns such as MirPur Sakro or some road pass nearby.

There is no system of excreta or waste water disposal in the coastal settlements. In the settlements where piped water has arrived, the disposal of waste water poses problems as there is no drainage system. The result is that these settlements are full of large stagnant pools of foul water in which flies and mosquitoes breed and children play. The UNICEF tried to introduce its pit latrine system through an extension effort in the area. However, it was unsuccessful as the subsoil water is only 2 to 4 feet below the surface (Arif Hasan - personal communication)

2. WATER SUPPLY IN KARACHI

1) PRESENT SITUATION AND FUTURE EXPANSION

An inventory of the current water supply and sewage disposal services for the city of Karachi is presented in the Table-9. The monthly rate of water supply to the Karachi City from Indus Water.

i) Bulk Water Supply and Demand

The available bulk water supply for Karachi city from all the sources, which is about 324.00 MGD and the present demand, based on a 1985 population estimate of 6.715 millions, comes to 371.90 MGD, indicating a short fall of 47.0 MGD. The following Table - 7 shows the bulk water supply availability against the current demand.

An analysis of per capital demand by socio-economic group for various domestic uses, indicates the demand varies from 46 to 381 liters per capita per day. An average day and peak day water demand forecast to the year 2025 are estimated to be 2451.7 MGD to 2878.7 MGD, respectively. The per capita demand by socio-economic group is shown in the Table - 8.

TABLE - 7. INVENTORY OF WATER SUPPLY & SANITATION SERVICES

	BULK WATER SUPPLY	
1.	Dumlotee Wells	7 Nos.
2.	Dumlotee Conduit	24 Miles
3.	Haleji Conduit	60 Miles
4.	Indus System	80 Miles
5.	Hub System	35 Miles
6.	Major Pumping Stations	6 Miles
7.	Filter Plants (Gharo-2, COD-2, Pipri-2, NEK-1)	7 Miles
8.	Tunnel	2 1/2 Miles
	RETAIL WATER SUPPLY	
1.	Water Mains and Distribution Lines	2030 Miles
2.	Pumping Stations and Boosters	72 Nos.
3.	Community Taps	21234 Nos.
4.	Hydrants (For Tanker Supply)	11 Nos.
	SEWERAGE SERVICE	
1.	Trunk Sewers	111 Miles
2.	Mains & Lateral Sewers	1526 Miles
3.	Rising Mains	44 Miles
4.	Treatment Plant (20m MGD each)	2 Nos.
5.	Pumping Station & ejectors	11 Nos.
6.	Automatic Sewer leaning Machines	7 Nos.

Source: KWSB-1989

TABLE - 8. BULK WATER SUPPLY AVAILABILITY V/S DEMAND.

1. AVAILABILITY

(A) Indus Sources:	
i) Greater Karachi Bulk Water Supply Scheme	
a) Phase-I = (1962) (Cost Rs.201.40 Million)	70.00 MGD
b) Phase-II = (1971) (Cost Rs.900.00 Million)	70.00 MGD
c) Phase-III =(1981) (Cost Rs.750.00 Million)	70.00 MGD
d) Phase-IV - Stage - 150 MGD (Cost Rs.36.2 Million)	Work in Progress by KDA -
ii) Haleji (Halaya Scheme - 1943)	20.00 MGD
(B) Hub Dam Source: (Oct. 1982) (Cost Rs.26.90 Millions)	89.00 MGD
(C) Dumlotee Wells: (Old system-1984)	5.00 MGD
Total Bulk Water Available	324.00 MGD
Availability Per Capita	49 Gallons/day
Domestic	21 " " "
Non-Domestic	28 " " "

2. PRESENT DEMAND

(A) 1985-Population-6.715 Million	371.90 MGD
(B) Present "Short fall" in Bulk Supply against demand - 1985/86.	47.9

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3. WATER DEMAND FORECAST

(Estimates of Average and peak day water demands to the year 2025)

Year	Average Day		Peak Day		
	Mm^3 / d	(mgd)	Mm^3 / d	(mgd)	1990
	2.238	492.3	2.630	(578.06)	
1995	2.792	614.2	1.278	(721.02)	
2000	3.728	820.0	1.377	(962.09)	
2010	6.086	1338.6	7.144	(1571.07)	
2025	11.146	2451.7	11.085	(2878.07)	

Equivalent per capita demands for the period, based on average day figures, increase from 252 liters *55 gallons - in the 1985 to 260 liters * 57 gallons) in 200 and to 368 liters (81 gallons) in 2025. (a) = Kacchi Abadis (Can't pay charges), (b) = As uses without connections (can pay), (c) = Small houses with connection's (paying). Source: KWSB - 1989.

ii) Water Treatment:

The details the various water treatment plants, the process plant manufacturers, the capacity in MGD and the date of construction is given in Table - 9. All these plants treat water derived from the Indus River. The remaining sources from Dumlotte and from the Hub River are disinfected by chlorination.

TABLE - 9. TREATMENT PLANTS INSTALLED IN KARACHI

NAME	PROCESS PLANT MANUFACTURER	CAPACITY M.G.D.	DATE OF CONSTRUCTION
Gharo 1	PC-I	10	1944
Gharo 2	PC-I	10	1953
COD Hills	Wabag	70	1962
COD Hills	Degremont	45	1971
Pipri	Degremont	25	1971
Pipri	Wabag	25	1978
North East Karachi	Wabag	25	1978

Source: KWSB - 1989

3. SANITATION IN KARACHI

1. SEWAGE DISPOSAL SYSTEM

The existing sewerage system of Karachi consists of 680 miles of trunk sewers and sub-trunk sewers and reticulation system and 7 pumping stations and 2 treatment plants of 20 MGD capacity each. The whole system was built at a total cost of Rs.91.20 million.

2. SEWAGE QUANTITIES

The population using 181 MGD water generates 120 MGD of sewage but only 20 MGD is treated in the treatment plants. However, the existing sewerage system serves the areas only within Sewerage District No. 1 & 2 containing a total population of 3.01 million. The served area works out to 30.02 per cent of the total area and 28.77 per cent of the total population is served by the existing sewerage system.

The total pollution load generated in terms of Biochemical Oxygen Demand (BOD) from various urban activities which includes residential, industrial, agricultural and other, is shown in the following Table - 10.

The per capita sewage generated is 30 gallons per day and pollution load is 375.50 gm BOD per day. A total of 1237 tons of BOD is generated daily within the urban area (KDA - 1981).

TABLE-10. POLLUTION LOADS IN KARACHI CITY

	Total Pollution in Tons BOD/day		Percentage	Per Capita pollution gm.BOD/day
1. Residential Zone	151.42		12.24	45.97
1) Housing		145.49		
2) Commerce		3.39		
3) Health Institutions		0.50		
4) Education		0.32		
5) Administrative		1.72		
2. Industrial Zone	1045.31		84.51	317.33
1) Large Industries		1040.43		
2) Small Industries		4.88		
3. Agricultural Zone	39.66		3.21	12.04
1) Live-stock Breeding		-		
2) Agricultural industry	29.66			
4. Technical Zone	0.52		0.04	0.16
1) Transportation terminals	0.42		0.42	
2) Utility terminals			0.10	
TOTAL:	1236.91		100.00	375.50

Source: KDA, 1987.

3. SEWAGE TREATMENT PLANTS

There are two sewage treatment (Bolni plants) designed to treat domestic sewage of Karachi city for a population of 1 million. The plants with capacity of 20 MGD each, are capable of serving a population 0.5 million only and treating the sewage obtained at an average flow of 40 gallons per capita per day.

4. MODES OF SEWAGE DISPOSAL

The distribution of population by modes of sewage collection and disposal facilities served by central sewerage system is given below in the following Table - 11. The effluent from the treatment plants is discharged into the rivers and nullahs to drain finally in to the sea.

About 25 per cent of the total capacity of the trunk sewer system is utilised. The treatment plants utilise 75 per cent of their hydraulic capacity and 4 per cent of biological treatment capacity and the efficiency in terms of BOD and suspended solids removal varies from 46-90 per cent.

TABLE - 11. MODES OF SEWAGE DISPOSAL IN KARACHI

Percent of Total Population

1.	Sewered and served with house to house sewer connection and connected with the central sewerage system.	28.77 %
2.	Served with local collection and disposal system including septic tanks.	3.41 %
3.	Served with in-effective system.	24.59 %
4.	Unsewered	43.23 %
	TOTAL:	100.00 %

Source: KDA - 1985

The drainage system of Karachi is totally inadequate and inefficient. An average annual rain of about 6-7 inches spread over 2-3 months of rainy season causes havoc in the city. Soon after the rains the two rivers of the city the Lyari and Malir, discharges on the down-stream side, sometimes are as high as 11,000 and 88,000 cusecs, respectively. The problem is intensified due to the existence of 1.6 million shelterless people living in the beds of these rivers and nullahs and in other low-lying areas of the city.

The existing storm water drainage system consists of a large number of open drains, designed on separate system, which discharge into the rivers and nullahs and finally into the sea. At present only 318 miles of open drains have been constructed at a total cost of Rs. 6.7 million. The overall progress achieved so far is 30 per cent.

5. NEW PROJECTS

1) Second Phase of the Sewerage Scheme:

The Government of Pakistan has approved, in principle, the plan for construction of two treatment plants and allied trunk sewers at a total cost of Rs. 500 million. KDA has also planned to construct the two treatment plants of 20 MGD capacity each. An independent Project Cell has been established with a Project Director and the requisite staff which have already started preliminary work on the project.

2) Waste-Water Reuse:

Although a land reservation upto 3000 acres was provided for, the Sewage Farms in the vicinity of each treatment plant for utilisation of treated waste-water effluent for irrigation but owing to various reasons, no effective utilisation of the area has been achieved as yet. However, 2.3 MGD of raw sewage is still being utilised for irrigation over 100 acres at sewage Farm No. 1.

From Treatment Plant No. 2, at least 1.5 MGD of treated sewage is being pumped to Karachi Airport for plantation. Moreover, at frequent places in Korangi, the raw sewage flowing in open drains is pumped up and is used for irrigation of vegetable crops by private persons.

3) Disposal of Un-used Waste Water:

Most of the treated waste water do not find its proper utilisation owing to high salinity. Therefore, the waste water effluent is being discharged into the Lyari and Malir River to drain finally into the Arabian Sea.

6. THE PRESENT SITUATION AND FUTURE EXPANSION

1) Current position:

The water supply to the city of Karachi, the sewage generated due to the water supply, the available treatment facilities and the untreated sewage flowing into the sea since the year 1951 to 1986 is given in the Table 13. Over 176 million gallons of untreated sewage is disposed into the sea every day, due to non-availability of treatment facilities, as a result of financial constraints. The untreated sewage is increasing with the increase in water supply (Table - 12). Due to the lack of adequate sewerage capacity, the untreated sewage is disposed off in open nallahs and drains, creating many aesthetic and environmental health problems in the city. The disposal of this large quantity of untreated sewage is causing serious pollution in the coastal areas, affecting the marine life and ecological balance.

2) Future Improvements of Treatment Facilities:

The highlights of the renovation and expansion of the existing sewage treatment plants 1 & 2, in Karachi as a special development project of the Karachi Water and Sewerage Board, its project cost, objectives and benefits, are given in the Table 13.

The total project cost is estimated to be 947 million rupees Rs. 101.07 million has been allocated by the government and the rest will be funded by the Asian Development Bank.

TABLE - 12 PRESENT POSITION & FUTURE REQUIREMENTS OF SEWERAGE

Present Sewage Generation (324 MGD x 2/3)	- 216 MGD
Present Treatment Capacity	- 40 MGD (TP-1 20 MGD+TP - II 20 MGD)
Short-fall	- 176 MGD
Estimated Sewage Generation	
1985 (2/3 of Water Supply Projections)	- 249 MGD
1990	- 330 MGD
1995	- 412 MGD
2000	- 549 MGD
Remedial Measures	
1. Treatment Capacity being enhanced under K.S.D.P.	
(1st Stage)	- upto 120 MGD
(2nd Stage)	- upto 160 MGD
Short fall even after improvements under K.S.D.P.	- 96 MGD
2. Greater Karachi Sewerage Feasibility Study being taken	

TABLE-13 KARACHI SPECIAL DEVELOPMENT PROJECT
KW & SB SUB PROJECT - III

RENOVATION & EXPANSION OF SEWERAGE
TREATMENT PLANTS NO. I & II.

- Completed/Commissioned in 1965/1969 - 20 MGD capacity each with sophisticated secondary treatment of sewage;
- Now require extensive renovation of plant and machinery besides duplication/expansion of capacity;
- ADB Mission proposed to resort to only primary treatment of sewerage thus enhancing treating capacity from 40 MGD in State-II (Shortfall 216 (-) = 176 MGD).

PROJECT COST — Rs. 497 Million
PC-I approved by ECNEC
Allocation for 1988-89 — 101.07 Million
COMPLETION PERIOD — 48 Months

- OBJECTIVES:
  - i) Increasing the treatment capacity of TP-I & TP-II;
  - ii) Use of Biogas for Power Generation;
  - iii) To accommodate the additional sewage from ongoing major sewage schemes;
- BENEFITS:
  - i) By increasing the treatment capacity, greater area of the city to avail the disposal facility;
  - ii) Provision of disposal facility to low income areas;
  - iii) Coastal pollution to be reduced - Providing safety to marine life;
  - iv) Overall environmental sanitation improvement;
  - v) Saving in Energy consumption - 3 MW;
  - vi) Detail design work and tender invitations during 1988-89.
- FUNDING: Asian Development Bank.

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7. SOLID WASTE MANAGEMENT

Solid waste management is a serious problem in all the urban and rural areas of Pakistan. Most of the country's waste is disposed off by crude dumping. Karachi city generates more than 6000 tons of solid waste every day. Only 33% of the generated waste is transported to the dumping sites and the rest is left on land to deteriorate creating a highly undesirable environment. The practice of burning part of the refuse at site, has also become very common, which adds to the polluted air of the city (Table - 14). The overall average composition (% by weight) of the Karachi city garbage is paper 3.6%; glass 2.5% and compos-table matter 52%. Table - 14 shows the physical characteristic of city refuse in Karachi.

TABLE - 14. SOLID WASTE GENERATION AND MANAGEMENT IN COASTAL AREAS IN SINDH

Daily generation	5880 tons
Refuse collection points	3873
Refuse bins	2513
Trucks & tractors	155
Area served	55%
Refuse transported	33% of total
Dumping sites	North Karachi & Korangi
Annual expenditure	Rs. 136 million
Annual Revenue	Rs. 27 million
Agencies responsible	KMC, KDA, KPT, Cantt. Boards, SITE, PWD, Defence Authority.

Source: KDA Environmental Pollution: A status report on the city of Karachi.

1) COMPOSTING

There are two compost plans in Karachi, that turn garbage into manure (compost) which can be used directly or in combination with other fertilizer for agricultural use. One such plant is built at SITE and another at Korangi area. These refuse composting plants aim at producing 24 tons/hour of compost. Apart from cost serving the establishment of these projects are helping in recycling only a small part of the solid waste generated in the city.

2) DISPOSAL

The current solid waste disposal situation in Karachi is totally inadequate. The present manpower and equipment can hardly manage about one third of the waste generated in the city. The remaining garbage remains uncollected. Large portion of garbage is incinerated in open all over the city to get rid of the volume and weight of the dumped garbage. There are two officially designated refuse disposal sites in Karachi; one is located 15 miles from the city near north Karachi and the other is located 10 miles from the city near north Karachi and the other is located 10 miles from the city in Korangi area; where garbage is dumped and leveled by bulldozer.

There is no arrangement for the disposal of non bio-degradable materials like plastic bags, containers and various other synthetic materials.

3) IMPROVEMENT PROGRAMMES

The city has recently added to its solid waste collection and transport fleet a number of packer type modern vehicles. The Government is trying to implement some of the viable recommendations made by foreign consultants for solid waste management some of the viable recommendations in the first phase.

8. CONTAMINATION OF DRINK WATER SUPPLY

The main sources of the biological contaminants are the unsanitary dispósal of human and animal wastes. Except for the main city of Karachi, almost all the liquid waste from the coastal settlements are disposed off directly into the nearby nullahs or open water courses. A large proportion of existing diseases in Pakistan are caused by the consumption and use of contaminated waters. Most of the industries in Pakistan are located near the water sources. Because of the uncontrolled expansion and operation of the industries, almost all of the untreated liquid industrial wastes are discharged in the nearby water courses. The water from these sources is used for human and animal consumption.

7. POLLUTION IN COASTAL AREAS

A large quantity of waste materials are being discharged into the coastal waters of Pakistan mostly from Karachi along Sindh coast. Most part of Pakistan coast is barren and without any big city/town except Karachi. Similarly, there is no industrial and trade centre located on the coast except Karachi and Hub Industrial area.

Karachi and its coastal zone is the most industrialised part of Pakistan and about 60% of the industries of Pakistan are located within this area. There are four major industrial complexes located in the coastal belt of Karachi. Out of these three are located within the limits of Karachi District and one adjacent to Karachi on Balochistan coast. These industrial complexes are Sindh Trading Estate (SITE) in the north and northwest of Karachi, Landhi Industrial Trading Estate (LITE) and Korangi Industrial Area (KIA) in the south and southeast of Karachi, and the West Wharf Industrial area in the centre of the city close to the Karachi Port. The Hub Industrial Trading Estate (HITE) is located in Hub on the Balochistan coast adjacent to Karachi District.

In addition to the industrial complexes there are a number of small and large industries within the Karachi District. According to an assessment, there are more than 6,000 small and large industrial units in Karachi including the industrial units within its industrial complexes and in the adjacent Hub Industrial Estate. Almost all of these industries discharge their untreated effluents into the coastal waters of Karachi. It is estimated that about 180 MGD of mostly untreated industrial effluents from the coastal zone industries and municipal wastes mostly from Karachi city reach the coastal waters through sewerage system, open sewers, outfall canals, discharges from seasonal rivers and storm water drains.

The coastal water bodies of Karachi such as the Karachi Harbour, Gizri Creek, and Korangi Creek receive large quantities of nutrients as part of the liquid waste and garbage being disposed of in these creeks. According to an estimate about 1500 tons of BOD loading constituting organics and nutrients are discharged into the Karachi Harbour per day. Similarly, the Gizri Creek receives about 800 tons of BOD loading per day. The Gharo Creek receives considerable amounts of phosphates and nitrates from various industries and municipal wastes which contains high concentrations of nutrients particularly from Pakistan Steel and Port Qasim, and other coastal Industries discharging their effluents directly into the Gharo Creek.

The municipal and industrial wastes are estimated to discharge about 60 tons of suspended matter per day into the Karachi Harbour. The corresponding figure for the Gizri Creek is more than 20 tons per day. The settling of the suspended organic matter causes anoxic conditions in the bottom sediments, produc-tion of Hydrogen Sulfide, in the sediments and in the water layers close to bottom, the eutrophication and the occurrence of phytoplankton blooms in the coastal waters are the impacts of the heavy loading of the receiving water bodies with the nutrients and organic matter. The anoxic conditions prevail in about 40% of the bottom areas of Karachi Harbour and about 60% of the Gizri Creek areas. The eutrophication is conspicuous in the middle and lower parts of the Gizri Creek. The phytoplankton blooms are common in the Korangi/Gizri Creek, and coastal waters adjacent to Clifton beach and dinoflagellate bloom in the waters of Sandspit beach, Hawkesbay.

The pollution loads from the SITE industries are estimated to be about 40% of the total pollution load in the coastal belt of Karachi. The LITE and KIA generate about 25% of the pollution and sea-outfalls about 20% and the industries of Karachi located outside industrial complexes generate about 12% of the total pollution load. The pollution load of the municipal wastes and sewage also follow a pattern somewhat similar to Industrial pollution. About 60% of the sewage pollution load is generated by the central and northern parts of the city enters the coastal waters through Lyari River outfall and about 35% of the load enters the sea through Malir River outfall, The remaining 5% of the load enters the coastal waters through open sewers and storm drains.

The water pollution loads generated by the industrial and municipal sources from the LITE, KIA, and the coastal industries located along Korangi and Gharo Creeks produce about 59 million meter cube of waste waters annually from this area. The high BOD, COD, and Suspended solids and TDS occur in the waste waters of industries such as textiles, tanneries, domestic effluents, metal industries, agriculture and Power plants. High hydrocarbons are being produced by oil refineries, metal industries. There are considerable phenols and cyanides in the waste waters of metal and rubber industries. High contents of heavy metals exist in the waste waters from tanneries and metal industries.

The seawater at the saltworks at Mauripur adjacent to the Lyari River outfall is contaminated with heavy metals from Lyari River discharge. These include Pb (1.48 ppm), Cd (0.21 ppm), Zn (1.08 ppm), Cu (0.09 ppm), Ni (1-12 ppm), and Mn (0.29 ppm) (Ahmed, 1983). The sea salt is most commonly used sea product in Karachi. Most of the sea salt produced from the coastal areas is not refined and is sold in the market for human consumption.

The high values of Zinc (1,300 ppm) in the effluents of Karachi Shipyard and Engineering Works discharged into the Karachi Harbour area. The other sources of Zn discharging directly to the sea, include Pakistan Steel (0.3-3 ppm) and Oil refineries (0.15 ppm). Chromium is being discharged into the sea from the tanneries effluents. The typical range of Chromium in the Karachi Tannery effluents is 0.2 to 8 ppm. A very high value of 5 g Cr/l has been reported in the effluent of Tanneries at shershah passes into the Lyari River. The Korangi tanneries are estimated to discharge about 225 tons of Cr per year into the coastal waters.

The impacts of the heavy metal pollution are localised because of their point discharge sources. However, they find their way into our diet through food chain and contamination of drinking water. The most critical areas affected are backwaters of Karachi Harbour, Gizri Creek, Bakran Creek, and parts of Gadani coast. This is evident by the accumulation of heavy metals in the sediments, and marine organisms from these areas. The heavy metals of more concern are Cr, Pb, Cd, Hg, Zn, and Cu.

Most of the open coast beaches of the coast of Karachi are relatively free of oil pollution. With the exception of some selected beaches along open coast, and a few beaches located within the backwaters, the entire coastline appears to be relatively free from oil pollution. The oil pollution on most of the open coast beaches is in the form of tar balls present mostly near the high water mark. The tar balls are the weathered residues of the degraded oil. They were observed to be mostly black or blackish grey in colour and coated with sand grains. The smaller sized tar balls were generally harder and more brittle than the larger ones.

The creek areas, as a whole, are relatively untouched by human encroachment except in Gizri, Korangi and Gharo creeks. The biotic development of the area is limited by low freshwater input, as evidenced by the condition of the mangroves.

Most of the beaches along Pakistan coast are free of pollution. From pollution point of view only the beaches along Karachi coast and the Gadani beach are worth considering. There are several beaches along the open coast as well as the creeks and backwaters in Karachi that serve as recreational spots for the people. Most of the open coast beaches are relatively clean and safe for recreational use from pollution point of view.

8. SUMMARY AND RECOMMENDATION

8.1. SUMMARY

The coastal areas of Pakistan with exception of Karachi and Hub coastal areas, constitute one of the most under-developed areas of the country and as such require special attention to build infra-structure and basic facilities to bring these areas at least at par with other fast developing towns of the country.

The basic features and specific characteristics of coastal environment and associated Oceanographic characteristics of the Indus Deltaic areas and of the Balochistan coast have been described. The potential of the major coastal resources of the coastal areas have been assessed and the need for their environmental management is stressed. The guidelines for their management are provided as recommendations.

The current state of the coastal environment, basic socio-economic structure, the development work so far carried out have been examined in the paper and to the basic priorities identified and need for incorporating environmental considerations in the existing and future development projects in the coastal areas has been emphasised.

The coastal environment along the coastal areas have three main issues: 1, environmental degradation of coastal forests due to reduced freshwater inputs, the growth of the coastal forests of mangroves threatened due to human exploitation; 2, lack of proper environmental management insanitation and water supply projects; 3, outdated technology in fisheries industry and fishing techniques, over-exploitation; 4, destruction of natural habitats of wildlife, drastic changes and threats to the ecology of the coastal environment in Indus Delta and Karachi coast, and coastal areas near Hub Industrial Estate and Gadani.

There is a great potential for the development of tourism as the city has large hotels for the tourists and recreational spots on the beaches and shores. There is a large space for development of new townships and establishment of coastal industries as all the necessary industrial infrastructure is available. All these resources require proper management.

The main areas where the environmental management and socio-economic development objectives have to be merged together include development of infra-structure for basic industries, management of coastal forests, and fisheries, water supply and sanitation, protection of coastal environment from pollution, development of basic communications such as all weather metaled roads, fish landing jetties, fish harbours and mini ports, electricity, and facilities for introducing and developing tourism in coastal areas. There is a growing need for preparing an environmental management plan for the coastal areas which should set priorities for the coastal development projects and frame an action plan for the rapid socio-economic development of these areas. Based on the available information recommendations have been made to provide guidelines for an environmental management plan for rational exploitation of coastal resources and development of essential civic amenities, communication and infrastructure for sustainable development. The priorities for the various development projects incorporating environmental considerations/safeguards have also been indicated to achieve sustainable socio-economic development of the coastal areas.

The various recommendations made in the paper basically focus on five main areas: 1, management of the coastal environment for sustainable development of resources such as forestry, fisheries, non-living resources and future expansion. 2, development of projects for water supply and sanitation, disposal of sewage and marine pollution with reference to the current situation, future expansion and basic health services. 3. the development of communications such as coastal highway, inland links, fish landing jetties and mini ports, regular sealink service between Karachi and other coastal towns and better telephonic and postal services; 4, development of infra-structure for industries particularly fisheries, tourism. The Karachi coastal areas have been described separately from the rest of the coastal areas because of the special problems inherent with this developed part of the Pakistan coast.

The main issues for environmentally sound and sustainable the human problems needs to be focussed in order to improve the standard of living through protection of the deteriorating environment in terms of improving human health, better sanitation clean air and water and socio-economic conditions. Thus the safety and prosperity of humans have being given top priority in the suggested recommendations for the environmental management of the coastal areas. In order to achieve these the resources of the country are required to be utilised economically and in well planned stages.

Keeping in view the main objective of the study to propose guidelines for evolving management measures to keep environmental health and socio-economic development projects in harmony with each other an outline of a programme is suggested in the following. To achieve this, a two phased programme has been proposed as an outline for a comprehensive management plan with objectives to keep environmental health and socio-economic development projects in harmony with each other. The approach does not intend to impose restrictions on the development of basic infra-structure which is essential for any development.

In the first phase, all the deteriorating changes need to be protected such as, environmental changes due to sanitation, control on industrial and marine pollution, protection of coastal ecology, particularly in the region of the Mangroves forest, controlling pollution to keep the coastal environment in healthy condition, protection of coastal structures, sea encroachment etc.

The secondary objective is proposed to be devoted to the improvement of the coastal environment to meet the basic standard for happy and healthy life. In general, this phase requires actual development such as in modernising fisheries, setting up of new fisheries industry, facilities for fishing in deeper waters, new fish harbours and fish landing jetties, fish storage and marketing facilities etc. In the field of conservation of resources and economic development of the coast: land and water development projects, establishment of new harbours/mini ports, metalled roads, communication, and extending coastal industrial infrastructure facilities to the coastline, new industrial complexes, inland water transport and development of tourism, etc.

The second phase should focus on the consolidation of all the projects which were developed uptill now. This will ensure sustainable development of the coast. The proper management of the coastal environment will generate substantial revenue which will contribute to the overall economy of the country.

8.2. RECOMMENDATIONS

The recommendations given in the following are based on the data/information collected and synthesised through various sources including discussions with the resource persons. Most of the recommendations are based on the data presented in the report and on the basis of the understanding of the current issues of environment and socio-economic developments in the coastal areas of Pakistan. The recommendations are briefly presented in the following:

1. COASTAL ENVIRONMENT:

1. Coastal Resources:

1. An inventory be made of all the major coastal resources present in the coastal zone of Pakistan;

2. Management measures should ensure rational exploitation of coastal resources mainly fisheries and mangroves forests, mineral sand, gravel, and sea salt;

3. Conservation of fisheries resources be done by existing enforcing legislation for observing mesh size regulations and closed seasons and closed fishing areas. The alternate strategies for promoting fisheries for less exploited fisheries resources and exploring new fishing areas should be encouraged.

2. Protection of coastal villages from shore erosion and Tidal waves:

1. The groynes and breakwater walls should be constructed at critical places to stop erosion of shoreline. The selection of sites and technical details should be worked out after careful evaluation of oceanographic data. Local expertise are available in this field should be utilised.

2. Suitable coastal protection be provided to the coastal villages at Gadani and sonmiani Hor against the Tidal waves. Local expertise in the field should be used to economise the cost of such projects.

3. Plantation of mangroves and other salt tolerant trees should be done at places where some freshwater input is available for their initial growth and survival. The grown-up mangrove belt will act as barrier to shore erosion. The department of Forestry in Sindh and Balochistan and National Institute of Oceanography can provide technical expertise to launch such a project at a minimal cost.

3. Development of infra-structure for coastal development:

1. Jetties or mini fish harbours be constructed at suitable places near all the major fishing villages/settlements along Sindh and Balochistan coast within a span of 5 years. The funds for these projects should be met through special funds marked for the coastal area development by the Federal as well as by provincial governments.

2. At least 3 small Tidal Power Plants can be developed along the coast of Pakistan at suitable places. The feasibility studies should be carried out to determine the technical details and cost estimates employing local consultants.

3. Small scale solar desalination plants be established near major coastal settlements to convert seawater into drinking water for the local communities.

4. Environmental Health:

1. Urban planning and investments should be focused on the preservation of coastal environment, amenities, and to improve public health conditions on the coastal beaches and holiday resorts.

2. The probably impacts of construction and creation of coastal recreational facilities such as jetties, piers, boating basins, and breakwaters should be evaluated before construction of these facilities.

3. A phased programme be implemented on a 4-5 years duration to ensure complete stoppage of the existing practice of disposing raw sewage to the sea. The adoption of appropriate sewage collection and disposal techniques will reduce the marine pollution and will also improve the sanitation in the coastal cities/towns to a great extent.

4. The sewerage system of Karachi be improved and expanded to provide effective coverage to all urban areas. The disposal of untreated sewage from Karachi to backwaters of Karachi Harbour and Gizri Creek and alternate disposal methods of sewage treatment and disposal techniques be adopted.

5. The sewage after minimum treatment can be disposed off in the sea through submarine outfalls. It is therefore, suggested that Marine Outfalls should be seriously considered as a long term option for the disposal of sewage for Karachi city. This will improve greatly the sanitation in the city, Karachi Harbour, boat basin, backwaters and Gizri/Korangi Creeks. Two probable sites be investigated along Karachi coast to cope with the sewage being collected at two separate locations.

6. Low cost decentralized methods of waste disposal should be developed and implemented.

2. FORESTRY:

The better management and sustainable exploitation of mangrove forest and its associated wild life along Sindh Coast can be achieved through co-ordinated efforts of the various concerned agencies within the country. The following recommendations are made for the conservation and management of the mangrove forest and its associated ecosystems:

1. Management and Conservation of Mangroves:

1. The human pressures on the mangrove should be reduced to a minimum by enforcing legislation taking into account the genuine requirements of fodder, firewood, and timber by the local communities.

2. A 10 year programme for plantation, conservation and protection of mangroves be prepared by Forestry departments of Sindh and Balochistan for implementation in the coastal areas.

3. In Sindh all the mangrove forests, at present, under the control of various agencies such as Board of Revenue and Port Qasim Authority need to be brought under one management.

4. All mangrove forests also need to be declared "Protected Forest." In fact, it is time to declare all mangroves as "Reserved Forests" under the "The Forest Act of 1977."

5. An effective programme be launched with the help of the local coastal communities and volunteers to plant mangroves in the areas particularly at the sites where human pressures have cleared them.

6. Current Management practices should take into account the slower growth rates of mangrove trees than the normal in the Indus Delta due to reduced freshwater input from Indus River.

7. The waste land in between the High tide mark and the adjacent cultivable agriculture land, where appropriate, should be used to store rain/flood water through earthen bunds/check dams/water sheds for later controlled releases of stored water to adjacent coastal waters/creeks for irrigation of mangrove forest. This water could also be used for aquaculture and irrigation.

2. Mangrove Management Studies:

1. Studies on the Natural and artificial regeneration including production, dispersal and storage capability of the dominant mangrove species.

2. Introduction of hardy species of mangroves such as Rhizophora species, that make good quality fuelwood with a hot flame without smoke.

3. Management studies including growth rate, spacing thinning, rotation and study of clear fellings v/s selective fellings v/s strip fellings.

4. Estimates of resources, ecology and economic utilization and micro climate of mangroves.

5. Mangrove-water relations. This is an important study because fresh water discharge into the sea from river Indus has decreased substantially by construction of a series of barrages and dams on river Indus and its tributaries.

6. Impact of biocide residues and heavy metals on mangrove.

7. To establish, quantitatively, the contribution of mangrove forest to the coastal productivity along Pakistan coast and to orient the management accordingly.

3. Participation of Local People:

Top priority must be given to a better understanding of direct human pressures on the mangrove forests, for fuel, fodder and other materials. An energy survey including animal fodder needs to be conducted along the entire Indus delta coast. Furthermore, a study of the camel trade as it imparts the mangroves is urgently required to devise policies to manage the large camel herds.

4. Wild Life:

There is a need to declare the entire coastal zone of Sindh province as "Wide Life Sanctuary" so that all types of hunting and shooting is stopped and the mangrove Wildlife develops in its natural habitat.

3. FISHERIES:

1. Conservation and Management of Fisheries

a. Shrimp and lobster fisheries may be made limited access fisheries. A major part of the shrimp trawling fleet may be diverted to other types of fisheries including gillnetting, longlining, and jigging. Closed season may be observed.

b. Fishing for juveniles of shrimp, lobster and selected fish shall be banned. Use of nets with small mesh such as those used in creek areas for catching shrimp juveniles should be stopped forthwith.

c. Information collecting capabilities should be improved using modern information systems and techniques. This will improve the efficiency and effectiveness of information gathering and dissemination through computerization.

d. Information pertaining to commercially important species in regard to biology, breeding and other aspects of life history should be collected.

e. Introduction of high open bottom in waters deeper than 30 meters. This will also reduce pressure on the dwindling shrimp stocks an increase fish production.

f. Purse seining should be used for pelagic fish in deeper waters (< 30 m) for sardines and anchovies.

g. Gillnetting and longlining for demersal fish should be done on in deeper waters.

h. Fish and shrimp aquaculture should be practiced in marine and brackish waters along the coast particularly in Indus Delta.

2. Modernising Fish Industry and Increasing Fish catch:

a. Incentive should be provided for modernization of existing plants. Custom duties may be relaxed for import of modern machinery for installation in old plants. Similarly plans may be made for setting up of modern fish processing plants especially in less developed areas.

b. Supporting industries such as can-making plants, net and twine-making plants and fishing gadget plants should be established forthwith. Incentives may be provided for setting up such industry.

c. Incentives should be provided for export of value added products. Export of raw material should be discouraged.

d. Quality control systems should be strengthened. Pre-shipment examination should be made mandatory.

3. Specific Recommendations for Development of Balochistan Fisheries:

a. Provision of infra-structure and on-shore facilities to operate fishing industry on sound line for greater productivity. This will result in decreasing spoilage, turn over time, handling and spoilage. Quick disposal and controlled marketing will therefore help in improving socio-economics of fishermen.

b. Training and extension programme, inservice & abroad.

c. Development of boat/engine repair workshops for providing back up services to the requirements of the fish industry, to decrease turn over and transit and thus increase fishing efforts for greater fish production.

d. Improvement of the vocational skills of the fish industry for an accelerated growth of fish industry and thus its production capacity.

e. Improvement of the socio-economics of the fishermen.

f. Improvement of the institutional developmental infrastructure and facilities of the fish industry.

g. Improvement of fish handling, distribution and marketing channels.

h. Opening export channels directly with the adjoining Gulf States.

i. For the improvements of Primary Fish Industry:

i) Improvements by mechanization of boats;

ii) Improvements of the vocational skills of the Fishermen and builders;

vi) Introduction of Electronic Gadgets for finding fish such as the Echo-sounders, fish finders, Omni finders;

vii) Installation of Manual Hydraulic winches to improve upon the hauling and recovery time of the Fishing nets as well as the fish so caught;

viii) Popularizing, Navigational aids, as well as the knowledge on the rules of the road;

xii) Strengthening of Extension Services and training of Fishermen;

xvi) Strengthening of workshop for repair facilities.

4. TOURISM:

a) All commercial & industrial enterprises in Pakistan have a contribution to make to this national industry. Possible tax relief of upto 5%, as for charity, for tourism promotion could well be an incentive to begin with.

b) Foreign investment and investors should be given an open hand with a status equivalent to that of a local investor. Constitutional guarantees though protecting foreign investment should sweeten the deal for initiatives.

c) Economic Objective: The economic objective principles have to be geared on a shelf financing methodology. This in fact means that the private sector must take the lead and with more degree of assistance from preferably non-repatriable foreign collaboration investments.

d) Communication being at the root of economic development for any industry, it is suggested that communicational projects supportive to transport, telecommunication, television and air/sea crafts be freely committed for the support of tourism.

e) The Industrial Investment Schedule must hence incorporate all tourism enterprise as an industry. This should be in form of tax relief and participational commitment which each industrial plan must incorporate.

f) With identification of CITS, instant deregulation of public sector holding must be taken up at hand, so that facilities which exist are passed out to the private sector on lease for fixed revenue to the government.

g) HOTELS, INNS & MOTELS, YOUTH HOSTELS & HOLIDAY VILLAGES

Within the coastal zone establishment/building of Hotels, Inns, Motels and the like should completely be deregularised into the private sector but with rigid laws regulating standards. This is a major support facility for tourism but at the same time, it is essential to keep strict laws on quality of hygiene, service and food as prerequisites.

h) SANCTUARIES & WILD LIFE RESERVES

These areas are of prime importance to environmental control ecological planning. The tourism receipts which support the activity notwithstanding reserves and sanctuaries, must be set up wherever possible throughout the coastal zone in the country with special laws for their security from poachers and preservation.

i) ZOOS/ZOOLOGICAL SITES, SAFARI PARKS

Land essentially has to be allocated in areas in all micro zones possible for the setting up of the above facility. Subject to weather conditions, these areas can mean from mini zoo units to safari parks and/or special animal farms (example alligator farms). This could one day become an export industry as well.

j) CAMPING SITES

Camping sites all along roads and in exclusive areas along the coast and adjacent wilderness, should be marked and leased out. These sites are aimed to support group tourism by schools and colleges and should offer the simplicity of nature, survival with it, and in conditions which can offer exposure to real camp life or coastal village living. Basic amenities of security against criminals, first aid, drinking water, and W.Cs. are the only prerequisites.

k) AQUARIUMS

Much like the Zoos & zoological sites aquariums have a special place as a potential tourist attraction all over Pakistan. The Arabian Sea and the Indus Delta have a lot to offer for public display. Open or natural aquarium sites to see the green turtle and the blind dolphin apart, aquariums should be set up in all micro zones for public education and tourist revenue.

l) COMMUNICATIONS

The role of communication is primary to the pace of optimizing tourist revenue. Telephones, roads, air & rail links and vehicles thereof are basic areas of concentration and it is suggested that master plans to reach all C.I.T.S. should be made with the help of local and foreign consultants and financial plans be so devised that in ten years, the entire CITS network is accessible with public help of labour & money.

m) NATIONAL ARCHIVES AND ARCHAEOLOGICAL SITES

National Archives is our history in record. Archives have an export potential & the matter available in Pakistan is vast with records of civilization extending beyond 6000 years.

n) PARKS AND MARINE PARKS

There are several interesting areas along our coast where Marine Parks can be established with the objectives to attract tourists as well as to conserve some of the rare and endangered marine species found here. The coral reef areas along Karachi, the Mangrove forests of Indus Delta, Miani Hor and Kalmat Khor, the Mussel and Clam beds along Pasni and Gwadur coasts, the Star Fish areas along Jiwani coasts, the turtle, dolphins and sharks along most of Balochistan coast are a few examples.

o) BEACHES

The entire Makran coast is littered with patches of top class beaches. With water based sports near absent such as water skiing, surfing, yachting trolling, fishing, crabbing, sailing, water scootering and ski flying these beaches are non productive almost altogether. All beach sites need identification and they aught to be leased out to the private sector for development into tourist villages with strict laws on pollution and environmental control. A five star hotel on the Sonminani beach may seem absurd, but is well worth. Beaches are a major national asset and for expensive tourism about the most in potential.

p) COMPETING ACTIVITY

To convert the tourism revenue as a support to the national exchequer in real terms, the private sector has to be given a complete free hand by the declaration of this policy marking all macro & micro zones and in them, the sites for the development of C.I.T.S. All an investor should be required to do is go to the area and lease land for the facility.

Tourists entering Pakistan must all be covered by accident & medical insurance and their security of movement and stay by world standards must be developed on war footings.

Free of duty import of tourism support equipment to all CITS Licenses should be allowed on N.R.I. licenses.

5. WATER SUPPLY:

1. The projects for providing drinking water supply and basic facilities for sanitation in the coastal villages and major settlements should get high priority of the provincial governments.

2. The local water resources such as ground water and rain water should be explored to provide drinking water supply to the small coastal settlements in particularly in Balochistan.

3. The small scale solar desalination plants be installed to provide drinking water to remote coastal settlements. The existing solar desalination plant at Gwadur should be improved and its output be increased to a possibly higher level.

4. All major coastal settlements and towns be provided piped water supply through nearest water sources such as dams, reservoirs, check dams, and ground water pumping in the nearby river beds or other sources.

5. Construction of Akra Kaur Dam be expedited to resolve the acute drinking water problems in Gwadur and surrounding areas.

6. The Mirani Dam Project be given due importance and the case should be processed on priority basis to ensure a regular water supply to south-western part of Balochistan coast.

7. A system of regular supply of water be developed for all coastal towns of Balochistan linking the dams, ground water sources, and Karezes.

6. SANITATION:

1. The Government should launch an effective public awareness, education and training programme using news media and other effective means, to educate the public in basic environmental health concepts. The public should always be kept informed about the potential existing and future environmental hazards, and effective measures should be recommended for their protection.

2. Basic health care facilities be provided for the coastal inhabitants under the supervision of qualified medical doctors, including necessary medication. Hospitalization facilities should be made available at convenient distance from larger settlements.

3. Suitable preventive measures including effective vector control methods should be applied to check the prevailing communicable diseases in coastal areas. The infant mortality rate should be reduced by effective immunization and other necessary control methods.

4. Adequate low cost, low maintenance and socially acceptable toilets and washing facilities should be provided for all coastal inhabitants particularly Kachchi Abadis. The steps should be taken to ensure community participation in the planning, construction and maintenance phases of these systems.

5. The possibilities of Marine outfalls should be investigated for the disposal raw/treated sewage from Karachi city into the safe & selected sites at sea and recycling and disposal into the sea through marine outfalls should be given due consideration as long term solution to solve sewage disposal problem of Karachi.

6. Adequate treatment facilities should be provided for treatment of all municipal waste waters in Karachi and other large coastal towns. The quality of effluent should be regularly monitored, and no effluent should be disposed off without proper disinfection.

7. The existing solid waste management programme in Karachi should be improved by providing adequate manpower and required modern equipment. Necessary legislation should be enforced for sanitary disposal of all city refuse and proper maintenance of the disposal sites.

8. Adequate arrangements be made for the proper collection and disposal of garbage and solid wastes in the coastal towns of Balochistan.

9. Public education programmes be conducted to teach and introduce the ways and means and the benefits of keeping good hygienic sanitary habits to the local population in the coastal areas.

7. POLLUTION:

1. Urban Development:

1. Urban planning and investments should be focused on the preservation of coastal environment, amenities, and to improve public health conditions on the coastal beaches and holiday resorts.
2. The probable impacts of construction and creation of coastal recreational facilities such as jetties, piers, boating basins, and breakwaters shouldbe evaluated before construction of these facilities.
3. The existing sewage treatment facilities should be upgraded or the possibilities of new systems to cope with the existing as well as future requirements should be investigated.
4. Adequate treatment facilities should be provided for treatment of all municipal waste waters in Karachi and other large coastal towns. The quality of effluent should be regularly monitored, and no effluent should be disposed off without proper disinfection.
5. Existing practices of open burning of solid waste materials be placed with new and safe disposal techniques for solid waste following standard procedures and developed technology. The plastic waste materials should be dealt separately.
6. The existing solid waste management programme in Karachi should be improved by providing adequate manpower and required modern equipment. Necessary legislation should be enforced for sanitary disposal of all city refuse and proper maintenance of the disposal sites.

2. Industrial Pollution:

1. Serious efforts should be made by the provincial Environmental Protection Agencies to regulate industrial waste discharges to conform to environmental standards for water quality. All industries should treat their wastes to meet safe limits and national/provincial standards.
2. The concept of community Industrial waste treatment plants should be promoted to bring down the cost of the treatment of industrial wastes on a community basis.
3. Environmental Impact Assessment must be carried out for all future industries along Pakistan coast. Environmental and Social Soundness Assessment must be carried out for the siting and operation of coastal installations (industry, power plant, ports, jetties,etc.,) and recreational facilities along the coast.
4. Prepare provincial standards of industrial/municipal waste discharges and water quality standards for the effluents and receiving water bodies along Pakistan coast.
5. Disposal of waste materials should be done following safe techniques. The technology for safe disposal is available in developed and several developing countries which should be acquired by industries and civic authorities. The local expertise available in the country can be utilised to adopt these techniquesfor efficient application under the local conditions. Recycling of waste materials be given due considerations.
6. The existing arrangement for the collection and disposal of toxic wastes and garbage be replaced with a proper arrangement. A special arrangement be made for the collection of garbage, waste materials and oil from ships and boats in the harbours and ports particularly in Karachi harbour.

7. The disposal of toxic waste materials including radio active wastes should be done following standard procedures. The common treatment facilities for such wastes may be built on cost sharing basis by various groups of industries.
8. Establish an effective programme to monitor environmental effects of industrial effluents from the existing industrial units on Karachi coast and coastline of Hub on Balochistan coast.
9. The introduction of new and cleaner technology be encouraged particularly for industries which are producing more pollutants and waste materials. The government should assist such programmes of the industries by providing subsidies or tax holidays.
10. Ensure an effective monitoring of oil pollution for the enforcement of anti-pollution regulations.
11. Strict legislative control should be enforced to immediately stop the disposal of all hazardous industrial waste waters, without proper treatment. Suitable methods for pretreatment and internal recycling of all recoverable wastes, should be investigated and implemented.
12. Stringent regulatory controls should be urgently implemented to control the import, manufacture, sale, use and handling of all biocides and fertilizers in Pakistan. A consultative technicalbody of experts should be formulated to advise on all aspects of the use of biocides. No application or handling of biocides be allowed without necessary training certification and safety equipment.

3. Conservation and Protection:

1. A survey of the coastline should be conducted to prepare an environmental sensitivity ranking of the entire coastline of Pakistan.
2. A list of endangered marine species to be prepared for the coastal waters of Pakistan and proper legislation should be formulated and practiced (e.g. such as is being done for green turtle on Karachi coast).
3. Establishment of marine and coastal parks to protect critical habitat of endangered species. The sandy beaches all along the Pakistan coast are breeding grounds of green turtle. Similarly, the mangrove ecosystem of Indus Delta should be declared coastal parks for the conservation of these ecosystems.

8. COMMUNICATION:

1. A coastal highway be constructed linking all the coastal towns/settlements.
2. All weather roads should be constructed to link a l l m a j o r towns/settlements with the rest of the country.
3. Regular boat/ferry services be established between Karachi and all major coastal towns/settlements.
4. Telephone and postal services be improved and expanded to all coastal towns/settlements.
5. Small Fish landing jetties be constructed at all coastal towns/settlements where at least > 30 fishing boats operate.
6. Mini ports or small Fish Harbours be established at Keti Bunder, Sajan Wari, Sonmiani, Damb, Gadani, Ormara, Gunz, Jiwani.

9. GENERAL RECOMMENDATIONS:

1. Environmental education at school level and public awareness through mass media to practice sanitary waste disposal methods.
2. Baseline studies of the ecologically sensitive areas.
3. Establish an appropriate legislative framework compatible with the local system and traditions.
4. Develop institutional arrangements for effective implementation of environmental legislation.
5. Ensure co-ordination of environmental management.

Annex V C

COUNTRY REPORT - SRI LANKA

THE COASTAL RESOURCES MANAGEMENT

1. INTRODUCTION

The Democratic Socialist Republic of Sri Lanka comprises the main island of Sri Lanka and several small off-shore islands covering an area of 65,610 sq km (25,332 sq. miles) lies in the Indian Ocean between latitudes 50 51' and 90 51' N, longitudes 790 41' and 810 51' E. Sri Lanka has a 1,585 km long coastline. The population of Sri Lanka is 16.806 million of that 70% of the population is concentrated along the West and South West coastal belt. Five cities or towns with populations of over 100,000 are located along the South West coastal belt.

2. PHYSICAL CHARACTERISTIC OF COASTAL ZONE

Nine-tenth of the island consists of crystalline rocks of Archaean age, with narrow belts of sediments. The major part of the coastline of the island, in particular the South of Kokkilai on the east coast, all of the South coast and the West coast up to Colombo, is characterised by rocky head lands.

The coastal zone consists of a diversity of highly productive systems like coral reefs, lagoons, estuaries, bays, seagrass beds, tidal marshes, dunes and beaches and mangrove swamps. These habitats in their natural state act as a buffer against the sea's erosive force.

Coral Reefs

Coral Reefs form two to three percent of the island's total shoreline. Coral reefs are mostly common along the Southern and Eastern coasts from Dondra to Nilavali. Along the Western coast, reefs are rare and occur off Kalpitiya and South of Mannar. In the Northern coast from Point Pedro to Keerimalai.

These coral reefs mostly fringing type occur adjacent to shore (example reefs of Hikkaduwa). Barrier reefs lying some distance from shore and running parallel with it are rare (example reef formations at Vankalai and Silavathurai).

The coral reefs protect the coastline against waves and storms, surge, prevent erosion and contribute to the formation of sandy beaches.

Some of the important reef systems are given below:

Hikkaduwa Reef	Galle	01.6 km (area)
Vankalai Reef	Mannar	04 km (linear)
Arippu Reef	Mannar	07 km (" ")
Silvathurai Reef	Mannar	02 km (" ")
Point-Pedro Keerimalai	Jaffna	10 km (" ")
Nilaveli	Mullaitivu	01-2 km (" ")
Pigeon Island	Mullaitivu	02-3 km (" ")
Coral Print	Trincomalee	02 km (area)
Foul Print	Trincomalee	06 km (linear)
Tennadi Bay	Batticaloa	08 km (" ")
Passekudah-Kalkudah (Vandaloos Bay)	Batticaloa	04 km (" ")

Estuaries and Lagoons

Sri Lanka's estuaries and lagoons are highly productive and support a wide range of diversive organisms. In addition to their natural functions, they also support a wide range of human activities such as disposal sites for sewage and industrial effluents, harbours, recreation, aquaculture, transport etc.

Seagrass Beds

Sea grass beds are abundant along Sri Lanka's coast in shallow, nearshore coastal waters. Locations of seagrass beds and their extents have not been precisely mapped.

Mangroves

Extensive mangrove stands occur in the Puttalam, Batticaloa, Trincomalee, Jaffna and Gampaha districts. They are absent along the South Western, Southern and North Eastern coastal sectors. Some dense localised stands occur in association with Koggala Lagoon and Kalametiya lagoon, the lagoons more or less separated from tidal influence. The estimates of mangrove cover in Sri Lanka, range from a low of 6000 hectares to a high 13,000 hectares.

Barrier, Beaches, Spits and Dunes

The barrier beaches predominate along the Southern and South Western coasts. These barrier beaches isolates lagoons and swamps from the sea. Some of these formations have extensive dunes associated with them as in Kalpitiya. Other barrier beaches are free at both ends and form islands as in Karaitivu.

Most prominent spits occur along the Western and Eastern coasts forming in the direction of long shore drift. Most spits are unstable, regularly shifting position and changing the location of estuarine inlets, example the spit at the Kaluganga estuary. Some extensive spits have been stabilized and are inhabited by relatively large populations.

Prominent sand dunes in Sri Lanka are found along portions of the Southern, North Eastern and North Western coasts. Extensive dune systems stretch between Mullaitivu and Point Pedro and Ambakandawila, Kalpitiya, Kirinda and Sangamakanda points. The formation and persistence of dunes depends on the delivery of sand to the dune by wind and retention of sand moisture and vegetation cover.

Table 1.
Extent of Coastal Habitats by District (in hectares)

DISTRICT	MANGR-OVES	SALT MARSHES	DUNES	BEACHES BARRIER BEACHES SPITS	LAGOONS BASIN ESTUARIES	OTHER WATER BODIES	MARSHES
Colombo	39	-	-	112	-	412	15
Gampaha	313	497	-	22207	3442	205	1604
Puttalam	3210	3461	2689	2772	39119	3428	2515
Mannar	874	5179	1458	912	3828	2371	308
Kilinochchi	770	4975	509	420	11917	1256	1046
Jaffna	2276	4963	2145	1103	45525	1862	149
Mullativu	428	517	-	864	9233	570	194
Trincomalee	2043	1401	-	671	18317	2180	1129
Batticaloa	1303	2196	-	1489	13682	2365	968
Amparai	100	127	357	1398	7235	1171	894
Hambantota	576	318	444	1099	4488	1526	200
Matara	7	-	-	191	-	234	80
Galle	238	185	-	485	1144	783	561
Kalutara	12	-	4	77	87	476	91

Source: CCD Internal Report No. 13: Report on the preparation of maps indicating coastal habitats, 1986.

Note: The project included an area of approximately 2 km inland from the coastline.

Sources of data were existing maps available at the Survey Department and air photographs for some areas. The maps were not ground truthed.

3. COASTAL ZONE MANAGEMENT ISSUES

The objective of coastal zone management is to ensure sustainable and balanced utilization of all living and non-living resources and where possible restore and enhance the environment quality of the coastal zone.

Prior to fifteenth century period, country's civilization was concentrated in the interior and the coastal belt was left as a protective area against cyclone and foreign invaders. Following the foreign occupation, during the last five centuries country's development has been closely related to maritime activities. The benefits of economic development have brought problems in their wake-increasing conflicts over coastal uses and the depletion and degradation of coastal resources.

The environmental issues in the coastal zone are :-

- coastal erosion;
- coral mining;
- sand mining;
- discharge of industrial effluents, sewage and waste water into coastal waters;
- degradation of natural habitats;
- effects of sand bar formation across river and lagoon;
- breaking of the reefs to provide navigation channels and anchorages;
- construction of buildings and other structures without considering the dynamics of coastal behaviour, construction of maritime structures, salt water exclusion schemes without due regard to effect on adjacent coast line;

- discharges from ships, oil slicks caused by spillage from fishing crafts;
- siltation of lagoon systems;
- dynamiting and use of explosives for fishing;
- over exploitation of resources like exotic ornamental fish, certain species of fish;
- clearing coastal vegetation, specially mangrove vegetation for aquaculture and various purposes;
- loss of physical and visual access to the sea.

Coastal Erosion

Coastal erosion is not a new phenomenon to Sri Lanka, since the medieval times, the coastal zone has been subjected to the erosion hazards. Out of the total of 1,585 km coastline, 685 km extending from the Kalpitiya to the Yala National Park bay about 1,750,000-285,000 sq m of coastal land is lost each year. Of this amount, about 95,000-160,000 sq m are lost annually from the 137 km coastal segment that extends from the South of the Kelani river to Talawila (Kalpitiya Peninsula).

The impact of coastal erosion is most severe along Sri Lanka's Western and South Western coasts causing severe other structures. The proportion of each coastal sector that is retreating is in Table 2.

Table 2
Coastal Erosion in Sri Lanka

Sector	District	Coastline in km	Erosion % of coast	Net Erosion m/yr
West	Puttalam	300	30-40	0.2-0.4
	Gampaha	40	60-70	0.9-1.0
South-West	Colombo	40	40-50	0.0-0.1
	Kalutara	40	70-80	0.0-0.4
	Galle	75	70-80	0.2-0.3
South	Matara	55	N.A-90	0.9-1.0
	Hambantota	135	40-50	0.1-0.2
East	Amparai	100	40-50	0.1-0.2
	Batticaloa	100	N.A-60	0.0-0.2
North-East	Trincomalee	210	N.A-40	N.A-0
	Mullaitivu	50	20-30	0.0-0.1
North	Jaffna	275	60-70	0.2-0.3
	Mannar	155	60-70	0.3-0.5
ALL COUNTRY		1,585	45-55	0.20-0.35

(Above erosion/accretion data are based on interviews with long-term residents of respective coastal reaches. Wherever possible the accuracy of these personal experiences have been cross-checked by comparing available maps. these figures should be treated as indicative.)

* N.A : not available

Source : Master Plan for Coast Erosion Management (1986)

Table 3
Activities Contributing to Coastal Erosion in Sri Lanka

Casual Agent	Process	Examples
Beach sand mining	Reduction of sand in beach maintenance system posing possible threats to renewal	Panadura, Lunawa, Angulana, Palliyawatta
River Sand Mining	Reduction of sand in beach maintenance system posing possible threats to renewal	Kalu Ganga, Kelani Ganga, Maha Oya
Inland Coral Mining	Conversion of productive land into waterlogged area	Akurala, Kahawa, Midigama, Ahangama
Collection of Coral from beaches	Reduction of beach nourishment material	Ambalangoda to Hikkaduwa, Midigama, Ahangama & Polhena
Reef breaking	Reduction of reef size, creation of gaps in reef	Ambalangoda to Hikkaduwa, Koggala, Midigama, Kuchchaveli, rekawa, Pasikudah & Nilaveli
Reef dynamiting & breaking for fishery activity	Reduction of reef size creation of gaps in reef	Ambalangoda to Hikkaduwa, Koggala, Midigama, Polhena, Kuchchaeveli, Rekawa, pasikudah & Nilaveli
Improperly sited groynes, harbour, revetments, jetties	Interference with natural sand transport processes	Beruwala Fishery Harbour Kirinde Fishery Harbour
Improperly sited coastal buildings	Interference with dynamics of coastal processes	Hikkaduwa, Bentota, Beruwala, Negombo
Improper removal of coastal vegetation	Exposed are subject to more rapid rates of wind erosion	Palliyawatte, Koggala, Polhena, Negombo

Coral Mining

Coral mining has been a traditional activity and significant percentage of the population in South Western coastal sector. The coral is extracted for the following uses:

- as a building material;
- as a chemical in certain industrial process;
- as a soil ameliorant to reduce acidity in agricultural lands.

The figures regarding the extraction of corals in South Western coastal sector taken in 1984 is given below;

Table 4
Coral collected from Sri Lanka's Southwestern Coastal Sector in 1984.

Location	Amount (in tons)	Percentage of Total Harvest
LAND		
Inland of Coastal Zone*	7,532	42
Within Coastal Zone*	2,868	.16
BEACH	5,377	30
SEA		
From reef	2,282	12
TOTAL	18,059	100

Source: CCD Internal Report No. 3: Socio-economic survey of those engaged in the coral mining industry (from Ambalangoda to Dickwella), 1984.

* As defined by the Coast Conservation Act of 1981.

Coral mining predominate in the South West coastal region where coral reefs play a major attraction in the tourist industry. The life coral reefs in these areas are under threat of extraction. Depletion of coral reefs in these areas would mean degradation of an important element of environmental attraction might affect the development of tourism in those areas.

Sand Mining

Sand is the major source of material supply for the nourishment of beaches in the rivers. Mining and collection of sand from rivers and beaches, decrease the supply of sand available for natural replenishment of beaches. Traditionally sand has been regarded as a free source. Mining of beach and river sand especially in lower reaches of rivers has now assumed critical proportions. This activity is most intensive in the areas close to big towns. Sand mining in the Kelani river also reached the critical level and recently strict regulations were introduced to restrict the mining days and quantity.

Table 5
Location and Estimated Volume of Sand Mining (Puttalam to dondra Head), 1984

	Number of landing sites	Number of cubes removed in 1984	Total %
RIVER SAND			
Name of River			
Kelani Ganga	181	222,771	43
Maha Oya	61	111,720	21
Gin Oya	2	79,445	15
Kalu Ganga	67	46,667	9
Deduru Oya	2	22,896	4
Gin Ganga	41	21,563	4
Nilwala Gang	7	2,005	1
SUB TOTAL	363	507,866	97
SEA SAND			
Name of Landing Centre			
Nalluruwa	15	3,756	
Thalpitiya	6	2,988	
Ratmalana-Weliwatte	3	2,592	
Angulana-Moderawatte	8	1,716	
Malanwatuna	3	1,422	
Panadura Estuary	2	1,080	
Ratmalana-Walauwata	5	768	
Egoda Uyana	3	672	
Lunawa	3	576	
Wellawatte (Hikkaduwa)	2	392	
Lunawa (Beach Road)	1	240	
Madampegama	1	104	
SUB TOTAL	52	16,306	3
GRAND TOTAL	**415**	**524,172**	**100**

* Note: a cube=100 cubic feet or approximately 3 cubic meters;
Source: CCD Internal Report No. 7: A Census of the exploitation of sand and seashell resources in the Coastal Zone of Sri Lanka. (1984).

Discharge of Industrial Effluents, Sewage and Waste Water

Discharge of industrial effluents into river systems and coastal water bodies have caused grave concern. The factories like textile mills, confectionery, factories producing asbestos, chemicals have directed the effluents to Bolgoda system in the Ratmalana area in the Colombo district has changed the whole Bolgoda Lake system which now appeared as a dead system.

The public sewage system outlets dumps the raw, untreated sewage into coastal waters. These discharges create health problems, destruction to aesthetic views and other environmental problems.

Degradation of Natural Habitats

The natural habitats like mangrove swages, marsh areas and other wetlands, are indiscriminately destroyed for various activities.

The acuteness of the problems in the coastal zone has paved the way to the establishment of the **Coast Conservation Department**, which has drawn up Coastal Zone Management Plan, providing strategies and guidelines for the better management of the coast.

4. INSTITUTIONAL AND LEGISLATIVE FRAMEWORK.

Prior to 1975, the management of coastal areas of Sri Lanka were governed by the general legislations which are not specific to the coastal areas.

These legislations were :-

i) The Housing and Town Improvement Ordinance No. 19 of 1915;
ii) The Town and Country Planning Ordinance No. 13 of 1946, Act No. 9 of 1950, Act No. 29 of 1953, Act No. 10 of 1955, and Act No. 22 of 1955;
iii) The Crown Land Ordinance No. 8 of 1947, Act No. 9 of 1947 and the Act No. 13 of 1949;
iv) Tourist Development Act No. 14 of 1968;
v) Water Resources Board Act No. 29 of 1964;
vi) Fisheries Ordinance of 1940;
vii) Chank Fisheries Act (1890/1956)
viii) Mahaweli Development Board Act No. 14 of 1970.

These legislations were drafted for variety of different needs aroused at those times, and incidental provisions of these acts cover some aspects of the coastal zone management. They are not comprehensive or specific enough to manage the large coastal line. Another draw back was the fact that the implementation of these acts were spread over several governmental organisations, which were established for various purposes. There were no co-ordination in the implementation process or co-operation during the implementation. So the implementation of these laws created conflicts and overlapping.

The need for the separate legislation was felt and drafting a new Act commenced in 1972. The draft Act was presented in Parliament as a Bill by the Minister of Shipping, Aviation and Tourism in 1976. Before this Bill could be taken up for discussion, Parliament was dissolved in 1977.

Then the subject of coast conservation was transferred to the Ministry of Fisheries in January 1978 as a result of a decision by the Cabinet of Ministers and a new division was established to handle this subject. This division was structured in three branches namely: Coastal Engineering Research Centre, Coastal Works Branch and Planning & Development Branch.

Finally, a separate legislation was enacted by the Parliament to establish separate institution, **the Coast Conservation Department** to manage the coastal zone. The Act No. 57 of 1981, is purpose directed and different to some of the parallel legislation in the sense that powers, functions and authority vested by it are specifically directed towards the clear objective of coast conservation. It is structured as follows :-

Part I - Administration

a) Vests the authority for administration, management, control and custody of the coastal zone in the Republic.
b) Clearly defines the duty and functions of the Director and limits for delegation of powers.

c) Establishes a Coast Conservation Advisory Council with representation in the Council by several concerned Ministries, Department, voluntary organisations and, special interest groups and defines its functions as that of in advisory and review authority.

Part II - Coastal Zone Management

a) Conduct of a survey of the coastal zone and the preparation of inventories a mandatory requirement.

b) Makes the preparation of a Coastal Zone Management Plan within a period of three years a mandatory requirement.

c) Provides for interim guidelines and criteria until the coastal zone management plan is prepared.

Part III - Permit Procedure

a) Details the procedure for permit applications and details condition for issue of permits.

b) Empowers the Director to call for Environmental Impact Assessments in respect of development projects where such assessment is deemed necessary and provides for inviting public comments on such assessments.

c) Empowers the issued of conditional permits and authority for varying the conditions attached to a permit.

d) Sets out an appeal procedure.

Part IV - General

a) Sets out certain transitional provisions.

b) Grants powers of entry into land within the coastal zone to the Director and his officials for discharge of their duties.

c) Empowers the Director to call for information.

d) Prescribes punishment for violations of the Law.

This Act giving following important provisions:-

- Establishes horizontal links between this Act and other parallel legislation such as the Urban Development Authority Act.
- Empowers the Director to order demolition of unauthorised structures.
- Makes provision for some measure of control over situations where stability and quality of the coastal zone is affected as a result of activity outside the zone.
- A uniform procedure for permit applications that does not distinguish between development activities undertaken by private and state sectors.
- The following institutions also having mandate for the management of the coastal resources and co-ordinate with the Coast Conservation Department in the management aspects.

Central Environmental Authority

The National Environmental Act No. 47 of 1980 established the Central Environmental Authority (CEA) in 1981. Initially, the CEA functioned as a policy making and co-ordinating body. The amendment of 56 of 1988, transformed the CEA to an implementing and enforcement agency. The provisions are made to the protection, management and enhancement of the environment, prevention, abatement and control of pollution.

The CEA gazetted the National (Protection & Quality) Regulations No. 1 of 1990 to control discharges in accordance with the standards and criteria specified in the schedule 1 of the regulations. Schedule 1 includes the Tolerance limits for Industrial and Domestic effluents Discharged into Marine/Coastal areas. (Table 6) and inland surface waters.

Table 6
Tolerance Limits for Industrial and Domestic Effluents Discharged into Marine Coastal Areas.

No.	Determinant	Tolerance Limit
1.	Total Suspended Solids, mg/l, max	
	a) For process waste water	150
	b) For cooling water effluents	Total suspended matter content of influent water plus 10 per cent.
2.	Particle size of:	
	a) Floatable Solids, max	3 mm
	b) Settlable solids, max	850 micro m
3.	PH range at ambient temperature	6.0-8.5
4.	Biochemical Oxygen Demand (BOD) in five days at 20 C, mg/l, max	100
5.	Temperature, max	45 C at the point of discharge
6.	Oils and grease, mg/l, max	20
7.	Residual Chlorine, mg/l, max	1.0
8.	Ammoniacal Nitrogen, Mg/l, max	50.0
9.	Chemical Oxygen Demand (COD), mg/l, max	250
10.	Phenolic compounds (as per phenolic OH) mg/l, max	5.0
11.	Cyanides (as CN), mg/l, max	2.0
12.	Sulfies (as S), mg/l, max	5.0
13.	Fluorides (as F), mg/l, max	15
14.	Arsenic (as AS), mg/l, max	
15.	Cadmium (as Cd) total, mg/l, max	2.0
16.	Chromium (as Cr) total, mg/l, max	1.0
17.	Copper (as Cu) total, mg/l, max	3.0
18.	Lead (as Pb) total, mg/l, max	1.0
19.	Mercury (as Hg) total, mg/l, max	0.01
20.	Nickel (as Ni) total, mg/l, max	5.0
21.	Selenium (as Se) total, mg/l, max	0.05
22.	Zinc (as Zn) total, mg/l, max	5.0
23.	Radio active material	
	a) Alpha emitters, qc/ml, max	10
	b) Beta emitters,qc/ml, max	10
24.	Organo - Phosphorus compounds	1.0
25.	Chlorinated hydrocarbons (as CI) mg/l, max	0.02

Note 1: All efforts should be made to remove colour and unpleasant odour as far as practicable.

Note 2: These values are based on dilution of effluents by at least eight volumes of clean receiving water. If the dilution is below eight times, the permissible limits are multiplied by one-eighth of the actual dilution.

The National Aquatic Resources Agency

The National Aquatic Resources Agency was established under Act No. 54 of 1981 to the development, management and conservation of aquatic resources in the inland waters, coastal wetland and off-shore areas and for the formulation of national policies relating to the management and development of the national aquatic resources of Sri Lanka.

5. THE MANAGEMENT APPROACH

The basic approach to the management of the Coastal Zone were evolved from the following management principles:

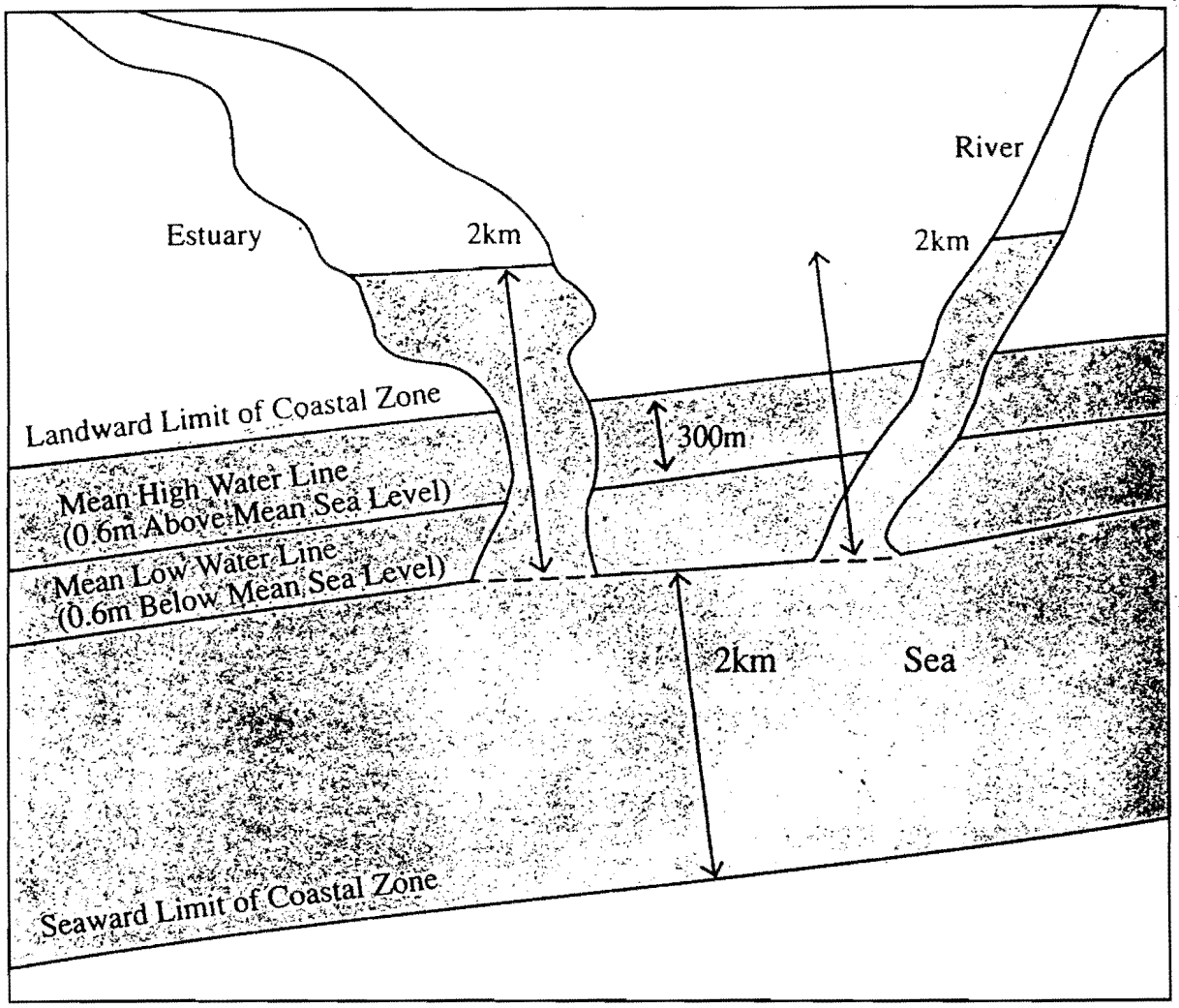
* The Coastal Zone is a fragile and vulnerable area that requires integrated management of human activities that affect natural resources.
* The Coastal Zone is the common heritage of the national to which every citizen has right of access.
* The control, custody and management of the Coastal Zone vested in the state.
* The State accepts responsibility to maintain and where possible to improve the quality of its Coastal Zone by means of regulation, acquisition, investment or other strategies as may be consistent with the needs and interests of this and future generations.

  In accepting responsibility for the management of the Coastal Zone, the state and its agents recognize that there are limits to that management responsibility. The Coastal Zone of Sri Lanka has ecologically vulnerable and inherently unstable areas, subject to natural processes as well as human intervention. Not all impacts of natural processes can be controlled and such attempts may result in social economic and environmental costs that are prohibitative.
* The Coastal Zone Management Plan should be an instrument to promote the socio-economic well being of coastal communities in particular and Sri Lankan community in general.
* Direct regulations by the Coast Conservation Department will occur only in the Coastal Zone as defined by the Coast Conservation Act.

DEFINITION

The Coastal Zone is defined as "area lying within a limit of three hundred meters landwards of the mean high water line and a limit of two kilometers seawards of the Mean Low Water Line and in the case of rivers, streams, lagoons on any other body of water connected to the sea, either permanently or periodically, the landward boundary shall extend to a limit of 2 km measured perpendicular to the straight base line drawn between the natural entrance points thereof and shall include the waters of such rivers, streams and lagoons or any other body of water so connected to the sea."

Figure 1.1
The Sri Lanka Coastal Zone



The "Coastal Zone" is defined in the Coast Conservation Act as. . .

"That area lying within a limit of three hundred meters landwards of the Mean High Water Line and a limit of two kilometers seawards of the Mean Low Water Line and in the case of rivers, streams, lagoons, or any other body of water connected to the sea either permanently or periodically, the landward boundary shall extend to a limit of two kilometers measured perpendicular to the straight base line drawn between the natural entrance points[1] thereof and shall include waters of such rivers, streams and lagoons or any other body of water so connected to the sea."

[1]By definition, the natural entrance points are defined with respect to the mean low water line

In accordance with Act and the above principles a comprehensive **"Coastal Zone Management Plan"** (CZMP) was prepared and the approval of the Cabinet of Ministers also received in April 1990.

Coastal Zone Management Plan

The main objectives of the plan are to:

- Identify coastal problems that need to be addressed;
- Identify research activities of immediate importance;
- Present the CCD's management programme to address these problems.

The Plan deals with the following coastal problems:

- Coastal erosion;
- Loss and degradation of natural coastal habitats;
- Loss and degradation of archaeological, historical and cultural sites.

The Regulatory Mechanism:

The management approach in the CZMP is achieved through the following regulatory mechanisms:

- Permit Procedures;
- Environmental Impact Assessments;
- Variable Setbacks.

Permit Procedures

The permit is required for the following activities in the Coastal Zone:

- Residential and other structures;
- Commercial and Industrial structures;
- Recreational structures;
- Harbour structure and navigation channels;
- Public roads, bridges and railway lines;
- Shoreline protection works;
- Sewage treatment facilities;
- Aquaculture facilities;
- Waste water discharge facilities;
- Disposal of wastes;
- Dredging;
- Filling;
- Grading;
- Mining;
- Removal of sand or seashells;
- Removal of vegetation;
- Removal of coral for research purpose;
- Breaching of sand bars;

The following activities may be engaged without a permit within the Coastal Zone:

- Fishing;
- Cultivation of crops;
- Planting of trees and other vegetation;
- Construction and maintenance of Coastal Protection;
- Works by the CCD in accordance with the **Coast Erosion Master Plan.**

Environmental Impact Assessments (EIA

An EIA will be required in case of development activities that are considered to have significant impacts on the coastal environment.

According to the guidelines provided by the CCD the EIA report should include the following chapters:

- Description of the proposed activity;
- Site description;
- Description of potential Impacts;
- Proposed mitigation measures;
- Additional requirements.

Variable Setbacks

A setback is defined as an area left free of any physical modification. Setback standards for construction in the coastal zone is listed by the CCD.

Coast Erosion Management - Master Plan

This is an integral part of the Overall Coastal Zone Management Plan. The scope of the Master Plan is:-

- To compile organize and synthesise available material which is required for understanding of coastal processes and identification of critical areas prone to erosion.
- To recommend and initiate such general investigations and studies which are considered required to fill gaps in existing information and knowledge.
- To formulate approaches/projects concepts for works in erosion problem areas and recommend approaches towards implementation of recommended actions.
- To carry out a cost assessment of the protection works recommended and prepare time schedule/priorities for implementation with due consideration to funding and construction resources.

Future Management Approaches for Coastal Resources

* Extend the present Coastal Zone to cover the critical coastal habitats.
* Acquisition of land within the Coastal Zone.
* Draw up programmes for water quality monitoring.
* Draw up programmes for erosion investigation (current wave pattern.)
* Increase public awareness and education programmes to get the support of the people.
* Obtaining the co-operation of the Non-Governmental Organisations in the management of critical natural habitats.

Annex VI A

CASE STUDY - MALDIVES

Maldives is a group of coral islands lying in the Indian Ocean. The length from north to south is 753.6 km and from east to west is 118.1 km. The closest neighbours are India and Sri Lanka. The group comprise of 1300 coral islands of which 200 are inhabited. Each island is surrounded by a shallow lagoon which is enclosed by a coral reef providing protection from the hazards of the sea. Hundreds of these islands along with other coral growth form an atoll.

The weather is dominated by two monsoon periods, the south west monsoon from April to November and the north east monsoon from December to March; temperatures range from 25° - 31 C with an annual mean of 28 C; rainfall averages 1927mm per annum; and sunshine hours average around 250 per month.

Ocean currents generally flow eastwards during the south west monsoon; westwards during the northeast monsoon. Information on tidal currents is very little as is information on the hydrographic conditions which are characterized by a seasonally fluctuating layer of relatively saline water from the Arabian Sea (30%) and less saline water from Bay of Bengal (34%).

The vegetation of the islands is mainly coconut palms with some robust shrub species. The coconut tree have an extensive roof network and are crucial to maintaining the integrity of the poor soils and preventing erosion. Considerable amount of vegetation have been removed during the development of a number of islands which has led to soil erosion.

The Environment Section of the Ministry of Planning and Environment is the implementing agency of the government responsible for both the operational aspects of environmental management and planning and the formulation and implementation of overall policies and directions.

At first the Environment Section of the Ministry of Planning and Environment was part of Ministry of Home Affairs. Late in 1988, in recognition of the importance of environmental issues to the sustainable development of the Maldives responsibility for environmental matters was transferred to the old Ministry of Planning and Development, which was renamed Ministry of Planning and Environment.

Following the development of the National Action plan in late 1988, His Excellency President Maumoon Abdul Gayoom announced in June 1990 the formation of the Environment Research Unit, within the Ministry; as a mechanism to implement the National Action Plan and associated work programme.

Due to cross-sectorial nature of environmental issues which arise in connection with all aspects of development the need for inter-departmental and cross-sectoral co-ordination of activities is of great importance. In recognition of this fact the Government established the National Council for the Environment, which following enabling legislation became the National Commission for the protection of the Environment.

Thus the Commission acts as the highest level advisory body on environmental matters. In addition to the formal Government Constitutions dealing with environmental matters, the most active in the environment sector is the Forum of Writers on Environment, which is already promoting environmental awareness in the country through various print media. And also every week there is a radio programme based on environment to create environmental awareness in the country.

The population of the Maldives is 190,000 with a density of 650 per sq.km, which is one of the highest population densities in the world, which has contributed to the current environmental problems. The population is aggregated on 200 of the islands. High population growth and urban drift have exacerbated the current problems. Traditionally the Maldivian Society is one of the low mobility and strong attachments to individual atolls and islands associated fishing grounds.

The economy of Maldives is based on 3 export activities; fishing, tourism and international shipping. Industrial activity, including the processing of natural resources is still in its infancy and the two main contributors to industrial output are fish canning and garment manufacture.

The coral reef of the Maldives are one of the most diverse marine ecosystems to be found elsewhere in the world. This area is unique not only for the assembly of some 200 coral species and more than 60 genera, but also the diversity of the fish species (more than 1000 species) which inhabits the reefs. Many species of corals and fish in the Maldives are yet to be identified.

The elevation of most of the islands in Maldives is no more than 2m and many areas less than 1m above mean sea level. It has been predicted that sea level rise in the Maldives by the year 2030 will be some 18cm which will result in the erosion of the islands. There is considerable concern over the future of the Maldive Islands and a number of International Organisations are evaluating the implications of sea level rise. Recent flood disasters of 1987 and 1988 experienced in the Maldives underline the need for urgent action to safeguard the islands.

The current environmental problems and the problems we have faced stem in large, apart from the high population density (748/sq. km) which is aggregated onto relatively few islands in each atoll. The problems of a number of more densely populated islands have reached critical levels in terms of environmental management, in particular the management of fresh water resources; coastal infra structure development; solid waste disposal; rain water runoff; sewage disposal and population pressure.

In all areas and atolls environmental problems are locally severe and the consequence of environmentally unsound developments have been recently highlighted by the wide spread impacts of storm generated long distance swells during 1987 and 1988 which caused wide spread flooding of reclaimed areas and weakening and / or destruction of coastal structures.

Live coral mining for road surfacing and construction is considerably reducing the capacity of the reefs to absorb ware energy and altering local current and sediment patterns.

Land reclamation, which is wide spread through out the country particularly on the oceanic sides of the islands, increases vulnerability.

Aquifer depletion and saline water intrusion are a problem for nearly all inhabited islands and a particular problem in islands with high population densities.

THE COASTAL ZONE

As Maldives consists of small islands, one side is the lagoon ward side and the side opposite - the ocean ward. Normally the lagoon ward side are deeper. A narrow strip of pure coarse coral sand encircles the island which risen from the ocean around. The lagoons of these islands are full of delicate corals not less than 200 species, coloured fish more than 1000 species and there are molluscs more than 5000 species which make our seas and lagoons one of the richest. The islands are low lying with an average elevation of 2m above mean sea level. Because Maldive Islands are exposed to the waves that are generated over vast expanses of ocean including the middle and high latitude Southern Ocean waters where several severe storms are very common, this gives way to flooding.

CURRENT PROBLEMS

Insufficient land to support such a big population has made it necessary to reclaim the lagoon - where the waves destructive energy is reduced - leading to a major flooding (though occasionally). During April 1987 and June 1988 we experienced a such flooding. Male', the capital got affected the most because about 1/3 of Male' is reclaimed. Also due to the dense population in Male', its ground water is affected. About 110 - 120 litre / head daily has depleted Male's fresh water-lens leading to a very high salinity rate.

COASTAL EROSION

Out of all the environmental problems our main concern is on the factors that affect the erosion of our coastal areas and on the reasons for that.

It is believed that each human interference with the existing hydraulic regime (from this the island itself is one of the products) will surely result in a change of the island's dynamic behaviour and of the island's average equilibrium shape.

Dumping solid wastes, plastic and polytheist products and sewerage have effected the growth of the natural reef which saves the island from possible, destructive forces of the waves. But these actions are still continuing and developing in some islands. Meanwhile Male' is on the track of solving this problem. Sand mining in Maldives' is very common. Since it is still one of the major building materials, mining of sand is so far uncontrollable but laws have been made forbidding the sand mining from the inhabited islands in order to save the coastal areas and to avoid erosion. The next major building material is coral. Coral mining is also very common. Heavy coral mining in Addu Atoll has eroded a great deal of the coast of those islands. The government has also banned taking corals from the house reefs of the inhabited islands. The reason for limiting of sand and coral mining without banning is that because some people will be affected by that. But the difficulty to provide corals from distant reefs is discouraging the people forcing them to shift to alternatives like cement bricks. Fortunately, on the other hand traditional 'uva' a building material we make by burning coral aggregate have been replaced by imported cement.

In Maldives, coral groynes and jetties which directly disturb the current pattern are very common. Active erosional actions in some of these islands have removed palm trees and other coastal crops after eroding the coast. In addition cause ways between some islands especially in far south, Handhdhummathi and Addu Atoll have given way for coastal erosion to such islands. Therefore actions to overcome all these problems must be taken immediately.

THE SMALL STATES CONFERENCE ON GLOBAL WARMING AND SEA LEVEL RISE

Having regarding the possibility of climate change and global rise in temperature and concerning deeper on the issue of global environment change and its possible tragic effects especially the nightmare of sea-level rise, our government has started taking necessary steps. In order to seek international co-operation and attention to defend the low-lying small coastal states and the islands like Maldives from the dangers posed by climate change, Global and sea level rise we have already taken steps.

The Small States Conference on Global Warming and Sea Level Rise is an example for this. Thirteen other small states like us joined this conference. We were able to bring forward a declaration on this matter. On this declaration there was the urgent need to

(a) establish an Action Group, initially comprising of representatives from the Caribbean, South Pacific, Mediterranean and the Indian Ocean regions, to oversee the implementation of the decisions and recommendations of the Small States Conference on Sea Level Rise, to coordinate a joint approach on the issues of climate change, global warming and sea level rise, and to pursue and follow up on global and regional response strategies;

From the observation surveys and studies we have made and from other various data we know that coastal erosion in the Maldives is due to our own actions. Coral and sand mining from the inhabited islands, building coral jetties, groynes and causeways especially constructed affecting the current patterns are the major reason for coastal erosion. In addition the rise in global mean sea level is further encouraging the process.

RECOMMENDATIONS

The Republic of Maldives is one of the most low-lying nations in the world. If sea-level rise of the order at the rate predicted many islands will not remain above water without artificial protection. There are islands on which it is already necessary to protect the coast from erosion. There are other islands on which coastal engineering structures have been built and where continued erosion or deposition is giving rise to some concern. Many of these need, and some are already receiving attention.

The erosional actions we are currently experiencing is expected to be continued or might get even worse if this process in continuing. Fortunately, all such actions are getting under control.

But in addition the following recommendation should be noted.

1. The Environment Section in the Ministry of Planning and Environment should start major public awareness programmes in order to educate the reasons for and the solutions for coastal erosion.
2. Even strict rules and regulations must be made to the law violators of general public. The tourists who visit must also be informed about the possible damages and effects that might occur if they disturb the coral growth and recovery while diving or snorkeling. Also rules and regulations must be made on this matter.
3. A major role by the government in the easy provision of an alternative like, cement bricks for building materials. eg : deduction on import duty, for cement bricks etc.
4. Government to prepare a reliable, Environment Impact Assessment before starting each project that might relate to our coastal areas in any way.
5. Total ban on coral and sand mining from identified areas.
6. Building of jetties should be only on piles so that flow of current and waves are not restricted.
7. Planting of trees should be encouraged like new and special attention to be paid to beach fringing plants and shrubs.

Annex VI B

CASE STUDY - PAKISTAN

ENVIRONMENTAL SURVEY OF KARACHI COASTLINE FOR THE KARACHI COASTAL ZONE MANAGEMENT AND PLANNING PROJECT

SUMMARY

The "Environmental Data Survey of Karachi Coastline" was conducted by National Institute of Oceanography as a contract study awarded by KDA/UNCHS/UNDP under a subcontract to their joint Project (Pak/88/001) entitled as "Karachi Coastal Zone Management and Planning Project." The acquisition of the environmental data of the coastal area of Karachi was considered essential by the planners to provide some basic inputs to the process of planning and designing of recreational facilities and coastal development projects in the area. The Environmental Data Survey is a component of the KDA project on Karachi Coastal Zone Management and Planning sponsored by UNCHS/UNDP and Government of Pakistan. The environmental data survey project was designed to conduct survey of the environmental conditions of the coastal belt of Karachi city in order to generate site specific baseline data required for the preparation of a coastal zone management plan. This type of plan is needed for the Beach Development Programme of the Master Plan and Environmental Control Department (MPECD) of Karachi Development Authority (KDA).

The main objective of the Environmental Data Survey Project was to prepare a comprehensive report on the coastal environment of Karachi coast to serve as a baseline data report for use by Coastal Zone Management and Planning Project in particular and for all future coastal development projects for Karachi Coast in general. This was to be achieved by compiling the available data and to generate essential environmental data to fill in the gaps of information for developing a picture of the seasonal pattern of various physico-chemical and ecological parameters of the coastal environment of Karachi city. The coastal environmental data is required to develop environmentally safe and sustainable coastal development projects, recreational facilities, and better land use planning for the coastal zone. The environmental data of the coastal area is particularly useful to identify the relative sensitivity and environmental suitability of the various coastal sites to the proposed future land use planning and specific development projects. The environmental data collected has to be categorized into various sets of environmental/ecological characteristics of the beaches and coastal waters to define the relative sensitivity of the shoreline types to urban developments in the coastal zone and recreational facilities and to identify the key ecological habitats, conservation issues with reference to exploitation of natural resources.

The study was designed in two phases covering 12 months. During the first phase, the state of the coastal zone of Karachi is described on the basis of the existing data. The data have been collected on the present levels and intensities of various physico-chemical, oceanographic and geological processes affecting the coastal environment and presented in the report covering phase-1. The present report covers the Phase-2 of the study. During this phase, the data on the time series of the various oceanographic factors has been collected and all the relevant data/information available has also been grouped and synthesized to prepare the time series. This report also updates the information presented earlier in the environmental Data Survey Technical Report No. 1 submitted under Phase-1. The present report describes the physico-chemical and ecological characteristics of the coastal belt along Karachi to determine the status of marine environment and to record baseline conditions. The emphasis was laid to record various parameters for monitoring water quality and marine pollution in the coastal waters.

The basic features and specific characteristics of coastal environment and associated Oceanographic characteristics of the Karachi coast are described under the following main categories.

1. Open Coastal Waters;
2. Backwaters and Estuaries;
3. Creek areas.

The basic physico-chemical features and ecological characteristics of the above categories including the local variations are described in detail. The water quality and parameters for pollution monitoring of the coastal belt has also been described in detail. The areas which are highly polluted and need immediate attention, include Karachi Harbour waters including Karachi and adjacent areas, Chinna Creek and Boating Basin area, Gizri Creek area, Korangi Creek area and Hawkesbay Backwaters. The polluted beaches include Clifton Beach and Sea View Beach.

The potential of the major coastal resources of the coastal areas have been assessed and the need for their environmental management is stressed. The guidelines for their management are provided as recommendations. The coastal environmental along the coastal areas have the following major issues:

The main areas where the environmental management and socio-economic development objectives have to be merged together, include development of infra-structure for basic industries, management of coastal forests, and fisheries, water supply and sanitation, protection of coastal environment from pollution, development of basic communications such as all weather roads, fish landing jetties, fish harbours and mini ports, electricity, and facilities for introducing and developing tourism in coastal areas.

The Karachi coastal zone lies in the north-eastern corner of the Pakistan coast bordering the Northern Arabian Sea. The coastal oceanographic features of the Karachi coastal zone are therefore, very much under the influence of the oceanographic characteristics of the Northern Arabian Sea. The unique oceanographic features of the Northern Arabian Sea such as the high salinities, low precipitation, high evaporation rates, reversal of seawater circulation during the two monsoon periods and the upsloping of the oxygen minimum layer, high primary production rates, prevail all along the coastal and nearshore waters of the Karachi coastal belt. However, due to the shallow depths of the inshore and backwaters, certain factors such as turbulence, turbidities, high suspended solids, littoral drift, and organic and inorganic pollutants are more pronounced in the coastal waters within the coastal zone of Karachi.

The coastal belt has two distinct units - the west coast and the southeast coast. The west coast with rocky shores, sandy beaches, backwaters and estuaries extends from Hub River Fall up to the Karachi Harbour area. The southeast coast consists of creeks of the north-western Indus Delta and inshore waters with tidal mud flats and creek channels. The geomorphological features of the coastal belt including the dominant shoreline features have been outlined. The data on the ground water resources within the coastal belt indicate presence of limited amount of slightly saline waters and a possibility of extracting ground water for the household works and other consumers. The data on the composition of the nearshore seabed, underwater profiles and geological resources (seasalt, gravel, sand and clay) of the coastal area have been described. The coastal hazards identified in the report include the possibility of the occurrence of moderate earthquake and the risks involved with the sea level rise in the area and the local erosion and siltation problems.

The climate of the coastal belt is hot and arid with an average rainfall of less than 200 mm/year and is usually restricted within a short spell of 5 to 10 rainy days, resulting in flash floods. The area is under the influence of monsoon winds. The winds up to 30 knots are common during south-west monsoon (May to September) period, but the probability of the occurrence of cyclones and storms is very low. The humidity is usually very high and range between 60 - 80% during south-west monsoon while the north-east monsoon (December - January) represent dry period. The sunshine is 100% most of the year except during south-west monsoon period which represents cloudy weather most of the time. The mean annual air temperatures range between 9 C to 38 C.

The mean annual seasurface temperatures for the open sea along the coast, range between 20 C to 30 C, while the seawater temperatures at about 10 meters depth in the coastal belt range between 18 C to 29 C. The seasurface salinities range between 33 ppt to 37 ppt per year, while at 10 meters depth, the range is 35 ppt to 37 ppt. The seawater salinities at the surface may drop to 28 ppt in the near-shore area for a few days during the rainy season. the seawater surface temperatures in the backwaters and creeks, range between 16 C to 31 C during the year. The seawater surface salinities in the creeks are usually high (36 ppt to 40 ppt for most of the year, except during rainy season when it drops to below 30 ppt.)

The seawater circulation pattern along the coastal belt is such that it moves in the clockwise direction during the south-west monsoon, in anticlockwise direction during north-east monsoon period and a mixed type of circulation with dominant direction depending upon the impact of prevailing wind system over 2-3 days at a time. As a result of topography and semi-diurnal tidal oscillations, there are several small gyres that develop along the coast. Out of these, one big gyre develops along Hawkesbay area, while the second develops opposite clifton and Defense area coastline. The direction of the seawater circulation in these gyres reverses with the reversal of the monsoon conditions. these local gyres are responsible for the initial mixing of the polluted waters of the Karachi Harbour and Gizri/Korangi Creeks with the open seawater.

The records of Mean Sea Level (MSL) changes over a period of 150 years within the coastal areas indicate a rising trend with an average rate 1.1 mm per year. The waves height in the coastal belt are usually 1.5 - 2.5 meters, while during the south-west monsoon periods, waves up to 4 meters significant heights are common with a maximum of 5 meters. The tides in the coastal belt are semi-diurnal with a tidal amplitude of about 4 meters. The tidal streams are very prominent in the circulation of water in the backwaters and creeks. The currents in the ebb tide are stronger than during flood tides, thus help in the flushing of backwaters and creeks over an average of 5 to 10 tidal cycles. The seawater currents along the open coast have an average speed of less than 1 meters per second and westerly direction during south-west monsoon, while easterly direction during north-east monsoon period. The littoral drift along the coastal belt has been assessed to be very high particularly during south-west monsoon period. It is estimated that on the average about 3 to 5 million metric tons of fine to coarse sand moves from one end of the intertidal and nearshore area of littoral zone. An average of about 0.1 to 0.5 metric tons of fine sand and silt gets eroded/deposited per meter square per year at some places along the coastal belt. The mean direction of littoral drift on the western coast is from west to east, while on the southern coast is from east to west. The surface drift follows the pattern of prevailing wind direction. the siltation and erosion problems are severe along the open coast have been marked. The severe erosion is taking place at some places along the open west coast (Hasan Point to Pacha, and Paradise Point to Western Buleji) and at various places along the deltaic creeks particularly along Budo Island. The siltation rates are very high in the area. It is about 3 million metric tons per year in the Port Qasim approach channel area and approximately 1 million tons per year in the western coastal areas.

The coastline of Sindh province is about 300 km long extending from Hub River in the west to the Sir Creek in the east and cover the entire delta of Indus River. There is a coastal belt of Sindh covers about 300 x 25 sq. Km area which extends up to 25 Km offshore from the coastline. Sindh coastal areas produce about 70% of total annual fish catch (about 400,000 metric tons) from marine areas of Pakistan. Out of which, about one third of the fish catch comes from the coastal waters of Karachi and shelf adjoining creeks near Karachi. The traditional fishing grounds are located up to a depth of about 30 meters within about 5-15 km offshore off Indus Delta and Karachi coast. In addition, the creek system of Indus Delta and the backwaters of Karachi are also used as fishing grounds by local fishermen. The fisheries industry in Karachi coastal belt is developed to some extent because of the existence of infrastructure facilities, such as a fish harbour, processing industries and availability and maintenance facilities of fishing gears and boats, etc.

The fisheries of the Karachi coastal belt is largely influenced by the fisheries of the Indus Delta. The continental shelf along Sindh coast is broad and extends from 80 up to 110 km offshore from the coastline. The shelf has sand silt and muddy bottom which is good for trawl fishing. The coastal fisheries of Karachi is mainly for small pelagic fish species, shrimps, demersal fish species and small scale fisheries in backwaters and estuaries. The main fishing activities are mostly carried out along the coastal belt spread from 2 to 10 km offshore, although some fishing is also done up to 15020 km offshore. There is also some potential for developing non conventional fisheries such as mollusks, crustacean and seaweeds, etc. along the coastal belt.

Karachi and its coastal zone is the most industrialised part of Pakistan and about 60% of the industries of Pakistan are located within this area. There are four major industrial complexes located in the coastal belt of Karachi. Out of these, three are located within the limits of Karachi District and one adjacent to Karachi on Balochistan coast. These industrial complexes are Singh Trading Estate (SITE) in the north and north-west of Karachi, Landhi Industrial Trading Estate (LITE) and Korangi Industrial Area (KIA) in the south and south-east of Karachi, and the West Wharf Industrial area in the centre of the city close to the Karachi Port. The Hub Industrial Trading Estate (HITE) is located in Hub on the Balochistan coast adjacent to Karachi District.

The Marine pollution problems are most severe on the coast of Karachi. The levels of existing marine pollution along the coast of Karachi are high in Karachi Harbour including its backwaters, and Gizri Creek area. The second most polluted areas are those along Korangi Creek and Gharo Creek. The third category includes Clifton beach and Gadani Coast. The forth category includes parts of the Indus Delta suspected of pollution from agriculture wastes and biocides.

In addition to the industrial complexes there are a number of small and large industries within the Karachi District. According to an assessment, there are more than 6,000 small and large industrial complexes and in the adjacent Hub Industrial Estate. Almost all of these industries discharge their untreated effluents into the coastal waters of Karachi.

The coastal water bodies of Karachi such as the Karachi Harbour, Gizri Creek, and Korangi Creek receive large quantities of nutrients as part of the liquid waste and garbage bring disposed of in these creeks. According to an estimate about 1500 tons of BOD loading constituting organics and nutrients are discharged into the Karachi Harbour per day. Similarly, the Gizri Creek receives about 800 tons of BOD loading per day. The Gharo Creek receives considerable amounts of phosphates and nitrates from various industries and municipal wastes which contains high concentrations of nutrients particularly from Pakistan Steel and Port Qasim, and other coastal Industries discharging their effluents directly into the Gharo Creek.

It is estimated that about 700 MGD of mostly untreated industrial effluents from the coastal zone industries and municipal wastes mostly from Karachi city reach the coastal waters through sewerage system, open sewers, outfall canals, discharges from seasonal rivers and storm water drains.

The SITE area generate about 40% of the total pollution load in the coastal belt of Karachi. The LITE and KIA generate about 25% of the pollution and sea-outfalls about 20% and the industries of Karachi located outside industrial complexes generate about 12% of the total pollution load.

The pollution load of the municipal wastes and sewage also follow a pattern somewhat similar to Industrial pollution. About 60% of the sewage pollution load is generated by the central and northern parts of the city enters the coastal waters through Lyari River outfall and about 35% of the load enters the sea through malir River outfall. The remaining 5% of the load enters the coastal waters through open sewers and storm drains.

The water pollution loads generated by the industrial and municipal sources from the LITE, KIA, and the coastal industries located along Korangi and Gharo Creeks produce about 59 million meter cube of waste waters annually from this area. The high BOD, COD, and Suspended solids and TDS occur in the waste waters of industries, agriculture and Power plants. High hydrocarbons are being produced by oil refineries, metal industries. There are considerable phenols and cyanides in the waste waters of metal and rubber industries. High contents of heavy metals exist in the waste waters from tanneries and metal industries.

The pollution loading of the air within the LITE, KIA, and coastal industries of the Gharo-Korangi Creeks is summarised in the Table - 28. The data demonstrates that high particulates are produced by metal industries, food, non-metallic industries, open burning of solid wastes, non-metallic industries and power plants. The Sulfur dioxide (SO-2) is produced mostly by Power plants,Industrial furnaces, Oil Refineries, and metal industries. The Nitrous oxides (NO-X) are produced mostly by the Power plants, Industrial furnaces and burning of municipal wastes in the open. The major sources of Carbon mono oxide (CO) in the air pollution of the area are metal industries, Disposal of municipal wastes, Power plants, Oil refineries, and Industrial furnaces located in the area.

The pollution levels in the Karachi Harbour and Gizri Creek areas need immediate attention. The current levels of discharge of untreated sewage from municipal sources and untreated industrial waste waters appear to have caused major impacts on the water quality and marine life (especially benthic fauna). The contamination of edible fish and shrimp with pathogenic micro organisms, the bio-accumulation of heavy metals in marine organisms including fish and shrimp, and loss of aesthetic value of these areas are matters of grave concern. The current levels of oil pollution are significant in limited areas of Gizri Creek and in the oil terminal area of Karachi Harbour and parts of Karachi backwaters and of Korangi Creek. Oil slicks are common in Manora Channel.

Thermal pollution is essentially localised around the effluent discharge points of the coastal power plants. However, an increase in delta T of about 3-60 C higher than the ambient in the summer months may pose a problem in the creek areas where sea surface temperature may rise to 320 C.

The existing levels of oil pollution in the coastal, inshore and backwaters along Pakistan coast are of some significance to recreational and aesthetic values of some of the oil polluted areas. The Karachi Harbour and backwaters are being used for recreation (boating, crab hunting, fishing, etc.) by Karachiites and tourists. The recreational and aesthetic values of the Karachi Harbour backwaters has already gone down due to increasing influence of the municipal and industrial waste disposal in the area. The increase in the frequency of the occurrence of oil slicks, floating tarballs, and oil coatings on the mud - sand flats of the intertidal areas of the Karachi Harbour is likely to render the entire area unfit for recreational use. The aesthetic values of the coastal resource is directly linked with the natural beauty,

environmental health, safe and hygienic use of the resource.

The impacts of the heavy metal pollution are localised because of their point discharge sources. The most critical areas affected are backwaters of Karachi Harbour, Gizri Creek, Bakran Creek, and parts of Gadani coast. This is evident by the accumulation of heavy metals in the sediments, and marine organisms from these areas. The heavy metals of more concern are Cr, Pb, Cd, Hg, Zn, and Cu.

The seawater at the saltworks at mauripur adjacent to the Lyari River outfall is contaminated with heavy metals from Lyari River discharge. These include Pb (1.48 ppm), Cd (0.21 ppm), Zn (1.08 ppm), Cu (0.09 ppm), Ni (1-12 ppm), and Mn (0.29 ppm) (Ahmed, 1983). The sea salt is most commonly used sea product in Karachi. Most of the sea salt produced from the coastal areas is not refined and is sold in the market for human consumption.

The high values of Zinc (1,300 ppm) in the effluents of Karachi Shipyard and Engineering Works discharged into the Karachi Harbour area. The other sources of Zn discharging directly to the sea include Pakistan Steel (0.3-3 ppm) and Oil refineries (0.15 ppm). Chromium is being discharged into the sea from the tanneries effluents. The typical range of Chromium in the Karachi Tannery effluents is 0.2 to 8 ppm. A very high value of 5 g Cr/l has been reported in the effluent of Tanneries at Shershah passes into the Lyari River. The Korangi tanneries are estimated to discharge about 225 tons of Cr per year into the coastal waters.

The bio-accumulation of heavy metals is taking place at almost all the critical areas along the coast. The concentrations of Cu, Zn, Ni, Co, and Fe in the marine organisms from Bakran Gharo Creeks appear to be considerably high.

The impact of oil pollution on the marine environment of Pakistan seems to be restricted to the few areas where chronic oil pollution occurs in the harbours, and near waste discharge points from municipal/industrial activities, and refineries. There has been no major oil spill in the coastal waters of pakistan. Small oil spills do occur mostly in the harbours around oil terminals. The impacts of oil pollution of some significance are therefore visible only in limited areas on the coast of Karachi. In general, the impacts of oil on the coastal waters and on most of the open coast of Pakistan are almost negligible at present. The oil slicks are present in the waters adjacent to Karachi coast only. The oil-slicks and tar balls have also been observed along the coast.

Most of the open coast beaches of the coast of Karachi are relatively free of oil pollution. With the exception of some selected beaches along the open coast, and a few beaches located within the backwaters, the entire coastline appears to be relatively free from oil pollution. The oil pollution on most of the open coast beaches is in the form of tar balls present mostly near the high water mark. The tar balls are the weathered resides of the degraded oil. They were observed to be mostly black or blackish grey in colour and coated with sand grains. The smaller sized tar balls were generally harder and more brittle than the larger ones.

There is a dearth of data and information about the marine and coastal ecology of the Pakistan coast including the coastal belt of Karachi. Almost no data is available for most parts of the coastline on the intertidal distribution and density of various dominant marine organisms. The information on the subtidal fauna and flora along Pakistan coast is almost non existent. There are some scattered information in the reports on the occurrence and taxonomic records of a number of marine fish and invertebrates which also comment partially on their distribution along the coast. Some ecological observations from the Karachi coast are described in the reports of Haq et al (1978), and Ahmed, et al (1980, 1981) and partly described in taxonomic descriptions from Karachi coast. The little information on the marine ecology of the area is available.

In general, there are about six types of coastal environments/beaches within the coastal belt of Karachi. These include sandy beaches, sandy cum rocky beaches, rocky beaches, sandy cum muddy beaches, backwaters, and the creek environment with or without mangrove vegetation. The south and south-eastern part of the Karachi coast constitute the north western end of the Indus River Delta. The delta covers about 1/3 of the total coastal belt of Karachi. The area is quite arid, with generally less than 200 mm of precipitation per year and this situation is also reflected in the terrestrial biota. The dominant aquatic vegetation is the extensive mangrove areas which appear to be mostly stunted and less dense than in the nearby coastal area (Karachi Harbour) where some freshwater input is available on a regular basis. The limited freshwater input in the area also appears to limit the development of other coastal forms such as halophytic grasses and sedges. The algal development is also limited to certain seasons in part due to lack of nutrient input from run-off and due to turbidity generated by tidal currents.

The semi-arid subtropical hot and humid climate, the coastal geomorphology of the area and subtropical oceanographic conditions of the site, has created an ecological environment which is somewhat similar to the marine ecological conditions prevailing in the nearby Indian coast. However, the Pakistani coast is very different from the Indian coast, because of different environmental and ecological setup. This has resulted in a different hydrographic and marine ecological data-set. These conditions have created a specific set of ecological conditions and distribution of marine fauna and flora on this coast.

The data on the breeding and recruitment of marine animals of the Pakistan coast in general is very limited. The various marine species along the coast can be broadly grouped into the four categories: 1. Monsoon spawners, 2. Winter spring spawners, 3. Spring-summer spawners, 4. Year round spawners.

In general, the species of marine invertebrates which occur in the high tidal zone or in the mid tidal zone spawn during the summer for a period of 6-8 months. The species which occur close to the lower tidal zone or subtidally have a tendency to spawn in the winter and spring and in some cases throughout the year. In the coastal waters of Karachi, two major peaks of larval abundance and larval settlement occur, one during the spring and other during the post monsoon season (October-November). The peaks of zooplankton abundance seem to coincide with the peaks of phytoplankton abundance. The data indicate that significant changes in the occurrence of these organisms are influenced by the recruitment in their population and favourable environmental conditions. The periods of favourable environmental conditions in the area start from September-October to November and from February to March-April.

The breeding activities of the benthic organisms of the area continues most of the year with at least two periods of major breeding activities. The larval settlement and recruitment in a number of marine organisms takes place in September-October and February-March periods. A third period of high breeding activities may take place in the backwaters and protected creek areas during June - July period.

The tidal flats in the backwaters behind the Sandspit area, and Chinna Creek area have flourishing green vegetation of mangroves. Despite the presence of a variety of pollutants in the harbour area, the mangroves growth in the Karachi Harbour area is considered to be better than any other coastal area of Karachi. Apart from the mangrove, the impacts of prevailing pollution are pronounced by the mere absence of benthic marine fauna and flora from most part of the Karachi Harbour and Boat basin area.

The creek areas, as a whole, are relatively untouched by human encroachment. The biotic development of the area is limited by low freshwater input, as evidenced by the condition of the mangroves. The food web of the system is based on oceanic input and is not detritally based as is the case in an estuarine situation. The phytoplankton bloom conditions have been reported for the immediate offshore after the monsoon, and they also occur in the creek system as well. The phytoplankton blooms have been

observed in the Gizri, Korangi, and Gharo Creeks mostly during autumn and winter seasons. The algal blooms have been observed in most of the creek areas near Karchi during October-November and January-February period. Given this condition, the area may act as a nursery area and be important for many species in a portion of their life cycle. This latter is evidenced by the presence of juventiles of shrimps and offshore fishes found within the system. The creek area is also acting as an important intermediate habitat for a number of coastal fishes to take advantage of the turbidity cover. This demonstrates that the area, in addition to being the nursery area for certain marine species is also an important intermediate habitat for many species. This needs further study and site-specific supportive data to elaborate and make concluding remarks.

The data on the primary production rates of the nearshore coastal waters of karachi are available from gharo Creek area recorded during September 1985 to March 1986. The data indicate that the gross primary productivity is very high during early October. However, the rates of net primary productivity were observed to be high during the months of September, December and February. The rates of primary productivity also justify the peak of chlorophyll observed during December 1985 and in February 1986. The rates of primary production appear to be low in comparison to the rates reported for the Northern Arabian sea (500-1000 mg C/cubic meter/day). The average of 238.48 mg C/cubic meter/day appear to be typical values of the creek areas with higher seawater salinities than that of the open sea for most part of the year. It is believed that the primary production rates are higher in other parts of the creek areas with lower salinities than that of the Gharo Creek area.

The available data on the Phytoplankton of the creek areas near Karachi indicate that the most common phytoplankter was Coscinodiscus sp. It was found in comparatively large numbers in the main gharo Creek than at the intertidal backwaters. The Coscinodiscus sp. was also observed to be very frequent in the Zooplankton samples collected from the area. The other dominant phytoplankton include the Chaetoceros sp., Navicula sp., Rhizosolenia sp., Nitzchia sp., and Pleurosigma sp. (Rizvi, 1989). The observations on the phytoplankton of the Gharo Creek area available through previous studies. A data set on the dominant phytoplankton of Gharo Creek indicate occurrence of dominant Phytoplankton in the creek area. The centric diatoms particularly Coscinodiscus sp. is the most dominant in the area. Among the pennate diatoms Bacillaria sp. and Phaeocystis sp. are present from July to September period. The commonly occurring flagellates in the area include Ceratium macroceros, C. furca, C. fusus, Peridinium depressum, Gymnodinium sp., and Noctiluca sp. The thecate diatoms Dinophysis caudata, and D. miles are also common in the Gharo Creek area. The tintinids (Petalotricha sp. and Flavella sp. are more common in the area than the other tintinids. There are some Coccolithophores and the Foramaniferans are also common in the creek areas. The centric diatoms were morse abundant during March-April and August-September period. The pennate diatoms were found during July-September period. The tintinids were more common during February, and flagellates were common round the year. The Coccolithphorids and Foramaniferans were more common during January - February and July-September period. The Radiolarians were found mostly during February in the study area.

The data on the zooplankton of the Gharo Creek area indicate that the dominant zooplankton groups in the Gharo Creek were Brachyuran zoea, Calanoid copepods, Decapod larvae including shrimp larvae were also found to be common in the samples. The other groups which were also common include Lucifers, Cirripede larvae, and Chaeteognaths. The results of the analysis of the plankton samples collected from the creek areas (Gharo - Korangi creeks) during 1983-86 period indicate that the major planktonic groups were Calanoid copepods, ctenophores; lucifer; larvae of shrimp, cirripede, bivalve, gastropods, and crustacean nauplii and zoea; and fish eggs and large.

The data recorded on the zooplankton from the creek areas indicate dominance of oceanic species. The seasonal variations in the biomass of the zooplankton from the Gharo Creek area exhibit an annual variation between 5 to 340 ml/1 (Rizvi et al. 1986). The seasonal variations indicate three peaks; a large peak (3400 ml/1) in November and two smaller peaks in February (65 ml/1 and in April (55 ml/1).

The various recommendations made in the paper basically focus on the following main areas: 1, management of the coastal environment for sustainable development of resources such as forestry, fisheries, non living resources and future expansions. 2, development of projects for water supply and sanitation, disposal of sewage and marine pollution with reference to the current situation, future expansion.

Keeping in view the main objective of the study the guidelines have been proposed to evolve the management measures to keep environmental health and socio-economic development projects in harmony with each other. To achieve this, a phased programme be prepared for a comprehensive management plan with objectives to keep environmental health and socio-economic development projects in harmony with each other. The approach does not intend to impose restriction on the development of basic infra-structure which is essential for any development. However, it does require proper integration of environmental safeguards with all coastal development projects.

The primary objective of a Coastal Environmental Management Programme should be address the problems such as environmental changes due to insanitation, industrial pollution, protection of coastal ecology, particularly in the polluted areas to control pollution to keep the coastal environment in healthy condition, protection of coastal structures. The secondary objective of the programme should be devoted to the improvement of the coastal environment to meet the basic standard for coastal development including recreational facilities. There is a great potential for the development of tourism as the city has large hotels for the tourists and recreational spots on the beaches and shores. There is a large space for development of new townships and establishment of coastal industries as all the necessary industrial infrastructure is available. All these resources require proper environmental management.

Annex VI C

CASE STUDY - SRI LANKA

CONSTRAINTS TO PLANNING IN DEVELOPING COUNTRIES: A CASE STUDY ON CORAL MINING IN SOUTH-WEST COASTAL BELT OF SRI LANKA

1.0. CORAL REEFS AND ITS DISTRIBUTION IN THE SOUTH WEST

Coral reefs are ecosystems normally situated in shallow tropical seas with structural foundation of calcium carbonate deposited by animals and plants. The key to the coral reef is a polyp. Reef building polyps require light, they prefer waters less than 25 metres deep and grow optimally at 10 metres depth (Swan, 1985). Sea water temperature for coral reefs should be between 25 - 29 C most of the time. Emersion or exposure above water could be tolerated only for short periods. Salinity level should generally be between 27 and 40 ppt. The growth rate of coral in Sri Lanka is slow and is about 2 cm per year.

The coral reefs in Sri Lanka are of recent origin (mid to Holoocene). There are three types of coral reefs occur in Sri Lanka, namely Fringing, Barier and Apron reefs (Bandara C.M., 1985). Ninety species of corals have been observed in Sri Lanka.

1.1. EXTRACTIVE AND NON EXTRACTIVE USES OF CORAL

Corals and coral reefs are important for at least five reasons.

1. Commercial harvest;
2. Scientific and educational interest;
3. Aesthetic enjoyment and recreational opportunity;
4. Habitat essential for associated species of special interest such as commercial fin fish, endangered and threatened species;
5. As a source of lime production.

2.0. CORAL MINING INDUSTRY IN THE SOUTHWEST, HISTORICAL

Background:

Sri Lankas ancient kings used coral lime for mortar and plaster work in temple and other important buildings and its use by the common people was forbidden (Knox, 1681). The arrival of Dutch and Portugese changed this trend when they used lumps of coral as building blocks for the construction of fortress as can be seen in the southwest coast. They also found lime from coral to be a cheap source of good quality material for plaster and mortar work for buildings within the fortresses. Use of coral base lime for construction of houses and other buildings spread throughout the coastal areas during the seventeenth and eighteenth centuries and spread to the other parts of the island with British occupation in early nineteenth century.

This industry became so well established in the southwest that it even led to the emergence of a particular coast consisting of people traditionally engaged in this activity.

During the last four to five decades the use of coral has increased tremendously due to use of coral base lime. Lime is presently in great demand and used for following purposes.

1. To remove acidity in soil and improve agricultural lands;
2. As a base material for mortar and plaster work in construction of houses and other building;
3. As a chemical in the ceramics, sugar, fertilizer and steel industry.

3.0. SOCIO ECONOMIC CHARACTERISTICS OF CORAL MINING INDUSTRY

It is estimated that annual requirement of lime for all uses is about 27,000 tons (ESCAP, 1985). Of this 50% is obtained from coral based lime. Most of the coral required for lime industry is being removed from southwest coastal zone. According to Premaratne (1984), the total quantity of coral supplied from this coastal area in 1984 was around 18,000 tons (see table 1).

Table 1

Exploitation of corals (1984)

Source	Amount (tons)	Percentage %
Buried deposits		
Inland	7532	41.70
Coastal Zone	2868	15.88
Offshore deposits		
Collection from beaches	5377	29.78
Reef mining	2282	12.64
	18059	100.0

(Source: Premaratne,. 1984)

The above figure shows that a total of 7,659 or 42% of the coral mined and collected in this region is from nearshore areas. The studies carried out by Coast Conservation Department in 1990 revealed that, despite of law enforcement, removal of coral has been increased considerably.

Annual Production of Lime in the Southwest Coast (including Rekawa cluster) 1990

Cluster	Quantity in tons	Sea coral %
Hikkaduwa	14,784	45
Habaraduwa	7,248	40
Rekawa	3,792	98
Madiha	2,460	70

In contrast to the 1984 figure it shows 11% increase.

4.0. EMPLOYMENT AND INCOME

Those employed in the coral mining industry in the southwest coastal sector fall into several categories such as, coral miners, kiln owners, lime sellers, collectors, and other engaged in ancillary activity in transport of coral and lime.

One of the direct benefits from the coral mining activities is the generation of employment opportunities in the southwest region. A recent survey conducted in this coastal areas indicated that there are approximately 2110 including many women are employed in these activities. Their dependents were more than 8000.

According to Premaratne (1984), occupational classification and the annual income in the coral mining industry along the southwest coast is as follows:

Table 3
OCCUPATIONAL CLASSIFICATION AND ANNUAL INCOME

Category		Annual Income
1.	Reef miners	8000.00
2.	Inland miners	5400.00
3.	Collectors	12000.00
4.	Kiln owners	41000.00
5.	Kiln workers	7200.00

In terms of financial earnings lime kiln operators along this coastal sector became well established entreprenuer group, while other people were employed on either a daily wage or piece rate basis.

5.0. IMPACTS OF CORAL MINING IN THE SOUTHWEST COAST

The impacts of coral mining in the southwest coast can be categorized into two broad types. The first category is the coastal erosion and direct and indirect losses associated with it. Second category, relates to the depletion of natural resources and the associated costs.

5.1. Coastal Erosion.

In the last decade, number of experts identified relationship between coral mining activities and sea erosion problem along the southwest coast. Among those Gerritson (1974), Amarasinghe (1976), Swan (1974) expressed their views on relationship between coral mining and coastal erosion in the southwest coast.

Coral collection from the beaches and reef breaking accelerated the coastal erosion in this coastal sector. Coral reefs located in the southwest coast, provide stability in two ways.

1. Coral communities serve as one of the principle source of sand for beaches and near shore areas. Coral debris is one source of beach material in this coastal sector, by collecting large amount of debris from the beach. The amount of material available for beach nourishment is reduced, causing erosion either locally or in downdrift areas.
2. Coral reefs also act as barrier for coastal reach within the southwest. These coral reefs absorbed the energy of breaking waves. In absence of coral reefs, the full force of waves strike the shore, thus increasing erosion.

5.2. Reduction of Tourist Potential

Coral reefs visually attracts underwater divers and tourists. Depletion of coral reefs tends to reduce the factor of attraction and thus diminish the potential for future expansion and growth of tourism in the southwest coast. A reduction of income and land values occurred as a result of coral mining in this coastal region.

Depletion of Marine Life

Coral reefs provide an environment where marine life thrives. The continued and unabated extraction of coral hampered the natural marine population of this coastal segment in the recent past.

6.0. FREE ECONOMIC POLICIES AND ENVIRONMENT IN LATE SEVENTIES

A major thrust based on a "free economic" model which has been adopted by the government since late seventies brought severe pressure on coastal resources. The pressures on coastal resources were further aggravated by the tourist industry and the housing programme launched by the government accelerated the coral mining activities in late seventies.

6.1. Housing Development Programme

After 1977, housing and urban development became one of the three major investment programmes of the government. In 1976, the capital allocated to housing construction was Rs. 48.5 million. In 1978, investment in housing has risen to Rs. 198.5 million and during the period of 1980-83, expenditure on housing exceeded an annual average of Rs. 1 billion (Marga Institute, 1986). During the 1977/83 period, public sector housing also had expanded more than ten fold.

Housing needs as well as the past construction pattern also highly affected the rapid rate of coral mining in the southwest coast. According to the past trends in construction patterns, in 1953, the country's housing stock consisted of units, 56.7% of which were constructed with mud walls, and 34.9% with permanent materials such as lime, bricks, cement. In 1983, share of houses with mud walls dropped to 50.3% whereas walls constructed with permanent material had risen to 42.6%. By 1971, the share of mud walls fallen to 45% while walls of permanent material had risen to 44.5% (Marga Institute, 1976). The changing construction patterns created higher prices on building materials, such as lime and cement.

7.0 POLITICIAN VS PLANNERS

Since early seventies local planners and foreign experts recommended the necessity of a ban on coral mining activities to control the severe sea erosion along the southwest.

During the period after 1977, elites of the coral mining became very powerful financially and politically. The parliamentary representative in the coral mining area came from the circle of elites and himself also attached to the lime production and transportation industry. Due to the political pressures, the government was unable to adopt a rigid attitude towards coral miners up to early eighties.

However, due to the public outcry and the influences of non governmental organisation and hoteliers, government imposed a total ban on coral mining under the Coast Conservation Act No. 57 of 1981 (further strengthened under the Amendment Act No. 64 of 1988).

Although the implementation of the act started in 1983, there is no action taken against coral miners in the southwest coast. Politicians as well as planners expected large scale unemployment, dislocation of the part of the economic base and community unrest as a result of rigid enforcement.

In early 1987, according to the direction given by political authorities, the planners prepared a action plan to control this activities using different perspective on coral miners. The planners collected necessary data and information on coral miners and their dependents through socio economic surveys. Planners identified several alternative strategies to minimise the community unrest and social dislocation in this process. Positive action has been taken to provide alternative employment for coral miners and their dependents. These includes:-

1. Two and half acres of land and other facilities for agriculture, for each family in new settlement areas.
2. Eighteen and half feet fibre glass boats and fishing gear for those who prefer fishing (limited amount of boats).

3. Eighteen feet non mechanized fibre glass boats for small scale fishing.
4. Assistance for aquaculture for those who are willing to develop aquaculture in abandoned inland coral pits.
5. Facilities for toddy tapping.

8.0. FAILURES AND SUCCESSES

The above alternatives were proposed by planners in consultation with the political authorities. Most of the politicians totally accepted this proposals for implementation.

In mid 1987, Coast Conservation Department with the assistance of Mahaweli Development Authority, selected 250 families among coral miners for resettlement programmes. Most of these selection were made under the direction of parliamentary representative. However, the first batch of selected settlers (52 families) were sent to the hamlets in new settlement areas which were provided with basic civic services, facilities of a unit services centre, health centre, school complex, small scale co-operative, post box and a cemetery. Within two months, most of these settlers (coral miners) returned to their native places due to lack of water services, presence of Malaria disease and other social inefficiencies. Other alternative such as supply of boats, aquaculture and toddy tapping programme, could not be implemented due to socio cultural conflicts and political involvements throughout the process.

CONCLUSION

In conclusion, the whole planning and implementation process had failed due to the following reasons:

1. Higher degree of political involvement throughout the planning and implementation process;
2. Lack of public involvement in the planning process;
3. Ad-hoc type planning procedures used by planners;
4. Lack of mediation and education;
5. Differences between needs of coral miners and proposed alternatives.

COASTAL ZONE MANAGEMENT; WHY A SPECIAL INITIATIVE

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1. INTRODUCTION

Today, coastal zone management has become a worldwide concern. The awareness of the need to strike a balance among completing coastal uses in ways that recognize commercial and strategic interests, potential coastal hazards and the need to protect important natural habitats to ensure sustained food yields, has led many countries to develop coastal resource management programmes. Why this special initiative? It is because the very nature of the coastal regions makes it impossible for traditional sectoral management to solve the major resource use problems that occur in these zones. Here, integrated strategies are required that cross sectoral boundaries and focus upon the interactions and interdependencies of sectors and upon the processes that govern the ecosystems in which they occur.

2. THE COASTAL ZONE

What makes the coastal zones so special? The words **Coastal Regions** -

1. Contain three-quarters of the world's population and will absorb most of the increase by 2020 when the planet's population is expected to double and attain 8.5 billion;
2. Supports the world's most naturally productive ecosystems: estuaries and lagoons, brackish and salt water wetlands (salt marshes, mangroves), coral reefs and seagrass beds;
3. Contains a high proportion of the best alluvial soils for agriculture;
4. Includes the most productive fishing grounds;
5. Supports water-dependent and water-enhanced industry and manufacturing;
6. Is the major focus for tourism - (soon to be the planet's number one industry);
7. Is the preferred dumping ground for wastes of all types;
8. Contains some of the world's highest biological diversity.

It would therefore be obvious that most of the development opportunities for the future are within these coastal regions and such regions will be and are being subjected to increasing stress.

The very complexity of this region and the variety of development activities that it has to support and the types of conflicts that these complexities give rise to, makes it impossible for sectoral approaches to management to have a chance of success. This rich mix of human activities, natural resources and tightly linked ecological processes makes cross sectoral management a necessity.

3. THE SOUTH ASIAN PERSPECTIVES

The global perspective of the coastal zones holds very true for South Asia too. In this region too, the heaviest population concentration is located in the coastal regions. For example, 45 percent of the natural population of Bangladesh, and 55 percent of the population of Sri Lanka are in their coastal provinces. In the Maldives, with a total population of 182,000 people dispersed over the 200 islands, none exceeding a land area of 13 sq. kilometers and 2-3 meters in elevation, the sea is the dominant influence.

Another feature that dominates is the extreme exposure of their populations to natural hazards such as storm surges, cyclones and floods. The heavy toll in human lives and property damage impose great burdens on the economies of these countries.

Poverty is also a common feature. Poverty alleviation through economic upliftment viz. development is a stated national goal in all of these countries. The prime developmental opportunities are in the coastal regions. Hence, the need for coastal resource management initiatives are self-evident. Implementation of CZM to this region could be summarised as follows:

- Large population concentrations in coastal regions;
- 500 million people in lands fronting the Indian Ocean are short of 10 grams of animal protein daily;
- Natural disasters in coastal areas dominate with heavy tool in human lives;
- Development opportunities are coast based -
    - * Tourism
    - * Coastal mariculture
    - * Intensified offshore oil/gas development Intensified industrial development (good sites, infrastructure, workforce, "easy" waste disposal)
    - * Expansion of ports
    - * Increased agricultural production
    - * Fishery development
    - * Siting of energy facilities

4. COMMON ISSUES

Several issues of common concern emerge when the problems of coastal zone management are analysed. They are :-

- Financial constraints on development;
- Inability to enforce resource ownership;
- Mounting ecosystem stress and resource degradation;
- Lack of information on which to base resource management decisions;
- Lack of enforcement capacity;
- Shortage of human resources.

Within this range of common issues some prioritisation is possible. We could identify these priority issues as follows:

* Destruction of natural habitats:-
    - Mangroves (over-exploitation, conversion)
    - Coral reefs (mining, blasting, silting, eutrophication by organic loading of coastal waters)
    - Seagrass beds (harmful fishing methods, gear)
    - Estuaries (landfill, pollution).
* Decline in coastal fisheries

* Degradation of water quality

* Rising sea level
* Coastal hazards
* Loss of scenic & cultural resources
* Urbanisation/population growth.

5. PROGRAMME DESIGN AND IMPLEMENTATION

An attempt at solving these coastal problems must necessary be within the framework of a natural or regional Coastal Zone Management Programme. Many models of such CZM Programmes are now becoming available. Even though there is a commonality in the problems such management programmes address there are no 'ready made' or 'off the shelf' models that one could use. One important aspect that has to be borne in mind is that, very often the regulatory aspects of coastline zone management focus on changing traditional use practices and impinge on traditional use patterns of common property resources. This necessarily implies that CZM programmes and plans have to be based on the political, social and economic setting of the individual country. However, the basis for programme design invariably rests on certain key elements, viz.,

a) An identification of coastal problems to be addressed;
b) An identification of priorities among these problems;
c) An analysis of specific processes that cause these problems;
d) A management strategy and set of management initiatives;
e) Institutional and administration mechanism for implementation (including integration with the existing management framework)
f) The designation of areas within which management will occur;

Once these elements have been defined and the required data base established, a management strategy has to be evolved. The success of such a management strategy will depend on how well the following questions are answered:

1) If coastal problems are to be mitigated, whose behaviour will have to be managed?
2) How much behavioral change does management require?
3) What is the optimum mix of regulatory and non-regulatory management strategies?
4) How can common property resources be managed?
5) Organisational and administrative arrangements?

6. CONCLUSION

The foregoing clearly exemplifies the need for formulating integrated management strategies for sustainable use of coastal resources. The question as to whether coastal concerns can be embodies in existing land use, urban and regional planning or other planning mechanisms or whether a brand new Coastal Zone Management Programme is required, depends on the ground situation in particular countries, and an evaluation of the local setting. One aspect that needs very careful evaluation, is the relevance and interaction with existing institutional mandates. Many new CZM Programmes have become unimplementable due to institutional conflicts that arise regarding existing institutional mandates. This is one problem that has to be resolved right at the outset if new programmes are initiated. Whatever the problems may be, the sustainability of coastal resources utilisation world-wide clearly rests on the ability of local planners to realize the need for integrated planning in the management of coastal resources.

Annex VII B

ABSTRACT

COASTAL EROSION HAZARDS AND ITS MITIGATION IN SRI LANKA

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Coastal Erosion is a natural hazard in Sri Lanka that results in damage to or loss of land, houses, hotels and other coastal structures, roads and railways. It is by nomeans a new problem but in the 1920's there was concern about protecting the coastline from erosion and construction of coastal protection works began. The country's development in the past has been closely related to coastal areas and humen settlements there have also increased, thus aggravating the damages caused by sea erosion.

Coastal erosion is the result of powerful natural forces that man can rarely control. Waves cause most of damage to the coast. Physical alterations to coastline for human uses and activities also contribute to erosion. The predicted sea level rise due to global warming would be another factor aggravating erosion.

The coasts which are fully exposed to the effects of the South West Monsoon wave climate are the areas where erosion damage is mostly felt because these are the most densely populated and economically active areas. In 1985 due to exceptional wave attacks from June 28 to July 3, there was major damage to highway, dwelling houses and infrastructure facilities on the South West region. The land area lost annually due to erosion in the whole country has been estimated at 15 to 20 hectares.
The Master Plan for Coast Erosion Management was prepared in 1986 as a document that defines the erosion problem, denotes its magnitude, sets out best possible technical approach towards mitigation and the capital investment necessary for such action. The implementation of the Plan got off the ground immediately and now it is in the fourth year of successful execution It is aimed at reducing or halting the hazards arising out of coastal erosion.

Attempts have been made to designate a coastal zone and manage the zone through the implementation of a regulatory system in order to minimise harmful effects ti life resulting from erosion. Coast Erosion Managemnt Plan that has been developed is within the Coastal Zone Managemnt Plan wherein structural solutions are considered the last option and advance physical planning the first initiative. Regular monitoring of the coast, investigations and surveys are being carried out to understand the coastal processes better. Public education programme is also in hand.

The complete mitigation of coastal erosion hazard is not easy but the implementation of Coast Erosion Management Plan would certainly minimise the hazards arising out of coastal erosion.

Annex VII C

ENVIRONMENTALLY SOUND PREPAREDNESS AGAINST NATURAL DISASTERS

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1. Introduction

Every once in a while the world is shaken by news of some catastrophic natural disaster wreaking havoc, resulting in heavy loss of life and property. While natural disasters can strike anywhere, some of the heaviest tolls in the wake of earthquakes and cyclones, volcanic eruptions and landslides have been recorded in the Asian and Pacific region. In the recent past, horrific accounts of death and destruction came in the aftermath of earthquakes in Iran and Philippines, landslides in Nepal and Thailand, while Bangladesh has suffered the most in the annual visitations of floods and storms. The cyclone in late April 1991 struck the eastern coastline and devastated the region around Chittagong and Cox's Bazar as tidal bores swept up the Gangetic delta all the way to Dhaka. Hundreds of thousands of people were swept away from the low-lying coastal areas and countless others lost their homes and means of livelihood.

Yet, despite the knowledge that the Asian and Pacific region is particularly prone to natural disasters, we remain neither prepared to deal with such calamities nor are we able to mitigate their impact even when that may be possible. This, ironically, is in sharp contrast to the considerable technological advances that have taken place in developing effective early warning systems. Satellite imagery and telemetry have vastly improved meteorological techniques whereas telecommunications and mass media networks have helped in the transmission of early warning signals.

However, this in itself is not enough. For instance, despite adequate advance information on an impending storm, it would never be feasible to evacuate the entire coastal population of Bangladesh to safer ground.

What then needs to be done?

Very often a technological answer is sought to mitigate the impact of natural disasters. Embankments are built to shore up crumbling mountains, channels are excavated to neutralize tidal bores, dams are built to hold in water and dykes are built to keep out water. However, these devices appear puny when faced by the full fury of natural elements. Moreover, such structural measures frequently have an adverse environmental fall out of their own. For instance, dams are known to trigger seismic activity, dykes may disturb tidal action and embankments may lead to increased run-off defeating the very purpose for which they were built. Flood abatement measures have often resulted in waterlogging and the salinization of fertile croplands. A public works approach may not then always be the remedy for what is essentially an environmental problem.

The environmental approach in tackling natural disasters entails going beyond the symptoms to the heart of the malady. Non-structural measures usually work best. For instance, in mountainous regions, conservation of natural forests and afforestation of denuded slopes with appropriate soil-holding species would help prevent landslides. It would be advisable not to disturb the rock structure in seismically active belts. In coastal areas, natural buffers against storms and tidal waves must be preserved. Even as the cyclone battered Bangladesh in April 1991, low-lying shores and islands protected by mangrove forests suffered the least damage.

Still, even where the solutions may appear to be simple and logical, this route may actually traverse far more complex social, economic and political considerations. For instance, protective measures against landslides would curtail the exploitation of timber reserves and call for a change in cropping patters; the conservation of pioneering grasses on low-lying islands, or chars, in the Bay of Bengal would succeed only if grazing was prohibited; and mangrove forests would flourish if exploitation was controlled and conversion to cropland or shrimp ponds was prevented. Social motivation and public awareness would thus have to be an integral part of this approach.

At the behest of the United National General Assembly, a global International Decade for Natural Disaster Reduction (IDNDR) was launched in early 1990 with the aim of fostering international co-operation in the field of natural disaster reduction. The overall objective of the Decade is to reduce, through concerted international actions, loss of life, property damage, social and economic disruption caused by natural disasters, especially in developing countries.

The organisation, conduct, performance and evaluation of natural disaster reduction and mitigation systems is a highly complex multi-disciplinary field which involves co-operation and collaboration internationally, regionally, nationally and eventually locally, between a variety of governmental and non-governmental, technical, social and organisational agencies. Given the magnitude of the problem that afflicts the Asian and Pacific region, successful efforts in natural disaster reduction would require the pursuance of an environmentally sound approach to preparedness against natural disasters.

2. Resume of natural disasters which occur in the Asian and Pacific region.

Regional impact:

A high proportion of the total global occurrence of natural hazards and disasters occurs in the vast Asian-Pacific region. The region contains over 3 billion people, about two-thirds of the world's population, most of the world's islands, the greatest mountain range and elevated plateaus, vast deltaic river systems. It has an immensely wide range of continental and oceanic climates manifested by frequent severe weather caused by contrasting cold and warm air masses, the great southwest monsoon which, in excess creates devastating floods, or in deficiency even more devastating drought resulting in growing socio-economic impact. To this scenario must be added the existence of the longest known active earthquake fault on land and one of the most active seismic regions of the world, and a region where 500 young volcanoes can be identified, over 180 of which are active. Furthermore, the seasonally-migrating monsoonal trough lines, in association with warm oceans in excess of 27 deg C, generate an average 50 of the world's severe tropical cyclones (typhoons, hurricanes and severe cyclonic storms) being 60 per cent of the annual average total of 80. The potential impact of these storms is particularly high in the region due to the exceedingly high vulnerability of the dense populations in the coastal zones of mainland Asia, particularly in the Bay of Bengal, the frequency of onset in the Philippines and the coast of Vietnam, and the isolation of island communities of the South Pacific.

Climate Change

The long-term impacts of global warming, the Greenhouse Effect and ozone depletion on global and regional climate change, and incidence and distribution of severe natural hazards and disasters is a matter of very considerable concern, especially in the hazard prone Asian Pacific region, where exceptional vulnerability to changes in sea level, height of storm surges accompanying cyclones, and either enhanced flooding or drought exists in many locations. The scientific debate on these topics, especially in respect of the magnitude and rate of change of hazard parameters, is not settled, but the strong consensus is that, despite the uncertainties, mitigative action must be initiated in expectation that adverse changes will eventuate.

Frequency of disasters in the region:

Tables 1,2,3 and 4 list the frequency, loss of life, numbers of people affected and the estimated cost of damage, in five disaster categories, in 13 selected countries of Asia and the nearby Pacific.

Frequency

It is noted that the most frequent disasters are typhoons, then floods and earthquakes, although the total of non-categorized types of disasters is about equal to floods.

Loss of Life

The highest casualties occurred in earthquakes but it is noted that the great majority occurred in China. The next highest cause of deaths were tropical cyclones. Here again, one cyclone catastrophe in Bangladesh contributed to most loss of life.

People affected

The disaster-type adversely affecting most people is drought, most in India, followed by floods with highest casualties occurring in India and Bangladesh. It may be noted that about 90 million people were subsequently affected in the Bangladesh floods of 1987 and 1988. Cyclones affect the third greatest number of people.

Estimated Losses

The unavailability of losses in drought and earthquakes make this table unrepresentative. The highest stated losses occur in floods which regularly occur in all countries, followed by cyclone damage. It is noted that is US$ terms, the costs of damage have been highest in India and the Philippines. However, the figures quoted for Bangladesh and possibly Japan appear conservative. The 1988 floods in Bangladesh caused US$ 1.3 billion in damage and lost production.

3. Natural Disasters and Environmental Management Policy Issues.

In terms of governmental ministerial responsibilities related to the occurrence of disasters, the provision for monitoring and early warning systems and provision of mitigation measures for each hazard, needs to be clearly established. It may well be that responsibilities for quick-onset hazards and their associated preparedness measures should be allocated to ministries whose directorates are experienced in handling emergencies, while the more pervasive hazards associated with degradation of physical and environmental resources are handles by other ministries.

A recent review conducted at an international conference on tropical cyclones in Manila organized by WMO in 1989 responded to by 24 countries, 15 in the Asia-Pacific region, showed that the ministerial responsibilities for the conduct of national weather services, which issue the majority of hazard warnings, was vested in 12 different broad departmental groupings. Of these the most usual were "transport, communications, public works and aviation," followed by "science and technology" and "agriculture and water resources." Only one contained reference to the environment as a ministerial responsibility related to weather warnings.

On the other hand, at least 8 different broad grouping of ministries were responsible for the conduct of disaster prevention and preparedness, the most usual being in respect of "defence, civil defence and emergency services" followed by "social and welfare services" and "home affairs." In the survey,only two countries, Japan and Vietnam listed identical ministries responsible for both hazard warnings and disaster preparedness in response to these warnings. In both these countries, flood control is

a major concern, each requiring strong components of long-term structural measures in hazard mitigation programmes. In the case of Japan, the logic of vesting both warning and preparedness implementation and funding responsibilities in a construction ministry will be apparent. Despite the self-evident impact of natural hazard disasters on the environment in no instance does a national ministry for the environment or environmental protection, in the countries surveyed, appear to be involved in disaster prevention and preparedness policy considerations. It may well be, that in some countries where disaster prevention and preparedness is a "State-level" responsibility, ministries for environmental protection have a deliberative policy and funding role in disaster planning. In view of the generally ineffective, state of disaster planning and preparedness in many countries in Asia and the Pacific - at least measured by significant reduction in the socio-economic costs of disasters in recent years - a stronger role for ministries of the environment, at national and state level, should be seriously contemplated, especially in training, educational and awareness roles at local community level where the impact of disasters is greatest.

Environmental Effects and Safeguards

The socio-economic impact of natural hazards, especially those which reach the dimensions of a disaster, may be considered to be the summation of a large number of individual minor, moderate and major impacts on the human and physical environment. Cumulatively, these have proved beyond the capacity of the affected community to absorb without substantial external assistance. This impact may be predicated to the extent that hazard risk and vulnerability studies of human settlements, each in their own unique local environment, have been previously assessed and contingency plans adopted. These should enable a variety of physical, social and economic coping mechanisms to be activated within the affected community to permit it to withstand the impact using locally available resources. For practical purposes of reporting, the impact of severe natural hazards and disastrous situations to national and regional authorities, with relief and rehabilitation needs in mind, routine disaster-reporting damage assessment formats have been adopted in most countries in the region, especially those enjoined in regional co-operative programmes or bodies such as the ESCAP/WMO Typhoon Committee. ESCAP has been active in conducting training programmes and leading missions to countries in the region to promote methodologies for this purpose.

Environmental Damage Assessment

National requirements for damage assessment will vary with the vulnerability of the socio-economic infrastructure to particular hazards. For example, the Philippines Office of Civil Defense requires each of its regions to assess damages in the following categories: crops, livestock, fishponds, and government properties listed as roads and bridges, school building, government building, ports and seawalls, flood control, public facilities, water works, irrigation, and others. Casualties are listed as dead, missing and injured, houses as totally and partially damaged, and population affected in terms of families and persons who may be homeless, or evacuated. Each damage assessment is accompanied by a summary of disaster operations and relief measures undertaken. Perusal of standard damage assessment proforma in various countries shows much additional information needed for either immediate restoration (such as the location and number of breaches in flood levees, and replacement tubewells for fresh water supply) or for planners interested in diversification of crops and selection of the most sturdy local building materials. But no where assessment of the environmental damage is the priority.

Post-disaster Surveys

A post-impact survey is essential to determine, a) the detailed physical environmental effects, b) the social and economic impact, c) the various factors which contributed to the conversion of the natural hazards occurrence being converted into a disaster, d) the effectiveness of all aspects of the disaster management cycle including the warning system and preparedness arrangements, e) deficiencies in the community's disaster coping mechanisms including availability of resources and f) additional factors which should be included in vulnerability assessments for the affected area to reduce the prospects of re-occurrence of a disaster in similar circumstances on a future occasion. The 1988 Bangladesh floods rate as the most serious global disaster in terms of economic loss in recent years. A description of floods in terms of cause and response, damage assessment and reconstruction and rehabilitation plans and costs in respect of agriculture and food, flood control and irrigation, transport and communications, power and electricity, industry, health, education, rural water supply and sanitation, urban infrastructure, and rural housing, as well as disaster preparedness and future national and international strategies for flood control is provided in the ESCAP Water Resources Journal, June 1989 issue.

Disaster Effects and Consequences

The environmental effects of the most frequent natural hazards and disasters has been well discussed elsewhere which is summarized in table 5. It relates major hazards to their effects and consequences; effects on land surfaces, structures, agriculture and trees. Figure 1 sets out the types of environmental damage which result from the high winds, intense precipitation and storm surge associated with tropical cyclones.

Environmental Management Concepts

Among definitions of the environment in this context is one which states it is "the aggregate of all external conditions and influences affecting life and external conditions and influences affecting life and development." Another definition states "the quality of an environment is measured in terms of its capacity to offer goods and services that satisfy the needs of the individuals and groups which belong to that environment." Ecosystems cover each of the homogeneous sets of interactions between a community and its non-living environment, each possessing a structure and function. Goods, services and hazards are the economic, cultural, social and political manifestations of the structure and function of ecosystems.

Therefore, ministries responsible for the environment, as it affects the quality of human life, have a prima facie interest in the mitigation of natural hazards and especially situations which lead to disasters.

Conventionally, this interest in mitigation has focused on the long-term structural and regulatory aspects of protection of people and their assets (goods and services) from the impact of natural hazards, such as floods, cyclones and seismic disturbances. However, the impracticability of such measures in developing countries due to high cost, population pressures to use hazard-prone land for daily sustenance and other development priorities, has enforced greater reliance on early warning systems, including the provision of environmental safeguards where feasible, and associated contemporary preparedness measures as the only available choice for communities to meet the threat of imminent hazards, such as cyclone events.

The crux of this interest by environmental ministries is centred, of course, not in the production of the early warnings, but in the response by threatened communities to preserve the quality of their life, measured by personal safety and sustenance of the goods and services which constitute their particular ecosystem.

4. Status of National Preparedness Systems in the Region

General

In the context of most of the disaster, prone countries of the region, the disaster preparedness is lagging much behind the disaster warning particularly for cyclone and flood. This is due to the priority in terms of budgetary allocation by national governments in the recent past and also for technological advances achieved for early warning of cyclones and floods.

The launching of the International Decade for Natural Disaster Reduction has drawn attention of the preparedness programme at national and international levels. Disaster prevention and preparedness is highly multidisciplinary activities involving a great range of technological organizational inputs from international groups, national governments and private sectors.

Disaster Preparedness Effectiveness

Some of the reasons why disaster planning proves to be ineffective in practice in ensuing an optimal pre-impact response and implementation of preparedness measures have already been alluded to. While, in general, the effectiveness of national disaster preparedness planning may be closely linked to the general socio-economic status and supporting community infrastructure, with a consequent impact on the resources applied to development of early warning system, community response and preparedness programme other reasons, deserving policy consideration, may be more fundamental. It has been noted that only a small minority of countries, vest disaster warning responsibilities in the same ministry responsible for the conduct of disaster preparedness functions. In many countries, the latter function is vested in "non-operational" ministries not geared to "round-the-clock" authoritative decision-making within the restricted time-frame provided by natural hazard warning capability. Such decision-making requires reliable point-to-point communication with the threatened areas, for effective implementation and martialling of resources. Numbers of countries which are particularly hazard prone do not possess operational counter-disaster centres manned on a 24-hour basis by trained personnel able to direct and co-ordinate response activities, for example, ensuring that warnings are delivered promptly to communities in the most exposed or vulnerable areas, or engaged in the most severe weather or hazard-sensitive areas, such as fishermen or ferry operators. Authorities such as national weather services, cannot be expected to guarantee their warnings have been delivered to all users, or to be aware of the particular vulnerability of many hundreds or thousands of human settlements at risk, whereas disaster preparedness offices should posses the knowledge to undertake such duties, as well as to ensure that hazard warnings are 'tailored' by the inclusion of particular environmental safeguards and protective advice relevant for the safety of particular communities.

National Warning/Response System Effectiveness

In the vast Asian-Pacific region, it is not surprising that the national effectiveness of warning/response systems ranges from among the very best in the world, in which the most advanced technology and scientific methodologies support very reliable local warning/response arrangements, to among the most rudimentary, in which national warning capacity is highly reliant on external advisory sources and local response organisation is in its infancy. This great range in capacity is not to be despaired about if motivation of the current IDNDR which provides for the utilization of the benefits of regional collaboration in bridging the gap between the highly resourced and the least resourced countries.

5. Natural Defence against Hazards

Use must be made of the protection that the nature provides. The Asia-Pacific region is rich in mangroves and corals. These resources are dwindling at an alarming rate due to harvesting for various uses, destruction of the habitat, pollution, and lack of adequate attention for their upkeeping. The shelter provided by the mangroves against cyclones and storm surges is well-known. During the recent cyclone in Bangladesh, the damages and loss of life in the islands with extensive forest cover were considerably less than those which did not have the natural protection. Therefore, mangrove reforestation in the coastal areas should be undertaken in a massive scale. They even serve the purpose better than the coastal dikes.

Similarly, afforestation programmes should be encouraged in inland areas. In China, for example, the so called ecological villages have large scale plantation. These help cut down fury of the high velocity wind. In addition, it provides for fuel and fodder.

Environmental degradation also may be the cause of disaster. One example is the flooding and landslide caused by intense rainfall in November 1988 in the Southern part of Thailand. This has caused numerous loss of life and severe property damage. At certain localities, whole villages, bridges, roads, agricultural land, orchards etc. were completely destroyed. Daily life was paralyzed for several days as all road, railway transport, telephone and electricity, were completely disrupted. In addition, ecology of the affected area was disrupted. The top soil and vegetation were washed out.

Therefore, arresting deforestation and promoting reforestation to increase forested area is essential to prevent such disasters. These measures would help maintain soil moisture in top soil, facilitate infiltration and augment groundwater, maintain base flow in streams, keep nutrients in the ecosystem, prevent siltation of rivers, and regulate the river flow.

7. Action Guidelines

The Asia-Pacific region encountered disproportionate number of disasters in the recent years. The floods, cyclones, earthquakes in Bangladesh, India, Philippines, Iran, Nepal, Thailand are testimony to this.

The global frequency of great natural disasters in the period 1960-1989 as illustrated in figure 2 gives the estimates of total loss, and the actual losses covered by insurance. The obvious message is that the socio-economic cost of natural disasters is still increasing steadily. Furthermore, the actual number of great disasters has strongly increased in the last decade. This evidence suggests that lack of preparedness or negligence on the part of our society, as the vulnerability of our human settlements rises with more intensive land-use, investment and population increase, is responsible for the conversion of more natural hazard occurrences into actual disasters. This throws extra emphasis on the requirement for more effective early warning and responsive systems and adequate preparedness against disasters.

Within the framework of International Decade for Natural Disasters, the following guidelines are suggested:

a) Shift in emphasis to pre-disaster planning and preparedness while sustaining and further improving post-disaster relief and management capabilities;

b) Acceptance of an integrated approach to disaster reduction that would include a shift in public attitudes towards disaster mitigation and the development of programmes linking prevention, warning research and preparedness in order to reduce vulnerability;

c) Public education to shift society's perspective from passive acceptance of disaster consequences to awareness of the opportunity for disaster mitigation and the role of individuals in protecting themselves;
d) Integration of disaster prevention and preparedness into the national and local planning process;
e) Enhancement of organisational strengths and training of specialists to improve disaster mitigation resources;
f) Promotion of increased technology and knowledge transfer to those at risk;
g) Incorporation of environmental consideration in disaster preparedness and planning.

Table 1. Frequency of Disasters in Selected Asian Countries - by Type (1964-1986)

(Source: ADPC Activities Report 1986-1989 quoting OFDA)

Country	Cyclone/ Typhoon/ Storm	Drought	Earthquake	Flood	Other
Bangladesh	36	2	-	18	24
Burma	6	-	-	5	16
China	10	3	16	18	7
India	43	7	9	32	52
Indonesia	5	6	34	32	19
Japan	31	1	13	8	9
Korea	13	2	1	11	5
Nepal	-	4	5	8	2
Pakistan	4	-	3	8	10
Philippines	59	1	14	14	13
Sri Lanka	3	5	-	12	5
Thailand	2	-	-	9	6
Vietnam	13	-	-	7	7
Total	225	31	95	182	175

Grand Total 708

Table 2. Loss of Life in Disasters in Selected Asian Countries - by Type (1964-1986)

Country	Cyclone/ Typhoon/ Storm	Drought	Earthquake	Flood	Other
Bangladesh	353 750	N/A	-	31 299	33 812
Burma	1 359	-	-	127	330
China	896	N/A	659 041	4 089	645
India	30 900	N/A	537	17 507	22 683
Indonesia	24	8 657	4 518	1 755	1 320
Japan	1 485	N/A	364	663	1 255
Korea	860	N/A	25	2 134	318
Nepal	-	N/A	476	1 938	117
Pakistan	479	-	4 932	2 139	226
Philippines	8 840	-	7 281	1 422	460
Sri Lanka	946	-	-	396	563
Thailand	55	-	-	504	189
Vietnam	9 197	-	-	653	1 100
Total	408 791	8 657	677 174	64 626	63 018

Grand Total 1,222,266

Table 3. Number of People Affected in Disasters in Selected Asian Countries - by Type (1964-1986)

Country	Cyclone/ Typhoon/ Storm	Drought	Earthquake	Flood	Other
Bangladesh	9 390 003	N/A	-	114 467 542	17 470 182
Burma	831 359	-	-	1 413 000	224 803
China	4 111 000	6 000 000	1 461 237	5 637 500	30 292
India	32 996 439	510 666 000	50 100	191 927 210	10 797 733
Indonesia	17 000	3 722 220	1 021 245	2 230 726	1 221 636
Japan	454 542	N/A	68 098	3 095 117	2 002 945
Korea	250 906	4 705 944	N/A	1 920 652	14 151
Nepal	-	4 400 000	195 000	318 500	24
Pakistan	400 000	-	30 000	13 613 427	1 503 530
Philippines	18335 036	200 000	424 433	6 675 300	82 745
Sri Lanka	1 288 000	4 050 000	-	3 513 347	1 405 055
Thailand	43 000	-	-	6 920 820	833 250
Vietnam	6 206 000	-	-	7 795 541	518 259
Total	74 323 245	533 744 164	3 250 113	359 528 682	36 154 605
Grand Total					**1 007 bil.**

Table 4. Estimated Disaster Losses in Selected Asian Countries - by Type (1964-1986) (000 US $)

Country	Cyclone/ Typhoon/ Storm	Drought	Earthquake	Flood	Other
Bangladesh	176 579	N/A	-	959 600	1 400 000
Burma	11 700	-	-	N/A	132 104
China	437 200	N/A	N/A	2 950 000	N/A
India	2 307 228	400 000	400	3 093 559	10 000
Indonesia	N/A	71 200	556 040	59 838	200
Japan	144 90	N/A	476 000	102 000	6000
Korea	264 22	N/A	N/A	352 634	12 577
Nepal	-	10 000	246 0	10 813	N/A
Pakistan	4 10	-	255	1 169 800	122 060
Philippines	1 092 79	N/A	156 777	349 800	30 200
Sri Lanka	37 30	N/A	-	17 500	165 512
Thailand	13 00	-	-	506 400	N/A
Vietnam	50 00	-	-	10 000	13 500
Total	4 539 026	481 200	1 438 472	9 581 944	1 892 153
Grand Total					**18 bil.**

Table 5. Environmental Effects of the Major Natural Hazards

HAZARD	EFFECTS	CONSEQUENCES
Earthquake	Tremors ground shaking	Damage buildings,dams,cause avalanches;can collapse underground structures such as caves and tunnels.
	Liquefaction	Buildings on surface sink into soil.
	Ground failure	Landslides;settlement.
	Ground rupture (horizontal displacement)	Damages buildings on the rupture;breaks utility lines in the ground;may alter flow of subsurface streams;offsets streams;roads and bridges.
	Tsunamis (seismically generated sea waves)	Floodings and impact damage from giant waves destroy manmade structures and crops scour land;salinate wells and standing water.
Tropical Cyclone	High Winds	Damage buildings and other manmade structures;destroy some standing crops, especially basic grains; damage orchards and other trees.
	Intense rains	Cause flooding which damages human settlements and may force evacuations;cause landslides;damage certain crops, especially tubers, may cause excessive erosion.
	Storm surge	Causes rapid flooding, which damages human settlements and forces evacuation;scours and erodes topsoil;deposits salt on fields;may increase salinity in subsurface water tables;destroys most crops.
Volcano	Blast	Destroys timber,crops,houses, bridges.
	Lava flow	Inundates all in its path; causes grass and timber fires may force evacuation of human settlements.

	"Bombs" (ejected lava and other large materials)	Can damage structures they hit may start fires,may force evacuation of human settlements.
	Ash fallout	Can destroy crops,damages machinery,can render croplands temporarily unusable(but restores nutrients over long term); may force evacuation of human settlements and destroy animal habitat;creates respiratory problems;can clog waterways.
Flood (can be caused by unusually intense rainfall or by changes to earth's surface such as deforestation upstream)	Inundation	Results in damage to human settlements,forces evacuation,erodes topsoil,may change course of streams, rivers,destroys most crops deposits silt in some downstream areas that may be beneficial.
Drought	Reduced cloud cover,increased daytime temperatures, increased evaporation rates;increasing likelihood of dust and sandstorms.	Dramatic reduction of surface water;severe crop losses,soil erosion.Food shortages, increased hunger and malnutrition. Losses to livestock. Population shifts and migration.

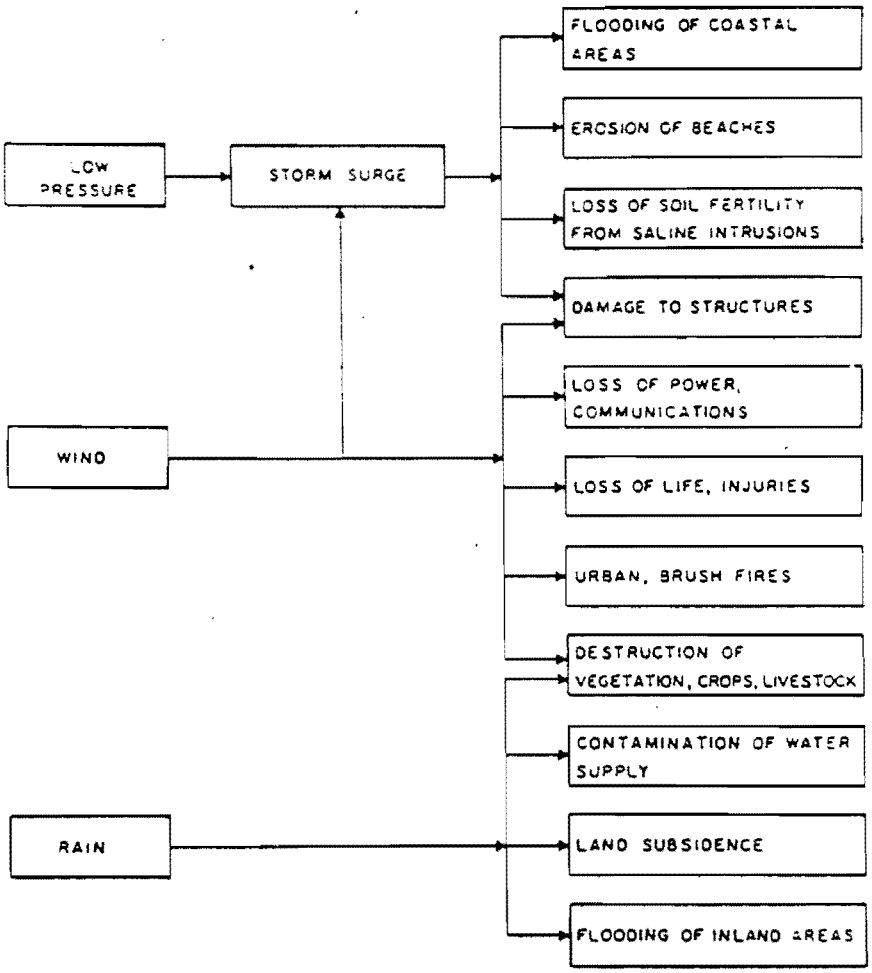

Fig. 1. Types of environmental damage accompanying tropical cyclones (Southern, 1979)

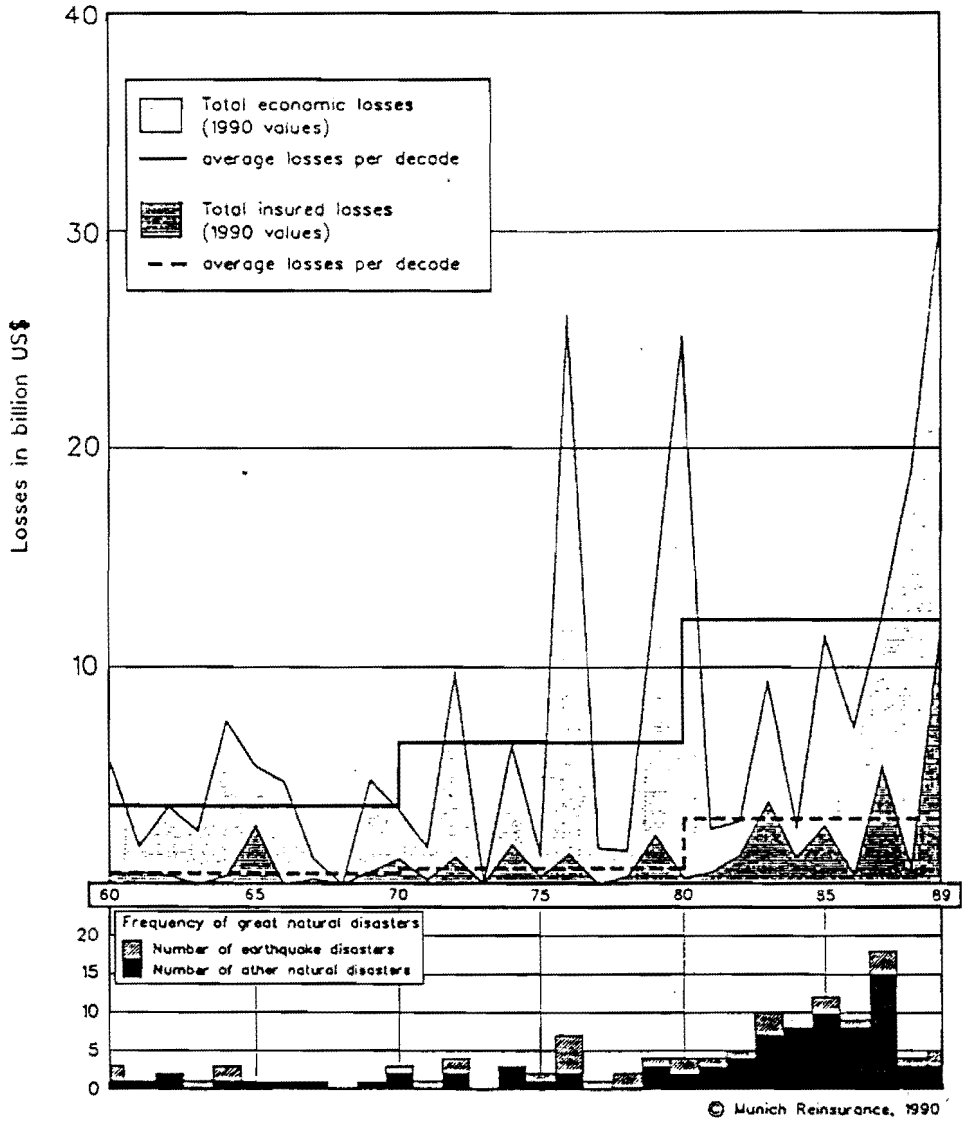

Fig. 2. : Great Natural Disasters, economic and insured losses (source UNDRO NEWS Jan. 1990)

ABSTRACT

ELEMENTS OF COASTAL ZONE MANAGEMENT PROGRAMME

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Elements of Coastal Zone Management Programme

Coastal areas have been the focus of past and present development activities, and are likely to tbe the primary targetted areas for new development. In view of diversity both in terms of environmental resources and development interests, traditional sectoral management cannot solve major coastal resources issues. The need for integrated strategies that cross sectoral boundaries and strategies that recognise the interactions and interdependancies among the sectors and ecosystem processes have therefore been stressed. It is also known that there are no widely accepted blueprints or management models that can be easily transferred. Each nation therefore has to carefully tailor it's own programme for management of its coastal resources.

Basic elements in the formulation of a Coastal Zone Management Programme as identified by Lowry (1989) include:

* An identification of the specific coastal problem to be addressed.
* Identification of priorities among these problems.
* Analysis of specific processes which cause these problems.
* Identification of specific management techniques to mitigate these problems.
* A set of organisational and administrative arrangements for implementing a management programme.
* The designation of a geographic area within which management will occur.

The importance of these elements will be discussed in the light of Coast Conservation Department's experience of a decade in implementing a Coastal Zone Management Programme.

Annex V11 E

ENVIRONMENTAL IMPACT ASSESSMENT

IN COASTAL ZONE MANAGEMENT

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Environmental Impact Assessment as an approach to the evaluation of development actions evolved in the early 1970's. This was as a response to:

- Unforeseen harmful impacts of resource development schemes such as large dams, motorways etc.
- An upsurge in environmental activism as the public became increasingly aware of environmental consequences of development actions.
- Inadequacy in existing appraisal schemes, projects were assessed mainly on technical and economic feasibility and potential environmental, social and health impacts were rarely examined explicitly.

It is important to stress that there is no general and universally accepted definition of EIA. In this paper, EIA is taken to mean the systematic examination of the likely environmental consequences of proposed projects, programmes, plans and policies. The results of the assessment - assembled in a document known as an EIA report - are intended to provide decision makers with a balanced appraisal of the environmental, social and health implications of alternative courses of action. When an EIA has been prepared it is used by decision makers as a contribution to the information base upon which a decision is made. In this way EIA can assist in formation and evaluation of environmentally sound development proposals.

The advantages of EIA

To be effective EIA should be implemented at an early stage of project planning and design. It must be an integral component in the design of projects rather than something utilised after the design phase is complete.

EIA may have long term financial advantages. If a potential problem is identified early in project planning, it may allow considerable financial savings to be achieved.

For example; a proposed dam and reservoir may have health effects which may require an expensive health care programme or a wrong location for a resettled population may result in agricultural failure and the need for food supplies to be sent to the relocated people from other areas.

The incorporation of EIA into decision making may create a number of benefits.

- If a forecast of the likely impacts are available, allowance can be made and infrastructure provided in a manner whereby impacts are minimised.
- Where uncertainty exists as to future development EIA can identify those areas most susceptible to adverse impacts and guide site selection.
- EIA can aid the identification of most suitable sites in terms of benefit maximisation and reduction of harmful effects.

In principle, EIA procedures should apply to all actions likely to have a significant environmental effect. A comprehensive EIA system would include the appraisal of policies, plans, programmes and projects. A major criticism which has been directed at the EIA, is that it causes considerable costs and delays. Initially, EIAs may be expensive to implement, particularly in areas where little is known about existing environmental and social conditions.

Design changes produced as a result of EIA findings may also increase capital costs but the savings to local, regional and national economics arising from the avoidance of deleterious impacts and from maximisation of beneficial impacts, will outweigh the costs of an EIA system in the long term.

The administrative structures of the EIA process vary from country to country. Some countries implement EIAs through legilative or administrative regulations, whilst others will integrate it with planning systems.

In any developing country, the problems of introducing EIA orginates from:

- A shortage of qualified persons together with a lack of any real understanding of the EIA procedure.
- The multi-disciplinary requirement of EIA also give rise to additional personnel problems.
- There is often a lack of commitment to EIA among the various agencies even though EIA is often required by law in some developing countries.

As a consequence, the actual implementation and performance of EIA in most countries has been rather poor. While it is generally agreed that EIA ought to be initiated during the project formulation stqage, in developing countries it is often undertaken in the later stages of a project.

ENVIRONMENTAL ISSUES IN COASTAL ZONE DEVELOPMENT

Coastal areas are especially sensitive ecological zones. Most of the world's fishery production, most of the world's valuable beaches and many of the world's most scenic areas occur in these zones.

- Coastal zones also include the sensitive estuarine areas in the discharge portions of rivers and streams. These may be drastically affected even by dam/reservoir projects constructed far upstream.
- The bulk of the world's population and cities are located in coastal zones. Hence the pressure for economic development in these zones is generally much greater than elsewhere.

All development projects in coastal areas will exercise profound effects on natural environmental resources. Therefore careful planning is needed to minimise or offset adverse effects.

Development projects in coastal areas include:

i) Ports/Harbours,
ii) Industrial estates,
iii) Oil pipelines,
iv) Recreational resorts,
v) Breakwaters,
vi) Dredging
vii) Housing projects,
viii) Aquaculture projects

Government agencies having responsibilities for controlling coastal zone development are in a most sensitive position of importance in terms of ensuring preservation of critical national resources.

Therefore, the Coast Conservation Department in Sri Lanka has focussed attention on :

i) Preparation of a Coastal Zone Management Plan;
ii) Preparation of guidelines for EIA in Coastal Areas;
iii) Initiated study programmes for developing practicable ways for protecting coastal resources (fisheries/mangroves)
iv) Special studies or projects for protection of coastal resources at selected sites.
v) comprehensive plan of water quality control for lakes and rivers.

Specific Environmental Effects

An indication of the complexity of Environmental analysis is indicated below:

Physical resources

i) Stream Waters: Coastal projects result in significant alterations in natural hydrologic regimes.
ii) Ground Waters: Ground water resources in the project are often used (quantity/quality). These can cause alteration in surface hydrology and salinity instrusions.
iii) Beach & Other Coastal Waters: The nearshore water quality will be affected by pollution discharges from industrial and community wastes.
iv) Land Uses: Beach and other recreational assests may be encroached upon by roads, housing, and other developments.
v) Land Alterations: Construction of breakwaters and jetties may significantly alter normal ocean sediment deposition/transport patterns, resulting in gradual removal of existing beaches and creation of new ones.

Ecological Resources

i) Aquatic Biology: Natural fisheries and all other aquatic will likely be altered.
ii) Terrestrial Wilklife: Development projects in rural or remote areas may sometimes have significant impacts on terrestrial wilklife including waterfowl and crocodiles.
iii) Forests: Coastal forests, especially mangroves, are likely to be seriously affected by most development projects.

ENVIRONMENTAL IMPACT ASSESSMENT IN SRI LANKA

An examination of the EIA procedure in Sri Lanka may be a useful introduction to the EIA procedure for countries just becoming involved in this subject.

The basic legislation for EIA in Sri Lanka is incorporated in the Coast Conservation Act No. 57 of 1981 and the National Environmental Amendment Act No. 56 of 1988. EIA as defined in the Coast Conservation Act is as follows.

" A written analysis of the predicted environmental consequences of a proposed development activity, and included a description of the avoidable and unavoidable adverse environmental effects of the proposed development activity, a description of alternatives to the activity which might be less harmful to the environment of the Coastal Zone, together with reasons why such alternatives were rejected, and a description of any irreversible or irretrievable commitments of resources required by the proposed development activity. "

As stated in the Coast Conservation Act an EIA will be required in the case of development activities that are considered to have significant impacts on the coastal environment. It is the responsibility of the developer to prepare the EIA, and general guidelines for its preparation have been formulated by the CCD. The CCD assists the developer during the design and preparation of the EIA.

On receipt of the EIA, the Director of the Coast Conservation Department will submit a copy of the EIA to the Coast Conservation Advisory Council for its comments. The legislation also requires the Director to publish a notice in the Gazette indicating the place and time at which the EIA can be inspected by the public and invite the public to comment on the EIA.

The Coast Conservation Advisory Council will submit its comments to the Director within 60 days of submission of an EIA. The public is required to submit comments to the Director within 30 days, of the Gazette notification. the Director will consider all comments received and within 60 days of receipt of comments from the Coast Conservation Advisory Council make a decision whether a permit can be issued and the conditions thereof.

Another important point to be mentioned here, is that the Government of Sri Lanka through a decision of the Cabinet of Ministers in 1984, made EIA mandatory for all development projects.

This was given legal effect through the amendments to the National Environmental act in 1988. The CEA has now finalised the draft regulations, procedure and methods for the application of EIA in Sri Lanka.

For the purpose of these regulations, the CEA has prescribed Project Approving Agencies to approve prescribed projects.

10 Project Approving Agencies have been identified by the CEA:

The functions of PAA's are to:-

- Subject all prescribed projects to EAP;
- Specify guidelines and any supplemental guidelines;
- Participate or conduct technical evaluation and reviews;
- Incorporate mitigatory measures in the permit conditions;
- Monitor permit conditions.

Criteria for identifying PAA

The agencies that have overall jurisdiction of the area/resources have been identified as PAA.

When there is more than one PAA involved, the lead agency is considered to be the agency that has;

a) jurisdiction over the largest area; or
b) jurisdiction over deverse or unique ecosystems;
c) within whose jurisdiction the resource depletion is the highest;

For Example:

Hotel/resort projects,

Coastal areas	- CCD
Urban areas	- UDA
Close to natural reserves	- Forest/Wildlife Department
Other areas	- relevant local authorities

If PAA become project proponents, the CEA becomes the PAA.

Prescribed Projects

Projects have been divided into two groups reflecting the severity of their likely environmental impacts. The first list (requires IEE report) includes projects whose impacts could be readily identified and quantified and for which remedial measures can usually be prescribed without much difficulty.

The second listing includes projects having significant adverse impacts requiring detailed environmental analysis.

Projects in environmentally sensitive areas: such as adjacent to sancturies, national parks, fragile coastal areas, wetlands, landslide prone areas, flood plains and places of aesthetic value.

Time targets

PAA will convey TOR to project proponent within 14 days from letter of intent. PAA will determine the adequacy of the EIA report with respect to TOR within 30 days. PAA will publish a Gazette notification and in the newspapers inviting the public to make its comments within 30 days. PAA will make a decision within 30 days.

Scoping Process

Scoping is carried out between interested agencies with the objective of identifying the important issues to be investigated in the EA.

Public Participation

The involvement and participation of the public is a most crucial aspect of the EIA process. The provision for public participation is contained in the National Environmental Act (NEA). This subjects both IEE and EIA reports to be placed before the public for inspection and comments.

EIA in terms of the Coast Conservation Act and the NEA

When the CEA is evaluating and EIA reports which has been submitted for the purpose of getting approval under provisions of the NEA, it would have to apply the criteria and procedure set out in that Act in deciding whether to grant approval or not while the Director of Coast Conservation in evaluating an EIA report which has been submitted for the purpose of getting a permit under provisions of the CC Act would have to apply the criteria and procedure laid down in that Act in deciding whether to grant a permit or not.

It should be noted that a proposed project within the coastal zone will need the approval of the CEA as well as the Director of Coast Conservation.

Annex VII F

DOWNSTREAM IMPACTS OF UPSTREAM DEVELOPMENT

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The topic as given above refers to a river and its behaviour when subjected to changes. In a broader sense, it deals with the development activities within a river basin and the possible effects they would have in the downstream reaches of the river, including the coast.

Today I would like to tackle this topic by sharing with you the information gathered relating to the behaviour of one of our rivers, the Kelani Ganga. This river, which forms part of the northern boundary of the City of Colombo, is the main source of water for the City and its environs.

This river is now being studied on a mathematical model developed by the Danish Hydraulic Institute (DHI) for the Irrigation Department, with funding from the Danish International Development Agency. The Institute for which I work, Lanka Hyraulic Institute (LHI), is associated with DHI in the day-to-day activities of this study. Starting from February last year, a lot of work has been done to -

1. Collect and analyse all data on rainfall, runoff, water levels and rating surveys;
2. Carry out extensive surveys of the river: cross sections, flood plains, embankments, bridges and existing irrigation structures;
3. Monitor the velocities of flow and collection of suspended and bed samples across selected sections of the river;
4. Calibrate and verify the rainfall-runoff model;
5. Calibrate the hydrodynamic model for routing the flow in the river. Various historical floods have been run to verify this model; and
6. Identify the possible technical alternatives for reducing the flood in the river. This exercise is being done in consultation with the relevant agencies (Ceylon Electricity Board, Water Supply & Drainage Board, Irrigation Department, Urban Development Agency etc.,)

By taking Kelani Ganga as a case study, I would like to expand on the development activities in the river basin and assess their likely impacts on the downstream reaches of the river and the coast.

Annex V11 G

THE ASSESSMENT OF MANGROVE RESOURCES THE SRI LANKAN PERSPECTIVE

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1. The Introduction:

The biological and ecological nature of mangrove vegetation of Sri Lanka has been extensively studied during the past by various researchers. However, little attention has been paid to assess the existing mangrove and the potential mangrove vegetation based on descriptive parameters such as area, major species distribution, present condition of the growing stock etc. Information on these categories is required as an essential pre-requisite for intensive management planning. A complete inventory of the mangrove resources in the Island, which is estimated as 19410 ha, is required as a base for the formulation of juridical safeguards to protect sensitive areas, rehabilitation of degraded and potential mangrove areas, to utilize on a source for raw material and for other multiple uses etc.

This paper briefly discusses the availability of resource related data, action taken in the past and planned action for the future.

2. The Major Components of a Resources Survey.

In general, a resources survey deals with two major activities.

i) The cartographic representation of the resource concerned, i.e. mangroves, in an appropriate scale related to the required level of information.

ii) Estimation of qualitative and quantitative parametres of the resource concerned. (i.e. stocked and unstocked areas, degree of stocking, species composition, dimensions of the growing stock etc).

3. The Cartographic Representation

3.1. The Available Cartographic Documentation.

During the past, various agencies have been mapping selected mangrove areas of their interest or included them in topographic or thematic maps prepared for general purposes. They are briefly listed below.

i) The traditional one inch sheets (1: 63,630).

This series of maps indicate mangrove vegetation on coastal areas. The scale is unsuitable for intensive management planning or to incorporate in a geographical information system due to limited intensity of available data. As these maps are relatively old and the mangrove vegetation may have been changed in the course of the time.

ii) The agricultural base maps (1: 50,000)

This new series of maps are based on aerial photographs obtained in the year 1981 or afterwards. However, the situation related to mangroves is similar to the one inch topographic sheets.

iii) Landuse maps (1: 100,000)

These maps of a new series are based on the interpretation of aerial photographs and includes patches of mangroves along the coastal region. They are more suitable to obtain an overall view on the locational information and the spatial distribution of mangrove vegetation. It does not classify the mangroves at a detailed level.

The distribution of mangroves in relation to the administrative districts could be obtained from these maps.

Table: 1. Distribution of Mangrove Vegetation (Source: Land Use Maps published by the Survey Department).

Administrative District	Extent (ha.)
Colombo/Kalutara	420
Gampaha	610
Galle/Matara	490
Hambantota	270
Puttlam	2320
Amparai	60
Batticoloa	1520
Trincomalee	11340
Mulativu	270
Kilinochchi/Jaffna	630
Mannar	1480
Total	19410

iv) Certain selected mangrove areas between Gintota and Kalpitiya are been sketch mapped by the Forest Department at a scale of 1: 25,000. Adding more information on infrastructure and topography, identification of mangrove formations and tightening to a geo reference system may have increased the value of these maps. However, they remain as a valuable guidance to a future detailed level mapping programme.

The above mentioned facts justifies the scope for a new mapping project to produce planimetrically accurate standardized, detailed level maps required for the intensive management of the mangrove resources.

3.2 The Proposed Mapping Programme and Objectives

Currently a mapping programme has been initialized to map the mangrove vegetation with foreign assistance (NORAD). The objectives of this task is as follows:

i) Preparation of detailed level planimetrically accurate maps (1: 10,000) of major mangrove areas of the Island in view of obtaining inventory data as à pre-requisite for the preparation of management plans.

ii) To serve as a base to formulate a computer assisted geographical information system, which incorporates other landuse types or cover classes of adjoining areas.

iii) To formulate a data base which acts as a benchmark to monitor time related spatical changes in the mangrove ecosystem.

3.3 Appropriate Technology

Our previous experiences have shown the unsuitability of the visual interpretation of the LANDSAT MSS data to map mangrove vegetation due to mixed pixels, Low resolution, confusion with other vegetation types etc.

Therefore, newly flown larger scale (1: 15,000) black and white aerial photographs will be interpreted to identify the various mangrove formations, combined with groundtruth verification.

3.4 The Map Specifications

The specifications for the proposed map series are listed in the following table.

Table 2. Map Specifications.

No of Maps	:	approx. 37
Scale	:	1: 10,000
Format	:	All maps should have a standard format. The size will be decided at the cartographic stage.
Aerial Photos	:	Black and White panchromatic photography of the scales 1: 15,000 - 1: 20,000
Base Maps	:	At scale 1: 10,000
Required Vegetation Related information.	:	Mangrove and associated vegetation types, Major landuse types (eg. Agriculture, Fish ponds etc.) Marsh Lands.
Topography	:	Main and Minor roads including permanent foot paths, Km posts, settlements other distinct permanent features.
Other information	:	The national grid, geographical co-ordinates geodetic points if any.
Restitution	:	Photogrammetric transfer technique.
Map original	:	Should be on shrinkage free transparent film.
Copying	:	Diazo printing method.
No. of copies	:	Will be decided at a later stage.

3.5. The Work Procedure

The work procedure adopted to this mapping programme is given as a flow chart in annexture 1.

3.6. Basic requirements for Management Maps.

A good management map should essentially possess 3 basic types of information. In the context of mangrove management they are as follows:-

i) Topographic Information.

This facilitates field orientation. An accurate planimetry and tightening to a geo reference system is necessary to incorporate the major mangrove areas as a single component of a complex land cover system to a computer assisted geographic information system, which serves as a promising tool for an efficient land management in future.

ii) Vegetative Cover Information.

In existing maps, the mangrove vegetation cover appears less detailed at a reconnaissance level. Therefore a detailed level classification of mangrove formations should be undertaken. In this process, collaboration between remote sensing experts, taxonomists and plant ecologists is required. As a result of this team work, classification keys to delineate various mangrove formations on aerial photos eill be developed.

iii) Cadastral Information

This information is quite necessary as mangrove ares could be under private ownership or under the jurisdiction of other state institutions. A clear marking of boundaries on maps should be undertaken.

3.7. The Use of LANDSAT thematic mapper (TM) data.

Studies have been commenced to find the suitability of Landsat TM data (ground resolution 30 m) to map the mangrove vegetation. The spectral band 3 in the visible region and the bands 4 and 5 of the near infrared are at present digitally analyzed using the ERDAS system for selected test ares in the West coast, but it si too early to comment on the outcome at these activities. However this seems to be a promising tool to monitor area related changes of the mangrove vegetation.

4. The Estimation of Qualitative and Quantitative Parameters

The major quantitative parameter which could be obtained from a map is the area information. The other qualitative and the quantitative parametres should be estimated by terrestrial investigations.

4.1. The Past Work

During the period 1985-1986, certain blocks of mangroves were investorized along the West coast of Sri Lanka, extending between Kalpitiya and Gintota. Strip transects were laid in a systematic manner and the following parametres were estimated.

For those plants greater than 2 m. height and 1 cm DBH. i) Height ii) Breast height diameter iii) Number of plants per hectare according to species.

Further for the plants less than 2 m in height and 1 cm DBH, only the number of plants per hectare according to species (Recorded as regeneration). The results for a selected area is given below. (diameter data not available).

Area Kalpitiya	Sub.Block No.	Pre-dominant Species	N/Ha.	Regeneration N/ha.
Avicennia marina	25	2762 Av. officinalis (MANDA)		
	2.	Luminetzera recemosa (BARIYA) Av. marina Excoecaria agallocha (Telakeeriya)	1937	3613
	3.	Talakeeriya Bariya Manda	2457	6957

1.

These examples shows a potential ability of regeneration exists in the sampled mangrove block.

5. Summary

The formulation of a data base on the existing mangrove vegetation of Sri Lanka is an essential pre-requisite for the effective management of this valuable resource. As no standardized detailed level cartographic documentation of the mangrove vegetation is vailable, it has been initialized to laucnch a mapping programme. The most promising tool for this activity is the interpretation of the conventional black and white panchromatic aerial photographs of a larger sclae, which could be subsequently supplemented with high resolution satellite data for the effective monitoring of changes. These detailed maps would serve as a valuable base in the qualitative and quantitative assessment of the mangrove formations in the field.

THE WORK PROCEDURE