



**Bangladesh National Programme of Action
for Protection of the Coastal and Marine
Environment from Land-Based Activities**

**Department of Environment
Ministry of Environment and Forests
Government of the People's Republic of Bangladesh**



Bangladesh National Programme of Action for Protection of the Coastal and Marine Environment from Land-Based Activities

Prepared by

**Department of Environment
Ministry of Environment and Forests
Government of the People's Republic of Bangladesh**

In Collaboration With

**IUCN – The World Conservation Union
Bangladesh Country Office
and
Bangladesh Center for Advance Studies (BCAS)**

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Preface

The Bangladesh National Programme of Action (NPA) for the Protection of the Marine Environment from Land – base Activities is a national document under the aegis of the Global Programme of Action (GPA) of the UNEP. In the year 1999, Bangladesh initiated the process of preparing their NPA, based largely on secondary information sources. In 2003, at a follow – up meeting held in Sri Lanka, the decision to scientifically validate the NPA was made. Accordingly, several projects were identified for incorporate the findings into the NPA of Bangladesh. The document chalks out strategies for the implementation of individual as well as joint action plans both at the policy level and resource utilization plans, affected by marine pollution and degradation caused by land – based activities.

The NPA document for Bangladesh has essentially 6 chapters, namely: Introduction; Methodology; Key issues for national action; Management of objectives for priority problems; Identification, evaluation and selection of strategies and measures and Action programme. The lessons learnt from pilot initiatives are probably at the heart of the updated NPA, citing 6 pilot initiatives implemented in the coastal areas of the country. IUCN Bangladesh Country Office and BCAS's projects – Rehabilitation of Critical Ecosystem: Chokoria Sundarbans; Minimum Environmental Flow Requirement for Ecosystem and its Functioning and Environmental Flow Assessment are some of the cases worth mentioning, funded by GPA. These successful initiatives pave the way for 7 major strategies to combat the pollution and degradation in the coastal areas, along with brief action programmes outlining the objectives, outputs, activities and so on and so forth. It is also worth mentioning that these strategies and action programmes are complementary to the country's other national priorities such as the Integrated Coastal Zone Management Plan (ICZMP) and the Poverty reduction Strategy Paper (PRSP).

It is a great pleasure to successfully launch this national document, signifying the needs and opportunities for the protection of the coastal environment and associated lives and livelihoods. I would like to thank all those involved in the preparation and finalization of this document and would like to believe that these policies and programmes will be materialized for the betterment of the country as a whole.

Secretary
(Jafar Ahmed Chowdhury)
Ministry of Environment and Forests

Foreword

Bangladesh is one of the largest deltas in the world, with a network of 230 rivers and rivulets and a coastline of 710 kilometers, hosting an unique diversity of ecosystems. According to the Integrated Coastal Zone Management Plan (ICZMP) of Bangladesh, 19 districts or 147 *upazilas* are defined as coastal districts, out of which 48 *upazilas* are exposed to the coast and 99 *upazilas* lie in the interior coast. In Bangladesh, about 30 million people are coastal inhabitants, relying on agriculture, fisheries, forestry, salt panning etc for their livelihood sustenance. Unfortunately, the coast of Bangladesh is identified as a zone of multiple vulnerability, prone to severe natural disasters such as cyclones, storm surges and floods. Combined with anthropogenic hazards such as erosion, arsenic contamination of the groundwater, water logging, soil salinity and various forms of pollution, the coastal and marine environment is under threat.

Against this backdrop, Bangladesh initiated a process to develop the National Programme of Action (NPA) in 1999 under the Global Programme of Action (GPA) for the Protection of the Marine Environment from Land – based Activities, formulated by United Nations Environment Programme (UNEP). The 1999 NPA was prepared on the basis of secondary information and lacked scientific guidance and methodology. In 2003, at a meeting held in Sri Lanka, several pilot scale projects were selected to incorporate the findings into the updated NPA of Bangladesh. The Department of Environment (DoE), Ministry of Environment and Forests was thus entrusted with the responsibility of formulating the updated NPA for Bangladesh, earmarking the challenges exist in the coastal zone and suggesting strategies to overcome them. IUCN Bangladesh Country Office and BCAS were also associated in the preparation of the updated NPA to enrich this key national document with their knowledge and experience gained through the implementation of pilot project.

I sincerely hope that the NPA and its suggested strategies are implemented for the betterment of the coastal environment, but moreover for the well – being of the coastal people. I would like to take this opportunity to thank UNEP – GPA for funding this strategy document. My heartfelt gratitude also goes towards IUCN Bangladesh Country Office and BCAS for successfully completing this task. I would also like to congratulate my colleagues at the DoE who have managed this arduous task of preparing this national document.

Allah Hafez

Bangladesh Zindabad

Honorable Minister
Ministry of Environment and Forests

Executive summary

United Nations Environment Programme (UNEP) formulated their Global Programme of Action in 1995 to protect coastal and marine environment from land-based activities. With the commitment to promote integrated coastal management and contribute to reduce the pressure on marine environments, Bangladesh initiated a process to develop National Programme of Action (NPA) under the Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities in 1999. The 1999 National Programme of Action was prepared based on available secondary information. In the year 2003 a meeting was held in Sri Lanka on GPA for South Asia Region. Several projects were selected for funding by UNEP/GPA at a pilot scale so that the findings can be incorporated while updating the National Programme of Action (NPA) for Bangladesh. It highlighted the necessity to develop strategies for the implementation of individual and joint actions in policies, priorities and resources for the prevention, reduction, control and/or recovery and elimination of the marine environment degradation caused by land-based activities. The National Programme of Action for the Protection of the Marine Environment from Land-based Activities in Bangladesh fits in the above context with a strategy that integrates the existing challenges and integrated coastal zone management.

In this context, the Bangladesh National Programme of Action takes into account the coastal management background of the past, introduces the procedures and arrangements that preceded the consolidation of this document and adopts the methodological framework suggested by the UNEP under GPA. The methodology consists of six steps:

- Identification and assessment of problems
- Establishment of priorities for national action
- Setting management objectives for priority problems
- Identification, evaluation and selection of strategies to achieve goals and objectives
- Determination of criteria for evaluating effectiveness of strategies and measurement
- Organize/reorganize programme support unit

Fifteen major issues/problems have been identified as the main sources of coastal and marine pollution. The issues are as follows:

- Industrial waste (including ship Break yards)
- Sewage disposal
- Solid waste management
- Agrochemicals and PoPs
- Deforestation
- Salinity intrusion
- Rapid urbanization
- Erosion in the coastal zone
- Extraction of coastal resources
- Gas oil and mineral resources
- Shrimp farming
- Coastal fishing and fish processing
- Coastal tourism

- Land use change
- Climate change

For each of the key issues the following four major aspects i.e. pressure, state, impact and responses were analyzed. While selecting management objectives for priority problems, careful considerations were given on environmental aspects, lesson learnt from pilot initiatives, sustainable livelihood and economic aspects. Synergies with Poverty Reduction Strategy Paper (PRSP) and Integrated Coastal Zone management Plan (ICZMP) have been indicated and considered carefully.

Considering the above mentioned priority problems, seven broad strategies have been identified to protect the coastal and marine resources from land and land based activities.

The strategies are as follows:

- Strategy 1. Proper management of waste (including agro-chemicals and pesticides, solid waste and sewage)
- Strategy 2. Proper management of industrial waste
- Strategy 3. Increase coastal afforestation
- Strategy 4. Capacity Building (Training, awareness, research and monitoring)
- Strategy 5. Assessment of environmental flow requirement and salinity Intrusion
- Strategy 6. Establishment of Central Data Base Directory
- Strategy 7. Ensure preparedness for the adaptation to natural disasters

Under the aforesaid strategies, 7 action programmes and 12 major activities have been identified. The action programmes are as follows:

- 1.1 Management of agro-chemicals
- 1.2 Management of solid Waste
- 1.3 Management of sewage
- 2.1 Management of industrial waste including Ship Breaking industries
- 2.2 Management of other industrial waste
- 3. Increase Coastal Afforestation and Conservation of Existing Forest Areas
- 4.1 Conduct training programmes
- 4.2 Initiate awareness programmes
- 4.3 Research and Monitoring Capacity Building
- 5. Assessment of Environmental Flow Requirement and Salinity Intrusion
- 6. Establishment of Central Data Base Directory and Information System
- 7.1 Land Management Options
- 7.2 Water/ Coastal Management Options

Also, the document detailed out objectives, activities, outputs, budget and implementing agencies for each of the action programmes.

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Acronyms and Abbreviations

BBS	Bangladesh Bureau of Statistics
BCAS	Bangladesh Centre for Advanced Studies
BEMP	Bangladesh Environment Management Project
BMP	Best Management Practices
BOD	Biological Oxygen Demand
BSBA	Bangladesh Ship Breakers Association
CBO	Community Based Organization
CPR	Common Property Right
DDT	Dichloro-diphynyle Trichloro-ethane
DO	Dissolved Oxygen
DoE	Department of Environment
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
FAO	Food and Agriculture Organization
FD	Forest Department
GPA	Global Programme of Action
ICZMP	Integrated Coastal Zone Management Programme
MOEF	Ministry of Environment and Forests
MoWR	Ministry of Water Resources
MT	Metric Ton
NGO	Non-Government Organization
NPA	National Programme of Action
NRCA	Natural Resource Conservation Activists
PAB	Pesticide Association of Bangladesh
PCB	Polychlorinated Bi-phenyls
PDO-ICZM	Project Development Office-Integrated Coastal Zone Management
POP	Persistent Organic Pollutants
PPM	Parts per million
PRSP	Poverty Reduction Strategy Papers
STP	Sewage Treatment Plant
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WRIP	Western Region Integrated Project

1. INTRODUCTION

Bangladesh is one of the largest deltas in the world, second to the Amazon, formed mainly by the Ganges-Brahmaputra-Meghna (GBM) river system, except for the hilly regions in the northeast and southeast and terrace land in northwest and central zones. The country is located between 20°34' to 26°38' north latitude and 88°01' to 92°42' east longitude. The total land area is 147,570 sq. km. and consists of low and flat land. A network of 230 rivers with their tributaries and distributaries crisscross the country and, therefore, the country is virtually a conglomerate of islands.

It has a population of about 131 million (BBS, 2002) with very low per capita Gross Domestic Product (GDP) of US\$ 351 per annum (UNDP, 2004). The population of the country is increasing over the years with significant variation in urban and rural population growth. In the last decade (1991-2001), the overall increase was about 16 percent while urban and rural growth was about 37 percent and 11 percent respectively (BBS, 2003). It is estimated that the population of the country will be 170 million by the year 2020 (WB and BCAS, 2000).

Coastal zones refer to areas where land and sea meet (Islam, 2004). It has been delineated previously in various ways (ESCAP/UN, 1987; Danida, 1999; SRDI, 2001; MoWR, 1999b; PDO-ICZMP, 2001). The coast of Bangladesh covers about 710 km in length and hosts a unique diversity of ecosystems. Depending on the geo-morphological features, the coastal areas of Bangladesh can broadly be divided into three distinct regions viz. the eastern region, the central region and the western region. PDO – ICZMP (2003 b) classified¹ the coastal areas of Bangladesh under two broad categories viz. interior coast and exterior coast. Out of 19 coastal districts (147 upazilas), a total of 48 upazilas in 12 districts that are exposed to the sea and or lower estuaries, are defined as the *exposed coast* and the remaining 99 upazilas of the coastal districts are termed *interior coast*.

In many parts of the world, coastal areas are highly populated and often the most developed stretches of land. It is estimated that 40% of the world population lives within 100 km of a coastline (UNDP, 2000), and expectations are that this figure grows further in the coming half century. In Bangladesh, about 36 million people live in the coastal area of Bangladesh and livelihood primarily depends on agriculture,

fishery, forestry, near shore transportation, salt farming etc. The coastal zone of Bangladesh comprises the largest delta of the world and is under a process of active

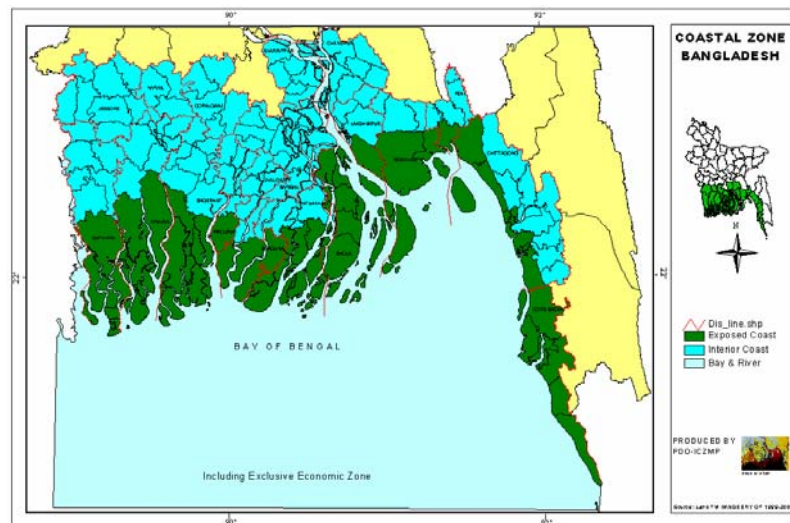


Figure 1. Map of the land part of the coastal zone of Bangladesh, ICZMP, 2004

¹ Threshold levels: tidal fluctuations 0.3 m; soil salinity 4 dS/m; surface water salinity 5 dS/m; groundwater salinity 2 dS/m; cyclone risk: wind risk.

The Coastal zone of Bangladesh

Depending on the geomorphological features, coastal zones of Bangladesh can broadly be divided into the following three regions:

The Eastern Region

Morphologically the eastern coastline of Bangladesh from the big Feni river to Badar Mokam (southern tip of the mainland) along Chittagong can be classified as a "Pacific Type" coast running parallel to the young (Tertiary) folded hill ranges. The East Coast is regular and unbroken and is protected along seacoast by mud flats and submerged sands. A continuous strip of sand (sandy beach) lies from Teknaf (Burma border) to Badar Mokam and form one of the longest beaches of about 145 km. The smaller rivers and the Chakaria and Teknaf mangrove forests of the eastern region (Karnafuli, Sangu, Mathamuhuri and Naaf) play an important role in determining the coastal ecosystem.

The Central Region

This region begins from the Tebegins from the Tetulia river to the big Feni river estuary including the mouth of the Meghna river upto the confluence of the Padma (Ganges-Brahmaputra) and the Meghna river near Chadpur. Heavy sediment load and one of the most complex tropical estuarine ecosystems of the world characterize this region. The coastline is most irregular, and consists of a series of islands, where the rivers are continuously changing their courses; the funnel shaped apex of the Bay of Bengal is relatively shallow, surrounded by numerous islands and estuarine channels- Tetulia-Rabanabad channel, Hatiya channel, and Sandwip channel. The area is dominated by semi-diurnal tidal currents, the maximum tidal range of 5 meters occurs in the Meghna estuary which gradually decreases southeastwards along the Chittagong coast. Since the last two hundred years the Meghna estuary went through intensive morphological changes with migration and the growth of islands in the southern direction. This region is also subject to the impact of cyclone and storm surges causing an innumerable loss of life and property.

The Western Region

The western region covers the coastline westward from the Tetulia River to the international boundary (India) located at the Hariabangha River. The region is mostly covered with dense mangrove forests with deeply scoured tidal channels of the tidal plain overlapping abandoned Ganges delta.

delta development and morphological changes by the Ganges-Brahmaputra-Meghna (GBM) river system. All major rivers in Bangladesh bring billions of tons of sediments into the Bay of Bengal. Bound to these sediments are unknown quantities of poisonous residues from agricultural chemical, industrial residues, farm effluents, solid waste, sewage disposal etc. Rapid urbanization, deforestation and unplanned extraction of coastal resources aggravated the situation further complex.

The coast of Bangladesh is known as a zone of multiple vulnerabilities as well as opportunities. It is prone to severe natural disasters, such as cyclones, storm surges, floods, etc. In combination with other natural and man-made hazards, such as erosion, the high arsenic contents of groundwater, water logging, water and soil salinity and various forms of pollution, these disasters have made coastal dwellers very vulnerable (Islam, 2004) and made the whole coastal and marine environment threatened.

United Nations Environment Programme (UNEP) formulated their Global Programme of Action in 1995 to protect coastal and marine environment from land-based activities. With the commitment to promote integrated coastal management and contribute to reduce the pressure on marine environments, Bangladesh initiated a process to develop National Programme of Action (NPA) under the Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities in 1999. The 1999 National Programme of Action was prepared based on available secondary information and there was no specific guideline and methodology. In the year 2003 a meeting was

held in Sri Lanka on GPA for South Asia Region. Several projects were selected for funding by UNEP/GPA at a pilot scale so that the findings can be incorporated while updating the National Programme of Action (NPA) for Bangladesh. It highlighted the necessity to develop strategies for the implementation of individual and joint actions in policies, priorities and resources for the prevention, reduction, control and/or recovery and elimination of the marine environment degradation caused by land-based activities. The National Programme of Action for the Protection of the Marine Environment from Land-based Activities in Bangladesh fits in the above context with a strategy that integrates the existing challenges and integrated coastal zone management.

In this context, the Bangladesh National Programme of Action takes into account the coastal management background of the past, introduces the procedures and arrangements that preceded the consolidation of this document and adopts the methodological framework suggested by the UNEP under GPA so as to design an ongoing and suitable programme to follow the concepts and guidelines that integrate the environment (confluence area) and the actions, which are described as follows:

- A. Identification and assessment of problems
- B. Establishment of priorities
- C. Setting management objectives for priority problems
- D. Identification, evaluation and selection of strategies and measures
- E. Criteria for evaluating the effectiveness of strategies and measures
- F. Programme support elements

Table 1: Districts and upazilas of the coastal zone of Bangladesh

District	Area (km ²)			Upazilas	
	Total	Exposed	Interior	Exposed	Interior
Bagerhat	3,959	2,679	1,280	Mongla, Saran Khola, Morrelganj	Bagerhat Sadar, Chitalmari, Fakirhat, Kachua, MollahatRampal
Barguna	1,831	1,663	168	Amtali, Barguna Sadar Patharghata, Bamna	Betagi
Barisal	2,785		2,785		Agailjhara, Babuganj, Bakerganj, Gaurnadi, Hizla, Mehendiganj, Muladi, Wazirpur, Banari Para, Barisal Sadar
Bhola	3,403	3,403		Bhola Sadar, Burhanuddin, Char Fasson, Daulatkhan, Lalmohan, Manpura, Tazumuddin	
Chandpur	1,704		1,704		Chandpur Sadar, Faridganj, Haimchar, Hajiganj, Kachua, Matlab, Shahrasti
Chittagong	5,283	2,413	2,870	Anowara, Banskhali, Chittagong port, Double Mooring, Mirsharai, Pahartali, Panchlaish, Sandwip, Sitakunda, Patenga, Halisahar, Kotwali, Boijid Bostami,	Boalkhali, Chandanaish, Lohagara, Rangunia, Chandgaon, Fatikchhari, Hathazari, Patiya, Raozan, Satkania, Bakalia, Karanaphuli, Kulshi
Cox's Bazar	2,492	2,492		Chakaria, Cox's Bazar Sadar, Kutubdia, Ukhia, Maheshkhali, Ramu, Teknaf	
Feni	928	235	693	Sonagazi	Chhagalnaiya, Feni Sadar, Parshuram, Daganbhuiyan
Gopalganj	1,490		1,490		Gopalganj Sadar, Kashiani, Kotali Para, Muksudpur, Tungipara
Jessore	2,567		2,567		Bagher Para, Chaugachha, Jhikargachha, Manirampur, Abhaynagar, Keshabpur, Jessore Sadar, Sharsha
Jhalokati	749		749		Jhalokati Sadar, Kanthalia, Nalchity, Rajapur
Khulna	4,394	2,767	1,627	Dacope, Koyra	Batiaghata, Daulatpur, Dumuria, Dighalia, Khalishpur, Khan Jahan Ali, Khulna Sadar, Paikgachha, Phultala, Rupsha, Sonadanga, Terokhada
Lakshmipur	1,456	571	885	Ramgati	Lakshmipur Sadar, Raipur, Ramganj
Narail	990		990		Lohagara, Narail Sadar, Kalia, Narigati
Noakhali	3,601	2,885	716	Companiganj, Hatiya, Noakhali Sadar	Chatkhil, Senbagh, Begumganj
Patuakhali	3,221	2,103	1,118	Dashmina, Rangabali, Galachipa, Kala Para	Bauphal, Mirzaganj, Patuakhali Sadar
Pirojpur	1,308	353	955	Mathbaria	Bhandaria, Kawkhali, Nazirpur, Pirojpur Sadar, Nesarabad (Swraupkati)
Satkhira	3,858	2,371	1,487	Assasuni, Shyamnagar	Debhata, Kalaroa, Kaliganj, Satkhira Sadar, Tala
Shariatpur	1,182		1,182		Bhederganj, Damudya, Goshairhat, Naria, Palong, Zanjira
Total	47,201	23,935	23,266		

Source: PDO-ICZMP, 2003

2. METHODOLOGY

A comprehensive framework methodology was developed to prepare National Programme of Action (NPA) under Global Programme of Action (GPA) to protect coastal environment from land-based activities. This methodology consists of the following six steps that have been used to prepare National Programme of Action for Bangladesh to protect its marine ecosystem from land-based activities.

- 2.1 Identification and assessment of problems
- 2.2 Establishment of priorities for national action
- 2.3 Setting management objectives for priority problems
- 2.4 Identification, evaluation and selection of strategies to achieve goals and objectives
- 2.5 Determination of criteria for evaluating effectiveness of strategies and measurement
- 2.6 Organize / Reorganize: Programme Support Elements.

2.1 Identification and assessment of problems

The following five criteria elements (GPA guideline) have been used to identify the key issues for national action:

- Nature and severity of problems considering coastal and marine resources and ecosystem health, economic and social benefits, food security and poverty alleviation, and public health;
- Contaminants released from land-based activities (e.g. agrochemicals, sewage, hydrocarbons, heavy metals etc);
- Physical alteration, including habitat modification and destruction of concerned areas (e.g. infrastructure development, wetland encroachment, excessive deforestation etc);
- Sources of degradation (e.g. industries, power plants, construction activities etc); and
- Areas of concern (critical habitats, habitats of endangered species, ecosystem components e.g. spawning areas etc)

2.2 Establishment of priorities for national action

Considering extent of adverse impacts or risk on coastal environment, human health, social, economic and cultural values by the above exposures, key issues were prioritized for national action. The availability of existing regulations, guidelines, management system and their enforcement as well as local level actions were also considered on prioritization of these issues.

2.3 Setting management objectives for priority problems

Management objectives will be determined based on priorities of action. These management objectives may address environmental, social and economic sustainability and protect marine ecosystem from land-based activities.

2.4 Identification, evaluation and selection of strategies to achieve goals and objectives

Recognizing Best Management Practices (BMPs) in each and every sector particularly industrial, urban utility service, and agricultural sectors, a number of strategies and measures were established for the protection of marine ecosystem of Bangladesh. These measures may be added or linked with Integrated Coastal Zone Management Programme (ICZMP).

2.5 Determination of criteria for evaluating effectiveness of strategies and measurement

The priorities of the key issues for action may change at different times. To ensure effectiveness and make it practical, review of the strategies and measures will be done from time to time. These changes must link up with management objectives to reach the goal at particular time.

2.6 Programme Support Elements

To implement NPA, comprehensive support elements should be ensured at the implementing area. The policy and institutional arrangement and coordination between relevant sectors are extensively required at the beginning to implement NPA. Training, educating, awareness programme, legal and enforcement mechanisms, financial mechanisms, contingency planning, research and monitoring, and public participation are necessary element to achieve this goal.

2.7 Composition of Steering Committee Members and TOR

In addition to the above mentioned prescribed methodology of UNEP, the Department of Environment, Ministry of Environment and Forest has set up a steering committee consisting of 18 members to review and monitor the progress, and advice in the process of development of National Programme of Action for Bangladesh. Composition of steering committee members with their institutional affiliation and terms of reference is given below.

- Director General, Department of Environment, Convener
- Representative, Ministry of Environment and Forest, Member
- Representative, Ministry of Science Information and Communication Technology, Member
- Representative, Ministry of Health
- Representative, Ministry of Water Resources
- Representative, Ministry of Land
- Representative, Bangladesh Internal Water Transportation Authority
- Representative, Ministry of Shipping
- Representative, Ministry of Industry
- Representative, Mercantile Marine Department (MMD)
- Representative, Ministry of Fisheries and Livestock, Member
- Representative, Department of Forest, Member
- Representative, Water Resources Planning Organization, Member
- Country Representative, IUCN Bangladesh, Member
- Executive Director, BCAS, Member
- Executive Director, IWM, Member
- Executive Director, CEGIS, Member
- President, Federation of Chambers and Commerce, Member
- President, Dhaka Chambers of Commerce and Industries, Member
- Representative, Khulna Chambers of Commerce and Industries, Member
- Representative, Chittagong Chambers of Commerce and Industries, Member
- Representative, Barisal Chambers of Commerce and Industries, Member

- Chairperson, CARDMA, Member
- President, Global Water Partnership- South Asia, Member
- Representative, Integrated Coastal Zone Management Plan, Member
- Deputy Director, Department of Environment, Member Secretary

ToR of the Steering Committee

- Overall monitoring of progress of on-going activities and provide necessary policy guidance
- Review and necessary endorsement of the different reports and plans proposed by the implementing partners
- Committee will convene at least once in every two months
- Member/s will be co-opted if necessary

It should be mentioned here that this committee will be responsible for monitoring of implementation of on-going activities.

2.8 Consultation with Relevant Stakeholders

Consultation with relevant stakeholder considered as an integral part of the preparation of the National Programme of Action. Both formal and informal consultations were carried out during the preparation of NPA. The two case studies were undertaken to facilitate the preparation of NPA. A number of stakeholder consultations were carried out to get feedback of the coastal communities as part of case study activities.

A national level stakeholder consultation was also organized to share draft NPA and case study findings. Fruitful contribution and suggestions of participants from different ministries, departments, agencies, non-government organizations, and academics were incorporated in the final report.

3. KEY ISSUES FOR NATIONAL ACTION

3.1 Industrial Waste (Including Ship Break yards)

There are various types of the industries in the coastal area of Bangladesh of which major types are Jute, pulp and paper, textiles, fertilizer, rubber and plastic, tannery, food and beverages, sugar, pharmaceuticals, tobacco, distilleries, ship breaking etc. The number of total industries in coastal zone of Bangladesh has been reported as 8,542 till 1998 (Islam, 2004). However, the waste of all these industries particularly tannery, textiles, pulp and paper and fertilizer, ship breaking, etc are may be significantly responsible for coastal pollution of Bangladesh. It has also been reported that nearly 600 industrial units established in and around the Khulna-Jessore urban corridor, the Karnaphuly and Bukkhali River, and in the Chittagong area that are primarily responsible for water pollution through discharge of huge amount of both solid and liquid waste that contains toxic substances (Islam, 2004). Toxic substances are generally released as a result of manufacturing operations, effluent discharges, and accidental spills. When accidentally released into the marine environment, they can have severe adverse effects on marine ecosystems. Many compounds are very persistent in the aquatic environment, bio-accumulates in marine organisms, and is highly toxic to humans via the consumption of seafood. In fact, most of these industries are located in the two major coastal districts, Chittagong (in 8 industrial zones) and Khulna (in 3 industrial zones). A number of studies have been carried out over the last two decades by several organizations and institutes on the coastal environment. Most of the studies identified high level of both fresh and marine water pollution due to improper management of industrial waste. The following Table provides a synopsis of existing causes, state, possible impacts and responses.

Table 2. Synopsis of existing causes, state, possible impacts and responses due to industrial waste

Pressure	State	Impact	Response
<ul style="list-style-type: none"> • Untreated industrial liquid waste • Hazardous waste from tannery • Chemical waste from ship break yards • Improper management of industrial solid waste • Lack of awareness, technical efficiency, transparency and accountability 	<p>High level of chemical concentration of the water bodies (e.g. Karnaphully river and coast of the Bay of Bengal) [Please see table-3]</p>	<ul style="list-style-type: none"> • Surface water pollution • Threat to both freshwater and marine ecosystem • Loss of biodiversity • Severe Human health Hazard • Significant Environmental risk for Future Generation 	<ul style="list-style-type: none"> • EIA guidelines for Industries, 1997 • Environmental Conservation Act, 1995 • Environmental conservation Rules, 1997 • Marine Pollution Ordinance, 1977 • Inland Shipping Ordinance, 1976 • Chittagong Metropolitan Master Plan (1995-2015) • Integrated Coastal Zone Management Plan • Coastal Development Strategy • A demonstration project is being undertaken by BCAS to reduce pollution from ship break yards through awareness building and capacity building of the workers of ship break yards.

A recent survey by the Marine Science Institute of Chittagong University indicated that the water of the coast of Shitakunda contains high concentrations of several heavy metals such as mercury, cadmium, lead, chromium, iron etc. The findings of their study are presented in the Table 3 below:

Table 3. Metal Concentrations at Sitakunda Area (near ship break yard)

Metal	Concentration (ppm)	Bangladesh quality standards (ppm)
Lead	0.5-21.8	0.05
Chromium	220	0.05
Cadmium	0.3-2.9	0.005
Iron	2.6-5.6	1.0

Source: Islam, 2004

According to the Asian Development Bank Study, the tannery industries, located at Kalurghat in Chittagong, discharge nearly 150,000 liters of liquid waste per day while the Karnaphuly Paper Mill releases 0.35 tons of china clay everyday (ADB, 2004).

3.2 Sewage Disposal

Sewage of nearly 36 million people living in 19 Coastal districts directly or indirectly goes to the water systems (rivers) and eventually flows into the Bay of Bengal. In fact, none of the coastal cities have any proper sewerage system or sewage treatment plant in place. All the urban cities are supported by septic tank and pit sanitation. Poor households use community latrines. However, these systems are directly or indirectly connected to canals or rivers through surface drain of the city. This resulted for about 3.5 tons/day of BOD load in the Karnaphully river in 1988 at Chittagong, when the population of the district was about 5 millions only (ESCAP, 1988 in Ali, 1997). In Khulna, the domestic load was estimated at about 2.2 tons BOD/day when the population of the district was less than 2 millions in 1988. In 2001, population of these two major coastal districts has increased to over 2.36 million (Khulna) and 6.54 million (Chittagong) respectively (BBS, 2001). Assuming 100 gm of human waste is generated per person/day, the total quantity of waste of only these two cities amount to around 900 metric tons (MT) of human waste in a day. Sewage from coastal settlements is also a major source of nutrients in coastal waters. In addition, nutrients, especially nitrogen, enter the marine environment via atmospheric deposition. However, there is no doubt that most of it directly or indirectly (during rainy season and flood inundation) goes to the river system and then into the marine waters. This situation is becoming more serious due to increase of population in coastal districts and lack of proper sanitation as well as sewage treatment facilities.

Table 4. Synopsis of existing causes, state, possible impacts and responses due to sewage disposal

Pressure	State	Impact	Response
<ul style="list-style-type: none"> • Untreated sewage disposal • Increasing coastal population • Resource constraints • Lack of sewerage system • Lack of awareness, technical efficiency and accountability 	High level of DO and BOD load and concentration in coastal water bodies (e.g. Karnaphully river)	<ul style="list-style-type: none"> • Microbial contamination • Loss of fishes and aquatic organisms • Increasing food and livelihood insecurity • Increasing human health risk 	<ul style="list-style-type: none"> • Integrated Coastal Zone Management Plan • Coastal Development Strategy

3.3 Solid Waste Management

A number of cities and towns in the Coastal region of Bangladesh may have solid waste management service through municipal or City Corporation (e.g. Chittagong, Khulna).

Most of these city corporations have specific area for dumping municipal waste, but none of them have any sanitary landfill sites. In urban cities, city corporations/ municipalities collect waste from temporary bins and dump into the designated landfill site. Some of the NGOs/CBOs are being active in community based waste management in some of the coastal cities e.g. Chittagong, Khulna, Barishal etc. It may be noted that all the municipal landfill sites are open and there is no leachate treatment technology in place at any of the coastal cities. It may also be noted that the major landfill sites of the Chittagong City Corporation are very close to the Bay Bengal. As a result, this waste may reach water system particularly during flood and the rainy season. On the other hand, many of the slums and squatters do not get solid waste management service from municipalities or CBOs/NGOs. Due to lack of this utility service and improper way of waste management, large volume of domestic waste of the slums and squatters remain uncollected. Dumping of solid waste into such places is still increasing with excessive rural to urban migration of low income groups which became a real threat to the coastal environment causing the following problems:

- Uncollected waste directly or indirectly goes to the water body
- Surface water pollution gets aggravated due to direct dumping from nearby slums and squatters
- Health hazards for the fishermen and poor people who are directly involved with the river/canal water

The following Table represents existing solid waste related issues in coastal area of Bangladesh

Table 5. Existing solid waste related issues in coastal area of Bangladesh

Pressure	State	Impact	Response
<ul style="list-style-type: none"> • Increasing waste generation • Improper waste management • Inadequate technical capacity - Lack of transportation, collection and equipment facilities • Insufficient workforce of City Corporation • Open waste disposal site • Budget constraints (Inadequate fund) • Lack of transparency and accountability 	<p>High level of DO and BOD load and concentration in coastal water bodies (e.g. Karnaphully river)</p>	<ul style="list-style-type: none"> • Increasing coastal pollution • Loss of fresh and marine biodiversity • Human health risk • Impaired fish breeding and fish ecology 	<ul style="list-style-type: none"> • Environmental Conservation Act (ECA), 1995 • Environmental conservation Rules (ECR), 1997 • Integrated Coastal Zone Management Plan • Chittagong Port Ordinance, 1976 • Coastal Development Strategy • Demonstration project on solid and medical waste management in Cox's Bazar and Barishal Municipal area, funded by BEMP • Urban Solid Management Handling Rules of Bangladesh' is being prepared by the Ministry of Environment and Forest (MoEF) with support from UNDP • Directorate General of Health Services, Ministry of Health and Family Welfare developed a manual on hospital waste management in 2001.

Besides domestic waste, a considerable amount of shrimp heads and refuse of slaughtered animals are dumped into the rivers of different coastal districts mainly in

Chittagong, Khulna, Cox's Bazar, Satkhira etc. Study related to this waste is not available.

3.4 Agrochemicals/Persistent Organic Pollutants (POPs)

According to the Pesticide Association of Bangladesh, the total use of pesticides in Bangladesh was 18,080 MT in 2003, whereas it was only 3,985 MT in 1984 (PAB, 2004). The uses of pesticides in Bangladesh have increased enormously in the last 20 years (nearly six times from 1984). Since the agricultural area of coastal districts is 28 % of the total of Bangladesh, Nearly one-fourth (based on area) of pesticides may be assumed of being used in coastal-cropped area. Therefore, over 4,520 tons of pesticides are used in the agricultural areas of coastal districts. Of them, 1,130 tons (25 %) may reach surface water system as residue during rainy season (ESCAP, 1987; FRI, 1994). Besides this, the same amount or even more may wash into the river system during flood inundation when nearly half of the country gets submerged. It may be noted that most of the farmers do not know the effect or consequences of the pesticides. They are unaware about both handling and applying most of the pesticides they use. However, excessive and improper use of pesticides and fertilizers in the cropped area may pose significant risk to coastal waters with surface soil erosion and wash out of the agricultural field by rainfall. The following table presents the problems and existing policy responses on agrochemical in coastal zone of Bangladesh.

Table 6. Problems and existing policy responses on agrochemical in coastal zone of Bangladesh

Pressure	State	Impact	Response
<ul style="list-style-type: none"> Increasing application of pesticides and persistent organic pollutants (POPs) Improper application of pesticides and POPs Lack of awareness of the effect of pesticides and POPs Lack of transparency and accountability 	<p>Increasing level of pesticides residue in the water bodies (25% of total applied agrochemicals runoff into water bodies)</p>	<ul style="list-style-type: none"> Increasing coastal pollution Loss of fresh and marine biodiversity Increased fish mortalities Human health risk Contamination through food chain 	<ul style="list-style-type: none"> Environmental Conservation Act, 1995 Environmental conservation Rules, 1997 Integrated Coastal Zone Management Plan Coastal Development Strategy National Fisheries Policy 1998 National Agriculture Policy 1999 Pesticides law, 1985 Integrated Pest management

On the other hand, the issue of human health and environmental hazards caused by persistent organic pollutants (POPs) has got increasing concern of the whole world because of their toxicity and availability in air, water and food. POPs are the toxic long lasting chemical compounds that are produced for use as pesticides, industrial chemicals, and some are produced as unwanted by-products of certain chemicals and /or combustion processes. These are 12 hazardous chemicals identified in the Stockholm Convention. POPs chemicals are considered to be very stable and persistent. They are able to persist in the environment for months, years and even decades. POPs are semi-volatile- evaporate relatively slowly. The twelve POPs include:

- Nine pesticides: aldrine, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex and toxaphene
- One industrial chemicals: PCBs
- Two unwanted by-products: dioxins and furans

It was reported that about 250 kg of PCB might release to the environment from each ship in the ship break yard of Chittagong area. Considering 90 old ships dismantled in each year, the total influx of PCB in Bangladesh from ship breaking industry could be assumed to be about 22.5 tons. The toxic chemicals may contaminate both coastal area and marine environment. The situation regarding POPs is certainly and undoubtedly devastating in the context of Bangladesh because most of these pollutants are used in agriculture as pesticides and 80% of the total population is still farmers and obviously they are exposed for long time to these chemicals and may face carcinogenic and non-carcinogenic health effects. The government already banned most of these POPs chemicals but unfortunately still lots of people are in risk because of the stock and illegal use. One more important thing about POPs is, their existence in the air is long and can be transported to a long distance through air and migratory species. This means that once they release to the environment, they represent a potential global threat. Bangladesh is preparing a national implementation plan to phase out and reduce these toxic chemicals from the environment of Bangladesh

3.5 Deforestation

Like all over the world deforestation is also a matter of concern in the coastal areas of Bangladesh. It is reported by UNEP that the rate of degradation of mangroves is less as compared to the overall degradation of forests. Comparison of aerial photographs of mid eighties to early nineties shows annual destruction rate is over 2,000 ha (UNEP website). Factors responsible for the destruction of the mangrove forests are the removal of forest products for fuel, haphazard fishing activities, human settlement, salt production and shrimp farming. For example, the Chokoria Sundarban has totally been cut down (IUCN 2004). The coastal mangrove forest of Sitakundu is not that much degraded but most of the coastal plantations of Noakhali Forest Division are encroached by local people and the land grabbers. Encroachment in the newly accreted charlands is a major concern in our country. The coastal mangroves of Sitakundu have also been degraded.

Anthropogenic factors are mostly responsible for those deforestations. More specifically, coastal shrimp farming, clearings for agricultural land, human settlements are the major driving forces for the deforestation. The deforestation in the coastal area frequently

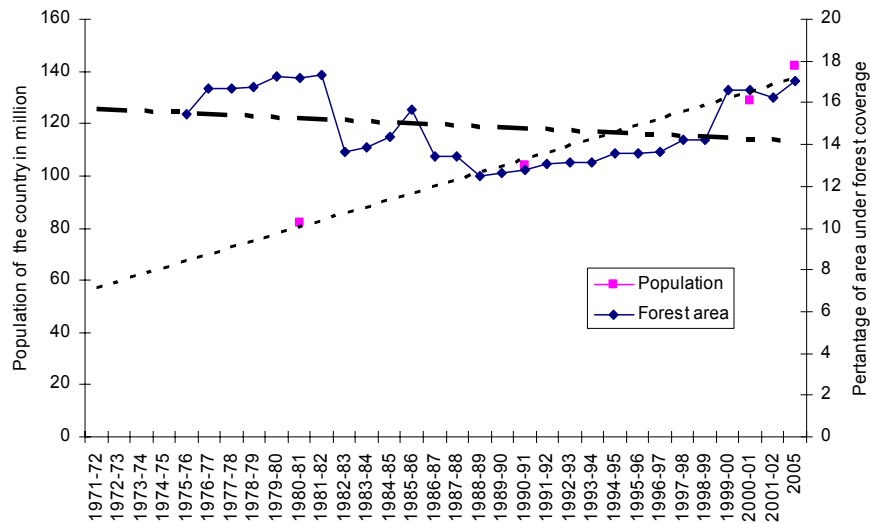


Figure 2. Change in the forest area of Bangladesh with increasing population (Source: Choudhury and Biswas 2005)

exposed the coastal communities to natural calamities. This has resulted loss of lives and properties more than before. Say for example the 1991 cyclone in the Chittagong coast had resulted loss of at least 0.25 million lives². Moreover, continued deforestation in the coastal area has increased the coastal erosion substantially. Also, productivity loss of shrimp and agriculture is also associated with the deforestation. All these have degraded the complex coastal environment and turn the coastal community vulnerable. Realizing the paramount importance of increasing the coverage of coastal mangroves, Government of Bangladesh initiated several programmes (e.g. Mangrove afforestation project, Second forestry project, Forest resources management project, extended forest resources management project and Coastal Green Belt project). Through these projects about 118,870 ha of newly accreted char lands have been planted with mangroves (FD 2004).

Table 7. Problems and existing policy responses to deforestation in coastal zone of Bangladesh

Pressure	State	Impact	Response
<ul style="list-style-type: none"> • Anthropogenic influences • Coastal shrimp farming • Clearings for agricultural land • Increase in land demand for human settlement 	<ul style="list-style-type: none"> • Increasing rate of deforestation • Clearings of mangroves • Encroachment of mangrove forest 	<ul style="list-style-type: none"> • Exposure of the coastal communities to natural calamities • Increase in the coastal erosion • Loss of biodiversity • physical environment threatened 	<ul style="list-style-type: none"> • National Forest Policy, 1994 • Environmental Conservation Act, 1995 • Environmental conservation Rules, 1997 • Integrated Coastal Zone Management Plan • Coastal Zone Development Strategy • National Fisheries Policy 1998 • National Agriculture Policy 1999

² Personal communication with the local UP chairman's

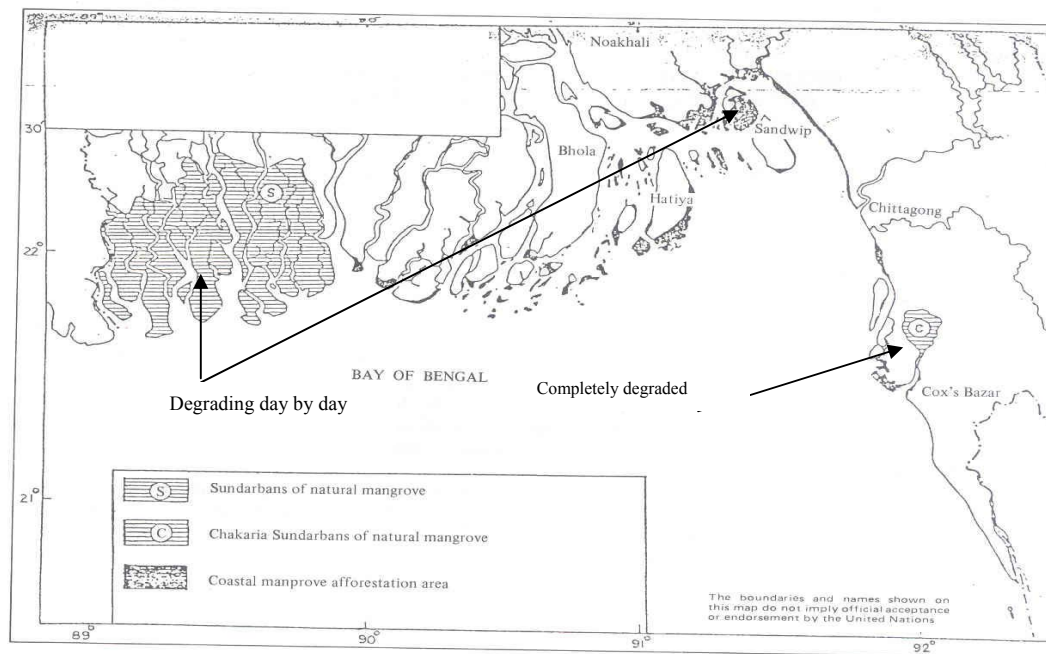


Figure.3. Mangroves in the coastal areas of Bangladesh (UNESCO, undated)

3.6 Salinity Intrusion

Water and soil salinity is a common problem in many parts of the coastal zone affecting agricultural and Industrial activities. Saline water intrusion is highly seasonal. It is at its minimum during the monsoon (June-October) when the main rivers discharge about 80 percent of the annual fresh water flow. In dry season months, the saline front begins to penetrate inland, and the affected areas rise sharply from 10 percent in the monsoon to over 40 percent. According to PDO-ICZM (2004), 70% of the 2.35 million hectares within the Khulna and Barisal Divisions is affected by different degree of soil salinity. The cropping area required for the cultivation of *aus* (summer rice), *boro* (dry season rice) and other *rabi* (dry season) crops is heavily restricted. The decrease in water flow to the Gorai distributaries during the dry season has accentuated the surface water salinity in the southwest region. Salinity now reaches as far as Khulna city, creating problems to normal agricultural practices and affecting the supply of clean water for industrial use. As a consequence, no new heavy industry has been set up in the recent years in the Khulna region despite increasing infrastructure facilities (road, sea-port, etc.).

Table 8. Problems and existing policy responses to salinity intrusion in coastal zone of Bangladesh

Pressure	State	Impact	Response
<ul style="list-style-type: none"> • Reduction in the monsoon water discharges • Decrease in the fresh water flow from the rivers during lean months 	<ul style="list-style-type: none"> • Increasing rate of water and soil salinity • Change in the salinity fronts in the coastal districts • Die out of mangroves 	<ul style="list-style-type: none"> • Reduction in the agricultural productivity • Reduction in yield • Mangrove forest under stress • Forest composition is changing • Change in the cropping patterns <i>viz. Aus and Rabi</i> • Lack of fresh water impedes industrial growth, specially in Khulna • Biodiversity loss 	<ul style="list-style-type: none"> • National Agriculture Policy 1999 • Environmental Conservation Act, 1995 • Environmental conservation Rules, 1997 • Integrated Coastal Zone Management Plan • Coastal Zone Development Strategy

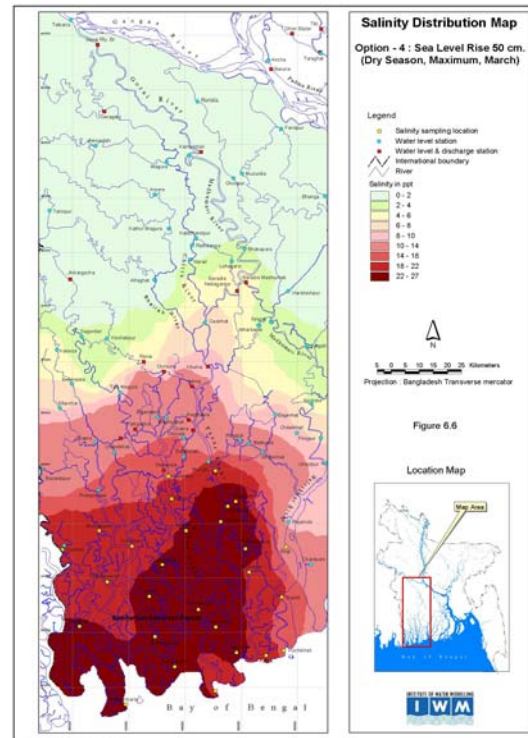
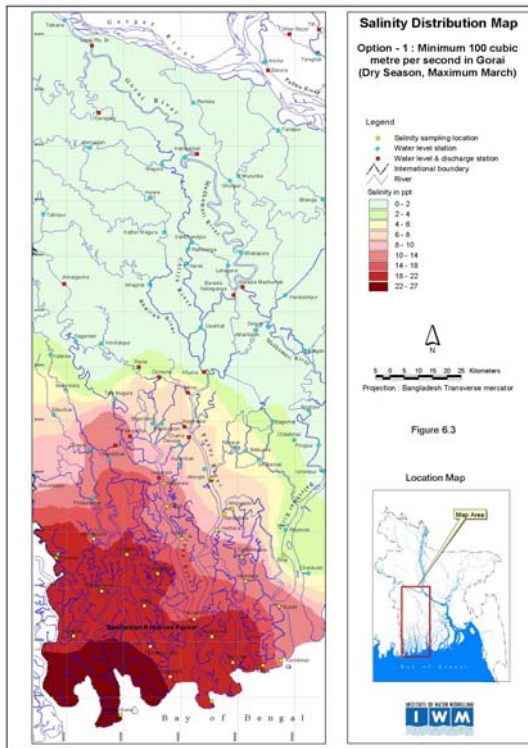
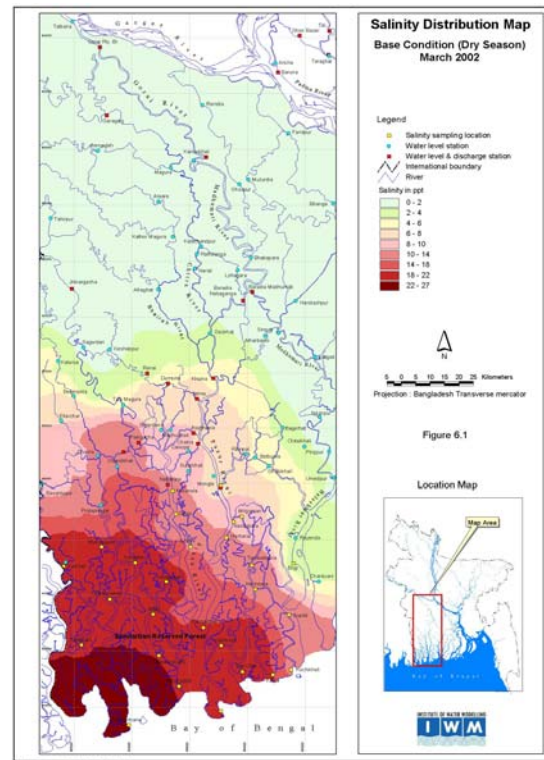
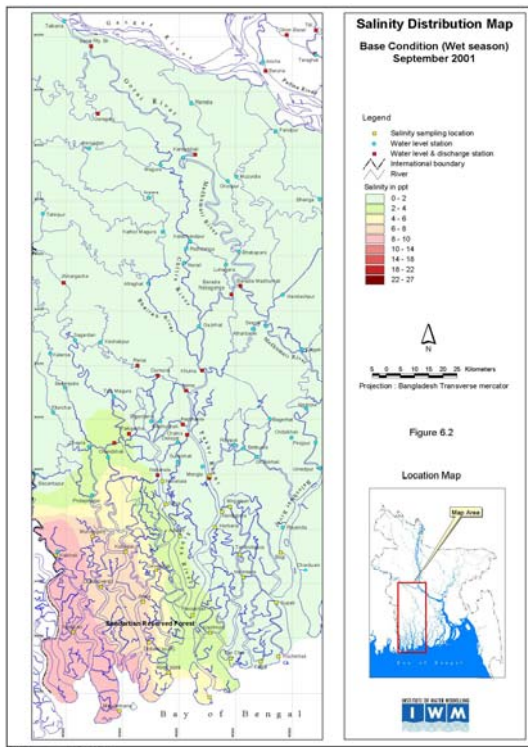


Figure 4. Changes in the salinity regimes of Sundarbans (Source: SWMC 2002)

3.7 Rapid urbanization

Unlike elsewhere in the world, the coastal zone of Bangladesh still reflects a rural setting and extensive urbanization has not happened as yet. However, changes are underway (PDO-ICZM 2004). Resembling the global trend of increasing population, coastal areas are not free from that. From the present urban population of only 8.5 million, it will be 12.8 million in 2015 and 30.2 million in 2050. This is 23 percent of the total population in 2001, 29 percent in 2015 and 50 percent in 2050 (PDO-ICZMP, 2005). An inevitable consequence of urbanization is the growth in demand for space for residential needs, and expansion of infrastructure and other associated urban attributes. There is a need for allocating space for a growing population of various income levels, including the needs for services in the direct environment, such as fresh food production, water supply and sanitation, employment, health and education facilities.

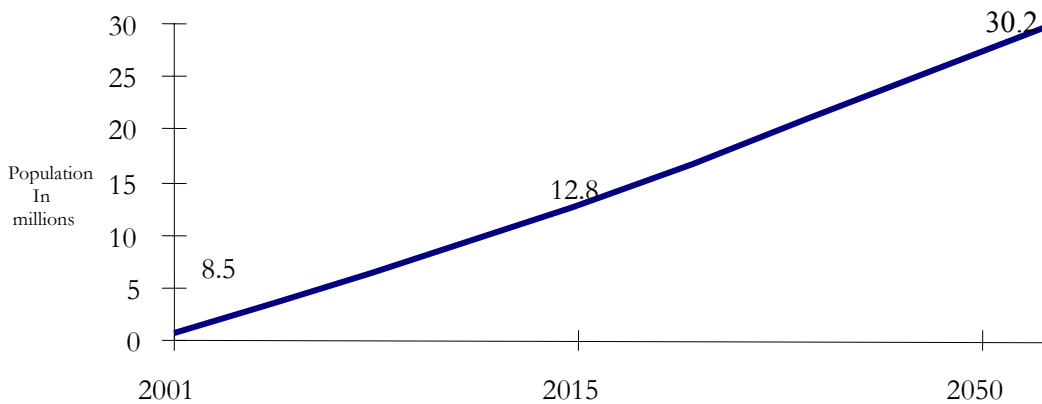


Figure 5. Project coastal population in Bangladesh (after PDO-ICZMP 2005)

Table 9. Problems and existing policy responses to rapid urbanization in coastal zone of Bangladesh

Pressure	State	Impact	Response
<ul style="list-style-type: none"> Increasing population Increasing demand for human settlement 	<ul style="list-style-type: none"> Unplanned growth of urban areas Expansion of infrastructure and associated urban needs Increasing rate of conversion of agricultural lands to settlements Fragmentation of land 	<ul style="list-style-type: none"> Increasing the coastal pollutants Loss of productive lands Rapid encroachments in the coastal areas Problem for space allocation for the growing populations Increasing load of waste and pollution 	<ul style="list-style-type: none"> National Forest Policy, 1994 Environmental Conservation Act, 1995 Environmental conservation Rules, 1997 Integrated Coastal Zone Management Plan Coastal Development Strategy

3.8 Erosion in the coastal zone

The natural shape of Bangladesh coastal and marine areas are controlled by dynamical processes such as tides, wave action, strong wind and sea level variations. Land erosion is a common natural phenomenon in the coastal zone (PDO-ICZMP 2004b). Massive changes have occurred in the coastline over the last two centuries due to land erosion, coupled with land accretion. Erosion is most severe in the Meghna estuary. A huge land

of 86,366 ha eroded during 1973-2000 (MES 2001). Strong tidal currents and storm generated swell in association with sea level rise may cause coastal erosion, irregular inundation and flooding. Sea swell may cause coastal erosion, depending on the height and periodicity of swell wave. Coastal erosion usually occurs during monsoon seasons, but it is more severe during southwest monsoon or any episodic events such as storm waves or sea swell hit the coast.

Besides the erosion of the riverbanks, the foreshore and the embankment systems are posing a continuous problem in the coastal areas. This exposes interior lands to the threats of cyclone surges and salt-water intrusion (PDO-ICZMP 2004b).

Table 10. Problems and existing policy responses to erosion in coastal zone of Bangladesh

Pressure	State	Impact	Response
<ul style="list-style-type: none"> • Changes in the coastal geomorphology • Increase land less people 	<ul style="list-style-type: none"> • Increased risk • Strong tidal current and wave action • Wind and sea level variations • Irregular inundations • Climate change and associated problems 	<ul style="list-style-type: none"> • Exposure of the coastal communities to natural calamities • Loss of human settlement areas • Loss of biodiversity • Salt water intrusion • Increase floating people in cities 	<ul style="list-style-type: none"> • Integrated Coastal Zone Management Plan • Coastal Zone Development Strategy

3.9 Unplanned extraction of coastal resources

The coastal and marine areas of Bangladesh are endowed with resources. These resources include gas, oil, minerals, aquatic flora (including algae), and aquatic fauna (snails, fishes, amphibians, mammals, reptiles etc). Harvesting of the coastal resources beyond its sustainable limit is a great concern now a day.

Table 11. Problems and existing policy responses to extraction of resources in coastal zone of Bangladesh

Pressure	State	Impact	Response
<ul style="list-style-type: none"> • Extraction of gas, oil and mineral resources • Shrimp farming • Coastal fishing and fish processing 	<ul style="list-style-type: none"> • Sea going vessels discharges huge amount of pollutants • Increasing rate of deforestation • Clearings of mangroves • Harvesting of resources beyond its sustainable limit 	<ul style="list-style-type: none"> • Increase risk of pollution load • Shrimp farming, fishing and fish processing plant lead towards massive deforestation • Loss of biodiversity 	<ul style="list-style-type: none"> • Environmental Conservation Act, 1995 • Mine and mineral resources (control and development) act, 1992 • Integrated Coastal Zone Management Plan • Coastal Development Strategy • National Fisheries Policy 1998

3.9.1 Gas, Oil and Mineral Resources

Coastal areas of Bangladesh are endowed with resources viz. oil, gas, minerals etc. The Government has offshore and in-shore petroleum and gas exploration plan. It is estimated that about 28 trillion cubic feet of gas can be recovered in Bangladesh (BBS, 2005). Under the Western Region Integrated Project (WRIP) there has been a proposal to develop Shahbazzpur gas field in Bhola, as well as installation of a 93-mile pipeline to Khulna, and construction of several gas-based power plants at Gopalganj, Bhola, Barisal and Khulna to serve southwestern Bangladesh. Besides, various commercially important minerals have been found in the sandy beaches along Cox's Bazar, such as, monazite, limenite, rutile, zircon and cesium. There are newspaper reports on extraction of minerals from the beaches of Kuakata by using hand-held magnet.

Table 12: Gas reserve in the coastal zone

Gas field	Volume (billion cft)			
	Total reserve (proven and probable)	Re-coverable	Cumulative production (June '03)	Balance reserve (June '03)
Sangu	1,049	734	221	513
Feni	165	116	40	76
Begumganj	46	32	-	32
Kutubdia	861	603	-	603
Shahbazzpur	174	122	-	122
Total	2,295	1,607	261	1,346

Source: MoF, 2003

Estimates of some mineral resources are shown in Table 8.

Table 13: Mineral resources in the coastal zone

Mineral	Location	Reserve
Peat	Chanda-Baghai (Gopalganj)	150 million t
	Kola Mouza (Khulna)	8 million t
Limestone	St. Martins Island (Cox's Bazar)	2.8 million t
	Cox's Bazar	3.2 million t
Beach sand mineral	Nijhum Dwip (Noakhali), Kuakata (Patuakhali)	Yet to be estimated
	Chittagong (+ Chittagong Hill Tracts)	1 million m ³

Source: BBS, 2004

3.9.2 Sustainable Shrimp Farming

Shrimp farming is the key economic activity in the Cox's Bazar, Khulna, Bagerhat and Satkhira regions of Bangladesh and contributes approximately 2.5% to the global shrimp production. The sector generates US\$ 301 million annually, from *bagda* and *golda* farms, US\$ 243 million from *bagda* alone (PDO-ICZMP, 2003b). It is the second largest export item of Bangladesh after ready-made garments. The increasing expansion of the shrimp industry is causing massive deforestation in the coastal areas and conversion of newly accreted land or mangroves to shrimp farms. Though accurate figure is not available at the moment, the coastal mangroves of Chokoria Sundarban, which accounts 8000 hectares, is completely converted to shrimp and salt farming. Similar situation is also experiencing in all the coastal and marine areas of Bangladesh. Say for example, in the Khulna, Satkhira, Bagerhat, Patuakhali, and all the coastal regions, people converting the newly accreted coastal land to shrimp farms frequently.

Table 14 Estimated growth of shrimp farming area (in hectares)

Year	Coastal and marine areas				
	Satkhira	Khulna	Bagerhat ^b	Cox'sBazar	Total
1983 ^d	8001	12821	11012	18671	50505
1990 ^d	22000	17308	25000	31740	96048
2005 ^e	22000	17308	25000	45740	110048
2005 ^f	34000	30290	25000	45740	135030

Source: MPO 1985b

^a Does not take into account all of the coastal area, but development in other areas is expected to be comparatively small.

^b 1990 ceiling of 25000 ha estimated from 1984/85 district fishery office estimate plus expected increase in area to total prime lands

^B Bangladesh fisheries resources survey system estimate of 1982/83

^d Estimated on the basis of 25% growth rate for Satkhira and Bagerhat. Khulna and Cox's bazra are expected to grow slowly at 10% as there is less suitable land available in these areas

^e Growth rate at 5% per year for Cox's Bazar only with hatcheries located in Cox's Bazar and Teknaf

^f Growth at 10% per year in Satkhira and 5% per year for all other locations except Bagerhat (low water salinity inhibiting further growth) with hatcheries in all areas.

3.9.3 Coastal Fishing and Fish Processing

The fisheries sector in the coastal zones provides an important source of income and employment for the local people. In 2002/03, a total of 445,000 tones of marine fisheries were extracted in Bangladesh. The coastal zone also accounts for 40% of total pond-fish production and 36% for inland capture fisheries (DoF, 2003). According to the MoF, from 1995/96 to 2002/03, marine catch has increased by about 65 percent, inland open water fish catch by 25 percent and closed water fish production has more than doubled, to the extent of 122%. Over-extraction and unsustainable harvesting of marine fisheries have been are a major threat in recent times.

3.10 Coastal tourism

From west to east, the coastal and marine area of Bangladesh possesses vast potential for tourism. Among the coastal and marine zones, Khulna, Kuakata (of Patuakhali district), Chittagong (Patenga beach), Cox's Bazar and St. Martin's island (a coral island) are the major tourist spots. The visitor includes both domestic and foreigners and government earns a significant amount of revenue from this sector. However, this tourism sector contributes enormously in costal and marine pollution (figure 6).

Table 15. Problems and existing policy responses to tourism in coastal zone of Bangladesh

Pressure	State	Impact	Response
<ul style="list-style-type: none"> Increased and uncontrolled access of tourists to biodiversity rich areas Unplanned infrastructure development 	<ul style="list-style-type: none"> Increased risk of biodiversity loss Increased rate of pollution 	<ul style="list-style-type: none"> Damage of coastal vegetation through trampling e.g. <i>Ipomea prescapre</i> at Beaches Collection of shells from the Beaches Throwing of 	<ul style="list-style-type: none"> Environmental Conservation Act, 1995 Environmental conservation Rules, 1997 Integrated Coastal Zone Management Plan

Pressure	State	Impact	Response
		bottles, poly bag and other non biodegradable substances, • Increasing coastal pollution • Loss of biodiversity	• Coastal Zone Development Strategy

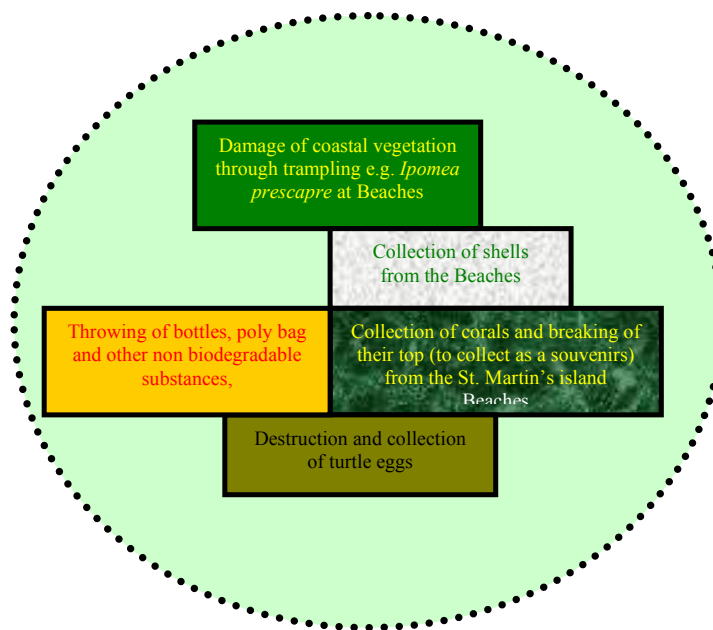


Figure 6. How coastal tourism pollutes the coastal and marine environments

3.11 Change in the land use pattern

Over the decade the land use patterns of the coastal areas have been changed. Say for example, many framers in Cox's Bazar have switched over to salt production and those

in Satkhira-Bagerhat-Khulna area to shrimp culture in the recent years from traditional agriculture, allowing more and more salt-water in the land. In 2003, 38,328 salt farmers operated on 23,735 ha of land in Cox's Bazar district (PDO-ICZMP, 2004). There are 37,400 *bagda* shrimp fields with an operated area of 170,000 ha (PDO-ICZMP, 2003). In earlier days most of these areas were under forest coverage. The MS satellite imagery showed the land use change in the coastal areas of Cox's Bazar particularly Chokoria Sundarban and its adjacent areas (fig 4). Similar situation can also be observed in other coastal districts viz. Satkhira, Khulna, Bagerhat, Barisal, Patuakhali etc. In those areas, newly accreted lands have been converted to either shrimp farms or agricultural fields.

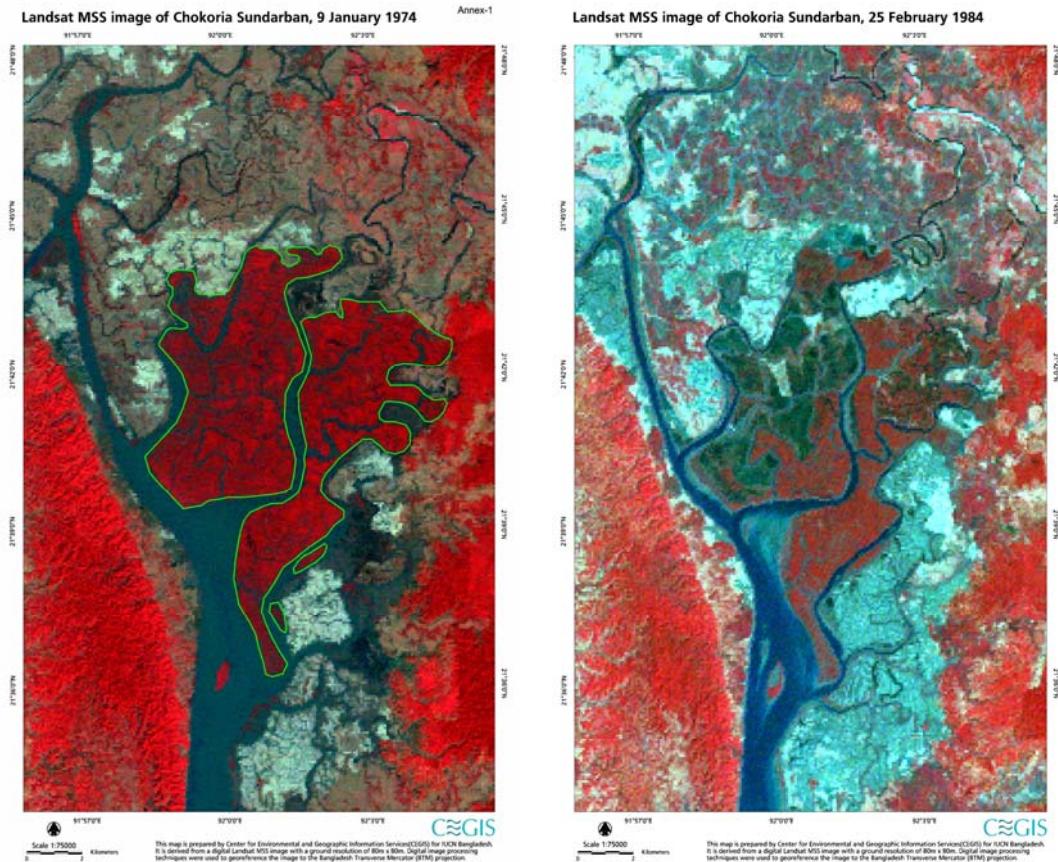


Figure 7. Changes in the land use³ of Chokoria Sundarban at the Cox's Bazar coast (IUCN 2005)

3.12 Climate change leading to increased natural Disasters: Tornado, Cyclone, Tsunami and Storm Surges

Unlike other countries, the coastal and marine zones of Bangladesh are susceptible to numerous natural disasters viz. tornado, cyclone, tsunami, storm surges etc. These events have become chronic now a day due to climate change. Besides, there are threats of upstream land and water uses. These threats affect almost every aspect of life and limit livelihood choices of the people.

³ These figures indicate the changes in the land use pattern of Chokoria Sundarban areas. Earlier these areas were under dense mangrove coverage. However, with the passage of time these areas are now characterized by the presence of numerous shrimp farms and salt ponds.

Table 16. Climate change scenarios for Bangladesh

Year	Sea level rise (cm)	Temperature increase (°C)	Precipitation fluctuation compared to 1990 (%)	Changes in evaporation
Based on Ahmed et al, 1999				
2030	30	+0.7 in monsoon; +1.3 in winter	-3 in winter; +11 in monsoon	+0.9 in winter; +15.8 in monsoon
2050	50	+1.1 in monsoon; +1.8 in winter	-37 in winter; +28 in monsoon	0 in winter; +16.7 in monsoon
Based on Agarwala et al 2003, OECD				
2030		+0.8 in monsoon; +1.1 in winter	-1.2 in winter; +4.7 in monsoon	
2050		+1.1 in monsoon; +1.6 in winter	-1.7 in winter; +11.8 in monsoon	
2100		+1.9 in monsoon; +2.7 in winter	-3.0 in winter; +11.8 in monsoon	

At least 70 major cyclones have hit the coastal belt of Bangladesh in the last 200 years. From the 1970s, cyclones have taken the lives of nearly 900,000 people. The Noakhali-Chittagong coasts are the most vulnerable and received 40 % of the cyclones during the last 35 years. Some examples of severe tropical cyclones are the Barisal cyclone of 1584, the Bakerganj cyclone of 1876, the 12 November 1970 cyclone, the May 1985 Urir Char cyclone, and the April 1991 cyclone. High intensity storm surges jeopardize the expansion of energy-recovery activities in the coastal areas and supporting industries, especially in the offshore areas. The recent Tsunami episodes in the Asia-Pacific region have added to the existing threats of the coastal region. Apart from the loss of lives, there is a high economic loss associated with these natural disasters.

Table 17. Climate change vulnerabilities in the coastal and marine areas of Bangladesh

Vulnerabilities	Vulnerable areas	Present status	Risk of aggravation
Cyclone and storm surge	Islands, exposed upazilas	Devastating but seasonal	Increasing
Land erosion	Meghna and other estuaries, islands and coastal rivers	Serious, localized, seasonal	Increasing
Flood	Exposed upazilas	Serious, seasonal	Increasing
Drainage congestion	Khulna, Jessore, Noakhali	Localized, year round	Increasing
Salinity intrusion	Western exposed upazilas	Localized, seasonal	Increasing
Drought	Satkhira	Localized, seasonal	Increasing
Earthquake	Chittagong	Unpredictable	Increasing

Vulnerabilities	Vulnerable areas	Present status	Risk of aggravation
Shortage of drinking water & arsenic contamination	All over	Serious, year round	Unknown
Ecosystem degradation	Marine, Sundarban	Serious, year round, cumulative	Increasing
Pollution	Chittagong, Khulna	Serious, year round, cumulative	Increasing
Climate change	All over	Year round, cumulative	Increasing

Source: Adopted from PDO-ICZMP 2004b

Given the extremely low elevation of the coastal zone, the threat of sea level rise is high. The likely climate change scenarios for Bangladesh are presented in Table 10.

Possible impacts of are:

- ◇ change in water levels and induced inundation and water logging;
- ◇ increased salinity in ground and surface water, and corresponding impact on soil salinity;
- ◇ increased coastal morphological dynamics (subsidence, erosion and accretion); and
- ◇ increased incidence of natural hazards.

Drainage congestion may become an even more serious threat than higher flood risks. Due to siltation and poor maintenance of the drainage channel networks in many parts of the coastal zone, drainage congestion is already a grave problem, and the problem is likely to increase considerably.

4. MANAGEMENT OBJECTIVES FOR PRIORITY PROBLEMS

The Ministry of Environment and Forest of the Government of Bangladesh has developed Environment Policy 1992, formulated and enacted Environment Conservation Act 1995, Environment Conservation Rules 1997 and Environment Court Act 2000. It has also set up offices at divisional level to implement environmental rules and regulations. It appears that the existing institutional capacity and allocated resources are inadequate compare to the scale and magnitude of the environmental problem prevails. Regarding addressing environmental problems related to land based activities in Bangladesh is new and institutional collaboration and integration with other sectoral programme is limited.

Degradation of the marine and coastal environment can result from a range of sources. A precautionary and anticipatory rather than a reactive approach is necessary to prevent the further degradation of the coastal and marine environments of Bangladesh. These require integration of social and economic components along with environmental components. Hence, the National Programme of Action aims to contribute to the protection of coastal and marine environments in Bangladesh with a view to curbing impacting activities by means of the following measures, among others:

4.1 Environmental considerations

The prime most management objective is to protect the overall environment of coastal and marine areas of Bangladesh from land and land-based activities. Defining in the most careful and judicious manner innovative strategies and practices compatible with environmental sustainability from the involvement of different players in impact producing processes and sectors is required. The EIA guidelines may be prepared for all sectors development activities.

4.1.1 Ensure Conservation practices and protection of marine ecosystem

Developing and implementing conservation practices aiming at harmonizing the efforts from different sectors with environmental conservation as the ultimate goal is targeted. Strengthening and up scaling the ongoing conservation/ restoration programmes activities and strategies is necessary. Moreover, efforts should be made to protect the marine ecosystems of Bangladesh from further degradation by proposing and improving the application of legal instruments to protect the marine environment, as well as strengthening existing control systems.

4.1.2 Sustainable use of coastal resources

At the moment vast coastal populations are dependent on the coastal and marine resources, so we cannot stop the harvesting of the existing resources at the moment. Thus the programme relies on setting a limit of resource extraction i.e., sustainable use. Developing plan for sustainable utilization of coastal resources is the ultimate management objective.

4.1.3 Promote good practices in shrimp farming from environmental point of view

Large-scale shrimp farming characterizes most of the coastal areas of Bangladesh. The disposal from those farms contributes a high degree of costal and marine pollution. There are several coastal areas, where organic shrimp farming is practiced. There exist examples of integrated aquaculture – mangrove farming in our neighboring countries viz. India, Thailand, Laos, Vietnam etc. Our management objective is to feed our good practices and develop a model integrating mangroves – aquaculture model, ensuring its sustainability.

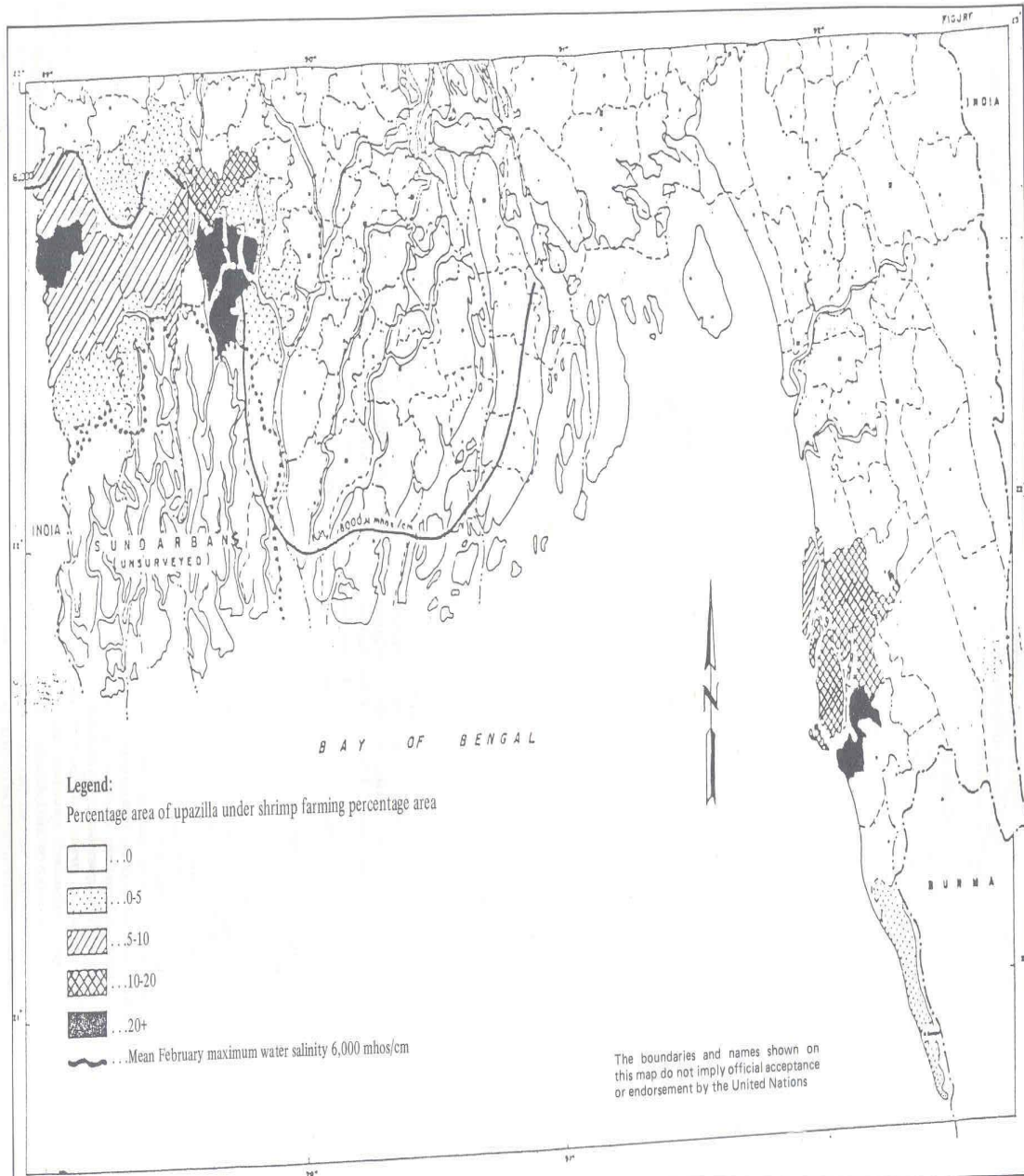


Figure 8. Coastal shrimp farming areas of Bangladesh (After UNESCO, undated)

4.2 Lessons learnt from pilot initiative

United Nations Environment Programme (UNEP) formulated their Global Programme of Action in 1995 to protect coastal and marine environment from land based activities. In the year 2003 a meeting was held in Sri Lanka on GPA for South Asia Region. Several projects were funded by UNEP/GPA at a pilot scale so that the findings can be incorporated while updating the National Programme of Action (NPA) for Bangladesh. The following sections highlight the findings of those pilot study and has been incorporated the fruitful lessons in this NPA.



Source: IUCN



Source: IUCN



Source: IUCN

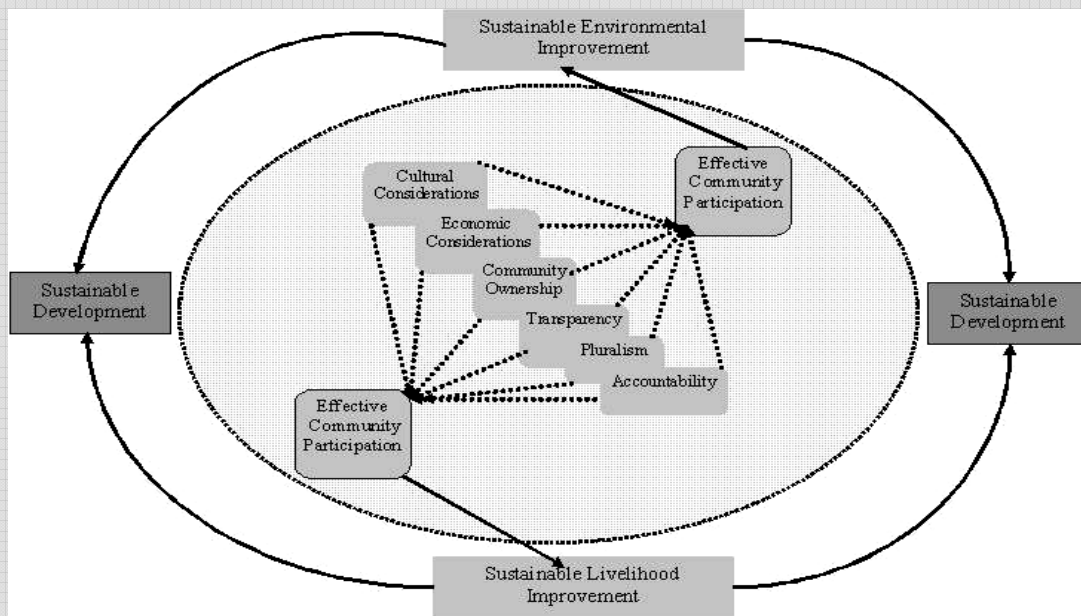
4.2.1 Rehabilitation of critical coastal ecosystem: Chokoria Sundarbans – IUCN's pilot experience

IUCN Bangladesh initiated "Rehabilitation of the critical coastal ecosystem: Chokoria Sundarbans programme" in 2004 under the UNEP/GPA programme. The overall objectives of this program was to restore and rehabilitate the degraded coastal mangrove ecosystem of Chokoria Sundarban on a pilot scale with community initiatives and to initiate a sustainable management regime.

The specific objectives are as under.

- To take stock of the present situation of Chokoria Sundarban area with a view to establish a baseline.
- To reach a common consensus on rehabilitation through multi-stakeholder consultation.
- To develop a strategy for the rehabilitation of forest patches after taking account of the social biological dynamics of the project area.
- To implement a strategy of initiating a sustainable management.
- To secure people's participation in planning and regeneration efforts.
- To raise awareness and sustain the community stewardship in conservation and sustainable management of coastal/marine resources, especially the mangroves.
- To develop ownership feelings of the community towards conservation, afforestation, mangroves, etc.

Community based approach was followed in the implementation of the programme. While searching for the rehabilitation and natural resources management options and strategies, the existing bio-physical and socio-economic conditions of the site was studied and considered. Moreover, considering the experience of others success and failure in rehabilitation, the highest degree of community involvement was ensured that helps to raise ownership the community on the programme and the whole system is transparent to all.



IUCN, 2004

Area-specific Chokoria Sundarban rehabilitation / restoration committees have been formed, which was developed by the communities themselves. Besides, two layered restoration committees both at district and village levels are formed and being functional. The members of these committees have been nominated by the stakeholders themselves to ensure transparency and accountability.

Through this programme about 20 hectares of coastal areas have been restored with mangroves. People are also more supportive of restoration and sustainable management/harvesting of natural resources in the regions, which was rare in earlier times. It is expected that the success of these community-based interventions, coupled with a comprehensive income generating activity will lead to the replication of this approach in other areas across earlier Chokoria Sundarbans.

4.2.2. Minimum Environmental Flow Requirement for Ecosystem and Its Functioning -IUCN's pilot experience

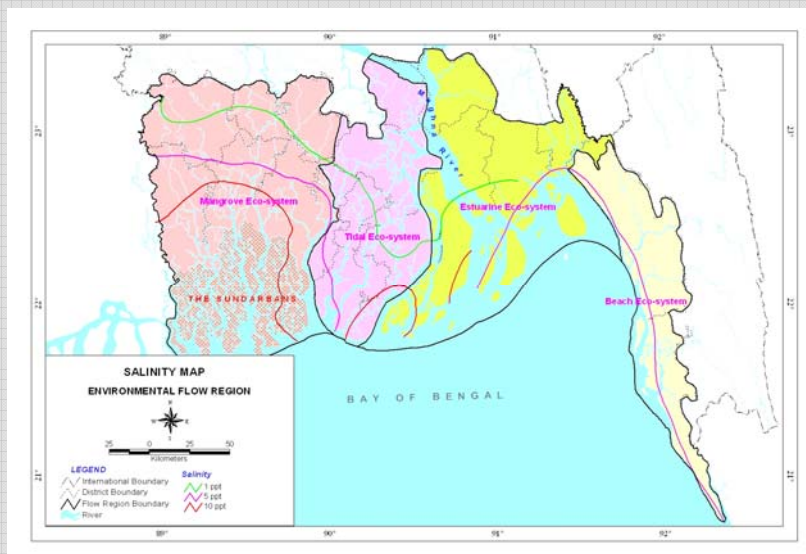
Background

Through a Memorandum of Understanding (MoU) between UNEP-GPA and Department of Environment (DoE), IUCN has been awarded to undertake a titled "minimum environmental flow requirement for ecosystem and its functioning". The project was aimed at developing a protocol for environmental flow assessment in Bangladesh. The following are the specific objectives of this project:

- To delineate coastal zone into appropriate environmental flow regions.
- To develop a set of GIS maps to indicate the spatial distribution of hot spots with illustration of physical and other characteristics.
- To develop protocols of environmental flow assessment to suite the local needs
- To organize a national workshop for securing the concurrence on the recommendations
- Planning design for intervention to address the problem in hot spots formulated and appropriate actions/interventions through a well-defined small-scale pilot in a hot-spot undertaken.

Delineation of Environmental flow regions

In this study, entire coastal zone of Bangladesh has been divided into four relatively homogeneous environmental flow regions. The regions are mangrove ecosystem region, tidal ecosystem region, estuarine ecosystem region and beach eco-system region. The regions have been delineated on the basis of three national level mapping exercises. These are hydrological zoning by WARPO, bio-ecological zoning of IUCN and coastal zoning of ICZMP.



The mangrove eco-system region consists of the Sundarban mangrove forest and adjoining region. The region is situated mostly in Greater Khulna district. The tidal eco-system consists of the active floodplain of the Ganges river and the adjoining meandering floodplains, and is mostly situated in the administrative districts of greater Faridpur and Barisal. A huge newly accreted mudflat is the main physiographic feature of the estuarine ecosystem, which is mainly situated in the districts of Noakhali and Lakshimpur. The beach eco-system lies in the eastern coastline of the country which is characterized by a 100km-long sandy beach facing the Bay of Bengal, extending from Chittagong to Teknaf.

Environmental Flow Assessment Protocol for Bangladesh

The concept of environmental flow is new in Bangladesh. Therefore, a national level protocol has been suggested for establishment of the concept in Bangladesh. Additionally, a protocol for environmental flow assessment has been developed. The protocol is based mainly on the expert assessment considering the dearth of data regarding environmental flow.

It is concluded that a unique method that relies primarily on expert opinion and local knowledge, and considers local water management practices should be followed for environmental flow assessment in the coastal regions of Bangladesh. The flow assessment protocol must include a scope for active interaction among experts from different fields, and among experts and local people. Although there may be significant difference of opinion among the experts at the initial stage of interaction, eventually they should be able to reach a consensus on how much flow is required for sustenance of the ecosystem with due consideration to other competing water uses. Local knowledge of flow requirement for different components of the ecosystem should be also an important consideration in flow assessment.

4.2.3 Pilot Study on Environmental Flow Assessment

Environmental flow requirement was assessed for a study area in Cox's Bazar following the protocol developed. In the study areas, river water is stored for dry season irrigation using rubber dams that are inflated in December-January, and are deflated in March-April. The three rubber dams known as Bakkhali, Eidgaon and Sonaichhari dams were taken for the study.

Like these three dams, most of the water sector structures in Bangladesh have been constructed for agricultural purposes. User rights are already established in these structures on behalf of farmers. During the case study, it was apparent that farmers, being mostly marginal and small, are not very willing to sacrifice this water right to ensure environmental flow. However, farmers do recognize the need for fish, which is a principal component of traditional diet. Therefore, fish has been recommended as an indicator species for environmental flow assessment.

In the Bakkhali River Rubber Dam project, the main trade off of flow was between irrigation water requirement and dry season flow requirement for fish movement to increase the fish production.

Preliminary assessment shows that surplus water is available in the study area which can be used as environmental flow. There is also scope for saving water by improving existing irrigation management. The surplus volume and additional volume conserved by improving management practices can meet the environmental flow requirement without compromising the irrigation water requirement.

Flow release requirement was assessed for Golda and Hilsa species. An overall flow release requirement was also assessed for all fish movement. It is calculated that a flow is to be released during night time for 6 to 8 hours per day, 7 days during new and full moon phases. The downstream pool depth should be about 1.0 m. Other requirements for flow release are given in Table 1.

Flow release requirements at Bakkhali dam for fish movement.

Fish species	Flow release period	No. of days flow released	Downstream velocity (m/sec)
Golda	Mar 1 to Apr 30	28	0.30 to 0.68
Hilsa	Jan 1 to Mar 31	42	0.6 to 0.8
Overall	Feb 1 to Apr 15	35	0.6 to 0.8

Required flow release volumes are calculated based on the criteria set forth above and are given in Tables 2, 3 and 4. The flow velocity at the dam is calculated based on the required downstream velocity for fish movement. To meet the criteria for fish movement, a minimum of 15.6 and 45.2 Mm³ of water is to be released for Golda and Hilsa, respectively. Considering both species, the minimum overall flow release volume is 37.2 Mm³.

Required flow release volume through Bakkhali dam for Golda movement.

Volume of water to be released (Mm ³)		
Flow velocity (m/sec)	Flow release (hr/day)	
		6.0
0.30	15.6	20.8
0.68	34.9	46.6

Required flow release volume through Bakkhali dam for Hilsa movement.

Volume of water to be released (Mm ³)		
Flow velocity (m/sec)	Flow release (hr/day)	
		6.0
0.6	45.2	60.3
0.8	60.4	80.5

Required flow release volume through Bakkhali dam for overall fish movement.

Volume of water to be released (Mm ³)		
Flow velocity (m/sec)	Flow release (hr/day)	
		6.0
0.6	37.2	49.6
0.8	49.6	66.2

These requirements are comparable to the surplus volumes calculated for the dam, and can be negotiated for release through the dam. Negotiation with the farmers at the field level and policy and planning level would be the key challenge to establish environmental flow in Bangladesh.

4.2.4 Solid Waste Management in Cox's Bazaar (The largest tourist spot of Bangladesh)

Bangladesh Environmental Management Project (BEMP) has funded for a pilot project on solid waste management in Cox's Bazaar during 2003-2004 (one year). The objectives of this initiative were:

- To make the first move of Best Management Practices (BMPs) of solid waste through community initiatives in the coastal area
- To reduce solid waste dumping into the sea
- To keep the largest tourist spot of Bangladesh clean and environment friendly
- To create awareness among the local community about the environmental requirement and importance of the sustainability of Cox's Bazaar tourist area.

The local NGO "Prattaya" started this demonstration project. Prattaya was involved in the collection and disposal of the solid waste generated in 7 wards (ward 2-9). This includes domestic, commercial, and waste from many hotels and restaurants within Cox's Bazaar area. According to the Executive Director of Prattaya, Mr. Zafar Alam, waste was collected from around 1000 households and nearly 80-90 hotels and restaurants close to the sea beach. Small vans were used to transport the waste to a designated spot, where these were composted manually.



Fig. Recycling of Solid waste in Cox's Bazar

It was found that a number of hotels and restaurants, for example hotel Seagull, produced nearly 200 kgs of solid waste/day during peak season.. The municipality of Cox's Bazaar has solid waste management service in place but cannot provide the required service. The municipality used to collect nearly 75 % of the total waste generation of about 15 tons per day. All these collected waste are disposed off in four dumping grounds that are located near the coast. These improper management results in a substantial amount of solid waste being dumped directly or indirectly into the sea. However, the pilot project of BEMP has got several following outcomes:

- Ensured total waste generation of domestic and commercial, particularly of the hotels and restaurants, to be collected (within 7 wards), of which organic wastes were used for composting
- Reduced a substantial amount of waste dumping into the sea directly
- Ensured community participation on solid waste management
- Created awareness about the solid waste related problems and the opportunity of recycling the waste.

4.2.5 "Mobilizing communities in protection, conservation and Management of coastal fisheries resources"

The Government of Bangladesh has initiated a pilot project on "Empowerment of Coastal Fishing Community on Livelihood Security" with technical and financial support of Food and Agriculture Organization (FAO)/United Nations Development Programme (UNDP). The aim of the project was to enhance the capacity of the coastal fishing community to ensure reduction of vulnerabilities and security of livelihoods through protection, conservation and management of the coastal and marine fisheries resources. However, the main objectives were to (BCAS, 2005):

- Facilitate sustainable conservation and management of coastal marine and estuarine fisheries resources and habitats through strengthening of community-based management of the resources.
- Introduce various economic and community welfare activities which are operated and managed by their community organizations
- Assist the communities to empower themselves in order to collectively address their problems and needs

A large number of the population is involved with fisheries activities in coastal areas, especially in Cox's Bazaar. Many of these fishermen are unorganized and disadvantaged in the society. These problems and lack of social and financial capacity threatens the sustainability and security of their livelihoods in coastal region of Bangladesh. However, FAO has assigned the Bangladesh Centre for Advanced Studies (BCAS) and Bangladesh POUH to implement the component namely "Mobilizing communities in protection, conservation and management of coastal fisheries resources" in the coastal regions. This project selected 33 fishing villages in 4 Upazillas (Cox's Bazaar, Ramu, Ukhya and Moheshkhali) for the activities. The main activities of this project are:

- Training of Fisheries Management Organizations (FMOs)
- Organizing rallies and meeting with all organizations and communities related to fisheries
- Interventions for protection, conservation, restoration of coastal resources
- Village level meeting for awareness on Codes of Conduct for Responsible Fisheries (CCRF), acts and regulations
- Conducting Participatory Action Plan Development (PAPD) program
- Training of FMO members on Biodiversity, CCRF, Fish Acts/Regulations
- Award for the best individual/group for showing highest compliance
- Coordination with local government and communities related to fisheries activities

Outcome of the pilot project:

- Natural Resource Conservation Activists (NRCA) forum have been formed consisting of 37 members from 37 village organizations of the project areas. NRCAs were given a guideline with few specific duties and responsibilities to reach the project goal
- 28 training programs were conducted on biodiversity, CCRF, Fish Acts/Regulations to make the people aware and share the knowledge about best conservation management practices of natural resources or fisheries resources. About 20-25 participants (male/female) including FMO members and NRCAs have been aware about biodiversity and fisheries conservation practices.
- Created mass awareness about environment and coastal pollution through rallies and meetings
- Communities are now active to protect, conserve and manage the coastal resources.
- Major learning from this project is that the poor and fishermen community, the neglected part of the society, can raise their voice to save the environment and coastal resources for their livelihood security.

4.2.6 "Sensitizing and Awareness Raising Through Trust Building With Bangladesh Ship Breakers Association (BSBA) On Issues Of Environment Of Coastal Area Including Health And Safety Aspects"

With financial support from United Nations Environment Programme (UNEP) Department of Environment and Bangladesh Centre for Advanced Studies (BCAS) is assessing source of land based coastal pollution and identifying possible mitigation measures under Global Programme of Action (GPA). One activity of the study is to undertake "Pilot Project" to reduce possible adverse impact on marine environment and human health by the existing ship breaking activities. BCAS has initiated discussion with Bangladesh Ship Breaking Association (BSBA) from the beginning of the project for facilitating a demonstration activity. It may be noted that BSBA is locally very powerful and quite indifferent in conducting any project activities in and around ship break yards. BCAS study team had continued meetings, discussions and dialogues with president, vice presidents and most of the members of BSBA with primary focus on developing a local code of conduct in line the Basel Convention considering existing practices of Ship breaking yards in Bangladesh. In addition, convince BSBA to ensure that this is being followed by these industries as best management practices for the protection of marine resources as well as human health. After continuous meeting and discussion with BSBA, they have committed to cooperate with us for developing code of conduct and in principle agreed to follow local code of conduct or guideline depending on capacity and resources that it would require. We are at final stage of preparing local code of conduct and hopefully able to begin demonstration activity at Ship Breaking Industries in Chittagong. Understanding that it would be really a major breakthrough if we could have an opportunity to exercise the measures that may protect our marine environment from this particular source, we had to negotiate with them (BSBA) giving enough time and delicate approach. The whole process of discussion with BSBA has given us several lessons and key are:

- More time and coordination may ease inflexibility to get access in the organizations or institutions to make them understand importance and their role to the environment;
- Continuous discussion and softer approach may be important tools in reaching the goals and objectives of any intervention.

4.3 Sustainable livelihood

The coastal zone is lagging behind in many respects. However, the variation within the zone is high, implying that there are areas within the coastal zone that are the most disadvantaged in terms of infrastructure and accessibility. Any coastal development/protection strategy would necessitate interventions to enhance the capacity of the people and pave the way for their sustainable livelihoods. In most of the cases, what happens? The poor often pay the price for development. One major development objective of the government is to ensure a pro-poor growth (ERD, 2003). In order to achieve this and other objectives mentioned in the national strategy for poverty reduction that incorporated the millennium development goals, it is necessary to target resources for the poorer and vulnerable sections of the population on a priority basis, thereby enabling and empowering them to reduce their vulnerabilities, so that they can reap fruits of development in a sustainable manner. Thus, the National Programme of Action should focus on these areas on with sustainable livelihood⁴ as a priority basis. This echoes the national strategy (ERD, 2003) "to reach out to the poorest and remote rural areas, which are vulnerable to adverse ecological processes (including *chars* and river erosion affected areas)."

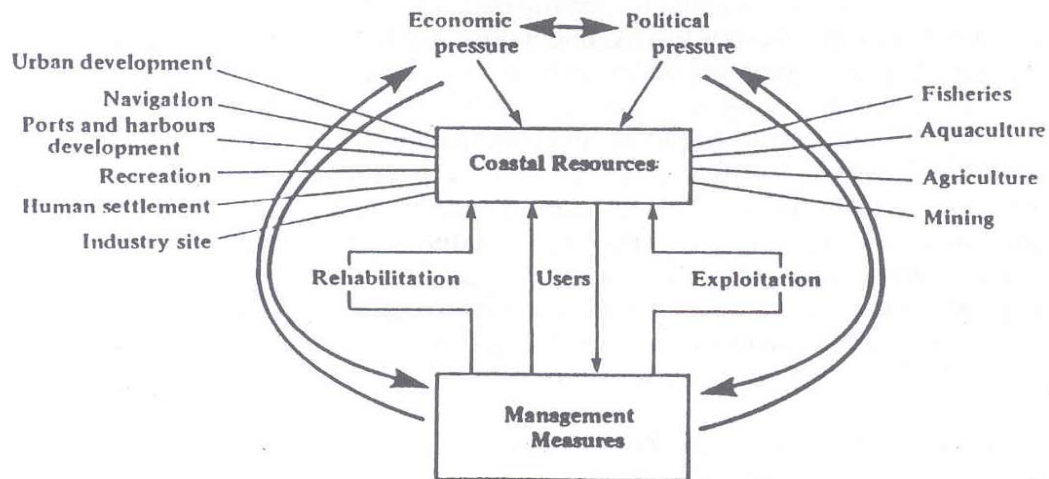


Figure 9. Complex issues in the coastal areas (source: FAO 1992)

4.3.1 Agriculture

To achieve sustainable agricultural livelihood, management activities would include education, training and awareness of the local people to appropriate management of agricultural production systems; diversification of cropping systems, agro-forestry and proper application and utilization of agro-chemicals.

4.3.2 Fisheries

To achieve sustainable livelihood, management activities in the fisheries sector would include education, training and awareness of the local people to concepts of sustainable harvesting, integrated mangrove-aquaculture shrimp farming, proper application and utilization of chemicals etc.

⁴ A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Carney, 1998).

4.3.3 Others

Sustainable livelihood of people can be achieved only if the local people are educated and aware of conservation and preservation of natural resources. If they can manage the resources on which their livelihoods depend on then sustainability can be achieved. The management objective to ensure sustainable livelihood is to promote community ownership of resources and empower the women.

4.4 Economic considerations

In generic term the economy of the peoples of coastal area are poor. The extent of poverty is relatively high compared with the remaining part of Bangladesh: 52% are poor and 24% are extreme poor (PDO-ICZMP 2003). However, the coastal resources, contributes a lion share of the countries economy viz. the shrimp sector. Realizing the paramount importance of sharing benefits among the poor and enhance the economic activity at the grass root level, the programme put emphasis on the 'improving infrastructural facilities' and involvement of the community in the local economy instead of the middle men.

4.5 Synergies with the Poverty Reduction Strategy Paper (PRSP)

PRSP emphasizes the conservation and expansion of natural resource base so that the poor and vulnerable communities can depend upon the natural resources on a sustainable basis. This objective corresponds to that of NPA particularly, the enhancement of livelihood opportunities in the coastal areas through the conservation and sustainable use of coastal natural resources.

The Strategic goals set forth by the PRSP include, the reduction in the rate of deforestation, conservation of biodiversity, solid waste management and improvement of water quality. Of particular significance is the PRSP's strategic action to improve the coastal water quality by the installation of ETP (Effluent Treatment Plant) in industries and introduction of environmental audit for the ship breaking industry. These along with other recommended priority areas of the PRSP such as capacity building, impact study of agricultural residue etc. have direct linkages and synergies to the activities targeted by the NPA.

The following checklist is a selection of the strategies proposed by the PRSP and the synergies that exists with NPA.

Table 18. PRSP and its Linkages with NPA

Key Environment and Sustainable Development Strategies in PRSP	Linkages With NPA
<p>Ensure Sustainable livelihood of the poor (Integrate environmental issues in all policies and plans. Strengthen the process of environmental analysis in project design and implementation). Key targets are</p> <ul style="list-style-type: none"> ▪ Improve access of the poor to natural resources for production, health and nutrition ▪ Increased access of the poor to Common Property Resources (CPR) through policy and project interventions ▪ Raise general awareness about the role of environment in sustainable livelihood ▪ Increased public participation in environment related decisions 	<p>A major portion of the coastal communities are depended on coastal resources. Protection of coastal resource base both land and water will facilitate livelihood of the coastal communities.</p>
<p>Reduction in the rate of deforestation</p> <ul style="list-style-type: none"> ▪ Bring 20% of land under forests by 2015 	<p>NPA suggests increasing plantation in coastal area through community</p>

Key Environment and Sustainable Development Strategies in PRSP	Linkages With NPA
	participation which is in line with the PRSP i.e. the increase in forest cover to act as a shelterbelt in the coastal areas of Bangladesh.
<p>Conserve the bio-diversity of the country</p> <ul style="list-style-type: none"> ▪ Improve flora and faunal biodiversity ▪ Halt destruction of habitat and overexploitation of flora and fauna, and encroachment of the natural forests ▪ Document the state of floral and faunal biodiversity of the country by ecosystems ▪ Implement policies to protect biodiversity by involving local communities. 	Reduction of coastal and marine pollution will facilitate conservation of bio-diversity in the coastal area.
<p>Improve Solid Waste Management System</p> <ul style="list-style-type: none"> ▪ Introduce efficient collection and transportation of municipal waste to the disposal site ▪ Improve solid waste disposal method in all towns 	The NPA has identified the proper disposal of solid waste as a key issue for national action for the protection of the coastal areas and is complementary to the strategies and goals of the PRSP.
<p>Control Industrial pollution</p> <ul style="list-style-type: none"> ▪ Bring all the amber-b and red category industries as classified under Environmental Conservation Rules, 1997 to Environmental Clearance procedure. 	Both NPA and PRSP emphasize the need to set-up ETP in accordance with the ERC' 97. The NPA also emphasizes the need for Environmental Management Plan and Environmental Audits in all orange-B and Red category industry in and around the coastal areas esp. for the ship breaking industry.
<p>Improve water quality</p> <ul style="list-style-type: none"> ▪ Reduce Pollution load in water ecosystem ▪ Identify and monitor pollution sources ▪ Enact and enforce laws to control emissions into water of hazardous/toxic wastes. 	Improving water quality by the proper disposal, treatment and management of solid waste, sewage and industrial effluent has been cited as the major goals and objective of the NPA. Proper law enforcement and monitoring of pollution sources has also been indicated in the NPA, which compliments the strategy set forth by the PRSP.
<p>Integration of climate change issues with other policies, programmes, and projects</p> <ul style="list-style-type: none"> ▪ Sector-specific vulnerability to climate change studied ▪ Preparation of a National Adaptation Plan of Action (NAPA) ▪ Integration of climate change adaptation in all policies, programmes and projects as appropriate 	Coastal afforestation will play positive role in reduction of vulnerability of coastal community against natural disasters and support livelihoods.

4.6 Integration with Coastal Development Strategy

Bangladesh Government has approved the 'Coastal Zone Policy' 2005. ICZM has developed their programme for the coastal areas of Bangladesh. All the activities need to be in line with their identified programme. This will ensure proper utilization of resources

and comprehensive development of the coastal and marine areas of Bangladesh. The policy focus on the following broad areas:

- Economic development in the coastal areas
- Livelihood upliftment
- Mitigation of risks
- Sustainable management of coastal resources
- Proper land utilization planning
- Taking measures against salinity intrusion

In addition to CDS, the NWMP identified relevant programmes may also be integrated to protect the coastal ecosystem.



Source: IUCN

4.7 Involvement of other Sectoral Agencies as a means of Mainstreaming

It has been recognized that involvement of other relevant agencies in the implementation of the proposed activities will help in mainstreaming land based coastal pollution issues. The proposed projects have identified a number of relevant ministries, agencies and departments who will be involved during designing and implementation of the activities. A final list of ministries, departments and agencies will be identified during the design phase and they will be involved accordingly during implementation of project activities.

5. IDENTIFICATION, EVALUATION AND SELECTION OF STRATEGIES TO ACHIEVE GOALS AND OBJECTIVES

5.1 Goal

To protect the coastal and marine environment of Bangladesh from land based activities.

5.2 Guiding principles

The principles form the basic guidelines for the implementation strategy. These principles are based on the following facts and assumptions:

- NPA programmes and projects emphasize popular participation, or are "people - led", to promote their ownership among communities and enhance their execution and sustainability.
- The identified strategies are in line with the PRSP and Coastal Zone Policy 2005.
- NPA provides an enabling environment allowing communities to help themselves achieve their stated goals.
- It is essential to adopt an integrated approach in the NPA to facilitate the full integration of UNEP/GPA activities within other national policies for sustainable development. Adoption of this approach also conforms to its increasing usage by governments.
- The implementation of the NPA emphasizes building of partnerships between the various stakeholders and government.
- The implementation of NPA programmes and projects is based on self - initiative and on the learning - by - doing approach. The experience accumulated is carefully documented and fed back into subsequent stages of programme / project implementation.

5.3 Identified strategies to achieve the goal

A number of strategies and measures were identified to address the existing land-based pollution activities. The following measures may reduce risk of marine environment through both point and non-point sources:

Strategy 1. Proper management of waste (including agro-chemicals and pesticides, solid waste and sewage)

In the coastal and marine areas of Bangladesh waste including agrochemicals and pesticides, solid waste, and sewage contributing a lot in polluting the environment. Proper management of the waste is needed to minimize and ultimately reduce the pollution.

Strategy 2. Proper management of industrial waste

Industrial waste (including ship breaking) is a major concern in the coastal and marine areas of Bangladesh. Proper management of those industries is needed to reduce the pollution from industrial sources.

Strategy 3. Increase coastal afforestation

Coastal ecosystems are highly dynamic in nature and deforestation in the coastal areas increases livelihood vulnerability (IUCN 2004). To protect the coastal and marine

ecosystem for ensuring the sustainable environment as well as livelihood improvement, large scale degraded coastal and marine ecosystem and afforestation/reforestation is a must. Realizing the paramount importance of protecting coastal and marine ecosystem, Government, Intergovernmental Agency (IUCN) as well as several Non Governmental Organizations has taken afforestation/restoration programme in different coast areas. The Forest Department of the government of Bangladesh is the pioneer in coastal afforestation in the world and has been raising mangrove plantations in the coast since 1960. However, these efforts are not sufficient. These programmes need to be scaled up immediately as well as successful models need to be replicated throughout the coastal areas of Bangladesh. Land use of newly accreted Charlands should be forestry and this must be a legal binding for all agencies concerned in land use in the coastal areas. The Coastal Afforestation should put emphasis on:

- The creation of vegetative cover under a 'shelter-belt' concept, especially those areas that remain exposed to natural calamities. Presence of a Green belt greatly decreases the vulnerability of coastal zones to tsunami, cyclone and tidal surges.

Table 19. Total coastal plantations raised by FR from 1982-2004.

Name of the Forest Division	Name of the Project and duration				Area affected after planting (ha)			Predicted reclaimable land for plantation (ha)	
	Mangrove Afforestation Project (MAP) (1980-85)	Second Forestry Project (1985-92)	Forest Resources Management Project (FRMP) (1992-2001)	Extended Forest Resources Management Project (FRMP) (2002-2004)	Total mangrove Plantation (1980-2004) (ha)	River erosion (ha)	Encroached forest land (ha)	Total area of plantation affected (ha)	
Coastal Forest Division, Chittagong	11,437	10,057.0	4,958.0	550.0	27,002.0	11,371.25	5,604.0	16,975.25	5,000.0
Coastal Forest Division, Noakhali	14,615.0	15,314.0	18,200.0	1,163.0	49,292.0	14,153.8	15,700.0	29,853.8	80,000.0
Coastal Forest Division, Bhola	11,011.0	7,758.0	5,845.0	800.0	25,414.0	11,849.15	2,036.0	13,885.15	4,000.0
Coastal Forest Division, Patuakhali	6,114.0	5,932.0	4,565.0	552.0	19,163.0	2,233.0	190.0	2,423.0	5,000.0
Total	43,177.0	39,061.0	33,568.0	3,065.0	118,871.0	39,607.20	23,530.0	63,137.20	94,000.0

Source: FD 2004



Strategy 4. Capacity Building (Training, awareness, research and monitoring)

At the national level, coordinating bodies and research facilities should be strengthened for systematic observation of marine pollution, environmental impact assessment and development of control recommendations. At the local level, Government, Non Governmental Organizations, Intergovernmental Agency, should come forward and mobilize communities so that they will be inclined to adapt techniques and activities that are sustainable. Training and Awareness Programmes aimed at particular focus groups should be promoted.

Strategy 5. Assessment of environmental flow requirement and salinity Intrusion

The Pilot study of the Environmental Flow Assessment of the Bakkhali River Rubber Dam in the Cox's Bazar area can be replicated to assess the impacts of increasing salinity in the coastal regions. Certain species can be selected as indicator species for the environmental flow assessment and the trade off of flow between the salinity levels and abundance of species can be determined.

Strategy 6. Establishment of Central Data Base Directory and Information System

Perhaps the greatest barrier towards the development of coastal-based management projects is the unavailability or inaccessibility of useful data. Before proceeding with preventive mitigation measure, existing environment of individual sectors like ship scrapping and shrimp culture and the extent of environmental damage caused by the sectors should be assessed. A web enable database management system should be developed for proper management of the resources and fulfill the future demand. Collection of data and information should be stored in a centralized system that enables to store, modify, and extract information for users. The directory will consist of the following:

- Land-use zoning maps indicating the types and uses of land in the coastal areas with aim to assist in future land use planning process.
- A directory of all industries in the coastal area indicating the location, type, and other sets of parameter to assess their impact on the coastal ecosystems
- Environmental directory indicating the ecosystem conditions, species abundance etc. in the coastal areas

Strategy 7. Ensure preparedness for the adaptation to natural disasters

The occurrence of flood, tidal surges, cyclones, earthquake and most recently tsunami in the coastal areas of Bangladesh has increased the need for the development of proper adaptation measures against these natural disasters. Moreover, the coastal areas of Bangladesh are highly vulnerable to the future impacts of climate change which will not only cause an increase in sea level leading to enhanced salt water intrusion but will also aggravate the frequency and magnitude of natural disasters that already plague the coastlines of Bangladesh.

6. ACTION PROGRAMME

Action 1. Proper Management of Agricultural and Domestic Wastes

Pollution prevention measures such as source reduction, recycling and treatment plant can reduce waste disposal needs, minimize impacts across all environmental media, reduce the toxicity of waste and ease some of the burdens, risks and liabilities of waste management.

Objectives:

- Proper management of agrochemicals (fertilizers, pesticides, insecticides etc.)
- Proper management and disposal of solid waste
- Proper management of sewage

Outputs:

- Pollution in the coastal and marine environments due to waste will be reduced significantly.

Activities:

1.1 Management of agro-chemicals

Agricultural wastes, wood waste and mortalities must be collected, stored, handled, used and disposed of in accordance with a manner that prevents pollution. Following facts should be practice in agriculture waste management:

- Agricultural waste must not be applied to the land if, due to meteorological, topographical or soil conditions or the rate of application, runoff or the escape of agricultural waste causes pollution of a watercourse or groundwater.
- Agricultural waste must not be directly discharged into a watercourse or groundwater
- Agricultural waste must be applied to land only as a fertilizer or a soil conditioner
- Encourage the use of organic fertilizer: Pilot scale farming initiatives need to be taken demonstrating the benefits of organic farming. Once these become popular that may be scaled up further.
- Encourage biological control of pest

The steps that can ensure the proper use and management of agro-chemicals and help in reversing the effects on marine and coastal ecosystems by these pollutants are:

a) Training Programmes on use of agrochemicals/pesticides: The training may include education and awareness raising about the following concepts:

- How to apply/handle the pesticide
- Particular pesticide that should be used in particular cropped area
- Quantity of pesticides that should be used in specific cropped area
- POPs pesticide
- Longevity of specific pesticide etc
- Integrated pest management
- Indirect effects of pesticides

1.2 Management of solid Waste

The proper management of solid waste can take place through the following steps:

- Formulation of a 'Solid Waste Management Service' in all municipal or city corporation area so as to ensure the proper transportation and disposal of waste to landfills.
- Establishment of sanitary landfill site (long-term) and Compost plant (short-term).

- Awareness Raising Programmes in order to encourage community participation in collection, transportation and disposal of solid waste.
- Awareness raising on waster reduction through behavioral change (recycle, re-use etc.)
- Monitoring of solid waste disposal
- Set up of waste reception facilities

1.3 Management of sewage

The direct discharge of sewage into the marine ecosystem has major environmental implications. With the increasing population of the coastal areas of Chittagong and Khulna, it has become pertinent that sewage treatment plants (STP) be set up in order to manage the huge amount of sewage that is generated each day. At least one STP should be set up in each of these two major cities. NGO/Civil society/Community initiatives may be encouraged to provide sanitation facilities for poor and slum people.

Institutional setup for implementation:

Implementation of the proposed activities requires involvement of a number of ministries and departments notably the Ministry of Local Government and Engineering Department, Ministry of Environment and Forests, Ministry of Agriculture, Ministry of land, Ministry of Health, Ministry of Water Transportation, Ministry of Industries, Ministry of Food and Disaster Management. Roles and responsibilities of each ministry and department will be developed during designing phase of the project. However, the overall coordination responsibilities will lie with the Department of Environment, Ministry of Environment and Forest.

Implementation Period: 5 years

Tentative budget

Scoping and designing: 25,000 US\$

Implementation: 1.5 million US \$

Action 2. Proper Management of Industrial Waste

Objectives:

- Proper management of industrial waste including ship breaking industries

Outputs:

- Pollution in the coastal and marine environments due to waste will be reduced significantly.

Activities:

2.1 Management of industrial waste from Ship Breaking and recycling

Ship breaking and recycling activities at Sitakunda have to be considered as one of the potential dangers to the marine and coastal environment. The breaking and recycling activities take place on approx. 10 kilometers of beach North of Chittagong.

Ship breaking is besides being a very hazardous occupation, potentially dangerous to the environment. From the moment a vessel is beached, various types of hazardous materials can contaminate the surrounding area. The primary contamination, occurs when a vessel beaches,

scraping the bottom of the vessel on the beach. As this part of the vessel is painted often with paints containing a.o. heavy metals, this layer of paint deposits unwanted material in the beach sand,

An obsolete ship often contains a large quantity of undesirable and hazardous substances on board. Vessels can contain asbestos or asbestos containing materials (ACM), PCB's, TBT's. (H)CFC in refrigeration and air conditioning systems, to name but a few of the products commonly found on board. To lessen or completely nullify the impact of such environmentally hazardous products, extensive measures will have to be devised and implemented in the future.

One of the methods currently being used to decontaminate parts of a ship when it is being demolished is to flush various spaces with large quantities of sea water. Needless to say, this crude method unfortunately carries potentially detrimental products out with the water and can have the effect of polluting the surrounding waters.

It is unfortunate that asbestos and ACM's are improperly treated. Lack of knowledge is the main reason and reuse is unfortunately common.

Chemical substances currently find their way into the atmosphere too easily. Refrigerant gases are not evacuated but are let free without any attempt to collect them. This causes air pollution. Another form of air pollution results from the burning of electrical wiring. The outer protective coat is burned off to enable the copper wire to be easily freed from the insulation. Burning this material can potentially liberate unwanted and harmful matter into the air.

Many oils on board contain PCB's. PCB's are also often found in electrical systems (capacitors, etc.) and should be carefully handled. This is true for many products found on board. A comprehensive list of possible environmentally hazardous materials can be obtained from UNEP or from International Maritime Organisation (IMO).

The location where ships are dismantled may also endanger the surrounding area. Expanding businesses need more area and this can result in unwanted deforestation.

Ship breaking definitely causes unwanted and detrimental pollution. For this reason the future of this industry is going to have to implement improved standards of recycling so as to limit environmental damage.

Ship breaking and recycling industries may be encouraged to do the following activities:

a) Ensure Environment Management Plan (EMP)/ Environment Management System (EMS) in Industry: All Red Category industries may need to set up separate Effluent Treatment Plan, Environment Management Plan, Environment Management System in overall management. This plan or system may ensure that the following activities are included to reduce land-based source of pollution:

- Waste management
- Drainage system
- Water quality management
- Air pollution control
- Proper storage, handling and transportation of hazardous material
- Emergency management during disaster
- Occupational health and safety measures

The Orange A & B category industries may also need EMP/EMS in overall management to reduce waste and maximize economic efficiency and product quality.

b) Develop Environmental Audit Programme: To ensure environmental quality and performance of all industries (red and orange) and relevant establishments (e.g. terminals, dock yards, ports etc), environmental audit programmes may be introduced. This systematic audit programme would find noncompliance and may take necessary action by regulatory agency (Department of Environment) for sound environmental performance. This will ultimately reduce risk of pollution and may protect coastal resources.

c) Waste Minimization Incentive Policies

There are several ways in which government can attempt to overcome the barriers and actively encourage industrial waste minimization activities. These include the provision of technical assistance programs, the creation and enforcement of pollution control regulations, the dissemination of information about waste minimization programs and opportunities, the establishment of financial incentives, and the foundation of award programs recognizing significant achievements in waste minimization.

d) Set up of waste reception facilities

To minimize the contamination or spread over of the waste from ship, certain mechanisms need to be in place so that it can act as a receptor of waste. Inclusion of a disaster management plan for accidental oil spill and noxious substances should also be considered in this context.

e) Enforcement of Existing laws and orders

Enforcement of available laws and orders may reduce the risk of industrial pollution

2.2 Management of other industrial waste

Crude oil is spilled into the water during transporting and handling it from nearly 1200 coaster tanker, 600 foreign going tanker, 2600 mechanized vessels, dockyards, slipways etc cause pollution of Bangladeshi coastal belt. Scientists say that the thin layer of oil on water prevents light penetration and exchange of oxygen and carbon di oxide across the air water interface. This also prevents photosynthesis and cause depletion of dissolved oxygen (DO). The average DO of the water of the Karnaphuli is below the WHO standard. The decrease in fish stocks from fish diseases particularly in the gills indicates the severity of the pollution problems.

- Type and quantity of hazardous hydrocarbon substances adultrating river water not assessed
- Current anti-pollution measures and plans to enforce MARPOL convention to be adopted
- MARPOL convention not enacted through Government gazetted law in Bangladesh.
- Oil and waste reception facility not established in Ports
- GOB lacks in manpower and resources to implement Pollution contingency plan

To mitigate the above problems following activities should be considered.

- Proper oil generated pollution research has to be undertaken to detect source and amount of harmful substances causing sublethal effect to fisheries resources
- Impact of current pollution to be assessed in consideration with few decade ahead and preventive measures to be in place and make operational
- Department of Shipping may arrange to make draft of pollution prevention law in the light of MARPOL 73/78 and submit it to Ministry of Law for faster enactment.
- Expert view oriented reception facility to be developed so as to quick clean up and reclaim arrangement of spilled oil can be made by port's pollution cell.
- Specially trained manpower including environmentalist, lab technician, clean up gear operator for both afloat and shore units.

Institutional setup for implementation

Implementation of this programme will be coordinated by DoE involving NGOs as well as intergovernmental and private agencies. The Ministry of Environment and Forests, Ministry of Agriculture, Ministry of Education, Ministry of Water Resources, Ministry of Land and Co-operatives, Ministry of Industry, Ministry of Health, Ministry of Water Transportation, Ministry of Food and Disaster Management will house and facilitate implementation of this programme.

Implementation Period: 7 years

Tentative budget

Scoping and designing: 25,000 US\$

Implementation: 5 million US \$

Action 3. Increase Coastal Afforestation and Conservation of Existing Forest Areas

Objectives:

- Plantation in the newly accreted coastal areas and char lands
- Integrated farming with shrimp for improvement of the livelihood of the coastal peoples

Outputs:

- Coastal zones are protected from natural calamities
- Peoples get alternative income generation activities

Activities:

- Identification and preparation of land for afforestation
- Development of coastal nurseries and preparation of planning materials
- Participatory plantation programme in the coastal areas and char lands
- Integrated shrimp-mangrove techniques introduced
- Scaling up the pilot experiences in rehabilitation of the degraded coastal areas with mangroves
- Coastal afforestation is needed to be prioritized using satellite based information so that the hotspot areas can be easily identified and action program can be maintained considering the severe natural calamities areas.
- Awareness raising of the mass people regarding development and conservation of mangrove forest

- Bangladesh Forest Department has planted the newly accreted char lands in many coastal areas (e.g. Bayer char, Char Rahman, Char Nurani, Dhal char and Jalia Char of Noakhali district and Telir char, New Telir char and Char Srizani of Laxmi Pur District) with mangrove species. However, According to Bangladesh Forest Department (2006), these chars are under threat of erosion due to the wave action caused by the movement of ships (container) nearby these chars. Also, noxious waste from those sea going vessels threatening the coastal and marine biodiversity, decreasing the soil quality and fertility of those lands. To overcome these trends of degradation and to maintain the ecosystem integrity the navigation routes need to be redesigned/shifted.

Institutional setup for implementation

The Forest Department will implement the coastal afforestation programme and will involve NGOs as well as inter-governmental and private agencies if/whenever needed. The Ministry of Environment and Forests, Ministry of Agriculture, Ministry of Fisheries and Livestock's, Ministry of Water Resources, Ministry of Education, Ministry of Land and Ministry of Local Government Rural Development and Cooperative, Ministry of Health, Ministry of Water Transportation, Ministry of Industry, Ministry of Food and Disaster Management, should also facilitate implementation of this programme. BIWTA and MMD should be responsible for maintaining the proper navigation routes of the sea going vessels.

Implementation Period: 5 years

Tentative budget:

Scoping and designing: 30,000 US\$

Implementation: 10 million US \$

Action 4. Promotion of Awareness and Capacity Building (training, awareness, research and monitoring)

Objectives:

- Training and Awareness Programmes aimed at particular focus groups have been promoted.

Outputs:

- Personnel especially associated with waste management of industries, medical college/hospital/clinic/diagnostic center, Municipal/city Corporation, and agricultural farming build up their capacity for smooth operation and management of their job.
- Farmers are aware about pesticides use to reduce adverse impacts of them on water resources. All the farmers must know the short term and long effects of pesticides. They should also know about the specific registered pesticides and proper way of application.
- Increased awareness of the pollution in the coastal and marine environment due to land based activities issues among the community and other stakeholders

- Policy making and monitoring system will be improved through research and establishing monitoring and evaluation mechanism.

Activities:

4.1 Conduct training programmes

- Training of critical personnel required for the adequate protection of the marine environment
- Training of farmers (agriculture and shrimp) on proper application and usage of agro-chemicals
- Training of local people on agro-forestry/biodiversity techniques, seed banks etc. for preservation of species
- Training of industries for effective waste management and environmental auditing
- Training of farmers on IPM and preparation of organic manure

4.2 Initiate awareness programmes

- Introduction of marine environmental protection topics in school curriculum
- Community based workshops on coastal zone management
- Dialogues and discussion at grassroots levels focused on stewardship in conservation and sustainable management of coastal resources

4.3 Research and Monitoring Capacity Building

- A survey on environment pollution from industries
- A complete study may be taken on quantity and quality of waste/effluents of all red category industries in coastal areas
- A comprehensive technical study on structural and hydraulic condition may be taken at least in two major coastal cities, Chittagong and Khulna to establish sewerage system. Both geographic and topographic condition should be considered (long-term)
- A study or survey may be conducted to identify the areas/zones that are responsible for direct disposal of sewage in the water system to introduce low-cost, on-site sanitation system as short-term measure
- A study on total waste generation, per capita waste generation, composition of waste, contribution of waste from different sectors (industry, domestic, commercial, medical) may be taken in major urban areas. This study may include waste associated organization/workers and their effective initiative in waste management
- A comprehensive study on type and quantity of pesticides that may be used by the farmers at agricultural fields in coastal zone (short-term) and nation wide (long-term) is needed. The frequency and procedure of applying of pesticides may be included in the study
- An impact study and analysis of agrochemicals on river/marine water resources may be conducted immediately to determine the level of pollution. The City Rivers may be included for study as prior basis for example Karnaphully for Chittagong area. The agricultural practices and water bodies may be considered before study.
- A study on existing land use, current potential growth of different sectors and availability of land for future infrastructural development is also necessary. This might help policy makers and implementing agencies to avoid informal growth and their land-based activities that may pollute marine water.
- Identification of Environmentally Critical Area (ECA)

Institutional setup for implementation

Implementation of this programme will be coordinated by DOE with extensive involvement of NGOs as well as intergovernmental and private agencies. The Ministry of Environment and Forests, Ministry of Agriculture, Ministry of Fisheries and Livestock's, Ministry of Education, Ministry of Land, Ministry of Health, Ministry of Water Transportation, Ministry of Industry, Ministry of Food and Disaster Management should also facilitate implementation of this programme.

Implementation Period: 5 years

Tentative budget:

Scoping and designing: 25,000 US\$

Implementation: 2.5 million US \$

Action 5. Assessment of Environmental Flow Requirement and Salinity Intrusion

Objectives:

- Clear understanding of the minimum flow requirements and take necessary measures to those ecosystems in accordance with that

Outputs:

- Delineation of the ecosystems with their minimum flow requirements.
- In depth understanding of the minimum environmental flow requirements for ecosystem functioning
- Identification of the hot spots

Activities:

- Delineate coastal zone into appropriate environmental flow regions.
- Develop protocols of environmental flow assessment to suite the local needs
- Develop a set of GIS maps using remote sense satellite based images
- Organize a national workshop for securing the concurrence on the recommendations
- Planning design for intervention to address the problem in hot-spots formulated and appropriate actions/interventions through a well-defined small scale pilot in a hot-spot undertaken.
- Scaling up the pilot experiences

Institutional setup for implementation

Implementation of this programme will be coordinated by DOE with extensive involvement of NGOs as well as intergovernmental which has relevant experience in this aspect. The Ministry of Environment and Forests, Ministry of Agriculture, Ministry of Fisheries and Livestock's, Ministry of Water Resources, Ministry of Education, Ministry of Land, Ministry of Health, Ministry of Water Transportation, Ministry of Food and Disaster Management, Ministry of Industry should also facilitate implementation of this programme. CEGIS holds long temporal series of satellite –based images and GIS maps covering the whole country, which can be used for mapping of environmental flow areas.

Implementation Period: 3 years

Tentative budget:

Scoping and designing: 25,000 US\$

Implementation: 2 million US \$

Action 6. Establishment of Central Data Base Directory and Information System

The database should cover the natural resources of the coastal area. A knowledgebase is needed to be prepared for the coastal zone. WARPO has developed an Integrated Coastal Resources Database (ICRD), which can be a starting point for preparing the knowledge of the region.

Objectives:

- Establishment of benchmark

Outputs:

- Baseline data on key issues
- In depth understanding on key issues

Activities:

- An industrial database should be formed in the coastal area based on the following
 - Number of industries
 - Name and Type
 - Type of inputs materials
 - Product
 - Category of the industry (formulated by DOE)
 - Area of the industry
 - EMP/EMS in place (Yes/NO)
 - Quantity of the waste

Institutional setup for implementation

Implementation of this programme will be coordinated by DOE to work with relevant government agencies who has their own data management setup, like WARPO, Department of fisheries, BARC, CEGIS etc. NGO sector can also provide critical help in developing the database and providing monitoring data.

Steering committee members' i.e.

- Director General, Department of Environment, Convener
- Representative, Ministry of Environment and Forest, Member
- Representative, Ministry of Science Information and Communication Technology, Member
- Representative, Ministry of Health
- Representative, Ministry of Water Resources
- Representative, Ministry of Land
- Representative, Bangladesh Internal Water Transportation Authority
- Representative, Ministry of Shipping
- Representative, Ministry of Industry
- Representative, Mercantile Marine Department (MMD)
- Representative, Ministry of Fisheries and Livestock, Member
- Representative, Department of Forest, Member
- Representative, Water Resources Planning Organization, Member
- Country Representative, IUCN Bangladesh, Member
- Executive Director, BCAS, Member

- Executive Director, IWM, Member
 - Executive Director, CEGIS, Member
 - President, Federation of Chambers and Commerce, Member
 - President, Dhaka Chambers of Commerce and Industries, Member
 - Representative, Khulna Chambers of Commerce and Industries, Member
 - Representative, Chittagong Chambers of Commerce and Industries, Member
 - Representative, Barisal Chambers of Commerce and Industries, Member
 - Chairperson, CARDMA, Member
 - President, Global Water Partnership- South Asia, Member
 - Representative, Integrated Coastal Zone Management Plan, Member
 - Deputy Director, Department of Environment, Member Secretary
- will specially take care of implementation of this action.

Implementation Period: 2 years

Tentative budget:

Scoping and designing: 25,000 US\$

Implementation: 1 million US \$

Action 7. Ensure Preparedness to Address Natural and Man-made Disasters

Objectives:

- To aware people to cope up with the natural disasters
- To make people necessary preparatory measures against disasters

Outputs:

- Loss of life, property and pollution reduced

Activities:

7.1 Land Management Options

- Establishing extensive land management programs
- Afforestation / Planting to overcome land and water degradation
- Integrated mangrove-aquaculture model for shrimp farming to reduce encroachment of natural ecosystems by shrimp farms
- Removing policy distortions that result in loss and or unsustainable use of biodiversity

7.2 Water/ Coastal Management Options

- Establishment of a Research Vessel which will collect data/information on all resources of marine ecosystem including soil, water, biodiversity etc. This will help all relevant government and non-government agencies for planning and programme development to protect coastal environment.
- Disaster Management Plan to Address Accidental Spill of Oil and noxious Substances
- River dredging
- Improvements in runoff management and irrigation technology (e.g., river runoff control by reservoirs, water transfers, and land conservation practices)
- Monitoring salinity levels at various location
- Monitoring water quality

7.3 Conservation of Biodiversity Options

- Protection of major biodiversity "hot spots"

- In-situ and Ex-situ Conservation

Institutional setup for implementation

Implementation of this programme will be coordinated by DOE involving NGOs as well as intergovernmental and private agencies who have proven track record in dealing with issues regarding climate change and climate variability and adaptation tools and techniques. The Ministry of Environment and Forests, Ministry of Agriculture, Ministry of Water Resources, Ministry of Fisheries and Livestock's, Ministry of Education, Ministry of Land and Ministry of Local Government Rural Development and Cooperatives, Ministry of Health, Ministry of Water Transportation, Ministry of Industry, Ministry of Food and Disaster Management, BIWTA, MMD and Disasters Management Bureau should also facilitate implementation of this programme.

Implementation Period: 5 years

Tentative budget:

Scoping and designing: 100,000 US\$

Implementation: 10 million US \$

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