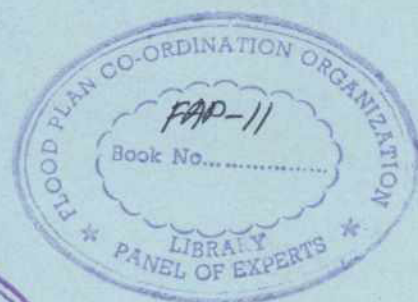


United Nations Development Programme
Government of the People's Republic of Bangladesh

Assistance to Ministry of Relief in Coordination of Cyclone Rehabilitation (BGD/91/021)

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Final Report

Volume II

NATURAL DISASTERS AFFECTING BANGLADESH

Part 1: Physical Aspects

Part 2: Social Aspects

Mott MacDonald International Ltd.
in association with
Asian Disaster Preparedness Centre
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House of Consultants Ltd.

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ASSISTANCE TO MINISTRY OF RELIEF
IN COORDINATION OF CYCLONE REHABILITATION
(BGD/91/021)

The Final Report for the Project comprises the following volumes:

- Volume I : Main Report
- Volume II : Natural Disasters affecting Bangladesh
- Volume III : Organisation and Systems for Disaster Management in Bangladesh
- Volume IV : Damage Caused by Disasters (Agriculture [including Livestock and Fisheries], Forestry and Infrastructure)
- Volume V : Disaster Management Training Strategy
- Volume VI : Concept Plan for Integrated Coastal Protection

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**ASSISTANCE TO MINISTRY OF RELIEF
IN COORDINATION OF CYCLONE REHABILITATION**

FINAL REPORT

VOLUME II

NATURAL DISASTERS AFFECTING BANGLADESH

PART 1: PHYSICAL ASPECTS

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FINAL REPORT
VOLUME II
NATURAL DISASTERS AFFECTING BANGLADESH
PART 1 : PHYSICAL ASPECTS

CHAPTER 1

INTRODUCTION

Bangladesh is one of the poorest and most densely populated countries of the world. The overall density of population is more than 700 per sq.km., while the density is 1,200 per sq.km of cropped area. Heavy pressure on the land results in the settlement of marginal lands vulnerable to recurring cyclones, surges and floods.

Bangladesh's exposure to natural disasters is highlighted in Table 1.1. Such frequent events have had a serious effect on the population, the economy and the environment. While the response to disasters from the people, Government, non-government and external agencies is generally rapid, disaster management requires considerable strengthening.

Living and economic conditions for many, if not most, people, both urban and rural, are difficult even in normal times. When disaster strikes the loss of life, crops and property are high, and life is made even more difficult than before for the survivors, particularly for the rural poor and landless. In 1987 and 1988 severe floods occurred, followed in April 1991 by a devastating cyclone. Table 1.2 shows the losses.

The casualties, human suffering, damage to crops, property and infrastructure together with disruption of the economy and damage to the environment had a serious effect on the country. It is always the poor and the under-privileged, particularly the women and children who suffer the most.

Floods, cyclones and droughts are categorized as severe hazards while landslides earthquakes, tsunami (under-sea earthquake) and fire are considered as low/medium hazards (Gupta, 1992). Riverbank erosion which renders many thousand families, who live on the banks of the eroding rivers, homeless every year and brings endless miseries is also regarded as low/medium hazard. Hazard Indices for the thanas of the country have been devised and these are discussed in Chapter 10 and Annex A.

The seasonal distribution of the natural hazards are shown in Figure 1.1



TABLE 1.1
Bangladesh : Major Natural Disasters

Year	Type of Disaster	Deaths
1644-45	Floods	+
1648	Floods	+
1769-70	Drought	+
1783-84	Drought	+
1797	Cyclone	+
1833	Earthquake	+
1822	Cyclone	40,000
1865-66	Drought in West Bengal, present Bangladesh largely escaped	135,000
1871	Floods (Rajshahi)	+
1873-74	Drought	100,000
1876	Cyclone	+
1885	Floods (Rajshahi/Dinaipur)	+
1892	Floods (Rangpur/Dinaipur)	+
1896-97	Drought	+
1897	Earthquake	+
1897	Cyclone	+
1898	Cyclone	175,000
1906-7	Floods in East Bengal	+
1901	Cyclone	+
1909	Cyclone (2)	+
1911	Cyclone	+
1917	Cyclone	+
1918	Earthquake	+
1918	Floods	+
1919	Cyclone	+
1922	Cyclone	+
1922	Floods	+
1923	Cyclone	+
1926	Cyclone	+
1936	Cyclone	+
1941	Cyclone	+
1942	Cyclone	+
1943-44	Drought, irregular rain, transport dislocation and War, includes West Bengal	3,000,000
1947	Earthquake	+
1950	Earthquake	+
1954	Earthquake	+
1955	Floods	+
1957	Earthquake	+
1960	Cyclone (2)	11,149
1961	Cyclone	11,468
1963	Cyclone	11,520
1964	Cyclone	196
1965	Cyclone	19,270
1966	Cyclone (2)	850
1969	Cyclone	75
1969	Tornado	922
1970	Cyclone	300,000
1972	Drought	+
1973	Cyclone (2)	103
1974	Cyclone	20
1974	Floods followed by famine	30,000
1975	Cyclone	5
1975	Floods	+
1977	Cyclone	+
1978/79	Drought	+
1981	Cyclone	2
1982	Drought	+
1983	Cyclone(2)	343
1984	Floods	+
1984	Cyclone	+
1985	Cyclone	11,069
1986	Cyclone	14
1987	Floods	1,657
1988	Floods	2,379
1988	Cyclone	5,708
1989	Drought	+
1991	Cyclone	138,868

Source : BBS, 1990; Munir-uz-Zaman, 1990; CDL, 1992a; Kafiluddin, 1991; ADB 1991a; Mahalanobis, 1927; Gp. Capt. Syed Ahmed, 1985.

+ : No data found

Figure 1.1
Hazard Seasons

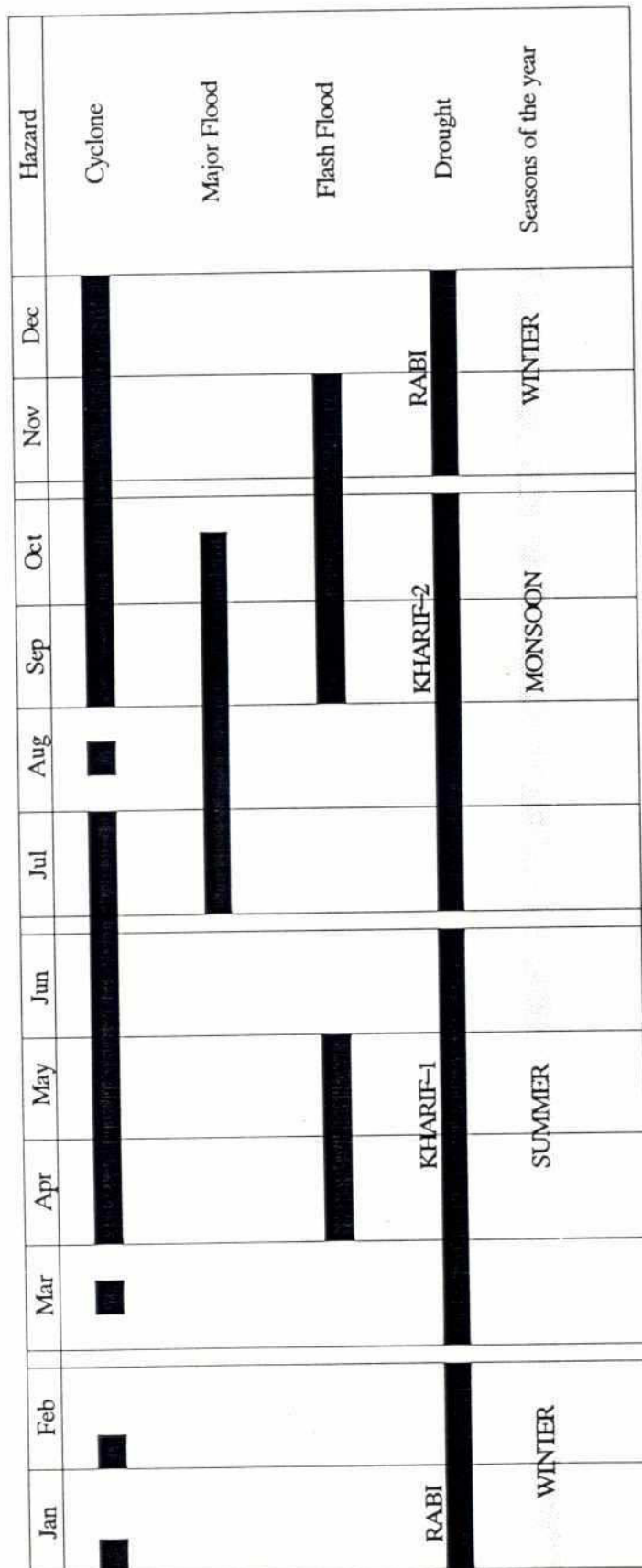


TABLE 1.2
Official Estimates of Losses and Damage by
the Floods of 1987 and 1988 and the Cyclone 1991

	Flood 1987	Flood 1988	Cyclone 1991
Area affected (sq.km)	57,000	82,000 62,500	36,000
House totally/partially damaged (m)	2.50	7.20	1.75
Human lives lost	1,657	2,379	140,000
Livestock lost	64,700	172,000	442,000
Poultry lost	206,000	410,000	442,000
Rice production lost (mt)	3.50	2.00	117,753 acre fully 791,621 acre partly
Roads : trunk (km)	1,523	3,000	-
Rural (km)	15,107	10,000	2,350
Bridges, culverts	1,102	898	6,000 rdft
Railway Embankments	698	1,300	na
Bridges/culverts	166	270	na
Flood Embankments (km)	1,279	1,990	436
Irrigation/Drainage Channel/canals(km)	222	283	973
Structures	541	1,465	na
Electric Power			
Substations flooded	na	18	na
11 KV power line de-energized (km)	na	2,000	na
Industrial Units flooded	na	1,000	na
Hospitals flooded/damaged	na	45	11
Health Centres flooded/damaged	1,305	1,400	420
Schools flooded/damaged	6,689	19,000	9,287
Rural hand-tubewells flooded/damaged	na	240,000	84,362

Source : BWDB, 1987 and MOI 1988 and MOR 1992

na : No data

CHAPTER 2

PHYSICAL CONDITIONS

2.1 Introduction

Located at the eastern zone of the Indo-Gangetic Plain, Bangladesh is bounded by longitudes 88 30 E and 92 56 E, and latitudes 20 30 N and 26 45 N. The boundary of Bangladesh is 4685 km long of which the coastline is 710 km long, all of its is lying along the Bay of Bengal.

Although a small country, Bangladesh has three of the world's major river systems passing through it. The country has considerable climatic variations. The salient physical features are described below. The specialised institutions that are charged with monitoring the climate, meteorological and hydrological conditions in the country are discussed in Annex B.

2.2 Geology

In the Oligocene period, 38 to 26 million years ago, a portion of the northeastern part of India fractured and sank below the sea-level. Over the next 37 million years, this portion was covered by much eroded rock from the Gondwana Continent to form the Bengal Basin, most of which is now Bangladesh. The Bengal Basin has been subsequently overlain by sediments washed down from the Himalayas by the rivers Ganges and Brahmaputra. Most of the southern part of Bangladesh is probably not more than 10,000 years old.

The Bengal Basin is bounded to the west by the Chhota Nagpur Plateau and to the east by the Meghalaya Plateau. The Basin and the adjacent areas form one of the most active tectonic regions of the world and large areas in Bangladesh are still subsiding. The geological setting is shown in Figure 2.1.

2.3 Seasons, Climate and Physiography

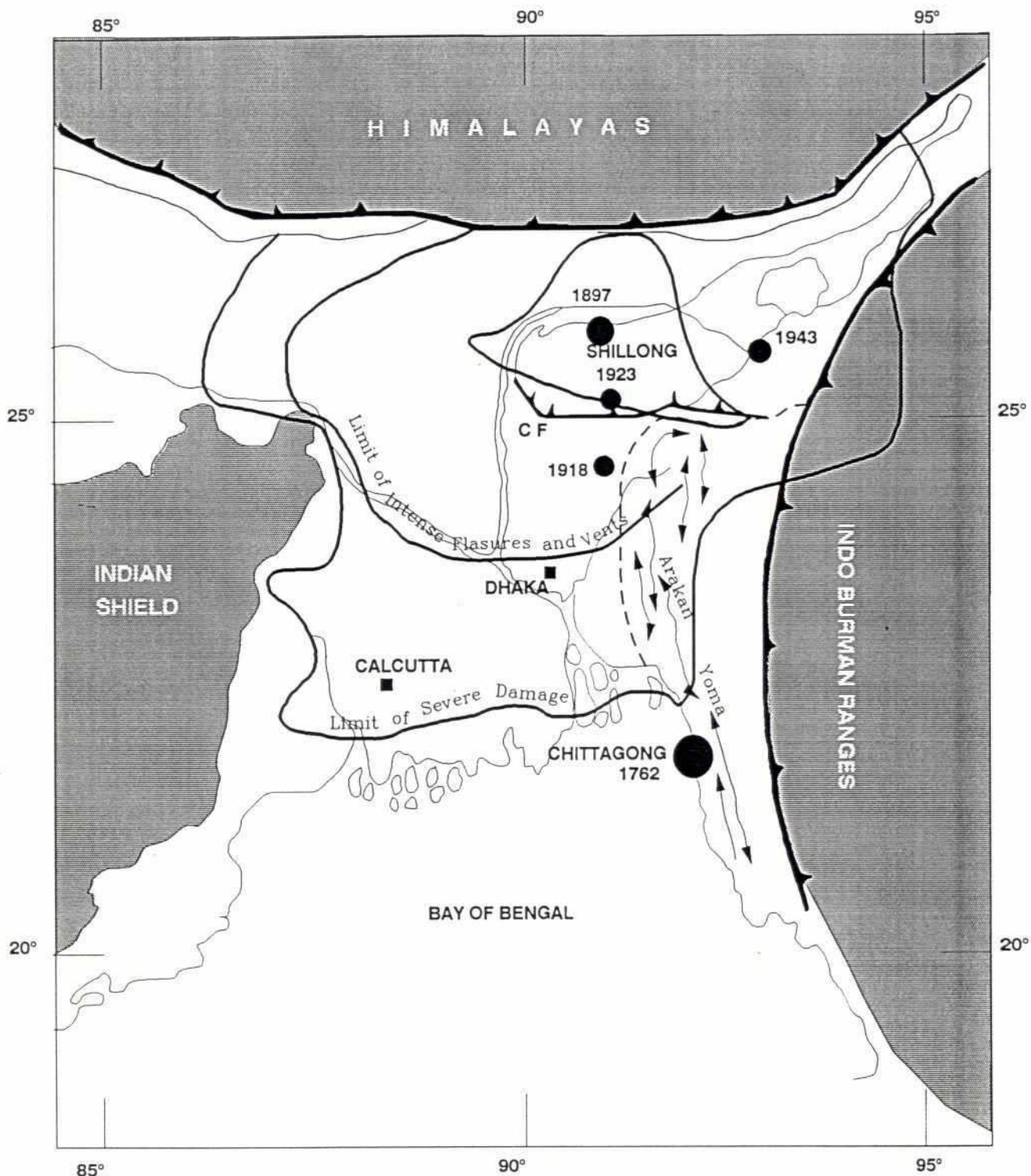
The climate of Bangladesh is generally hot and humid. It is classified as Type A-Rainy Climate (Haurwitz, 1944) and is greatly influenced by the Himalayan mountains. There are three main seasons in a year: summer, rainy season (Monsoon) and winter. The average annual rainfall is 2500mm.

The summer extends from March to June and has an average temperature of 27.8°C. Nor'westers (strong winds for a north westerly direction) are common during the summer months. The weather generally remains hot and dry. Cyclones and tornadoes are also common. The average rainfall during the summer is 762mm. Storm surges associated with cyclones occasionally inundate large areas in the coastal area during summer.

The rainy season (Monsoon) extends from July to October. Humid air blowing from the south-west brings torrential rains. During this period, the rainfall varies between 1270 and 3988mm, the humidity is very high and the sky remains cloudy.

The winter season runs from November to February, the average temperature is 17.8°C while the average minimum is 7.2°C. Rain is infrequent during the winter season and the skies remain clear. Early morning fog and mist are a common phenomenon. Between the middle

Figure 2.1
Seismotectonics of Bangladesh



Notes:

1. Dark circles are representative of major historical earthquakes, approximately in proportion to magnitude
2. Isoseists of the 1897 earthquake and Chodrang Fault (CF) are taken from Oldham (1899)
3. Location of the 1762 earthquake in the Arakan Yoma ranges (Montessus de Ballore, 1960) is approximate

of October and November, the wind changes direction. Low pressure develops in the Bay of Bengal and cyclones can build up over the Bay of Bengal.

Although the area of Bangladesh is small it has quite wide variations in climate. Geographers have suggested several climate zones, those proposed by Rashid (1977) are generally followed.

Although about half the country falls below the 7.5 meter contour, the physiography of Bangladesh has significant variations. The land can be divided into three broad categories namely: Tertiary Hills, Pleistocene Uplands and Recent Plains.

The Tertiary Hills are found in the Chittagong Hill Tracts region in the south-east and are mainly sandstones and shales. The Pleistocene Uplands comprise the Modhupur Tract north of Dhaka, the elevation of which varies between 9 and 18m, the Barind to the north-west and Lalmai Hills near Comilla.

The Recent Plains cover 90% of Bangladesh and these are sub-divided into Piedmont Plain, Flood Plain, Deltaic Plain, Tidal Plain and Coastal Plain. Elevations vary between less than one metre in the south to 64 meter in the north.

More than twenty different soil associations have been recognised, attributed to the three major rivers. The soils are azonal and have little profile development.

2.4 River Systems

Bangladesh is traversed by more than 250 rivers, including the Ganges (Padma), Brahmaputra and Meghna, together with their associated large number of tributaries and distributaries. The combined river system transports 1.5-2.00 billion metric tonnes of sediment each year and deposits it in the coastal region, extending the world's largest delta system.

Some of the larger rivers are:

Atrai, Mahananda, Korotoya, Tista, Bangali, Gorai, Rupsa, Sibsa, Karnafuli, Sangu, Matamuhuri, Surma, Sitalakhya, Dhaleshwari.

Most of these rivers cause floods of one kind or another and many continuously erode their banks.

The Ganges and the Brahmaputra have their origins in the mountains of China, India, Nepal and Bhutan. The catchment area is over 1.2 million sq.km in extent, 92.5 % of which lies outside Bangladesh. The Meghna catchment is also largely outside Bangladesh (70%) (Figure 2.2)

2.5 Coastal Geomorphology

Hydrological conditions prevailing, the large quantity of suspended sediments brought down by the rivers and the effects of the tidal flow have created three distinct geomorphological

regions namely, the Western, Central and Eastern Coastal Regions. (Pramanik, 1983), (Figure 2.3)

Tides in the Bay of Bengal occur twice in 24 hours 50 minutes. Tides approach the coast from the south-east in about three hours and vary in height between 0.6m to 3.0m along the coast; at Sandwip island, they may reach 4.0m.

a) Western Coastal Region

The western part of the coastal region extends from the international border with India the river Hriabhanga, to the Rabnabad Channel of the river Tetulia, lying to the south-west of Bhola Island. This area is influenced by the river system of the moribund delta of the Ganges-Brahmaputra. The south-western part of this region is covered by mangrove forest, the Sunderbans.

The sediment load of the rivers in this region is lower than in the other coastal regions. Hence, accretion is also relatively lower. The presence of a deep sub-sea trench, termed the 'Swatch of No Ground' into which the rivers tend to discharge may also act to reduce the sediment deposition in the immediate coastal region.

b) Central Coastal Region

The central region extends east from the Rabnabad channel to the mouth of the river Feni and forms an arch-shaped coastline.

The discharge from the rivers in this region is heavily sediment laden. At the inter-face with the Bay, water velocities are reduced and heavy silt deposition occurs.

The estuary of the lower Meghna and the Feni is the most active accretion zone. The sedimentation pattern seems to be influenced by the flow pattern induced by of the 'Swatch of No Ground' which is located to the south-west.

The water depth in the actual accretion zone is relatively shallow. Satellite imagery and false colour infra-red photograph indicates that land accretion is very active. At low tide, even low draft boats are unable move due to the existence of submerged accreted land.

c) Eastern Coastal Region

The eastern region lies at the base of the north-south elongated fold hills of the Tripura-Chittagong region. It extends from the mouth of the river Feni to the south of Teknaf. The coast line is bordered by a continuous submerged sand bed. Due to steeper land gradients prevailing in the region, the pattern of tidal flow is quite different from the other parts of the coastal.

Like the Western Region sedimentation is limited and land accretion is not significant. Except in the Feni estuary along the coast near the Sitkund hills, geomorphological conditions are not undergoing any significant changes along the whole of the Chittagong coast.

2.6 Environment

Key data on the population and food production in Bangladesh are given in **Annex D**. General discussion of the environment is given in **Annex E**.

Figure 2.2
The Ganges, The Brahmaputra and The Meghna Basins

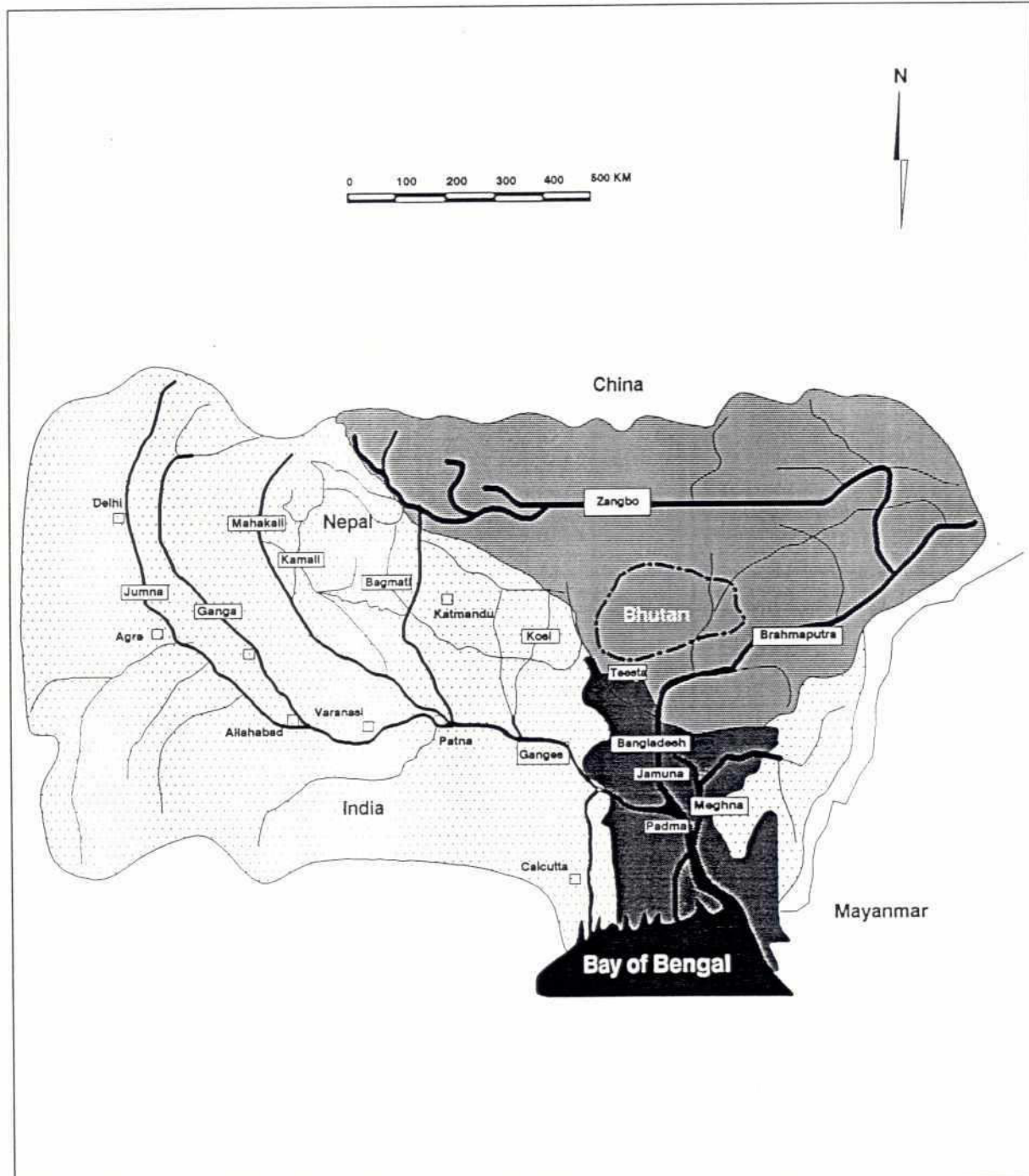
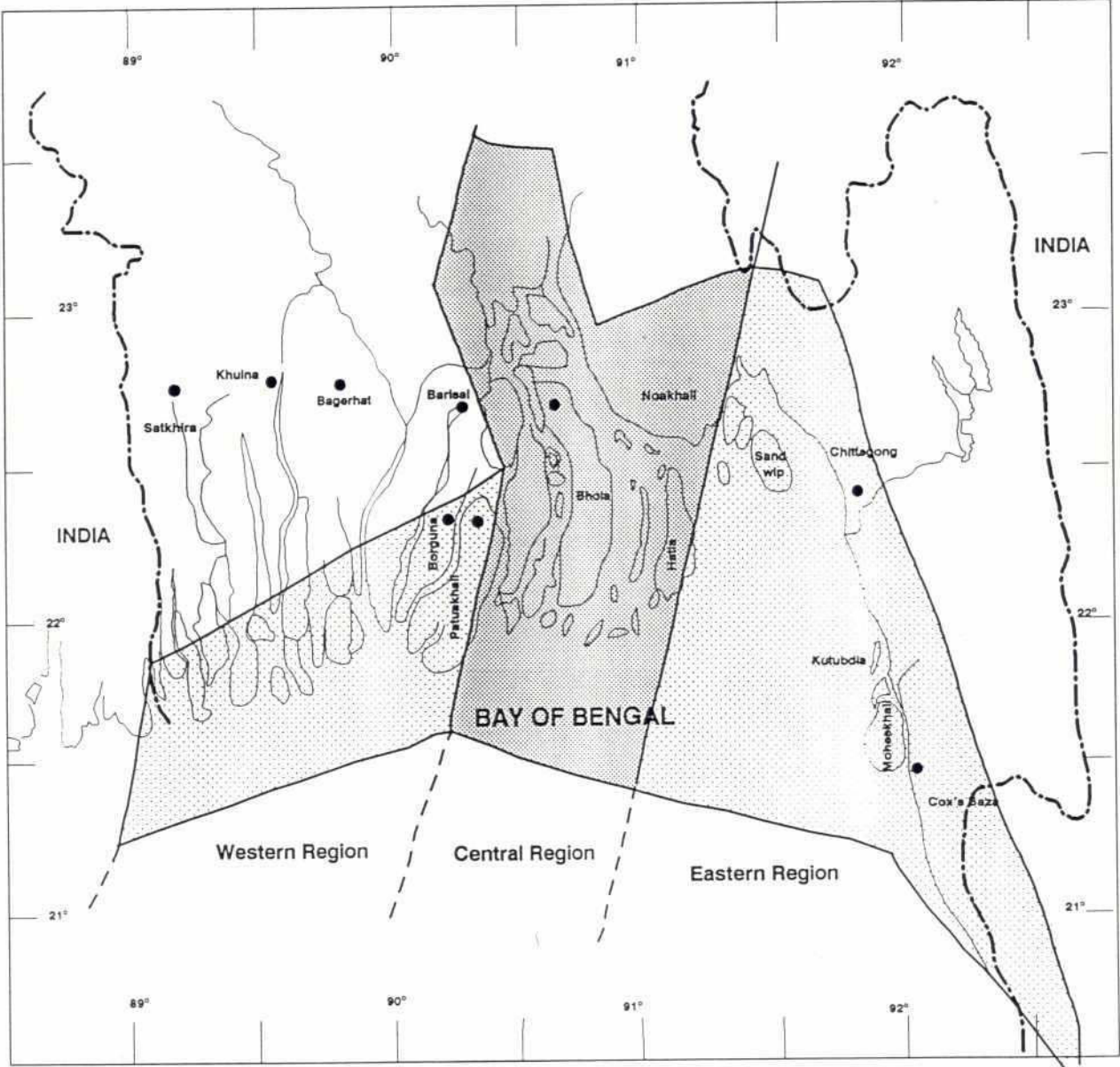


Figure 2.3
Bangladesh Coastal Regions



Source: M A H Pramanik, 1983

CHAPTER 3

CYCLONES

3.1 Introduction

Bangladesh is situated at the north eastern corner of the Indian sub-continent with the Bay of Bengal forming its southern boundary, India forming its western, northern and eastern boundaries, and Burma its south-eastern boundary.

The geography of Bangladesh brings not only the life sustaining monsoon, but also catastrophic ravages of tropical cyclones, nor'westers, tornadoes and floods. The Bay of Bengal appears to be an ideal breeding ground for tropical cyclones.

3.2 Cyclone Features

A cyclone will only form if:

- the ocean temperature is more than 27 degree C. This condition is met in the Bay of Bengal almost throughout the year.
- presence of a low pressure region with cyclonic vorticity.
- particular wind configurations

As the temperature falls, rainfall occurs, which releases (latent) heat. This increases the evaporation which in turn lowers atmospheric pressure still further intensifying the cyclone.

The most characteristic feature of a cyclone is its "eye", (Plate 1). The "eye" can be seen in satellite pictures of severe cyclones. The "eye" is small and almost circular. It coincides with the area of lowest pressure and has a diameter ranging from 8-50 km. The "eye" is warmer than the rest of the storm. The more violent the storm, the warmer is the "eye". Winds are very light in the "eye", usually not more than 24-30 km/hr and rainfall is sparse. In contrast, the strongest winds and the heaviest rain occurs just outside this central "eye". A cyclone can rise 15 km above the earth's surface.

Windspeed gradually diminishes with distance from the region of strongest wind. The main core of a cyclone is nearly circular, and has a diameter ranging from 160-800 km. It has been observed from weather satellite pictures (NOAA and GMS) that a mature cyclone has a recognised cloud pattern. A cyclone is often accompanied by a long tail, the whole having a spiral structure and looking like an inverted comma. The tail may extend to a few hundred kilometres. It is possible to deduce the windspeed in a cyclone from the cloud pattern.

While the April 1991 cyclone had the classic pattern described above, the eye of the May 1985 cyclone was not visible at any stage. At times, it had a multicentred structure without the presence of an eye. In its mature stage, the main cyclone had a central overcast cloud over 500 km in extent with a core of about 160 km. It had a few tail bands of clouds extending over several hundred kilometres.

3.3 Classification of Cyclones

Cyclones in the Indian sub-continent are classified according to their wind speed:

	Windspeed (km/hr)
Depression	: up to 61
Cyclonic Storm	: 62-86
Severe Cyclonic Storm	: 87-117
Severe Cyclonic Storm with a core of Hurricane Intensity	: above 117

Atmospheric pressure is measured in millibars (mb). Normal atmospheric pressure (NAP) is equivalent to the weight of a column of mercury 760mm high. NAP varies from season to season and from ocean to ocean. During pre-monsoon months in the Bay of Bengal near the Bangladesh coast, NAP is slightly more than 1000 mb. A drop in the atmospheric pressure from the local seasonal normal is an indication of the formation of an area of low pressure, which may or may not develop into a tropical cyclone depending on other factors.

The extent of the drop in the atmospheric pressure from its value before the development of the 'low' gives an indication of the maximum wind speed that any cyclone is likely to attain.

In 1985, sensors mounted on the Ocean Buoy stationed at a point 95 nautical miles south of the coast recorded a pressure drop of 19 mb in the evening of May 24, giving a Mean Wind Speed (MWS) of 125 km/hr.¹

The actual windspeed when this cyclone struck was higher as it had gained more heat energy and further intensified as it moved towards the coast. The Meteorological Observatory at Chittagong recorded a maximum wind speed of 152 km/hr at 04.20. 145 km/hr was measured at Sandwip at 03.00 and 105 km/hr at Cox's Bazar at 2.30 in the morning of May 25, 1985.

3.4 Movement of Cyclones

The precise forces responsible for the motion of tropical cyclones are not understood clearly and hence the determination of the path of a cyclone in advance is one of the most difficult tasks in meteorology. The entire warning system and preparation for evacuating people from the likely land fall areas depend largely upon how accurately the track of the cyclone can be predicted and the 'strike' areas identified.

The classical methods for forecasting cyclone tracks are consideration of the climatology of cyclones, persistence of motion and some steering current of the upper atmosphere. Tropical

¹ Maximum Wind Speed (MWS) can be calculated approximately using Fletcher's formula $[MWS = C \cdot \sqrt{dP}]$, where dP is pressure drop in mb, C is a constant with value around 15]. This gives MWS of 102 km/hr for a pressure drop of 19 mb.

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cyclones often show different preferred paths at different seasons of the year. Recently various statistical and numerical dynamic methods have been introduced to predict cyclone paths. The track of the cyclones can be monitored from satellite pictures.

The cyclones in the Bay of Bengal are categorized as Type 5 (Haurwitz, 1944). In the initial stages, they move at a speed of 8-12 km/hr increasing to 48km/hr. They usually move northwesterly at the outset and then curve eastwards, but this pattern is not uniform as can be seen from the tracks of various cyclones which struck Bangladesh during recent decades (Figure 3.1). The wind damage caused by a cyclone is proportional to the square of the wind speed.

Although cyclones decay after striking land, the excessive rainfall associated with them and the presence of large waterways and the flat terrain in the Bangladesh coastal areas does allow fairly deep inland penetration of both cyclones and surges (Ali, A 1980)

3.5 Storm Surges

Cyclones are accompanied by a rise in sea level, so called 'storm surges'. If the cyclone occurs at high tide, then the 'storm surge' is considerably reinforced. The maximum height of a 'storm surge' can be 12 metres in the Bay of Bengal and most of the damage caused by cyclones is a result of the surge.

In the northern hemisphere, cyclones have an anti-clockwise pattern. This explains why cyclonic winds blow from the sea to the land on the right hand side of the cyclone track pushing water on-shore and causing a high surge while on the left hand side the wind blows from the land to the sea depressing river levels.

While the windspeed is directly related to the pressure drop, the surge height also depends on the nature of the coast; flat coastlines naturally suffer more than hilly coasts.

Table 3.1 shows the relationship between pressure drop, wind speed and surge height.

Cyclone risk zone areas are shown in Figure 3.2. Forty nine thanas with a total population of over five million are within the high risk zone, where the surge height exceeds one metre.

3.6 Records of Cyclones

Some of the greatest disasters in the history of the world have occurred in the northern Bay of Bengal where storm surges can grow to great heights and strike very densely populated shores (Simpson et al, 1981).

Most of the damage occurs in the coastal districts of Khulna, Patuakhali, Barisal, Noakhali and Chittagong and the off-shore islands of Bhola, Hatiya, Sandwip, Maheskhali, Monpura, Kutubdia, Sonadia and the newly formed chars.

The most damaging cyclones occur mostly during pre- (April-May) and post - (September-December) monsoon periods. The pre-monsoon period is the planting season for Aus rice and the post monsoon season is the harvesting season for Aman rice in the coastal areas.



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TABLE 3.1
Relationship Between Pressure Drop, Wind Speed
and Surge Height

Pressure Drop (mb)	Wind Speed (km/hr)	Surge Height in m (maximum value)
10	64	1.17
12	74	1.73
14	86	2.27
16	90	2.78
18	107	3.28
20	115	3.75
22	123	4.21
24	131	4.64
26	139	5.05
28	146	5.54
30	150	5.82
32	156	6.18
34	162	6.51
36	166	6.82
38	170	7.12
40	174	7.39
42	178	7.64
44	181	7.87
46	184	8.08
48	187	8.28
50	190	8.45
52	194	8.60
54	197	8.73
56	200	8.84
60	206	9.00
62	210	9.05
64	213	9.08
66	218	9.09

Figure 3.1
Tracks of Major 'Cyclones' (1968-1991)

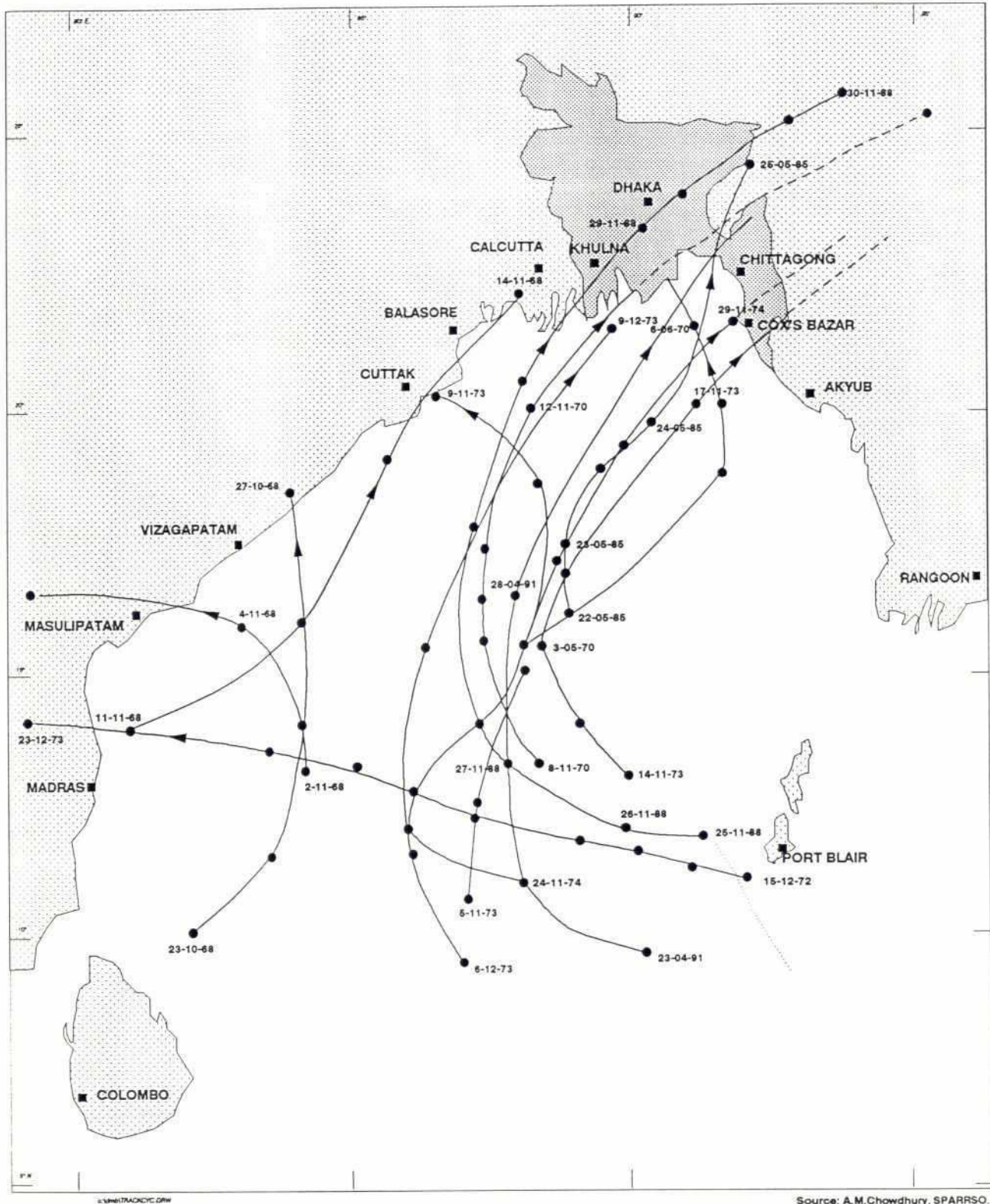
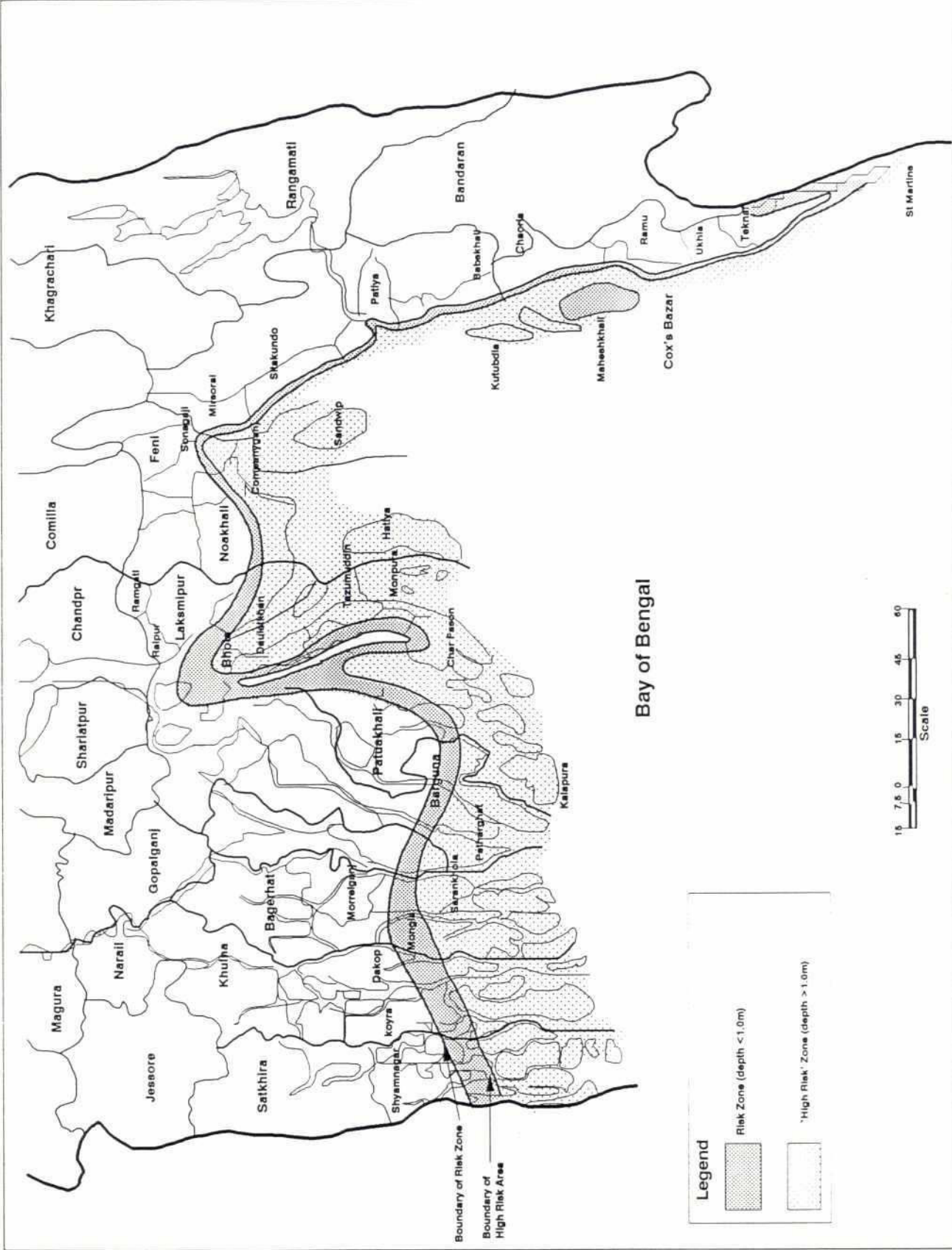


Figure 3.2
Cyclone Risk Zone



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Cyclones with windseeds of more than 86 km/hr which formed in the Bay of Bengal and their monthly distribution of occurrence are given in **Table 3.2**.

Although anecdotal records of cyclones affecting Bangladesh in the past are available, they do not reveal the full picture as the recording devices and data collection systems available today were not available in the past. It is only with the launching of weather satellites that storms have been detected and tracked reliably.

In the *Ain-E-Akbari*, a scholarly work produced during the reign of Akbar, the great Moghul emperor, there are records of severe storms causing large scale destruction in the districts of Barisal, Noakhali and Chittagong. Storm surges reached heights of about 12m. An estimated 200,000 people died in the cyclone of 1876; perhaps more people died from the after-effects such as epidemic and famine. No relief reached them for months. Considering the low population at that time, the casualty figures were catastrophic.

The great cyclone of 1919 should also be mentioned. It originated in the Pacific Ocean about 12,800 km away and it took some twenty days to reach the coast of Bangladesh.

Table 3.3 gives details of cyclones that have struck Bangladesh since 1960. Between 1960 and 1991, fifteen cyclones caused significant damage. During the period 1960 - 1992, 14 cyclonic storms struck the Chittagong coast, 12 the Meghna delta and 11 the Barguna/Khulna coast: MCSP, 1992. During the period 1877 and 1978 a total of 1050 depressions formed in the Bay of Bengal of which 254 turned into cyclones and 158 into severe cyclones.

3.7 Some Severe Cyclones

Short descriptions of 1991, 1985 and 1970 cyclones are given below.

a) The 1991 Cyclone

The cyclone was of April 1991 was detected on 23 April as a low pressure zone near the Andaman Islands. It took six days to reach the coast of Bangladesh. Its position was monitored by the BMD weather radar and the satellite ground station operated by SPARRSO.

The cyclone was very destructive with a maximum wind speed of 225 km/hr and a surge height of over five meters. The surge completely submerged the islands of Sonadia, Moheshkhali, Matarbari, Ujantia, Koriandia, Kutubdia and Sandwip (UNCRD, 1991). It brought death to as many as 140,000 people and caused massive damage to property and infrastructure. The estimated damage was US \$ 2.3 billion, excluding damage to the military.

The severely affected areas were the islands mentioned above. Other severely affected areas were the western part of Cox's Bazar, Chakaria, Banshkahli, Anowara and Sitakund Thanas, the islands of Hatiya and Manpura, and the mainland chars of Feni and Noakhali districts. Significant damage was also suffered by Patuakhali, Bhola and Barguna districts.

b) The 1985 Cyclone

The May 1985 cyclone caused much damage to Urir Char. It initially moved north-westerly



TABLE 3.2
Monthly Distribution of Cyclones

Month	Occurrence (nr)	Proportion (%)
January	1	Neg }
February	1	Neg } 2
March	1	Neg }
April	10	6
May	32	18
June	6	3
July	8	5
August	4	2
September	14	8
October	31	18
November	47	27
December	20	11
Total	175	100

Source: Khan, F.A., 1976, Haurwitz and Austin, 1944

TABLE 3.3
Cyclones Affecting Bangladesh Since 1960 With Loss of Life

Date	Max. Windspeed (km/hr.)	Storm surge height (m)	Deaths (m)
09 Oct 1960	160	3.0	3,000
30 Oct 1960	208	4.0-6.0	5,149
09 May 1961	144	2.0-3.0	11,466
30 May 1961	144	6.0-8.8	—
28 May 1963	200	4.2-5.2	11,520
11 Apr 1964	—	—	196
11 May 1965	160	3.6	19,279
31 May 1965	—	6.1-4.1	—
14 Dec 1965	208	4-6.1	873
01 Oct 1966	144	4-9.1	850
11 Oct 1967	—	1.8-8.5	—
24 Oct 1967	—	1.5-7.6	—
10 May 1968	—	2.7-4.6	—
17 Apr 1969	—	—	75
10 Oct 1969	—	2.4-7.3	—
07 May 1970	—	3.0-4.9	—
23 Oct 1970	—	—	300
12 Nov 1970	224	6.0-9.2	300,000
08 May 1971	—	2.4-4.2	—
30 Sep 1971	—	2.4-4.2	—
06 Nov 1971	—	2.4-5.5	—
18 Nov 1973	—	2.4-3.9	—
09 Dec 1973	120	1.5-4.6	183
15 Aug 1974	96	1.5-6.7	—
28 Nov 1974	160	2.1-4.9	a few
21 Oct 1976	104	2.4-4.9	—
13 May 1977	120	—	—
10 Dec 1981	96	1.8	2
15 Oct 1983	96	—	—
09 Nov 1983	120	—	—
03 Jun 1984	88	—	—
25 May 1985	152	3.0-4.6	11,069
29 Nov 1988	160	1.5-3.0	5,708
29 May 1991	225	4.0-5.0	140,000

Source:

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with a speed of about 8 km/hr, then turned north-eastward and finally, making a double loop, moved north-northeasterly crossing the Chittagong coast in the early hours of the morning of 25 May, 1985.

The track of the cyclone was monitored in satellite pictures received by the SPARRSO ground station. These were passed onto the Meteorological Department to aid forecasting. The 23-24 May pictures were taken both day and night. During its final stage, the cyclone travelled at about 30 km per hour. There was a pass of NOAA-9 satellite at 0230 hrs in the early morning of 25 May. The satellite picture taken at this time showed that the cyclone system covered the full length of the eastern coast of country.

The cyclone damaged the eastern coastline from St. Martin's Island to Patuakhali. The storm surge was 1.5m between St. Martin's Island and Patuakhali and 3.03-3.64m was reported at Urir Char, north of Sandwip, where it did maximum damage. Similar surge heights were reported in the newly formed chars in the southern part of Noakhali district.

c) The 1970 Cyclone

Of all cyclones that have struck Bangladesh, perhaps the most severe was that of 12 November 1970. Officially, the deaths caused were 300,000, but in reality were probably many more.

Cyclone tracking systems were not so developed in 1970 as they are today. Even so, the cyclone was identified in the Bay of Bengal as soon as it formed. Pictures of the cyclone, transmitted by the ESSA (European Space Agency) weather satellite, were received by the APT (Automatic Picture Transmission) ground station located in the premises of the Atomic Energy Centre, Dhaka. These pictures aided the Storm Warning Centre (SWC) to prepare bulletins on the approach of the cyclone. Being convinced of the severity of the impending cyclone, information based on satellite pictures was regularly despatched by NOAA(USA) to Dhaka.

Nearly 90% of the marine fishermen operating in the cyclone-affected region lost their lives. Some 9,000 fishing boats were destroyed during the cyclone. The damage to property and crops was very high. The estimated maximum wind speed of the 1970 cyclone was 224 km/hr and the maximum storm surge height about nine metre. The cyclone occurred during the high-tide period which explains the large surge height. It caused severe damage to property and infrastructure all along the coastal belt.

3.8 Protection Against Cyclones

A cyclone is a natural phenomenon having enormous destructive power. Scientific experiments are being conducted in the United States and other countries in an attempt to reduce the intensity of cyclones by using special aircraft which destroy or partly destroy the eye of a cyclone. These experiments are being watched with interest, but until cyclones are controlled it is necessary to improve cyclone warning systems and precautionary and post-cyclone relief measures to minimize the loss of life and suffering of the affected people. An adequate number of well-designed cyclone shelters distributed over the coastal region, particularly in the high surge areas, is required so that people from the risk areas can be

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evacuated into these shelters and their lives protected.

It has been reported that people are sometimes reluctant to move to cyclone shelters for various reasons. One reason is that they are afraid of losing their belongings and domestic animals. This is a social problem and has to be solved by the people themselves. Moreover, they do not always take warnings seriously as in the past there were occasions when predicted cyclones took different paths.

The BWDB has constructed about 5,000 km of embankments in the coastal belt under their Coastal Embankment Project (CEP) to protect agricultural land of these areas from salinity intrusion due to tidal surges. These embankments also provide some measure of protection to the people who live behind them against cyclones.

a) Coastal Afforestation

The Sunderbans, the largest mangrove forest of the world over 5000 sq km in extent situated in the southern part of the greater Khulna acts as a cushion against cyclones and associated tidal surges for the areas north of the forest. The Sunderbans have shrunk and suffered degradation. Although to some extent, this process has been arrested the density of the forest is still decreasing at an unacceptable rate (ODA Report, 1984).

GoB, assisted by World Bank, has taken up a coastal afforestation programme throughout the coastal belt on newly formed islets, chars and mud-flats. One of the purposes of the project is to create a forest belt that would give protection against cyclones and tidal surges. It would also help stabilize the newly accreted lands. During the last ten years, more than 200,000 acres of new plantation has been raised by the Forest Department on the islands along the coastal belt. The success of this programme however is yet to be seen as cyclonic storms continue to hit the coast causing damage to the plantations, particularly the young ones. The 1991 cyclone damaged over 60% of the new and 20% of the old plantations.

b) The Cyclone Preparedness Programme (CPP)

Besides taking up 'structural' programmes of afforestation and construction of shelter and embankments, Bangladesh has a comprehensive Cyclone Preparedness Programme (CPP) operated jointly by the Bangladesh Red Crescent Society and GoB/MoR. It has a membership of over 20,000 trained and devoted volunteers spread over 2,043 wards of 195 Unions in 24 thanas of the coastal belt. The CPP is currently expanding the Programme to six more thanas bringing up the total to 30.

In each ward, the volunteers perform duties for which they have been trained in the event of a cyclone. Each ward is provided with a transistor radio, a megaphone-cum-siren, a signal torch light and first aid kits.

Almost every thana is provided with a wireless set which maintains communication with Dhaka although during cyclones some of them have been found to be inoperative. The Red Crescent volunteers are responsible for the following:

- i) disseminating warnings of approaching cyclones reported by radio, surveying

✓✓ damages caused by cyclones and reporting them to the Union Headquarters.

- ii) arranging shelters for people, if possible also for domestic animals and for the security of other properties.
- iii) rescuing survivors still in danger.
- iv) giving first-aid to the wounded and taking post-cyclone sanitary measures.
- v) distributing food, clothing and medicine among the needy.

The CPP volunteers have proved themselves to be dedicated and have provided commendable services to the stricken people after many recent cyclones.

CHAPTER 4

TORNADO

A tornado is a vortex of destructive whirling wind with speeds exceeding 500 km/hr, having a central core of up-rushing air with great lifting capacity.

Tornadoes are more destructive than cyclones but fortunately they strike much smaller areas than cyclones. They cover widths of a few hundreds of meters and travel over a distance of up to 10 km.

Tornadoes are formed under Cumulonimbus clouds in zones between dry continental winds and moist tropical winds where the temperature is as high as 40 degree C. The central region of Bangladesh covering the districts of Dhaka, Faridpur and Jessore are relatively more affected by tornadoes, which occur during the summer months of March to June when the weather generally remains hot and humid.

The Demra (near Dhaka) tornado 1969, the Gopalganj tornado 1977 and Shaturia (near Manikganj) tornado 1989 were very severe. All occurred in the month of April and caused extensive local damage. In 1991, six tornadoes strick Bangladesh but mere caused significant damage.

In the period 1970 to 1991 about 850 tornadoes/severe storms were reported. Records show that Dhaka, Noakhali, Manikganj, Pabna, Kurigram, Mymensingh, Jamalpur, Netrokona and Sylhet districts are relatively more prone to tornadoes and severe storms. (Table 4.1)

TABLE 4.1

Major Tornadoes since 1965

Location	Date	Estimated wind speed (mph)	Killed (nr)	Injured (nr)	Estimated Loss (Tk million)
Demra	14.4.69	400	922	16,511	40/50
Manikganj	17.4.73	200	100	1,000	10
Bogra	11.4.74	150	28	75	10
Faridpur	10.4.74	150	146	innumerable	several million
Narayanganj	09.5.76	150	1	42	several million
Faridpur	01.4.77	200	500	6,000	12

Source : Hasan, M. R., 1985

CHAPTER 5

FLOODS

5.1 Types of Flood

Four different types of floods occur in Bangladesh:

- i) flash floods in the eastern and northern rivers (April/May and Sep/Nov).
- ii) floods triggered by heavy rains and silted waterways ('drainage congestion')
- iii) Monsoon floods in the major rivers during mid-August to mid-September. Most extensive damage is caused by these floods.
- iv) floods in the coastal belt, tidal flats and estuaries caused by cyclonic storm surges.

Water enters Bangladesh through three major rivers but the discharge takes place through only one, the Meghna. The river system has a normal carrying capacity for the water generated in the catchment area. Whenever the inflow exceeds this capacity, floods result. The magnitude of the flood depends on the amount of excess water. Generally, the major (iii, above) floods occur during the period mid-August to mid-September.

The river Ganges originates near the Gangotri Glacier of the Himalayas at an elevation of over 7,000 m and has a length of about 2500 km. It receives the flow of a number of major tributaries namely Gogra, Gandak and Kosi originating in Nepal and Tibet. Another tributary of the Ganges, the Mohananda, which flows through Bangladesh, originates in India. The catchment area of the Ganges is about 900,000 sq km spread over four countries, namely, China, Nepal, India and Bangladesh.

The river Meghna is formed by the confluence of the Surma and Kushiara together with other streams flowing from the hills in the northeast. The Surma is fed mainly by the tributaries from the Jaintia hills, while the Kushiara tributaries from the Tripura hills. The Meghna system is about 800 km long of which about 400 km lies in Bangladesh and the rest in India. The total catchment area of the Meghna above Bhairab Bazar is about 65,000 sq.km, of which about 32% lies in Bangladesh.

The Brahmaputra originates in the glaciers of the north-west chain of the Tibetan Plateau and flows for half its length in a trough parallel to the Himalayan range. Turning south and passing through the plains of Assam, the Brahmaputra enters Bangladesh in the district of Rangpur. The important tributaries of the Brahmaputra in India are the Dibang, Jobidhal, Subansiri and Lohit and in Bangladesh the Dhudhkumar, Dharla, Tista and Hurasagar.

5.2 Causes of Flood

The primary cause of flood is heavy rainfall in the catchment areas of the rivers. About 80 percent of the rainfall occurs during the five month period from May to September. The annual rainfall varies from about 1500 mm in the south-western part of the country to about 5000 mm in the north-eastern part.

The average annual rainfall at Dhaka is about 2000 mm, while that at Cherapunjee (Assam, India) is 12500 mm, with a maximum 20000 mm a year, which is the highest in the world. Rainfall in Bangladesh itself generates only about 200 million acre feet (MAF) annually, whereas 900 MAF of water comes from the catchment areas outside Bangladesh in India, Nepal, Bhutan and Tibet (Figure 2.2).

These rivers carry water from an area of about 1.6M sq km of which only 7.5 percent lies inside the country. Thus, though there may not be much rainfall in Bangladesh, there may be heavy rainfall in the catchment area which causes flooding. Simultaneously, if there is rainfall within Bangladesh as well, the flood will naturally worsen.

Besides rainfall in the catchment area, there are other factors which can increase the level of floods.

- i) **Snow-melt in the Himalayas.** Maximum flooding occurs in Bangladesh during August-September, whereas maximum snow-melt occurs during May-June. As the snow melting process is normally quite slow, this alone would not be an important factor in causing damaging floods. However, as rainfall accelerates the process of snow-melt, its contribution to flooding is not negligible. More research should be undertaken in this area
- ii) **Geomorphological changes** have taken place in region, especially in the Brahmaputra basin, as a result of the 1950 earthquake in Assam. This has caused the bed level of the Brahmaputra to rise in its upper reaches, and reduced its carrying capacity.
- iii) It is estimated that about 1-2 billion ton of **sediments** are carried by the river systems of Bangladesh every year and much of this sediment is deposited in the river beds reducing their normal carrying capacity.
- iv) Forest cover areas absorbs more rain than bare soil and consequently deforestation increases runoff. It is believed that large scale **deforestation** which has taken place in the hills of Nepal is aggravating floods in Bangladesh and the adjacent areas. Within Bangladesh, deforestation is also taking place at an alarming rate, of 8,000 ha per year, which will be aggravating the flood situation.
- v) **Construction** of roads, railways, barrages, and embankments without taking due care to provide cross **drainage works** creates obstacles to flow which cause local flooding

- vi) Because of the prevailing south-west monsoon wind, **mean sea level rises** by about 60 cm during summer. If there are depressions in the Bay of Bengal the magnitude of the wind increases, and the sea level will rise further creating obstacles to the riverflow which aggravates flooding
- vii) **'Spring' high tides** occur at new and full moon twice every month. If flood peaks occur during high tide periods, flood may result.

5.3 Flood Probability

Mahalanabis (1927) defined floods by their recurrence interval:

Type of Flood	Recurrence Interval (years)
Normal	2.25
Moderate	4.00
Severe	7.00
Catastrophic	33 to 50

Areas prone to flooding are shown in **Figure 5.1**. The National Water Plan (1986) estimates normally 35% is shallowly flooded (30-90 cm), 16% is moderately flooded (90-180 cm); and 12% is deeply flooded (more than 180 cm), 31% is not flooded that in a 'normal' year of the net cultivated area.

An analysis of flood data between 1954 and 1991 shows that the inundated area is slowly decreasing. This decrease will be particularly due to the effects of over 400 large and small flood protection schemes constructed by the BWDB and partially to the construction of schemes in India including the Farakka Barrage (**Figure 5.2**).

5.4 Severe Floods of Recent Years

The highest river levels for some of the great floods of Bangladesh for the years 1954, 1955, 1974, 1987 and 1988 in 34 stations have been examined. At 10 stations, the flood level was were the all time highest during the 1988 flood and for 22 stations the 1988 levels were higher than those from 1987. Hence, for 32 stations out of 34 levels during the 1988 flood were higher than from 1987 which was itself a high flood year. (Miah, M.M. 1988).

The area submerged in different flood years is given in **Table 5.1**.

a) Flood of 1988

The flood of August-September 1988 was perhaps the worst flood in recorded history. River hydrographs are shown in **Figure 5.3**. It was strange when little monsoon rain fell within the country, that all the major rivers rose rapidly submerging increasingly large areas including about two thirds of Dhaka. However, as mentioned earlier, the water which is carried by the rivers in Bangladesh arises from a catchment 92.5 percent of which lies outside the country (**Figure 2.2**). It must be noted that August is the middle of the monsoon season when soil

TABLE 5.1
Flood Affected Areas Since 1954

Year	Flood affected area (sq.km)	Proportion of total area (%)
1954	36920	25.64
1955	50700	35.21
1956	35620	24.74
1957/1959	NA	NA
1960	28600	19.86
1961	28860	20.04
1962	37440	26.00
1963	43160	29.97
1964	31200	21.67
1965	28600	19.80
1966	33540	23.29
1967	25740	17.87
1968	37440	26.00
1969	41600	28.89
1970	42640	29.61
1971	36475	25.33
1972	20800	14.44
1973	29900	20.76
1974	52720	36.61
1975	16590	11.52
1976	28418	19.73
1977	12548	8.71
1978	10832	7.52
1979	NA	NA
1980	33077	22.97
1982	3149	2.19
1983	11112	7.72
1984	28314	19.66
1985	11427	7.93
1986	4589	3.19
1987	57491	39.92
1988	120973	84.00*
1989	9000	6.20

Source : B.W.D.B.
Miah, M.M. 1988

is saturated because of previous rainfall. Even in a non-flood year, rivers are full at this time. Therefore, even a moderate amount of additional rainfall is sufficient to cause considerable flooding (Figure 5.4).

It was reported on 23 August 1988 that, at Dibrugarh in Upper Assam (India), the Brahmaputra was flowing 1.4m above the danger mark, an all time high. The largest Bailey bridge in Asia at Arunachal Pradesh (India) with a length of 285m collapsed. In Assam, oil production was closed down at many places and the tea industry suffered badly. All schools and many government offices were closed down. (Source: Choudhury, A.M. 1988).

It takes a few days for flood water in Upper Assam to reach Lower Assam and thereafter Bangladesh. During that time, heavy rain had fallen continuously for several days in the region as could be seen by satellite. Thus, the water level in the Brahmaputra continued to rise. At Bahadurabad, the flood peaked on 29 August, 1988 at an all time high. On 28 August, there was a full moon and the moon was at perigee (nearest point to earth) and consequently the tides were also very high. The peak water levels in the Ganges and the Brahmaputra occurred simultaneously, which is unusual, normally the Brahmaputra peaks about 3-4 weeks earlier.

Imagery from NOAA-9 and NOAA-10 satellites, processed at SPARRSO, show that from 20 August to 1 September, 1988 most of the catchment of the Brahmaputra, and at times of the Ganges and Meghna were covered by Cumulonimbus clouds indicating heavy rainfall. If this type of cloud occurs for 2/3 days in one place, it is sufficient to cause a moderate flood. Thus, the degree of flooding that occurred is easily explained. Even after this period, there was sporadic moderate to heavy rainfall in places which prolonged the flood until the third week of September.

b) Flood of 1987

A catastrophic flood also occurred in 1987, although it caused less damage than the 1988 flood. The two floods were quite different in character. In 1987, the monsoon failed over most of the South Asian sub- continent. The Bay of Bengal monsoon depressions which usually travel north-westwards up to western India changed their course drastically.

A careful study made by SPARRSO of the satellite imagery indicated that almost all the depressions with the exception of one or two travelled northwards causing rainfall in Bangladesh, Assam, Bihar, West Bengal, Bhutan and Nepal. Consequently, these areas were flooded and Bangladesh, being the lower riparian, suffered the worst flood. In some areas of Bangladesh, rainfall during the months of July and August were two to three times normal. Another significant feature was that rainfall in the catchment area was not caused by the usual moving depressions but to stationary 'lows' above the foothills of the Himalayas adjoining Bangladesh.

c) Flood of 1984

The 1984 flood was widespread of long duration and had four 'peaks' (Hossain, M et al, 1987). It started earlier than it was normal with flash floods in the Meghna basin in the month of May. All time high levels were surpassed at Maulavibazar on the river Moni at

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Figure 5.1
Flood Prone Areas

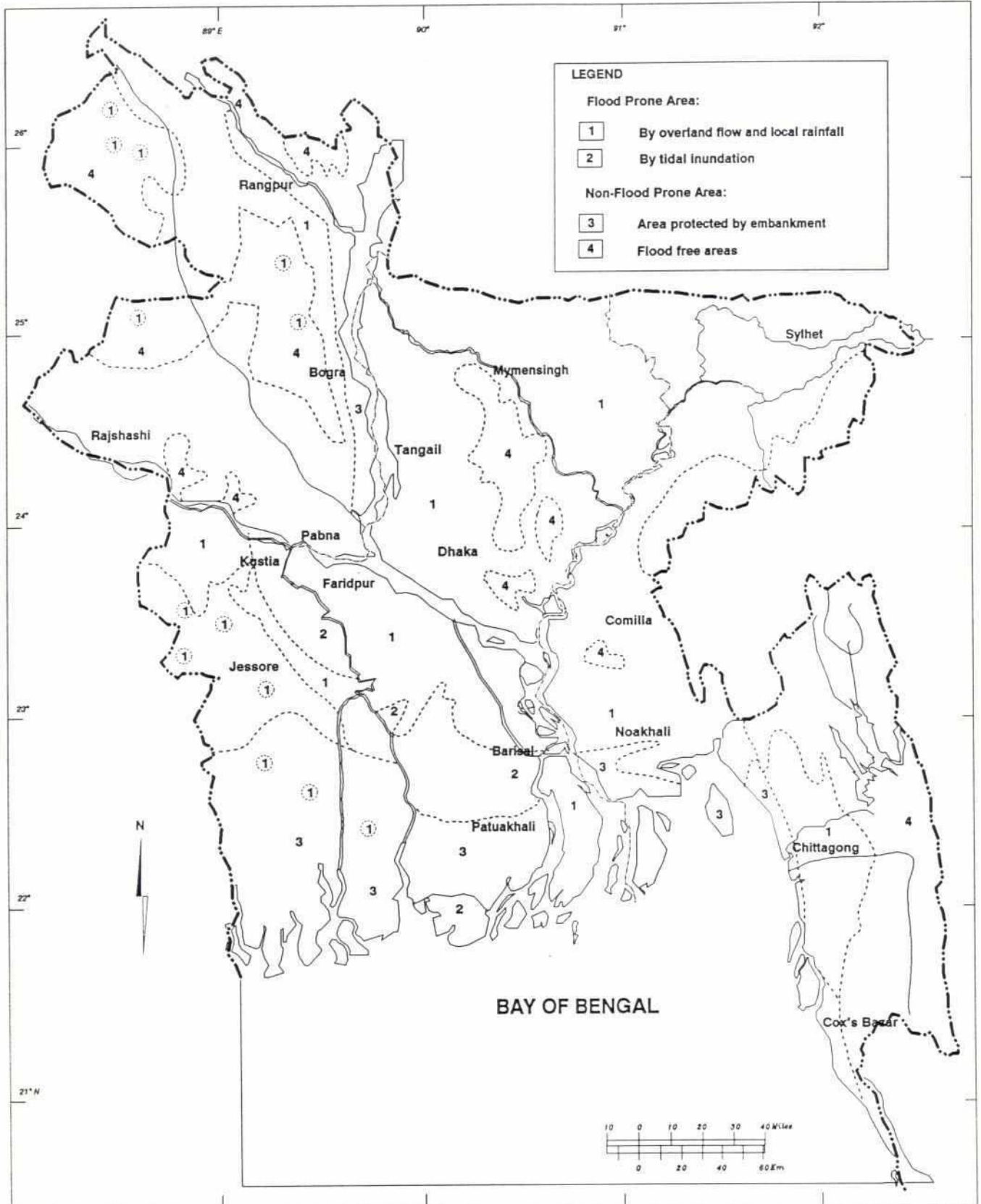
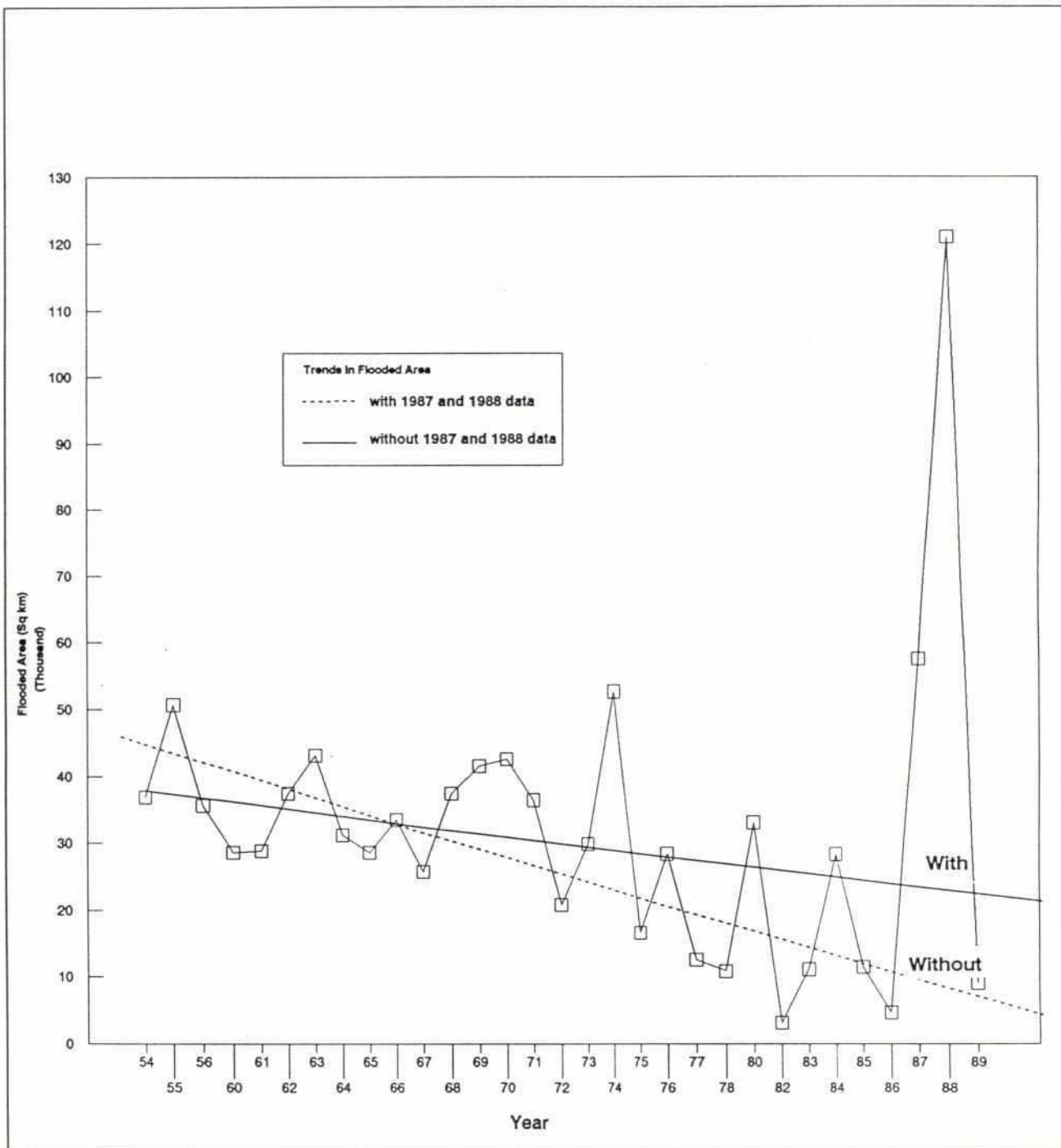
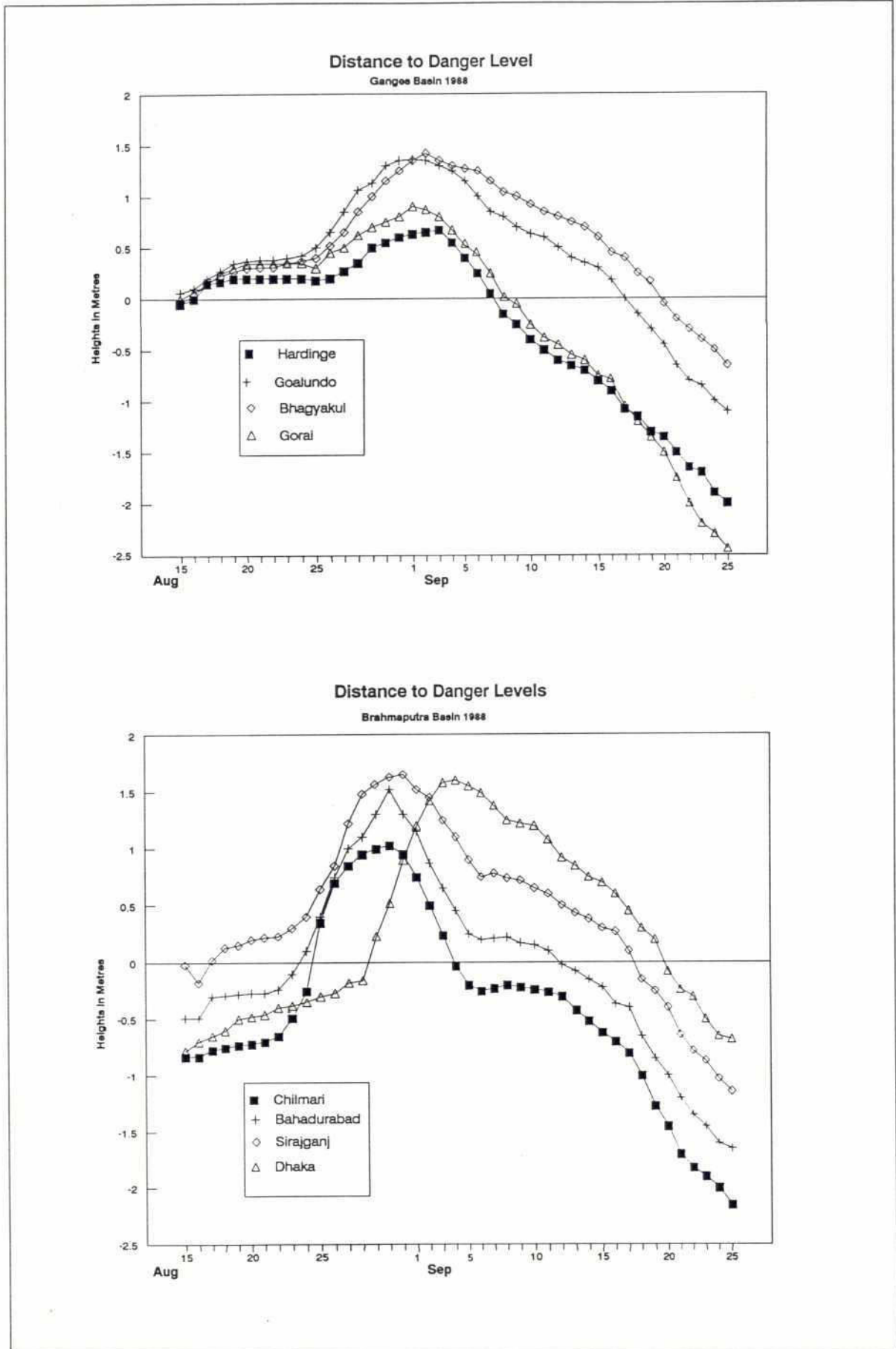


Figure 5.2
Flooded Areas 1954/1992



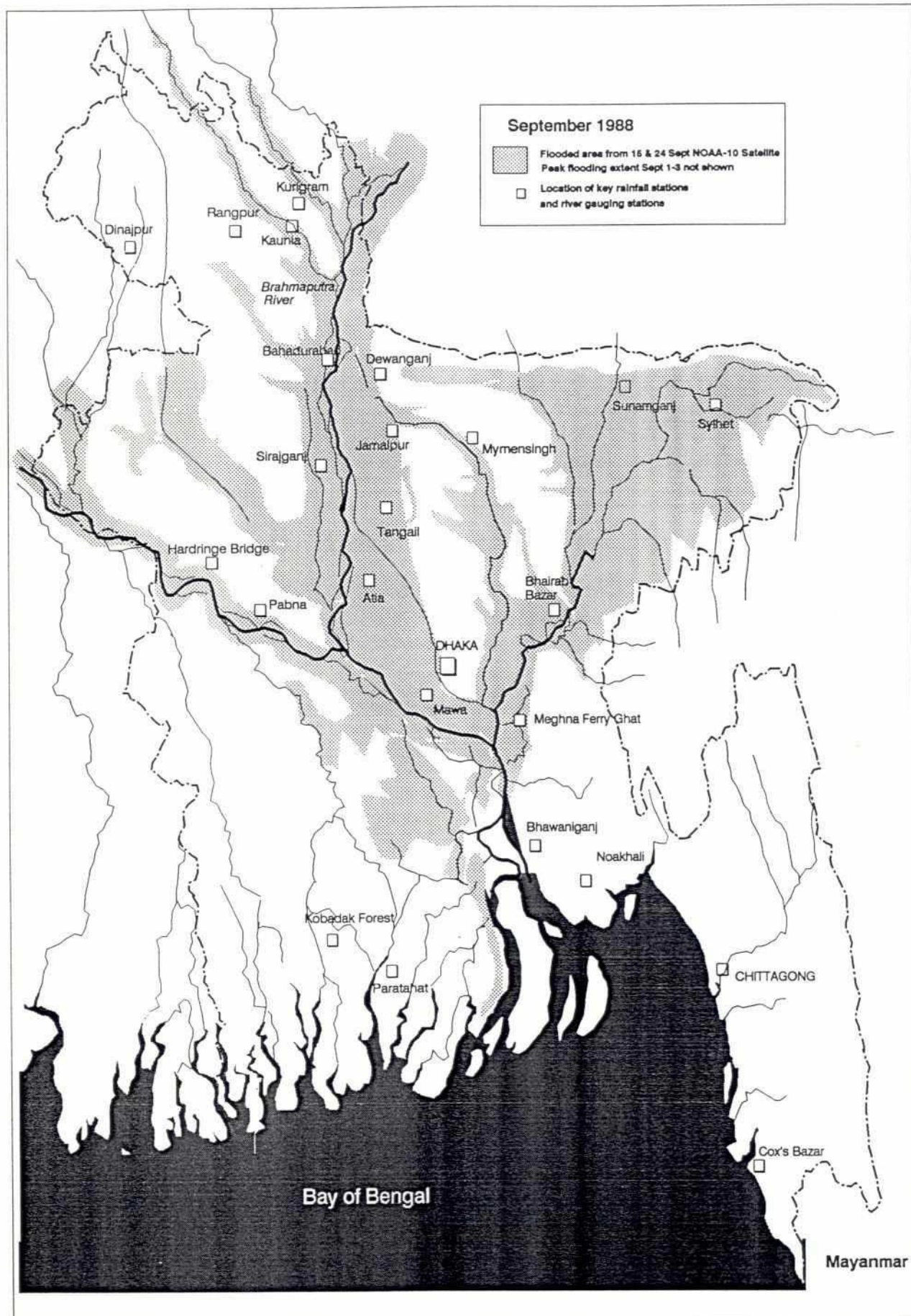
Source: BWDB data

Figure 5.3
1988 Flood Levels



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Figure 5.4
1988 Flood Extent



Habiganj on the Khowai and at Kanairghat on the Surma. These floods inundated vast areas in the districts of Sylhet, Maulavibazar, Habiganj, Comilla, Chittagong, Cox's Bazar and Noakhali. These early monsoon floods occurred as a result of heavy rain in concentrated spells. Rainfall was more than 500 mm above normal over the whole of eastern Bangladesh, near the Tripura hills.

In June, the centre of the country had rainfalls of 370 mm to 500 mm above normal. The highest recorded rainfall for the month was exceeded at Dewanganj, Jamalpur, Tangail, Pachagarh, Rajshahi, Kushtia, Jessore, Faridpur, Khulna and Barisal. This widespread rainfall caused drainage congestion in medium to low lands and crop damage was extensive in the Sylhet and Comilla regions, especially of Boro during harvesting.

In July, rainfall over the western, eastern and southern parts of the country was below normal while rainfall in the central and northern belts was 100 to 200 mm above normal. The river Brahmaputra, followed by the Ganges, exceeded the danger level towards the end of July. While the rise in the Brahmaputra proceeded normally, i.e. from north to south, the Ganges attained higher levels in downstream areas earlier followed by rises upstream. The duration of the peak flood was shorter than during some previous years of high flood, however, the damage was severe and extensive.

Breaches in flood embankments on the right side of the Brahmaputra caused by bank erosion resulted in serious floods in Gaibandha, Bogra and Sirajganj districts. Flooding of the major rivers continued from the end of July to mid. Further flooding in the first week of September.

The losses due to be 1984 flood are summarized below:

- Districts affected (nr)	59	Proportion of crop destroyed (%)
- Thanas affected (nr)	402	- Broadcast Aman 50
- Population affected (million)	28	- Aus 30-33
- Crop damaged (sq km)	21,850	- Jute 30-37
- Houses damaged (nr)	587,000	- T. Aman 10
- Deaths (nr)	533	
- Livestock lost (nr)	71,295	

d) Flood of 1974

The 1974 flood was severe and inundated 64,000 sq km, and more than 2000 people lost their lives. In the aftermath, many more died as a result of acute food shortages. Some 50,000 cattle and 600,000 poultry perished, while 1.5M mt rice was lost.

Due to heavy rains there were landslides in the hills of Chittagong and the Chittagong Hill Tracts districts.

5.5 Flood Policy Options

Bangladesh is prone to regular and often devastating floods. Hence, it is necessary to protect cities, towns, villages, homesteads, infrastructure and agricultural lands from the damaging



effects of such floods as far as is practical.

Effective flood protection is a pre-requisite for development and economic growth. Therefore protective measures along the major rivers have become imperative. Small schemes have not proved to be effective against catastrophic floods as experienced during 1987 and 1988.

Government strategy is to:

- accord the highest priority to flood protections.
- implement effective flood protection works with emphasis on the need to confine major river flood waters within channels
- further riparian cooperation leading to long lasting solution

Elimination of flooding is neither desirable nor feasible from the agro-ecological point of view. On the other hand, the government policy of increasing industry's contribution to GDP means that flood protection measures should also include townships, urban areas and existing and potential commercial and industrial centres in addition to agricultural lands. Eleven principles to guide flood related development have been devised. (Annex C)

5.6 Strategies and Remedies for Flood Control

Since floods will continue to effect Bangladesh as in the past, remedial measures will have to be found. Different strategies could be adopted both in the short and medium terms to preserve the resource base, and protect the natural environment and its ecology. The following need to be considered:

a) Institutional strengthening

- all institutions that are associated with the detection and monitoring of natural hazards should be strengthened, particularly BMD, SPARRSO and BWDB.
- data collection systems should be improved and a databank set up i.a. for quick retrieval of weather data.

b) Living with floods

People have adapted their way of life and have developed a remarkable degree of resilience. However:

- the resilience of the population should not lead to complacency, the desire to improve the quality of life and the physical environment accordingly is fundamental to human nature.
- the population of Bangladesh continues to increase, and may reach 165 million in 2005. The increase will result in a large expansion of urban

centres.

- there is a limit to the expansion of dry season crop production. Production increases in the wet season will become necessary in the course of time and hence some degree of water control will be a prerequisite.
- development of non-agricultural employment opportunities requires investment in capital stock which will not take place if there is the likelihood of frequent flooding.
- the implementation of a coherent programme of flood protection measures will take several years, possibly some decades. Unless planning, design and construction are expedited the country could be faced with a difficult situation in sustaining the livelihood of its population.

c) Structural flood protection strategy options

- although construction of **storage dams** has been regarded as not viable, such works as part of an integrated flood control programme, merit consideration. Full control or partial control with low embankments that can be over topped are also options.
- **floodwater might be stored in low-lying areas and depressions.** Although it might be possible to use such areas to divert floodwater as a relief for areas which are more densely populated, actual conditions in Bangladesh make this option largely hypothetical. It is relevant to note that average annual flood flow passing through Bangladesh is equivalent to a depth of more than 7m over the entire nation.
- **the conveyance capacity of the river system can be increased** in a number of ways. By means of dredging, the hydraulic section of the main rivers could be increased. However, considering the sediment load, the annual maintenance dredging needed renders this option uneconomic.
- **the discharge through various distributaries could be increased.** In most cases this would require dredging of the offtakes, which usually have low hydraulic efficiency. A considerable amount of annual dredging would be required. Whereas condition in the main rivers would be marginally, improved conditions along the distributaries would deteriorate.
- **new channels** might be excavated or derelict channels excavated. They would have to have a considerable capacity in order to be effective, and in passing high discharges and sediment loads, would represent an inherent danger of uncontrolled erosion of the banks.
- **embankments** are constructed to keep high water levels out. In fact this option has been applied in Bangladesh for a long time, in the coastal areas to prevent tidal inundation as well as along rivers to reduce the risk of river

02

floods. Increasing emphasis has been placed on embankments during the last decades, and inspite of some clear drawbacks, they have proved to be effective during most floods, and are regarded as the only option that can protect the country against regular flooding in the foreseeable future.

It may be concluded that, the construction of embankments is the only effective way to achieve the Government's objective of flood protection. Nevertheless, embankments have their limitation and drawbacks, which have to be fully recognized to make them successful and to avoid disappointment and waste of efforts and resources.

CHAPTER 6

DROUGHT

6.1 Introduction

From the agricultural point of view, drought may be defined as any soil condition such that plants cannot extract sufficient water for optimal growth. This is a frequent hazard in Bangladesh, although the annual rainfall is more than 2000 mm on average. The problem is caused because rainfall is not uniform throughout the year. Dominated by the monsoon, Bangladesh receives 77% of its rainfall between June and October, 3% between November and February and the remaining 20% between March and May. Long spells of rainless days ranging upwards from two weeks between April and November can cause droughts.

6.2 Monitoring Drought

Climatologists have defined drought through a parameter called Precipitation Effective Index (PEI):

$$\text{where PEI} = 115(P/T-10)^{10/9}$$

P is monthly precipitation (in) and

T is temperature(°F)

Summation is carried over twelve months (Thornthwaite, 1931). PEI for Bangladesh is computed to be 100 (Haurwitz et al, 1944) whereas in an arid zone PEI is less than 16 (Choudhury A.M., 1989).

Soil moisture has been quantified through a decadal frequency analysis of precipitation in relation to Potential Evatranspiration (PET) using historical rainfall (P) records. Decades of 10 day periods have been classified (Karim, Z et al, BARC, 1990)

- Humid	$P > PET$
- Moist Sub-humid	$P > 0.5 PET$
- Dry Sub-humid	$P < 0.5 PET$
- Dry	$P = 0$

Warm ocean currents, originating in the Pacific Ocean and occurring once every 3-5 years known as El-Nino, appear to co-relate with drought in Bangladesh. There seems, however, to be no way of predicting El-Nino in advance.

Day and night data from the NOAA weather satellites of the TIROS- N series can be used to calculate what is known as the 'Thermal Inertia' (Manual of Remote Sensing, American Society of Photogrammetry, p-83) of soils in Bangladesh. From the value of Thermal Inertia, soil moisture conditions can be determined. SPARRSO, together with BMD which can provide ground data, can conduct regular measurements on soil moisture and thus monitor drought conditions.

6.3 Classification

Agriculturists have defined drought as 'Very Severe', 'Severe', and 'Moderate' depending on the number of rainless days and temperature over a specified period. Droughts can last for several years at a time. A study carried out by BRAC (Karim et al, 1900) highlighted the adverse effects of droughts on agriculture and suggested some corrective measures.

Some areas, particularly in the north-western region, are drought prone (Karim et al, 1990). These areas are:

Very severe	:	About 0.6 Mha in Rajshahi and Nawabganj districts.
Severe	:	More than 1.7 Mha in Dinajpur, Bogra, Kushtia and Jessore, and Dhaka and Tangail districts.
Moderate	:	About 2.18 Mha in Dinajpur, Rangpur, Bogra, Kushtia, Jessore and Barisal districts.

6.4 Areas Prone to Drought

Droughts in Bangladesh occur rather frequently with a return period of 3-5 years and may be extremely damaging. They can occur in almost any season, although the Rabi season (November-February) and the Kharif season (July -October) are somewhat drought free. The most likely drought season is the pre-Kharif (dry) season (March-June).

Almost five million hectares of agricultural land in the districts of Rajshahi, Natore, Chapai Nawabganj, Rangpur, Dinajpur, Bogra, Kushtia, Jessore and Dhaka are susceptible to droughts of varying degrees. Table 6.1 lists some years when bad droughts occurred, together with the area and number of people affected.

A UNDP/FAO sponsored survey on water bodies in Bangladesh (SPARRSO, 1984) found that there were 1.3 million small water bodies with an area less than 20 acre, of average area less than 0.3 acre, and 12,200 sq km of large water bodies with an area more than 20 acres. It was found that the concentration of water bodies (ponds and tanks) were higher in low rainfall regions. These had obviously been excavated as a precautionary measure against dry spells and droughts.

TABLE 6.1
Severe Droughts since 1950

Year	Proportion of Total Area Affected (%)
1950	13.7
1951	31.6
1957	46.5
1961	22.4
1966	18.4
1972	42.5
1979	42.0

Source : Chowdhury M.H.K and Hussain M. Amirul,
Bangladesh Meteorological Department, Dhaka.

CHAPTER 7

EARTHQUAKE

7.1 Introduction

Mankind has suffered from earthquakes throughout history and many lives and much property has been lost. In spite of efforts by scientists, no reliable method has been discovered to predict earthquakes. They occur suddenly, which makes prediction difficult.

Earthquakes are caused by the slipping or faulting of parts of the earth's crust when stresses within build up. This usually occurs at depths varying between 8 and 30 km of the earth's surface.

The scientific study of earthquakes started after several earthquakes occurred in England during 1750 and the great earthquake of Lisbon occurred in 1755, which killed 60,000 people. In 1892, John Mitchell, a physicist working in Japan, constructed a seismograph which could detect and measure the intensity of seismic waves generated by earthquakes.

Throughout the world, there are now more than 600 seismic observatories which collect and publish data on earthquakes. In Bangladesh, the Bangladesh Meteorological Department operates a seismic observatory in Chittagong.

7.2 Regional Seismicity

An extensive seismic zone exists along the Himalayan mountain region (Sarma, N.K. 1990) from the Hindukush in the north-west to Sadiya in the north-east. This zone forms part of the great Alpine-Himalayan seismic belt.

Bangladesh has been divided into three earthquake zones in order of severity of earthquakes. (Figure 7.1). The zones have seismic coefficients of 0.08g, 0.05g and 0.04g respectively.

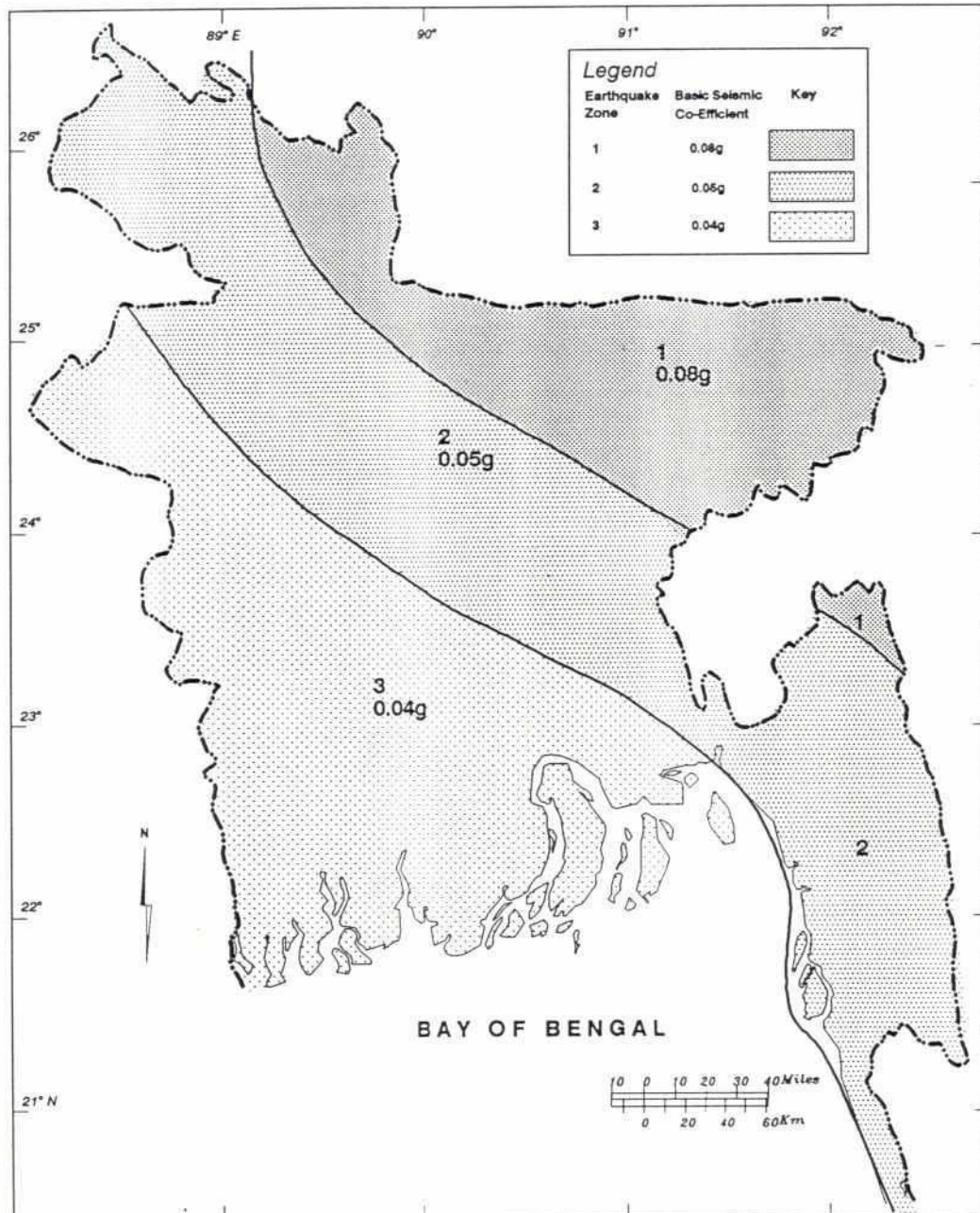
There are no active or live volcanoes in Bangladesh or in the Indian sub-continent as a whole.

7.3 Severe Earthquakes in the Region

Some severe earthquakes which have occurred in the region are listed below:

- i. **1885, July 14.** An earthquake of 7.0 on the Richter scale struck the districts of Bogra, Sirajganj, Jamalpur, Sherpur and Mymensingh. The epicentre was near Manikganj and the earthquake caused substantial damage.
- ii. **1897, June 12.** The greatest earthquake recorded in the region affected northeastern India and measured 8.7 on the Richter scale. The shock was felt over 400,000 sq. km. Some 10,000 people were killed and the epicentre was located in the Shillong Plateau. This earthquake caused damage to the northern

Figure 7.1
Earthquake Zones



Source: Bangladesh: Nature and Resources: Hasan M. Bangla Academy, Dhaka

districts of Bangladesh and the districts of Dhaka, Comilla and Chittagong.

- iii. **1918, July 8.** An earthquake measuring 7.6 on the Richter scale occurred near Srimangal and caused damage in the surrounding area.
- iv. **1930, July 30.** An earthquake of 7.1 on the Richter scale centered on Dhubri in Assam caused widespread damage in the Rangpur district.
- v. **1934, January 15.** The great earthquake of Bihar, registering 8.3 on the Richter scale, caused severe damage over a wide area of Bihar and Nepal and caused many deaths and much destruction. Although the shock was felt in Bangladesh, no damage was caused.
- vi. **1950, August.** A major earthquake of magnitude 8.7 on the Richter scale, centred on Assam, caused large scale damage. The shock was felt throughout Bangladesh but no obvious damage occurred. This earthquake was followed by several others of smaller magnitude in quick succession and as a result several rivers altered their courses through changes in surface elevation.



CHAPTER 8

RIVERBANK AND COASTAL EROSION

8.1 Introduction

Between 1970 and 1990, at least seven million people were affected by river-bank erosion. Every year, almost a million people are affected by eroding banks along 75 rivers, including the major ones, in about 130 different locations.

For centuries, rivers have supported human activities such as fishing, agriculture, navigation, and trading. As a result, population centres have grown up on the banks of the rivers more than in other areas. In general, heavy population concentrations are found along most of the major rivers; the population density of 950-1450 per sq km on river banks compares with 500-650 elsewhere in non- industrial areas. (Bangladesh in Maps, 1981).

Riverbank erosion is a process largely controlled by river dynamics. However man's activities affect the process. Comparison of old maps with recent data from the satellite imagery indicate the extent of changes that have taken place over the years.

River bank erosion and the changing course of rivers disrupt life of the local communities and are almost continuous processes. Normally, riverbank erosion and accretion take place simultaneously and there is usually no net loss or gain of land. While it causes suffering and hardship to the affected people, it is only when sensitive areas are threatened that government and public attention focuses on this pervasive problem.

Embankments and other structures to resist river bank erosion are expensive.

8.2 Areas Prone to Riverbank Erosion

All the major rivers Brahmaputra, Ganges, Padma, and Meghna and many smaller rivers cause bank erosion regularly and threaten towns and villages situated along their banks. However, during the period 1973/1978 the flow in the Padma decreased, possibly due to the construction of the Farakka Barrage in India, as a result the rate of erosion of its banks has decreased. More work needs to be done to verify this conclusion (Hasan,M 1985).

The Brahmaputra and Ganges continue to 'devour' large areas and require urgent protective measures. The towns of Sirajganj and Chandpur are under constant threat from the Brahmaputra and Meghna respectively. Dumping boulders and concrete blocks has not been very effective. To prevent erosion near Sirajganj town, old railway goods wagons have also been dumped into the river.

The George V railway bridge and the newly constructed road bridge over the Meghna on the main Chittagong-Dhaka highway are threatened by erosion and this is causing concern to GoB.

A field survey in 1984/87 indicated that of 462 thanas, 94 were affected by erosion in 1983-84, 61 in 1984-85 and 55 in 1985-86 (REIS-JU/UM 1984-87:). The worst affected districts were in Barisal, Bhola, Chittagong, Cox's Bazar, Bagerhat, Chapainwabganj, Bogra, Jamalpur, Tangail, Faridpur, Lakshmipur, Rangpur, Gaibandha, Kurigram, Pabna, Sirajganj, Manikganj and Chandpur.

Another study carried out recorded 254 places of major erosion along 16 river banks. (BWDB 1987). The BWDB has taken up schemes valued at Tk. 3270 million to protect urban centres threatened by riverbank erosion (REIS-JU/UM, 1991).

8.3 Coastal Erosion/Accretion

A study carried out in coastal areas (Pramanik and Jabbar, 1990) reports the following:

- erosion along the wider channels was more pronounced.
- most of the erosion on the Bay of Bengal coastline was due to storm surges and wave action.
- significant erosion was found at the mouths of the two 'trench' areas 'the Burma Trench' and the 'Swatch of No Ground', erosion was less at the head of the 90 degree East Ridge.
- although erosion was in evidence in certain places, an overall seaward extension of the delta was observed.
- no erosion or accretion was observed in the Meghna basin.

Some accretion near the mouth of the river Tetulia and at the southern end of Hatiya island was reported in a study conducted for the Multipurpose Cyclone Shelter Project (SPARRSO, 1991)

Although there are indications of accretion in many places, there is considerable erosion along the sea coast in others. Sandwip island has been reduced to 250 sq km from 650 sq km during the last two hundred years. The island of Tozimuddin in Bhola is being eroded at the rate of 150 m/year and the northern tip of Hatiya at the rate of 400 m/year (Siddiqi, M H., 1988).

CHAPTER 9

GLOBAL WARMING

9.1 Introduction

The amount of carbon dioxide, methane, CFCs and other 'green-house' gases released into the earth's atmosphere by industrial plants throughout the world and the use of various industrial products have now become major matters for concern.

9.2 Sea Level Rise

Many scientists and meteorologists are of the view that the global atmospheric temperature is rising and that the earth's climate will become more erratic with floods, cyclones and droughts occurring more frequently. Melting of the polar ice cap is predicted and this would cause a rise in sea level and inundate low-lying areas. Bangladesh would be one of most adversely affected countries. By the middle of the next century, the sea level might rise by between 0.5 and 1.5 m. A 1.5 m rise might mean that about one-third of Bangladesh would be inundated from the Bay of Bengal. If all the polar ice melted, the sea-level would rise by about seven meters, which would result in the whole country being engulfed by the sea.

However, mean temperatures in and over Bangladesh between 1991 and 1992 were below means between 1991 and 1960 (Rahman, BMD, private communication) and no evidence of mean temperature increases has been found in or over Pakistan.

The 'Doomsday' scenario described above is also unlikely, particularly for Bangladesh, in that the processes of sedimentation would tend to be accelerated by sea level rise. To a large extent, the rise in sea level would be balanced by rises in land surface caused by accretion/sedimentation.

9.3 Ozone Layer

Large holes in the earth's atmospheric ozone layer have been recently discovered over both the poles caused perhaps by the release of CFCs and similar gases. The amount of ultraviolet rays reaching the earth's surface would increase if the 'holes' become larger. This would in turn increase health hazards, including some forms of skin cancer.

9.4 International Action

Global action has become imperative to fully understand and monitor the various processes that are taking place. Adverse action needs to be halted and appropriate mitigation measures put in hand to prevent further degradation of the environment. The United Nations Conference on Environment and Development (UNCED) held in 1993 in Brazil, attended by several thousand delegates from almost all the countries of the world, deliberated at great length on environmental concerns and issues but unfortunately little positive action appears to have resulted.

CHAPTER 10

HAZARD AND COASTAL AREA MAPPING

10.1 Hazard Mapping

Although maps showing areas susceptible to a particular type of hazard, such as cyclone floods or droughts, were available from scattered sources, no integrated attempt to prepare hazard maps to similar scales or in one compilation had been made. The work is expensive and time consuming. As a first effort, maps showing cyclone, flood (hydrological hazard and drought prone areas and areas susceptible to flash floods, river bank erosion, tornadoes and severe storms and seismic zones have been prepared to a scale of 1:1,000,000 (500,000 to 1,000,000) is the scale suggested for such maps: UNDRO, 1991).

These will assist in disaster management. The work involved collecting information on hazards from existing maps and bringing the together all onto a base map. Scale changing was with the aid of a photocopier hence the accuracy of the maps is limited. However, a high degree of accuracy is not essential for recording thematic information of natural hazards on maps of such a scale.

Much information has been gathered. Data on tornadoes and severe storms have been taken from the last 20 year records from 'Dainik Bangla', a government owned newspaper with a reputation for good reporting of natural hazards. Information on river-bank erosion has also been gathered by project staff.

The following scaling system was adopted to identify the areas most susceptible to natural hazards and to develop a Hazard Index for each thana and district.

		Points
Cyclone:	High risk areas as shown in MCPS map	5
	'Risk' areas as shown in MCPS map	3
	'Wind risk' areas not shown in MCPS map	1
Flood:	Severely flooded areas, due to major river floods	3
	Flash flood areas and medium major river flood areas	2
	Other floods	1
Erosion:	Severe erosion	2
	Erosion	
Drought:	'Very severe' drought prone areas (as shown in BRAC map)	2
	'Severe' drought prone areas (as shown in BRAC map)	1

The ten most hazard-prone districts are the following: Bhola, Barguna, Chandpur, Cox's Bazar, Manikganj, Sirajganj, Chapai Nawabganj, Kurigram and Patuakhali. (See Annex A)

The following maps at scale 1:1000,000 in colour have been prepared and widely distributed under the project.

HM.1	Cyclone-Affected Areas:
HM.2	Flood-Affected Areas (including river bank erosion)
HM.3	Drought-Affected Areas
HM.4	Tornado-Affected Areas
HM.5	Earthquake Zones
HM.6	District-Hazard Indices
HM.7	Thana-Hazard Indices
HM.8	Composite Hazard Map

10.2 Coastal Area Mapping

The Multi-purpose Cyclone Shelter Project (BUET), 1992) prepared maps to a scale of approximately 1:1,500,00 showing the boundary of cyclone 'high risk' and 'risk' areas in the coastal zone. Maps of the coastal area, comprising 43 thanas, have also been produced at 1:50,000 scale using SPOT imagery, aerial photographs and the help of SPARRSO. The population of the 'high risk' area is estimated to be 5,000,000. These maps show the locations of the existing cyclone shelters and 'killas', communication systems and other information.

Under the project, a large scale map showing the physical infrastructure in the coastal area at a scale of 1:250,000 was prepared and widely circulated. This will help to focus attention on improvements to facilities required in the disaster-prone areas.

CHAPTER 11

CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

Bangladesh because of its unique geographical position, a monsoon dominated climate with very large river systems flowing into the turbulent Bay of Bengal where they form a very large delta system, is an area visited frequently by natural hazards like floods, cyclones and nor' westers. It is also very near to the active tectonic zone stretching along the Himalayan mountain range. As a result earthquakes are also quite frequent in nearby Assam, Bihar and Nepal. The land is also prone to droughts which have a repetition period of between three and five years. There are no available technologies to prevent these natural hazards. Even in the most advanced countries the natural hazards take their toll.

Even after constructing hundreds of miles of embankments during the last three decades it has not been possible to stop the ravaging floods. Currently the government is seriously considering new flood control measures based on both short term and medium term concepts stretching over 15-20 years. The investment will be very high. The plan also includes such measures as better warning system and improved post disaster relief and rehabilitation.

Flood data over a period of 30 years show that, on average, every year about 20 per cent land area is flooded. These areas have high population densities. The coastal areas which are prone to cyclonic storms constitute about 20 per cent of the total area of Bangladesh and are generally heavily populated. It is therefore not feasible to think of permanently transferring population to other areas. During the 1970s, a programme was taken up by government to resettle landless families from the plains in the hill districts of Chittagong. The programme ran into difficulties and caused social tensions. Consequently, it was abandoned.

11. Recommendations

Some recommendations on mitigation and monitoring of natural hazards are given below:

- the management of natural hazards should be given high priority and appropriate measures should be taken in this regard.
- overall improvement in the hazard monitoring system is desirable. For controlling flood both short and medium term measures have been suggested in the Flood Policy Study (Bangladesh Flood Policy Study - Final Report, May 1989). Similar studies may be undertaken for cyclone and other hazards and government action taken to implement them.
- more coastal embankments, 'killas' and cyclone shelters are needed to reduce the effects of cyclones and the associated surges. A reliable communication system,

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particularly roads within the coastal areas, is essential for efficient relief and rehabilitation work. The embankments should be regularly checked for timely maintenance.

- a review of the existing data collection systems and facilities whether they exist and their overall improvement is considered necessary. Upgrading and modernizing BMD, SPARRSO and BWDB should be part of any plan that may be taken up for improving natural hazard warning systems.
- continuous monitoring of the environment, the weather and the coastal zone is necessary and collection and processing of data should be given due priority. Data collection platforms using satellites for relay of data as well as those using meteor scatter principle may be installed in the catchment areas of major rivers for direct reception of weather data, particularly on rainfall.
- the coastal afforestation programme should continue to cover more accreted areas and alongside of coastal embankments. The forests, both mangroves and other species including coconut palm, have been found to act as a cushion against cyclones and tidal surges.
- low cost house building materials may be supplied to the coastal communities (on subsidized basis) to enable them to build stronger houses in an effort to make them self reliant.
- legislative measures to safeguard the life and property of the citizen in the event of natural hazards in all the three stages (including pre and post) may be considered. Such actions require a deep understanding of the problems and issues arising out of natural calamities, and a firm national commitment in this direction is required to overcome the situation.
- the existing flood, cyclone and drought codes should be revised and followed with more seriousness of purpose than has been the case in the past.
- overall national effort in hazard management/mitigation should be strengthened.

Natural hazards will continue to be a part of life in Bangladesh and therefore they have to be accepted as they are and all possible measures have to be taken in order to mitigate the sufferings of those who are affected by these scourges. There is a lot more than can be done in this regard than what is being done now.

ANNEX A
HAZARD INDICES

ANNEX A
HAZARD INDICES

A.1 Scaling System

The following scaling system was adopted to identify the areas most susceptible to natural hazards and to develop a Hazard Index for each thana and district.

		Points
Cyclone:	High risk areas as shown in MCPS map	5
	'Risk' areas as shown in MCPS map	3
	'Wind risk' areas not shown in MCPS map	1
Flood:	Severely flooded areas, due to major river floods	3
	Flash flood areas and medium major river flood areas	2
	Other floods	1
Erosion:	Severe erosion	2
	Erosion	
Drought:	'Very severe' drought prone areas (as shown in BRAC map)	2
	'Severe' drought prone areas (as shown in BRAC map)	1

A.2 Hazard Indices

Table A.1 gives the Hazard indices from all Thanas and Districts of Bangladesh. The ten most disaster-prone districts are Bhola, Barguna, Chandpur, Cox's Bazar, Manikganj, Siraganj, Chapai Nawabganj, Kurigram and Patuakhali.

TABLE A.1
Hazard Indices

Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Kuchua	1	1	0	0	2	3.22	Bager
Rampal	3	0	1	1	5		Bager
BagerhatS	1	0	1	1	3		Bager
Chitalmri	1	0	0	0	1		Bager
Sarankola	5	0	1	1	7		Bager
Mollahat	1	1	0	0	2		Bager
Fakirhat	1	0	1	0	2		Bager
Morelganj	1	0	1	1	3		Bager
Mongla	3	0	1	0	4		Bager
Bainshari	1	0	0	0	1	1.00	Bandar
Roangchri	1	0	0	0	1		Bandar
Bandarban	1	0	0	0	1		Bandar
Ruma	1	0	0	0	1		Bandar
Naikhngchri	1	0	0	0	1		Bandar
Alikadam	1	0	0	0	1		Bandar
Lama	1	0	0	0	1		Bandar
Thanchi	1	0	0	0	1		Bandar
Betagi	1	0	0	0	1	5.00	Barguna
Barguna S	5	0	0	1	6		Barguna
Bamna	5	0	0	1	6		Barguna
Patharghata	5	0	0	1	6		Barguna
Amtali	5	0	0	1	6		Barguna
Banripara	1	1	0	0	2	2.90	Barisal
Agailjhra	1	1	0	0	2		Barisal
Hizla	3	1	0	0	4		Barisal
Muladi	1	1	0	0	2		Barisal
Ujirpur	1	1	0	0	2		Barisal
Bakerganj	3	1	0	1	5		Barisal
BarisalS	3	1	0	0	4		Barisal
Mehndignj	3	1	0	0	4		Barisal
Babuganj	1	1	0	0	2		Barisal
Gaurnadi	1	1	0	0	2		Barisal
Nabinagar	0	2	0	1	3	1.88	Bbaria
Sarail	0	2	0	1	3		Bbaria
Nasirnagr	0	1	0	0	1		Bbaria
Banchrmp	0	2	0	1	3		Bbaria
B.baria s	0	1	0	0	1		Bbaria
Ashugnj	0	2	0	0	2		Bbaria
Akhaura	0	1	0	0	1		Bbaria
Kosba	0	1	0	0	1		Bbaria
Charfassn	5	0	0	0	5	5.67	Bhola
Borhanddn	5	0	0	1	6		Bhola
Lalmohan	5	0	0	0	5		Bhola
Bhola S	5	0	0	1	6		Bhola
Tozmuddin	5	0	0	1	6		Bhola

Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Daultkhan	5	0	0	1	6	1.82	Bhola
Sherpur	0	2	1	0	3		Bogra
Dupchacha	0	0	1	0	1		Bogra
Sonatala	0	2	0	0	2		Bogra
Dhunat	0	2	0	1	3		Bogra
Adamdighi	0	0	1	0	1		Bogra
Bogra S	0	0	1	0	1		Bogra
Sariakndi	0	3	0	2	5		Bogra
Nandgram	0	0	1	0	1		Bogra
Kahalu	0	0	1	0	1		Bogra
Shibganj	0	0	1	0	1		Bogra
Gabtali	0	1	0	0	1		Bogra
Haimchar	1	3	0	2	6	4.00	Chand
Chandpur	1	3	0	2	3		Chand
Sharasti	1	1	0	0	2		Chand
Faridgnj	1	3	0	0	4		Chand
Matlab	1	3	0	1	5		Chand
Hajignj	1	2	0	0	3		Chand
Kachua	1	1	0	0	2		Chand
Rangunia	1	0	0	0	1	2.86	Chitt
Boalmari	3	0	0	0	3		Chitt
Patiya	3	0	0	0	3		Chitt
Banshkhli	5	0	0	0	5		Chitt
Hathazari	1	0	0	0	1		Chitt
Chndraish	1	0	0	0	1		Chitt
Satkania	1	0	0	0	1		Chitt
Sandwip	5	0	0	2	7		Chitt
Lohagara	1	0	0	0	1		Chitt
Fatikchri	1	0	0	0	1		Chitt
Sitakunda	5	0	0	0	5		Chitt
Anwara	5	0	0	0	5		Chitt
Rouzan	1	0	0	0	1	0.75	Chitt
Mireswari	5	0	0	0	5		Chitt
Alamdanga	0	0	1	0	1		Chua
Jibannagr	0	0	0	0	0		Chua
ChuadngaS	0	0	1	0	1		Chua
Damurhuda	0	0	1	0	1		Chua
Gomastapr	0	2	2	1	5	3.60	Cnwab
Shibganj	0	1	2	0	3		Cnwab
Bholahat	0	2	2	0	4		Cnwab
Nachole	0	0	2	0	2		Cnwab
ChapaiNG	0	1	2	1	4		Cnwab
Langolkot	1	1	0	0	2	2.67	Comilla
ComillaS	1	1	0	0	2		Comilla
Homna	1	2	0	1	4		Comilla
Chandina	1	1	0	1	3		Comilla

Table A.1 (Cont)

Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Barura	1	1	0	0	2		Comilla
Muradngr	1	1	0	0	2		Comilla
Brahmnpra	1	1	0	0	2		Comilla
Burichng	1	1	0	1	3		Comilla
Daudkndi	1	2	0	1	3		Comilla
Laksam	1	1	0	1	3		Comilla
Chowddgrm	1	1	0	0	2		Comilla
Debiduar	1	1	0	1	3		Comilla
Ramu	1	0	0	0	1	4.00	Cox
Chokoria	5	0	0	0	5		Cox
Teknaf	3	0	0	0	3		Cox
Ukheya	3	0	0	0	3		Cox
Moiskhal	5	0	0	1	6		Cox
CxBazarS	5	0	0	0	5		Cox
Kutubdia	5	0	0	0	5		Cox
Savar	0	0	0	0	0	1.29	Dhaka
Dhamrai	0	0	0	0	0		Dhaka
Demra	0	1	0	1	2		Dhaka
DhakaS	0	0	0	0	0		Dhaka
Dohar	0	2	0	1	3		Dhaka
Nwabgnj	0	2	0	1	3		Dhaka
Keranignj	0	1	0	0	1		Dhaka
Parbatipr	0	0	2	0	2	1.46	Dianj
Kahroul	0	0	1	0	1		Dinaj
Hakkimpur	0	0	2	0	2		Dinaj
Chirirbnd	0	0	2	0	2		Dinaj
DinajpurS	0	0	2	0	2		Dinaj
Bochaganj	0	0	1	0	1		Dinaj
Khanshama	0	0	0	0	0		Dinaj
Nawabganj	0	0	1	0	1		Dinaj
Ghoraghat	0	0	1	0	1		Dinaj
Fulbari	0	0	2	0	1		Dinaj
Birampur	0	0	2	0	1		Dinaj
Birganj	0	0	1	0	1		Dinaj
Birol	0	0	2	0	2		Dinaj
FaridpurS	0	2	0	1	3	2.13	Farid
Bhanga	0	2	0	1	3		Farid
Sadarpur	0	3	0	1	4		Farid
Chrbdrshn	0	3	0	1	4		Farid
Alfadanga	0	0	0	0	0		Farid
Boalmari	0	1	0	0	1		Farid
Modhkhli	0	1	0	0	1		Farid
Nagarknda	0	1	0	0	1		Farid
Sonagazi	5	0	0	1	6		Feni
Dagonbhya	1	0	0	0	1		Feni
Feni S	1	0	0	0	1		Feni

Table A.1 (Cont)

Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Chaglnya	1	0	0	0	1		Feni
Fulgazi	1	0	0	0	1		Feni
Parshurm	1	0	0	0	1		Feni
Gobindgnj	0	0	0	1	1	2.14	Gai
Sadullapr	0	1	0	0	1		Gai
Palashbri	0	0	0	0	0		Gai
Gaibandha	0	3	0	2	5		Gai
Shagata	0	3	0	2	5		Gai
Sundergnj	0	0	0	0	0		Gai
Fulchhari	0	3	0	0	3		Gai
Kapasias	0	2	0	0	2	0.83	Gazi
Kaliganj	0	0	0	0	0		Gazi
GazipurS	0	0	0	0	0		Gazi
Kaliakoir	0	1	0	1	2		Gazi
Sreepur	0	1	0	0	1		Gazi
Tongi	0	0	0	0	0		Gazi
Kashiani	1	2	0	0	3	3.40	Gopal
Moksudpur	1	2	0	0	3		Gopal
Kotalipra	1	2	0	0	3		Gopal
GopalgnjS	1	2	0	1	4		Gopal
Tungipara	1	2	0	1	4		Gopal
Baniachng	0	3	0	1	4	1.88	Habi
Ajmirignj	0	3	0	1	4		Habi
HabiganjS	0	2	0	0	2		Habi
Lakhai	0	2	0	0	2		Habi
Bahubal	0	0	0	0	0		Habi
Nabiganj	0	2	0	1	3		Habi
Madhabpr	0	0	0	0	0		Habi
Chunarght	0	0	0	0	0		Habi
Panchbibi	0	0	2	0	2	1.40	Jai
Kalai	0	0	1	0	1		Jai
Akkelpur	0	0	1	0	1		Jai
Joypurhat	0	0	2	0	2		Jai
Khetlal	0	0	1	0	1		Jai
Bokshignj	0	3	0	1	4	3.29	Jamal
Dewangnj	0	3	0	1	4		Jamal
Madargnj	0	3	0	1	4		Jamal
Jamalpur	0	2	0	1	3		Jamal
Melanda	0	0	0	0	0		Jamal
Islampur	0	2	0	2	4		Jamal
Sarisabri	0	3	0	1	4		Jamal
Sarsa	0	0	1	0	1	0.38	Jessore
Monirampur	0	0	0	0	0		Jessore
JessoreS	0	0	1	0	1		Jessore
Bagerpara	0	0	1	0	1		Jessore
Jhikrgcha	0	0	0	0	0		Jessore

Table A.1 (Cont)

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Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Keshabpur	0	0	0	0	0		Jessore
Abhoynagr	0	0	0	0	0		Jessore
Chowgacha	0	0		0	0		Jessore
Kathalia	1	0	0	0	1	2.00	Jhala
Rajapur	1	0	0	0	1		Jhala
Nalchiti	1	1	0	1	3		Jhala
JhaloktiS	1	1	0	1	3		Jhala
Moheshpur	0	0	1	0	1	0.83	Jhenai
Jhenaidhs	0	0	1	0	1		Jhenai
Kaliganj	0	0	1	0	1		Jhenai
Harinkund	0	0	1	0	1		Jhenai
Sailkupa	0	0	0	0	0		Jhenai
Kotchnopr	0	0	1	0	1		Jhenai
Laxmichri	1	0	0	0	1	1.11	Khagra
Guimara	1	0	0	0	1		Khagra
KhgrchriS	1	0	0	0	1		Khagra
Matiranga	1	0	0	0	1		Khagra
Mahalchhri	1	0	0	1	2		Khagra
Dighinala	1	0	0	0	1		Khagra
Manikchri	1	0	0	0	1		Khagra
Panchhri	1	0	0	0	1		Khagra
Ramgarh	1	0	0	0	1		Khagra
Koyra	3	0	1	0	4	1.70	Khulna
Dacope	3	0	1	0	4		Khulna
Paikgacha	1	0	1	0	2		Khulna
Dumuria	1	0	0	0	1		Khulna
Daulatpur	1	0	0	0	1		Khulna
Khulna S	1	0	0	0	1		Khulna
Rupsa	1	0	0	0	1		Khulna
Fultala	1	0	0	0	1		Khulna
Terkhada	1	0	0	0	1		Khulna
Baithaghta	1	0	0	0	1		Khulna
Kuliarchr	0	2	0	0	2	2.15	Kishore
Ashtogram	0	2	0	0	2		Kishore
Bajitpur	0	2	0	0	2		Kishore
Hossainpr	0	0	0	0	0		Kishore
Nikli	0	2	0	1	3		Kishore
Pakundia	0	2	0	0	2		Kishore
Karimganj	0	2	0	0	2		Kishore
Bhaiarab	0	2	0	0	1		Kishore
Katiadi	0	2	0	0	2		Kishore
Itna	0	2	0	1	3		Kishore
Tarail	0	2	0	1	3		Kishore
Mithamoin	0	2	0	1	3		Kishore
Kishorgnj	0	2	0	0	2		Kishore
Fulbari	0	2	0	1	3	3.56	Kuri

Table A.1 (Cont)

Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Chilmari	0	3	0	2	5		Kuri
Ulipur	0	2	0	1	3		Kuri
Kurigram	0	3	0	1	4		Kuri
Raumari	0	2	0	1	3		Kuri
Nageshwri	0	3	0	1	4		Kuri
Bhurungmri	0	2	0	1	3		Kuri
Razarhat	0	1	0	1	2		Kuri
Chrajibpr	0	3	0	2	5		Kuri
Mirpur	0	0	1	0	1	2.50	Kush
Bheramara	0	0	1	0	1		Kush
Daulatpur	0	0	1	0	1		Kush
Khoksa	0	2	1	1	4		Kush
Kumarkhli	0	2	1	1	4		Kush
KushtiaS	0	2	1	1	4		Kush
Hatibandha	0	2	0	1	3	1.80	Lal
Kaliganj	0	2	0	1	3		Lal
Patgram	0	1	0	1	2		Lal
Aditmari	0	1	0	0	1		Lal
Lalmonirhat	0	0	0	0	0		Lal
LaxmiprS	3	0	0	0	3	3.00	Laxmi
Ramganj	1	0	0	0	1		Laxmi
Ramgati	5	0	0	0	5		Laxmi
Raipur	3	0	0	0	3		Laxmi
Rajoir	1	0	0	0	1	2.25	Madari
MadariprS	1	0	0	0	1		Madari
Kalkini	1	2	0	0	3		Madari
Shibchar	1	2	0	1	4		Madari
Mohammadpr	0	1	0	0	1	1.00	Magura
MaguraS	0	0	1	0	1		Magura
Salikha	0	0	1	0	1		Magura
Sreepur	0	0	1	0	1		Magura
Harirampr	0	3	0	2	5	3.86	Manik
Ghior	0	3	0	1	4		Manik
Shibalya	0	3	0	1	4		Manik
Singair	0	2	0	1	3		Manik
Saturia	0	2	0	1	3		Manik
Daulatpur	0	3	0	2	5		Manik
ManikgnjS	0	2	0	1	3		Manik
MeherpurS	0	0	1	0	1	1.00	Meher
Gangni	0	0	1	0	1		Meher
Sirajdkhn	0	2	0	1	3	3.17	Munshi
Lohajang	0	3	0	1	4		Munshi
Munshignj	0	2	0	0	2		Munshi
Gajaria	0	2	0	1	3		Munshi
Sreenagar	0	3	0	1	4		Munshi
Tongibari	0	3	0	0	3		Munshi

Table A.1 (Cont)

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Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Kamalganj	0	0	0	0	0	0.83	Mvi
Baralekha	0	0	0	0	0		Mvi
Rajanagar	0	1	0	0	1		Mvi
Moulvibzr	0	2	0	1	3		Mvi
Kulaura	0	0	0	1	1		Mvi
Srimangal	0	0	0	0	0		Mvi
Haluaghat	0	1	0	0	1	1.08	Mymen
Fulbaria	0	1	0	0	1		Mymen
Nandail	0	1	0	0	1		Mymen
Ishwargnj	0	1	0	0	1		Mymen
Fulpur	0	1	0	0	1		Mymen
Trishal	0	1	0	0	1		Mymen
MymensngS	0	1	0	1	2		Mymen
Gaffrgaon	0	1	0	1	2		Mymen
Gouripur	0	1	0	0	1		Mymen
Bhaluka	0	0	0	0	0		Mymen
Muktagcha	0	1	0	1	2		Mymen
Dhobaura	0	0	0	0	0		Mymen
Patnitala	0	0	2	0	2	2.00	Nao
Damuirhat	0	0	2	0	2		Nao
Niamatpur	0	0	2	0	2		Nao
Badalgchi	0	0	1	0	1		Nao
Shapahar	0	0	2	0	2		Nao
Porsha	0	0	2	0	2		Nao
Mohadevpr	0	0	2	0	2		Nao
Manda	0	0	2	0	2		Nao
NaogaonS	0	1	1	0	2		Nao
Raninagar	0	1	1	0	2		Nao
Atrai	0	2	1	0	3		Nao
NarsindiS	0	2	0	1	3	2.17	Nar
Shibpore	0	1	0	0	1		Nar
Raipura	0	2	0	1	3		Nar
Palash	0	2	0	1	3		Nar
Belabo	0	2	0	0	2		Nar
Monohardi	0	1	0	0	1		Nar
Sonargaon	0	1	0	1	2	1.33	Nara
Sidhirgnj	0	0	0	0	0		Nara
Araihazar	0	1	0	1	2		Nara
Rupganj	0	1	0	1	2		Nara
Fatulla	0	0	0	0	0		Nara
NaryngnjS	0	1	0	1	2		Nara
Kalia	1	0	0	0	1	0.33	Narail
Lohagara	0	0	0	0	0		Narail
NarailS	0	0	0	0	0		Narail
Natore S	0	2	1	0	3		Natore
Bagtipara	0	2	1	0	3		Natore

Table A.1 (Cont)

Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Gurudaspr	0	2	1	0	3		Natore
Barigram	0	2	1	0	3		Natore
Lalpur	0	1	1	0	2		Natore
Singra	0	2	1	0	3		Natore
Purbadhala	0	1	0	0	1	2.00	Netro
NetroknaS	0	1	0	1	2		Netro
Kamalknda	0	2	0	0	1		Netro
Madan	0	2	0	0	2		Netro
Kendua	0	1	0	0	1		Netro
Durgapur	0	2	0	1	3		Netro
Khaliajri	0	2	0	1	3		Netro
Mohongnj	0	2	0	0	2		Netro
Barhatta	0	2	0	1	3		Netro
Atpara	0	1	0	0	1		Netro
Nilphamari	0	0	0	0	1	0.17	Nilpha
Kisorganj	0	0	0	0	1		Nilpha
Dimla	0	0	0	0	0		Nilpha
Jaldhaka	0	1	0	0	1		Nilpha
Saidpur	0	0	0	0	0		Nilpha
Domar	0	0	0	0	0		Nilpha
Senbag	1	0	0	0	1	3.33	Noa
Begumgnj	1	0	0	0	1		Noa
Chatkkhil	1	0	0	0	1		Noa
Compnygnj	5	0	0	1	6		Noa
Hatia	5	0	0	1	6		Noa
Sudharam	5	0	0	0	5		Noa
Santhia	0	2	0	0	2	2.67	Pabna
Faridpur	0	2	0	0	2		Pabna
Ishwardi	0	0	1	1	1		Pabna
Pabna S	0	1	1	1	3		Pabna
Bera	0	3	0	1	4		Pabna
Bhangura	0	2	1	0	3		Pabna
Chatmahar	0	2	1	0	3		Pabna
Atghoria	0	2	1	0	3		Pabna
Sujanagar	0	2	0	1	3		Pabna
Boda	0	0	0	0	0	0.20	Panch
Tetulia	0	0	1	0	1		Panch
Panchagarh	0	0	0	0	0		Panch
Debiganj	0	0	0	0	0		Panch
Atowari	0	0	0	0	0		Panch
Mirzagnj	1	0	0	0	1	3.50	Patua
Dashmina	5	0	0	0	5		Patua
PatukhliS	1	0	0	0	1		Patua
Kalapara	5	0	0	0	5		Patua
Baufal	3	0	0	1	4		Patua
Galachipa	5	0	0	0	5		Patua

Table A.1 (Cont)

Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Mothbaria	3	0	0	0	3	3.43	Piroj
Indurkani	3	1	0	1	5		Piroj
PerojpurS	1	1	0	1	3		Piroj
Swarupkti	1	1	0	1	3		Piroj
Nazirpur	1	1	0	1	3		Piroj
Bhandaria	3	0	0	1	4		Piroj
Kawkhali	1	1	0	1	3		Piroj
Bagha	0	0	1	0	1	2.00	Raj
Paba	0	0	2	0	2		Raj
Charghata	0	0	1	0	1		Raj
Tanore	0	1	2	0	2		Raj
Boalia	0	0	1	1	1		Raj
Durgapur	0	1	1	0	2		Raj
Godagari	0	2	1	1	4		Raj
Bagmara	0	1	1	0	2		Raj
Puthia	0	0	1	0	1		Raj
Mohanpur	0	1	1	0	2		Raj
Pangsha	0	2	0	1	2	2.75	Rajbari
Baliakndi	0	0	0	0	0		Rajbari
Goalundo	0	3	0	1	4		Rajbari
RajbariS	0	3	0	1	4		Rajbari
RangpurS	0	0	0	0	0	0.75	Rang
Peerganj	0	0	0	0	0		Rang
Pirgachha	0	0	0	0	0		Rang
Mithapukr	0	0	0	0	0		Rang
Badargnj	0	1	0	1	2		Rang
Taraganj	0	0	0	0	0		Rang
Gangachra	0	1	0	1	2		Rang
Kaunia	0	1	0	1	2		Rang
Juraichri	1	0	0	0	1	1.00	Ranga
Chndrghna	1	0	0	0	1		Ranga
Nanerchra	1	0	0	0	1		Ranga
Farua	1	0	0	0	1		Ranga
Rangamati	1	0	0	0	1		Ranga
Barkal	1	0	0	0	1		Ranga
Rajasthli	1	0	0	0	1		Ranga
Bagaichri	1	0	0	0	1		Ranga
Bilaichri	1	0	0	0	1		Ranga
Langadu	1	0	0	0	1		Ranga
Kaukhli	1	0	0	0	1		Ranga
Kaptai	1	0	0	0	1		Ranga
Sajek	1	0	0	0	1		Ranga
Kalaroa	1	0	1	0	2	2.71	Satkhira
Debhata	1	0	2	0	3		Satkhira
Kaliganj	1	0	2	0	3		Satkhira
SatkhiraS	1	0	2	0	3		Satkhira

Table A.1 (Cont)

Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Ashashuni	1	0	1	0	2		Satkhira
Shyamnagr	3	0	1	0	4		Satkhira
Tala	1	0	1	0	2		Satkhira
Goshairht	1	2	0	1	3	3.50	Shariat
Palang	1	2	0	0	3		Shariat
Naria	1	2	0	1	4		Shariat
Bhedrgnj	1	2	0	1	4		Shariat
Damuda	1	2	0	0	3		Shariat
Jajia	1	2	0	1	4		Shariat
Sreebordi	0	0	0	0	0	0.20	Sher
Zhinaigti	0	0	0	0	0		Sher
Sherpur S	0	0	0	0	0		Sher
Nalitabri	0	1	0	0	1		Sher
Nakla	0	0	0	0	0		Sher
Raiganj	0	2	0	0	2	3.78	Siraj
SirajgnjS	0	3	0	2	5		Siraj
Chowhali	0	3	0	2	5		Siraj
Taras	0	2	1	0	3		Siraj
Ullapara	0	2	0	0	2		Siraj
Shahzadpr	0	2	0	1	3		Siraj
Kazipur	0	3	0	2	5		Siraj
Belkuchi	0	3	0	2	5		Siraj
Kamarkhnd	0	3	0	1	4		Siraj
Dharmpsa	0	2	0	1	3	2.36	Sunam
Jamalganj	0	2	0	1	3		Sunam
Chhatak	0	1	0	0	1		Sunam
SunamgnjS	0	2	0	1	3		Sunam
Sulla	0	2	0	0	2		Sunam
Derai	0	2	0	0	2		Sunam
Duarabazr	0	2	0	0	2		Sunam
Bishambpr	0	2	0	1	3		Sunam
Tahirpur	0	2	0	0	2		Sunam
Madhyangr	0	2	0	0	2		Sunam
Jaganthpr	0	2	0	1	3		Sunam
Compnignj	0	2	0	0	2	2.45	Syl
Golapganj	0	2	0	1	3		Syl
Bishanath	0	2	0	0	2		Syl
Kanaighat	0	1	0	0	1		Syl
Gowainght	0	2	0	0	2		Syl
SylhetS	0	2	0	1	3		Syl
Fenshganj	0	2	0	1	3		Syl
Balaganj	0	2	0	1	3		Syl
Zakiganj	0	2	0	1	3		Syl
Beanibzr	0	2	0	1	3		Syl
Jaintiapr	0	2	0	0	2		Syl
Tangail S	0	2	0	2	4	2.36	Tang

Table A.1 (Cont)

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Thana	Cyclone	Flood	Drought	Erosion	Total	Average	District
Modhupur	0	0	0	0	0		Tang
Bhuapur	0	3	0	2	5		Tang
Ghatail	0	0	0	0	0		Tang
Delduar	0	2	0	1	3		Tang
Sakhipur	0	0	0	0	0		Tang
Nagarpur	0	3	0	2	5		Tang
Mirzapur	0	2	0	1	3		Tang
Bashail	0	1	0	0	1		Tang
Gopalpur	0	2	0	1	3		Tang
Kalihatti	0	2	0	0	2		Tang
Thakurgan	0	0	1	0	1	1.00	Thakur
Ranisnkhl	0	0	1	0	1		Thakur
Haripur	0	0	1	0	1		Thakur
Pirganj	0	0	2	0	2		Thakur
Baliadanga	0	0	0	0	0		Thakur

Table A.1 (Cont)

ANNEX B

SPECIALIZED INSTITUTIONS

B.1 Introduction

Brief descriptions of the working and the facilities of the Bangladesh Meteorological Department (BMD), the Bangladesh Space Research and Remote Sensing Organization (SPARRSO) and the Bangladesh Water Development Board (BWDB) which are responsible for forecasting and monitoring of natural hazards are given below.

B.2 Bangladesh Meteorological Department (BMD)

The Bangladesh Meteorological Department (BMD) has the overall responsibility for issuing regular weather bulletins and giving warning signals for cyclones, storms, droughts etc.

The BMD is a long established institution and has a long tradition of service to the community with technical knowledge and skill that has been developed over the past decades. Traditional methods of weather forecasting have been replaced by more advanced and sophisticated systems using technological innovations such as weather satellites, weather radar, computers etc.

The BMD's principal facilities include a modern weather radar (range 400 km) with associated computerised data analysis facilities installed at the BMD's main installation located in Dhaka, and two other weather radars (range 400 km) located at Cox's Bazar and Khepupara, both the places being situated on the coast of the Bay of Bengal.

The radars are capable of locating and monitoring cyclones continuously, generally at intervals of five minutes, as soon as the cyclones come within the range of 400 km. The computerised data processing system can simulate the cyclone on the colour monitor screen thus accurately predicting and following its course till such time it weakens away on the shore. The radars can also make an estimate of precipitation directly by making use of the supporting computer of the VAX 4000 series. The complementary facilities of BMD and SPARRSO make it possible to track cyclones for almost a range of 2000 km over the Bay of Bengal. The Cox's Bazar and Khepupara radars, recently replaced by ones as powerful and sophisticated as the Dhaka radar, provide also valuable information and data collected over the Bay of Bengal, the breeding ground of all bay cyclones.

The BMD has 35 synoptic observatories distributed throughout the country for collection of weather data. It also has 10 pilot balloon observatories which take 4 observations per day and 3 rawinsonde observatories at Dhaka, Bogra and Chittagong which take 1 daily observation. Data collected daily include wind velocity and direction, temperature, pressure and humidity.

The communication system includes 30 Single Side Band (SSB) transreceivers and 8 teleprinters. A fax system receives analyzed weather data from India and a Global Transmission System (GTS) operated by the World Meteorological Organization (WMO) bring in weather data from the Soviet Union, India and Thailand. To take care of a break down situation, the BMD has made a provision for a Radio Teletype (RTT) as a back-up system.

A well equipped Storm Warning Centre (SWC) at Dhaka keeps round the clock vigil on the weather in and around Bangladesh. Weather bulletins are regularly supplied to the mass media and to the Civil Aviation Department, Air Force, BWDB and SPARRSO. Regular exchange of data takes place between BMD, SPARRSO and BWDB.

The responsibility of operating the flood forecasting system and issuing flood warning is with Flood Forecasting Centre (FFC) of the Bangladesh Water Development Board (BWDB).

B.2 Bangladesh Space Research and Remote Sensing Organization (SPARRSO)

Realising the potential of space technology in dealing with the problems of natural disasters, an Automatic Picture Transmission (APT) station was established in Dhaka in 1968 for receiving directly pictures from weather satellites of USA, USSR and Europe.

At that time there was no infra-red sensor on the satellite and only one picture a day during the day light hours could be received from the ESSA series of satellites. The satellite technology advanced rapidly, and with the launching of TIROS-N series of satellites in 1978 by NOAA (USA) the APT system was upgraded.

A new advanced system for receiving and analysing satellite imagery, with technical support from NASA and NOAA, was installed in Dhaka for receiving both low and high resolution imagery from NOAA and GMS satellites. Computer system and software capable of analysing not only NOAA and GMS satellite data but also Landsat data was also installed.

The system consisted of the Ground Station, Alden and Muirhead recorders, two VAX-11/750 computers, one TRS-80 computer, two I2S image processors, disc drives/tape drives, plotters/printers, a digitizing table, matrix film recorder, Optronics scanner, Wing Lynch film processor, several terminals, a number of peripherals and interface equipment.

A number of Data Collection Platforms (DCP) on land and one in the Bay of Bengal were installed. The land-based DCP's can transmit real time data on atmospheric pressure, air temperature and water level and solar radiation. The DCP data are collected via the orbiting NOAA satellites up to a maximum of eight times a day on real time basis by the SPARRSO ground station and processed by the processing equipment. These data have largely augmented the existing network of meteorological and hydrological data collection capability within the country. The DCPs have exhausted their working life and new ones have become necessary.

Necessary softwares have been procured. These include real time low and high resolution GMS and NOAA satellite data ingest programme, programme to overlay latitude/longitude and political boundaries on images, DCP conversion programme, programmes to create computer compatible tapes from raw data, to output high resolution HRPT data, to print the product on Muirhead recorder/Facsimile paper, to analyse AVHRR data, to compute TIROS Vegetation Index, to obtain Sea Surface Temperature (SST), to classify Landsat scenes etc. Facilities also exist for extracting information on the upper atmosphere regarding water vapour content, temperature, ozone content, etc., as a function of altitude at 15 different levels from the Tiros Operational Vertical Sounder (TOVS) data of NOAA satellites.

SPARRSO scientists have been trained abroad on hardware, software and their applications. Some in-country training on satellite data interpretation has also been provided to scientists of other organizations who use the SPARRSO facilities for their professional work.

The system is capable of receiving cloud imagery transmitted by the GMS satellite every three hours and in addition by NOAA satellites 4 more times a day. These are regularly supplied to the Storm Warning Centre of the BMD, Dhaka for operational use. The system is most useful in tracking tropical cyclones which are formed in deep seas where no data is available otherwise. A cyclone can be detected at the time of its formation in the Bay, and its movement can be monitored and sustained wind speed can be estimated. Two separate models, one for the Atlantic and another for the Pacific Ocean, for the estimation of maximum wind speeds in cyclones from satellite data have been prepared by D'vorak (Choudhury, A.M. 1985).

An independent statistical model for determining maximum sustained wind speeds in the Bay of Bengal cyclones has been prepared and it has been found that this does not differ significantly either from the Pacific or the Atlantic model. The difference lies within the limits of error in the models. It is seen that the Bay of Bengal model resembles the Pacific model for weaker cyclones but resembles the Atlantic model for stronger cyclones. Present generation of NOAA satellites have 5 AVHRR channels and 27 channels of the TIROS Operational Vertical Sounder (TOVS). The TOVS has three instruments, the High Resolution Infrared Radiation Sounder (HIRS-2), the Stratospheric Sounding Unit (SSU) and the Microwave Sounding Unit (MSU). With the help of these instruments it is possible to obtain surface emissivity and temperatures, total precipitable water, stability

index, total ozone content, thermodynamic profile and temperature sounding and geopotential height as a function of altitude at fifteen different levels. The facility which SPARRSO has developed to analyse data from TOVS has certainly improved the understanding of severe storms and tropical cyclones in the Bay of Bengal. It may be possible to predict the onset and withdrawal of monsoons with TOVS data. With the AVHRR data floods can be monitored in the entire region. During the 1988 flood AVHRR data was used to delineate flooded areas (Figure B.1).

B.4 Role of Weather Satellites in Cyclone and Flood Warning

Weather is a global phenomenon, and to know the initial state of the weather at a particular time, accurate observations on worldwide scale are needed.

The distribution of surface observations is heavily biased towards well populated land regions. Commercial shipping does provide some observations over the oceans. But as the ships avoid cyclones and bad weather, most vital data on cyclones are left out. High in the atmosphere, balloons can rise up to a maximum height of 35 km only. Thus the vast expanse of the atmosphere and the oceans remained unexplored before the coming of the space age. With the advent of the space age, satellites can survey the earth's weather from a point well above the earth's surface. The advantages of space meteorology over the conventional methods are as follows :

- (i) **Spatial Continuity** : The observations are horizontally continuous; this eliminates interpolation and thus the ambiguity often present in synoptic charts.
- (ii) Provides information on a synoptic scale with virtually no time lag.
- (iii) **Visual Integration** : Permits integrated visualization of weather systems in a way readily acceptable to the human mind.
- (iv) **Independence of Communication Systems**: Provides large scale weather information even if normal systems of communications have broken down.

Pictures and data received regularly from the weather satellites are of immense value to the weather and flood forecasters. During the floods of 1987 and 1988, flooded areas were delineated from the NOAA -9/10 pictures by SPARRSO. These were extensively used by the concerned agencies and experts for producing flood maps and estimating damages.

Bangladesh does not have either weather rocket or satellite launching facilities of her own, but with the help of ground stations it is possible to receive weather data from weather satellites launched by other countries.

With the help of the equipment provided by US AID and NASA, both low and high resolution weather data from US NOAA-9, NOAA-10/11 and Japanese GMS-3 (improved version) satellites are received regularly on real time basis. These data are most useful in monitoring cyclonic storms as well as monsoon floods.

B.5 Agro-meteorological Use of Weather Satellite Data

In addition to its use in meteorological work the daily wide area coverage provided by the NOAA satellites has advantages in monitoring the agricultural crop cycle and the wetness/dryness of the soil due to rainfall and irrigation. The day/night coverage of the same areas allows the investigator to observe the temperature differences or thermal inertia of the earth's surface. The multispectral channels of the Advanced Very High Resolution Radiometer (AVHRR) allow the routine measurement of the greenness of vegetation or the Vegetation Index (VI) as described in the following section. Data from Natural resource satellites like Landsat can be used for Vegetation Index measurement at higher resolutions but the weekly or biweekly data is not always available to the investigator on a timely basis to be practical for a current season crop monitoring programme.

This restriction on access to data need not apply to countries which operate their own ground stations. For a

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country like Bangladesh, a single pass of the weather satellite provides a complete image of the country so that statistics on vegetation growth can be readily obtained. In comparison, complete coverage of Bangladesh by Landsat takes 16 days. These satellite data can be used for change detection studies including forestry, coastal accretion/erosion, river course changes and land use.

B.6 Vegetation Index

The Normalized Vegetation Index (NVI) can be conveniently calculated from NOAA data which gives an indication of soil moisture and therefore the capacity of soil to support agriculture. For land the value of NVI lies between 0 and 1 while for water the value is -ve. A value of 0.5 or above indicates healthy vegetative growth.

For post disaster monitoring the technique has been found to be very useful. It is also possible to measure the sea surface temperature regularly from the AVHRR data received from the NOAA satellites. Since formation of cyclones is directly linked with sea temperature such measurements are considered very useful. Cyclones form only if the sea surface temperature is more than 27 degree centigrade, enough to supply energy to the storm.

B.7 Agroclimatic Monitoring

The satellite ground station and associated data processing equipment provided by the US-AID to SPARRSO under the Agro-Climatic Environmental Monitoring (ACEM) programme and UNDP assistance have shown their usefulness in agro-meteorological studies in addition to their routine meteorological use.

Post disaster damage assessment can be done with the help of this system by comparing imagery taken before and immediately after the disaster. The imagery have to be procured from nearby ground stations in India or Thailand.

The current and potential uses of the system are the following:

- i) Conducting studies of monsoon clouds over Bangladesh for a better understanding of rainfall, flood, and drought.
- ii) Determining the structure, dynamics, intensity and movement of storms and storm surges.
- iii) Conducting studies on cropping patterns and cropping intensity.
- iv) Preparing estimates of the acreage and yields of principal crops, including the extent of damage by natural disasters.
- v) Preparing crop calendars.
- vi) Development of planning strategies for flood prone areas and inundation.
- vii) Conducting follow-up studies of land accretion in the Bay of Bengal.
- viii) Conducting forest resource inventories.
- ix) Mapping and monitoring coastal afforestation.
- x) Looking at coastal ecology.

ANNEX C

ELEVEN GUIDING PRINCIPLES OF FLOOD CONTROL

ANNEX C

ELEVEN GUIDING PRINCIPLES OF FLOOD CONTROL

1. Phased implementation of a comprehensive Flood Plan aimed at:
 - protection of urban, rural, commercial, industrial and public utility centres and communication networks;
 - controlled flooding, wherever possible and appropriate, to meet the needs of agriculture, fisheries, navigation, urban flushing, soil productivity and recharging the surface water/groundwater resource with minimum dislocation of the environment.
2. Effective land and water management of protected and unprotected areas, involving compartmentalisation, drainage, irrigation, drainage decongestion, land use, cropping patterns, environment, ecology, erosion/sedimentation control, etc.
3. Strengthening and equipping the disaster management machinery including infrastructure for quick and effective communication and transmission during disasters.
4. Improvement of the flood forecasting system and establishment of a reliable and comprehensive flood warning system with adequate lead times and at the same time evolving techniques for dissemination.
5. Safe conveyance of the large cross-boundary flow to the Bay of Bengal by channelling it through major rivers with the help of a reliable and comprehensive flood warning system with adequate lead times and at the same time evolving techniques for dissemination.
6. Effective river training works for the protection of embankments, infrastructure and population centres, linked wherever possible with the reclamation of land in the active river flood plain.
7. Reduction or distribution of load on the main rivers through diversion of flows into major distributaries or interception of local runoff/local rivers by channelling through major tributaries or special diversions.
8. Improvement of the conveyance capacity of the river networks to ensure efficient drainage through appropriate channel improvements and ancillary structures to provide regulation and conversion.
9. Development of flood plain zoning as a flexible instrument to accommodate necessary engineering measures and allocate space for habitation patterns, economic activities and environmental assets.

- 7d
10. Coordinated planning and construction of rural roads, highways and railway embankments with provision for unimpeded drainage.
 11. Encouraging maximum possible popular participation by beneficiaries in the planning, implementation, operation and maintenance of flood protection infrastructure and facilities.

ANNEX D
KEY STATISTICS



ANNEX D

KEY STATISTICS

The growth rate of population is presently about 2.3 percent per annum (Table D.1) while food production is increasing at the rate of 2.5%, a precarious balance. Table D.2 shows major crops production and Table D.3 shows annual trend of food grains import

Bangladesh has no exploitable mineral resources other than natural gas. All gas deposits are in the eastern districts of Sylhet and Brahmanbaria. A large proportion of foreign exchange earnings is spent on imported food grains and fossil fuel. Government spending on health, education, employment generation etc. falls well short of the needs.

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TABLE D.1
Bangladesh : Population Statistics

Year	Population ('000)		Rural Man/Agricultural ⁽¹⁾ Land Ratio (People/ha)
	Total	In Rural Areas	
1891	24,668	24,131	1.96
1901	28,928	25,644	2.09
1911	31,555	27,889	2.27
1921	33,254	30,152	2.45
1931	36,690	35,564	2.89
1941	39,785	38,440	3.13
1951	41,932	40,112	3.26
1961	50,841	48,199	3.92
1974	71,478	65,205	5.30
1981	87,120	73,892	6.01
1985	99,000	80,000	6.51
1990	112,000	89,000	7.24
1995	122,000	98,000	7.97
2000	132,000	105,000	8.54

Source : BBS, 1990

(¹) Area of Agricultural Land = 12,295,500 ha

TABLE D.2

Bangladesh : Production of Major Crops
(Million Metric tons)

Year	Rice (M mt)	Jute (M mt)	Wheat (M mt)
1980/81	13.9	0.9	*
81/82	12.6	0.8	*
82/83	14.2	0.9	1.1
83/84	14.5	0.9	1.2
84/85	14.6	0.9	1.5
85/86	15.0	1.6	1.0
86/87	15.4	1.2	1.1
87/88	15.7	0.9	1.0
88/89	15.3	0.8	1.0
89/90	17.9	0.8	0.9
1990/91	*	*	*

Source : BBS, 1990, BBS, 1991

* : Data not to hand

TABLE D.3

Bangladesh : Food Grain Imports (mt '000)

Year	Rice	Wheat	Total
1975/76	395	1065	1460
1976/77	195	613	808
1977/78	304	1341	1645
1978/79	54	1101	1155
1979/80	712	2070	2782
1980/81	184	892	1076
1981/82	144	1111	1255
1982/83	317	1527	1844
1983/84	180	1877	2057
1984/85	692	1898	2590
1985/86	36	1164	1200
1986/87	261	1507	1768
1987/88	593	2329	2922
1988/89	61	2076	2137
1989/90	301	891	1192

Source : Hamid, 1991

Mohammd Abdul Hamid

1991 A DataBase on Agriculture and Foodgrains in Bangladesh (1947-48/1989-90)

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ANNEX E
ENVIRONMENT

- natural hazards such as cyclone, tornado, flood, earthquake, drought, erosion etc
- improper disposal of human and animal excreta
- excessive use of non-biodegradable materials such as plastics, polythene and PVC
- population growth and urbanization

Wars are a major destroyer of the environment, in addition to the destruction they cause to human lives.

E.2 The Bangladesh Scenario

Concerns about the degradation of the environment are gaining ground in Bangladesh, both in government and non-government circles. Pollution of air, water and soil is no longer a concern of industrialized countries alone. Developing countries are now well aware of the effects of degrading the natural environment.

In 1990, the World Resources Institute, Washington D.C. carried out a study entitled 'Bangladesh Environment and Natural Resource Assessment'. In the report, environmental and natural resource management issues were discussed and 25 areas of environmental concern in Bangladesh were identified:

- | | |
|----------------------------------|----------------------------------------------|
| 1. West-Central Barind | 14. South Sylhet |
| 2. Middle-Karatoya Floodplain | 15. Gumti Basin |
| 3. Brahmaputra-Jamuna Floodplain | 16. Lower Meghna |
| 4. Chalan Beel | 17. Central Noakhali |
| 5. Atrai-Hurasagar Drainage | 18. Sandwip |
| 6. South-West Jessore | 19. Sitakund Range |
| 7. Northern Khulna | 20. Chittagong City |
| 8. Khulna City and Mongla Town | 21. Chandraghona |
| 9. Sunderban | 22. Chittagong Hill Tracts |
| 10. Garo Hills Piedmont | 23. Chakaria Sunderbans |
| 11. Modhupur Tract | 24. Cox's Bazar |
| 12. Sitalakhya River | 25. Jinjea Island Reef (St. Martin's Island) |
| 13. Dhaka City | |

The environmental degradation was caused by industrial and agricultural activities (including fisheries), large scale deforestation (Figure E.1 shown the major forests of the country) and by the construction of flood control embankments and highways. There are no easy ways of mitigating the adverse effects that have taken place over many years.

FCD (Flood Control and Drainage) and FCDI (Flood Control, Drainage and Irrigation), projects aimed at protecting agricultural land from flood damage, has caused considerable damage to flora and fauna, with significant reductions in the number of species being

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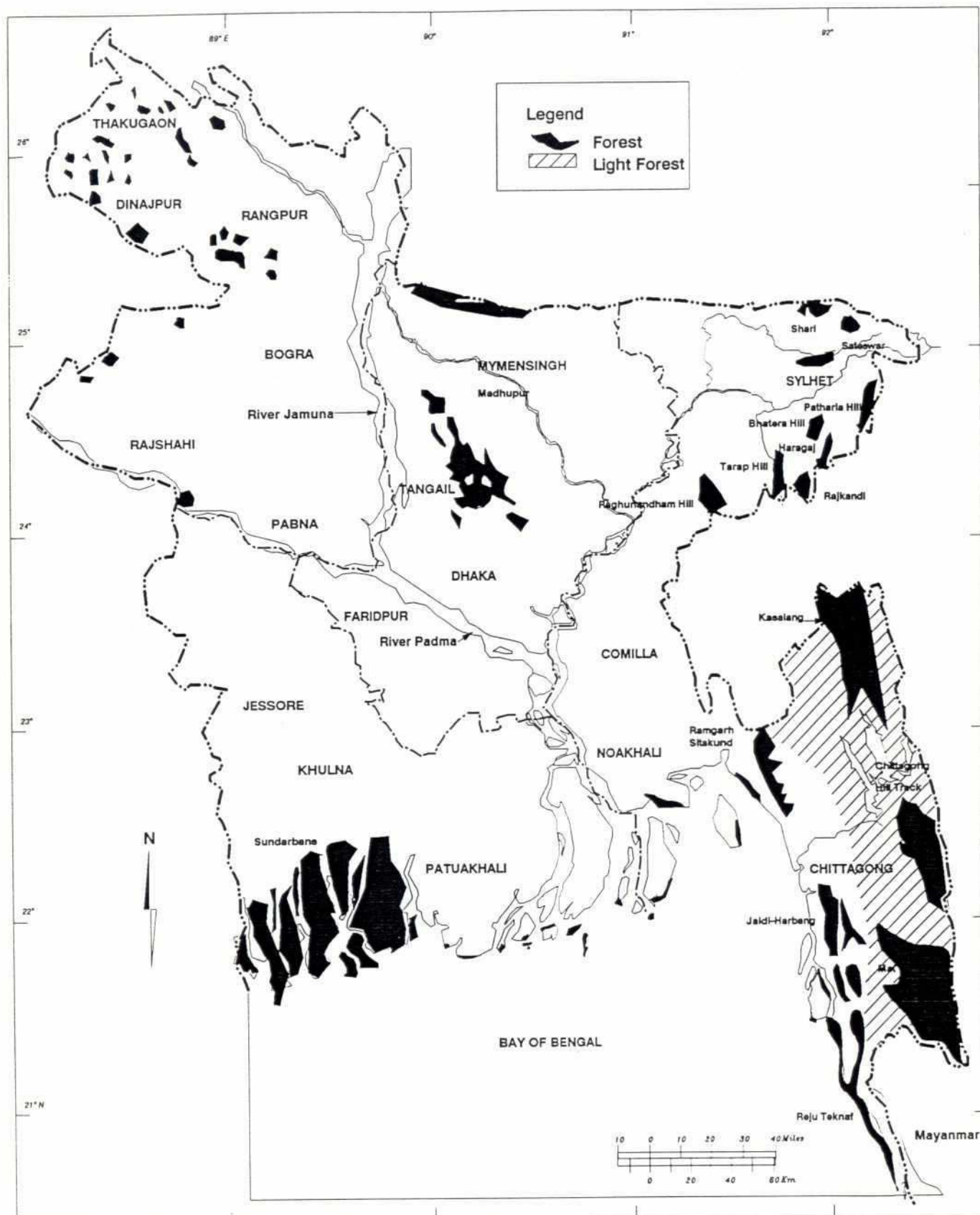
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Figure E.1
Forests



Source: Islam, 1988

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6-7
recorded. Many fish species have become extinct and many are threatened due to the shrinking of the wet-lands (beels, haors, baors etc).

In 1991, the International Union for the Conservation of Nature and Natural Resources (IUCN) carried out a series of studies on Energy, Environment and Natural Hazards which addressed the main environmental issues in Bangladesh.

E.3 Environmental Degradation in Bangladesh

Like most countries, Bangladesh has suffered and is suffering environmental damage, some of which is irreversible.

a) Urbanization and Industrial Pollution

The immediate and most critical environmental problems facing cities in the developing world have been collectively dubbed the "brown agenda" lack of safe water, sanitation and drainage; inadequate management of solid waste; uncontrolled emissions from factories, vehicles, and low grade domestic fuels; accidents linked to congestion and overcrowding; and the occupation and degradation of environmentally sensitive areas. The cost of these problems fall mostly on the current generation, particularly the urban poor, who pay for them in chronic ill health, low productivity, and reduced income and quality of life. (World Bank and the Environment, 1992)

According to the census of 1981, only 16% of the total population is urban (settlements of over 5000 people) This means over 15 million people live in cities and towns, which number about 500. The existing institutional capacity and the infrastructure are not capable of handling such a large population and providing them with the minimum facilities of housing, water supply, sanitation, health care etc. Half the urban population lives in the large cities and urban centres, with Dhaka, Chittagong and Khulna accounting for more the half of these.

The present rate of urbanization is 6.5% pa while the population growth rate is 2.3% pa. These data indicate that additional pressure is being constantly applied to a system which is already strained.

Severe pressure has been put on the good agricultural lands, which are generally flood free, to provide housing land for the new 'urbanites'. The increased demand for housing means more brick fields and thus even more agricultural land being lost every year.

The newly created Department of Environment (DOE) within the Ministry of Forest and Environment is primarily interested in controlling urban and industrial pollution, particularly effluent discharge and solid waste management. Far more people, however, are affected by deforestation, decline in fisheries resources, floods and, above all, due to poor land management.

Water and air pollution are the most common forms of pollution in Bangladesh. According to DOE, the two most polluting industries are tanneries and textile mills

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which account for half the 900 polluting industries. A large number of small and cottage industries have also been identified as sources of pollution.

A study found that the industrial effluents discharged into the rivers contain 10 to 100 times more heavy metals and toxic compounds than the allowable limits (Ahmed, F, BUET et al. Seminar, 1989). Studies carried out by the DOE conclude that due to the discharge of untreated effluents the level in the Buriganga river water is excessive. The BOD is also much higher than the acceptable limits.

Hot water discharged to rivers from the thermal power stations at Ghorasal and Sidhirganj, through the plant cooling systems, is causing death to free floating and drifting fish eggs.

b) Loss of Wetlands

Wetlands play their role in preserving the bio-diversity of aquatic flora and fauna and provide a habitat for a large number of fish species.

Shrinking of 'beel' and 'baor' areas due to rice cultivation is reducing surface water resources and habitat for many species of aquatic flora and fauna, and causing a substantial loss to capture fisheries. Loss of income to fishermen is a direct consequence of wetland reduction.

c) Biodiversity

Bangladesh has a rich diversity of flora and fauna. About 5,000 plant species have been recorded in Bangladesh in the last 100 years, including many of economic importance, to-day fewer than 3,500 can be found.

About 500 fish species, 19 amphibians, 124 reptiles, 579 birds, and 125 mammalian species have been recorded. In addition, there are many species of crustacea, insects and other arthropods, molluscs, and other invertebrate animals which have not been systematically listed.

149 species of fin fish, 19 species of shrimps and prawns, several species of crabs, snakes and dolphins occur in the estuarine waters of Bangladesh. Prawns and shrimps have great economic importance as they are very profitable export earners.

d) 'Greenhouse Effect'

The warming of the atmosphere would affect the global climate as a whole and might also increase the frequency to storms, cyclones, droughts etc. The melting of Himalayan ice may increase run off to the rivers passing through Bangladesh. The 'Greenhouse Effect' may therefore give rise to serious economic and social problems for Bangladesh which is already burdened with such problems.

E.4 National Environment Management Action Plan (NEMAP)

The National Environment Management Action Plan (NEMAP) prepared by the Ministry of Forest and Environment focuses attention on some important issues : Policy and Action Plan, Environmental Legislation and Institutional Strengthening.

NEMAP identified 14 environmentally degraded areas in which to undertake pilot projects with a view to bringing about improvements in the quality of those areas. The areas are:

- | | |
|------------------------|------------------------------|
| 1. Modhupur Tract | 8. Teknaf Peninsular |
| 2. Haor Basin | 9. Mirsarai-Sitakund Range |
| 3. Lalmai Hill Range | 10. Jinjira Coral Island |
| 4. Matamuhuri Delta | 11. Karnafuli |
| 5. Saline Polders | 12. Sitalakhya and Buriganga |
| 6. West Barind | 13. Bhairab-Pussur |
| 7. Garo Hills Piedmont | 14. Muhuri |

Work is in progress on some of the pilot projects.

Rivers such as the Karnafuli, the Buriganga and the Sitalakhya, and the Rupsa which flow through the industrial cities of Chittagong, Dhaka and Khulna respectively, are reported to be the most polluted rivers. Of these rivers, the Karnafuli is the most polluted because it receives the industrial effluents from the Karnafuli Paper and Rayon Complex. Surface water in and around the Dhaka city, which has a large concentration of industries, has also been very badly affected by the indiscriminate discharge of industrial effluents. Virtually none of the 300 Dhaka city industries, surveyed by the DOE, has waste treatment facilities.

River water pollution has caused extensive damage to fisheries

Kaptai Lake which produces about 4,000 mt fish annually is seriously infected by more than 100 strains of bacteria, although there are no polluting industries as such located on the shores of the 500 sq km lake. A fish disease, identified as Epizootic Ulcerative Syndrome (EUS), has recently become very common in Bangladesh and is causing the large scale death of inland fish. No remedy, medical or otherwise, has yet been found to combat it.

E.5 Conclusion

Any country with more than 110 million people living in an area of only 144,000 sq.km. would be resource-poor and Bangladesh is no exception. Poverty, hunger, illiteracy are only some of the problems. The depletion of resources continues almost unnoticed. Loss of forest resources, shrinking wetlands, silting of rivers and poorly planned roads, constantly produce strains on the environment. Much of the damage caused to the environment by the many thousand miles of flood control embankments and the Kaptai dam are irreversible.

Climate poses important environmental constrictions on agricultural activities in the Tropics. The severity of climate, vulnerability of the soil, and uniqueness of the biological regime all combine to make agricultural activities complicated.

Existing industries mostly based on old technologies, are without waste treatment plants which results in harm to the environment and in the long run will be very costly. Urbanization of about 6% pa and population growth of 2.3% pa are quite high. These have severe effects on the physical and biological environment.

In Bangladesh, as it exists today, serious consideration should be given to preserving the resource base and protecting the environment for which cautious planning is needed. DoE and other concerned agencies the BMD, the BWDB and the SPARRSO should be strengthened in terms of manpower as well as technical capabilities. (Annex B).

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H

ASSISTANCE TO MINISTRY OF RELIEF
INCOORDINATION OF CYCLONE REHABILITATION
(BGD/91/021)

FINAL REPORT

VOLUME II

NATURAL DISASTERS AFFECTING BANGLADESH

PART 2 : SOCIAL ASPECTS

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(Ishrat Shamim and Jahangir Kabir November 1992)
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- E. Persons met

VOLUME II

NATURAL DISASTERS AFFECTING BANGLADESH

PART 2 : SOCIAL ASPECTS

SUMMARY

Objectives

S.01 The objectives of the study were aimed at identifying :-

- vulnerable groups and their causes of death;
- people's perceptions and awareness of disasters;
- the extent to which different groups were aware of and understood the warnings issued;
- people's response to present warning systems and shelters;
- ways that individuals, groups, communities, and specialized organizations attempt to cope with natural disasters and its devastating impact;
- the coping mechanisms that operated within and between households and village communities, among different social and gender groups, and the factors which enhance or diminish individual and community capacities;
- lessons learnt from the experience of recent natural disasters about the state of disaster management;
- the specific needs of different groups for education and training, and actions to be taken to reduce human risks and minimize losses;
- the specific needs of community leaders, government officials, and NGO personnel for training in disaster related issues, particularly the social and gender aspects; and
- the policy implications and recommendations which follow from the consideration of the above issues for activities to be included under FAP-11.

This Working Paper discusses the above issues on the basis of the literature reviewed and the field visits made to disaster-prone areas. However, the Paper focuses upon the social and gender issues.

Introduction

S.02 Bangladesh is widely known as a land of natural disasters. The country's resources are limited and poverty is pervasive. Against the backdrop of repeated disasters : cyclones, storm surges, floods and riverbank erosion, not only does poverty increase, but the hardships and miseries of poor people are worsened. With a predominantly rural population, which is largely dependent upon agriculture, poverty is influenced by two types of access, one to cultivable land and the other to employment opportunities. The same is true in the urban areas, where there is a limited industrial base. The results of population growth remain, however have to be dealt within the rural areas.

S.03 The dramatic increases in population and density increase disaster risk. The fruits of development are taken away both by the disasters themselves and the consequent unproductive expenditure utilised to manage the response. Government is therefore forced to divert its limited resources, earmarked for overall development activities, to provide relief, rehabilitation and reconstruction of infrastructure. These activities have a negative impact on the country's economic growth and development.

Background

S.04 Geographically, Bangladesh is vulnerable to cyclonic storm surges, floods, coastal and riverine erosion. The traditional (inequitable) social structure results in poor landless people being forced into the most high risk areas. Hence, the most vulnerable are at the greatest risk.

S.05 The April 1991 cyclone was one of the most severe cyclonic storms in the history of this disaster prone country. It resulted in a death toll at nearly 140,000. The response of many people to the cyclone warnings and orders to evacuate with their movable property and livestock to either cyclone shelters or other safe and secure places were of indifference and disbelief. It is estimated that less than 20 percent of the inhabitants moved to safe places.

S.06 Excessive floods bring about disruption to normal life patterns and result in massive uprooting of people, many of whom become virtually destitute overnight. The floods in 1987 inundated about 40 percent of the land area and affected about 30 million people. About 1800 deaths were caused, while the 1988 flood surpassing all past records, inundated about 60 percent of the land area and affected 45 million people causing about 2330 deaths.

S.07 Riverbank erosion also uproots people from their settlements like floods. The difference is that this phenomenon results in the affected people losing everything they have - their entire land and homestead, sometimes their only resources for income generation, employment and habitation. As with all disasters, it affects the poor the most. They resettle on the embankments or migrate to urban centres to seek employment.

Disaster as a Social Phenomenon

S.08 The social dimension of disaster may be considered under four headings : causes, characteristics, consequences and human action. This approach gives a social science

perspective on the causes and consequences of disasters and provides feedback for social action at individual, community and national levels.

S.09 Repeated disasters lower the morale of the people, generate frustration and discourage people from making investments and hence slows economic development. The evolution of effective disaster coping mechanisms thus call for extensive training and manpower development of the affected people and the various categories people who are involved in relief as well as rehabilitation operations starting from the grassroots right up to the national level.

S.10 In all disaster prone areas disaster resiliency should be the primary consideration and it should be an integral part of development planning. All important infrastructure should be planned, designed, implemented, operated, and maintained to withstand known and expected natural hazards.

Social Vulnerability and Coping Mechanisms

S.11 Records of past disasters indicate that the people who are particularly at risk are single parent families, women, particularly when pregnant or lactating, mentally and handicapped people, disabled, elderly and the children. Similarly, people living and working in remote coastal areas and seasonal migrant labourers are also at risk. People, as a whole, react to disasters much better than they are usually given credit for. This is evident from the experiences of the successive floods in 1987 and 1988 and the cyclone of April 1991.

S.12 The capacity of an individual, family or village community to economically survive any crisis, be it a cyclone, surge, flood or other disaster depends on the resources they have at their disposal. It is therefore not possible to separate the issue of how a family or a community prepares for or copes with a natural disaster without considering their resource base - this may be economic or based upon community support resources. It follows that those with the smallest resources to begin with are the most vulnerable to economic loss. Natural hazards uproot people from their settlements, cause unemployment and marginalize people with few resources.

S.13 Women's traditional role in the division of labour

- preparing food
- taking care of the house
- fetching water
- gathering fuelwood
- rearing children
- looking after the sick and elders
- homestead production
- becomes more difficult to perform under the adverse post disaster situation.



Similarly, children who carry out vital but not paid activities, such as gathering fuel, fetching water, caring for younger children and similar activities are also affected. As a consequence, displaced women and children have to work for a greater number of hours.

S.14 In general, coping with poverty is more difficult for women and the aftermath of a cyclone or storm surge affects them most. Their men who survive a disaster have less opportunities for work as many of them lose the equipment necessary to earn a living, fishing nets, boats, livestock and poultry as well as their houses and belongings. However, it still remains the women's responsibility as wife and mother to cook and provide water for those of her family who survive.

S.15 Destitute women and children, without income or shelter have to live under the most acute conditions of deprivation and social insecurity while older women are helpless and forced to live on charity. The impact of disasters are far more severe on women and the children belonging to the poorest, this is reflected in the higher incidence of diarrhoea and measles amongst these children and the high rates of infant mortality in the post-flood periods.

Lessons Learnt from Field Visits

S.16 Group discussions were held in Sandwip, Sitakunda and Cox's Bazar to obtain information about the affected people, and their response before, during and after the cyclone, in order to assess the felt needs. Both men and women stated that the present warning system and the way the signal numbers are announced were not very well understood. Only between 10-20 percent moved from their houses to cyclone shelters and other safer places. Those families who did move actually took the decision only after water had entered seaside villages, having overtopped the coastal embankments.

S.17 People usually preferred to go to the houses of their well-to-do kin groups who mostly had tin roofs and or lofts ('dorma') believing it to be safer and more protected from the wind and the storm surge. Unfortunately, the tin roofed houses collapsed and in the process, people sheltering between the roof and the ceiling could not come out and were pressed between these heavy structures. The death rate was higher among families who took refuge in such shelters.

S.18 Many cyclone shelters, community centres and killas are located far away from houses in Sandwip that they are supposed to serve. They are not maintained properly: shelters had broken windows, doors and cracks on the roofs, while 'killas' were covered in bushes and jungle. As such, people preferred to stay in their own homes, believing that if the buildings collapsed, nobody will be able to survive.

S.19 The male members of families living on embankments and seaside villages were mostly away working at different places. They were not with their families at the time of need. The women and children stayed at home, waiting for their menfolk to come home and decide whether to move to safer places. Women do not have a significant role in decision making hence many women and children could not decide whether to leave home for the shelters.

S.20 In char areas of Ramgoti, Sonagazi and Mirsarai, migrant landless households have their dwellings built on macha to protect them from the daily tidal surges that submerge the area. Apart from agriculture, which is the primary occupation, fishing and cattle rearing are undertaken as secondary occupations. Many migrant labourers are engaged in such work,

although they have no assets.

S.21 The loss of human lives was comparatively lower in the char lands as people's response to the cyclone was quicker. Many people took refuge on the embankments, macha, and the earthen killas. Fortunately, for them the wind direction changed from south to the north at the vital moment or these coastal areas would have been more badly affected.

S.22 People of all social classes are reluctant to move to safer places because they do not want the inevitable dislocation that such a move causes. They are also afraid of losing possession of the land and other assets. They often do not even go to the mainland markets for fear of leaving their homes unattended, although their wives would be staying on in the homesteads. Insecurity and frequent char fractional violence and harassment cause this behaviour pattern amongst the char people.

S.23 Within the household, the consent of male members plays an important part in all decision making concerning women's movements and social participation. Thus, women have very little knowledge about warning systems and its content. Even if women were eager to go to shelters for the safety of their children, they have to depend on male decisions.

S.24 Since 1970 riverbank erosion by the river Jamuna in parts of Jamalpur has resulted in a considerable loss of land. Some households have been displaced five times since. In the process, many land owning households have become landless. Women are often abandoned by their husbands, and have to take over the full responsibility of running the entire households.

S.25 Among the displaced households living on embankments or in other people's compounds, the status of women has become lower in the social milieu. As a consequence, divorce, separation, desertion and prevalence of dowry demand have increased.

S.26 Erosion is not the only phenomenon, accretion is also taking place. Accreted land is unstable for some time after its formation and it is not feasible to use it for settlement and cultivation purposes. People commented that the accreted lands were more liable to be eroded in future and some symptoms had already been noted.

Concluding Comment

S.27 It is evident that poverty has increased the burden of women's work. Furthermore, over the last two decades, Bangladesh has experienced natural disasters of great dimensions which have placed millions of women on the margin of survival. If development priorities persist in ignoring gender inequalities, it will further tend to erode women's capacity to cope.

DISASTER AWARENESS SLOGANS

During discussions with different sections of the community (e.g. people at large, NGO workers, teachers, members of Union Parishad group members of organised by GOB & NGO). They were asked to suggest appropriate messages/slogans to help the process of stimulating awareness and to make people prepare for disaster. This was a brain storming exercise. The people suggest a lot of ideas/slogans/messages. These are given below:

- Don't disbelieve and ignore the Great Danger Signal.
Don't be indifferent to it.
- Make preparations to go to Cyclone Shelter as soon as you hear the announcement of the Great Danger Signal.
- Organise your family and kinship members. Arrange to keep livestock on killas, high embankments or roads situated in safer more distant place.
- Help women, children and old aged people to go to shelters.
- Take tubewell water and some food while going to shelter as reserve food so that you can use them for first 4-5 days after disaster.
- Help each other to go to shelters. If some people are unwilling to go, create social pressure on him/her/them. Remember it is a social responsibility to organise and help people for survival.
- Do not consider roof-tops of houses, high embankment, roads near to coastal areas as safe refuges.
- Those who are living on the embankments, villages, chars and accreted lands nearest to sea, must move their houses nearer to cyclone shelters.
- Remember life of human being is valuable.

If together with your family members you can survive the danger Insh'allah you will be able to acquire resources and assets in future. It is your task to take preventive measures against any danger. Allah will help you.

- After coming back home, first repair your tubewell collectively. Drink tubewell water. Use ORS in case of incidence of diarrhoea.
- Prepare your immediate needs collectively. Ask local Government and non-government agencies to respond to your needs. Help government to implement relief and rehabilitation programmes properly.

- Give priority to destitute women, children, orphans in access to relief assistance. Help each other and share your inputs whatever you have for reconstruction and rehabilitation purposes like : house repair, cultivating land etc.
- If following Great Danger Signal, a cyclone does not come to not consider it a waste of time to take shelter or feel yourself stupid. Think that it might have come.
- Remember, cyclone shelters, killas and Government 'pucca' structures are constructed for the whole community. You have every right to take shelter in the event of danger.

CHAPTER 1

INTRODUCTION

1.1 Background

Some countries are more prone to natural disaster than others and Bangladesh is one such country. Bangladesh stands third in disaster events that occurred between 1960 and 1981, after India and the Phillipines (USAID, OFDA, League of Red Cross and Red Crescent Societies and World Bank). However, in terms of the number of people killed Bangladesh was highest with 633000 (Hagman, 1984).

Patterns emerge while looking at the indicators of vulnerability in the disaster-prone countries. It appears that the amount of damage and lives lost usually bears a close relationship to the level of economic development. The less developed countries are affected more severely and within a disaster-affected community the poorest and most disadvantaged groups are likely to experience the most serious consequences.

By now, Bangladesh is widely known as a land of natural disasters. The country's resources are limited and poverty is pervasive. Against the backdrop of repeated disasters: cyclones, storm surges, floods and riverbank erosion, not only is poverty increased, but the hardships and miseries of the poor people are worsened. With a predominantly rural population, highly dependent upon agriculture, poverty becomes a function of two types of access, one to cultivable land and the other to employment opportunities in the countryside. The same is true for urban employment, which has a limited industrial base. The ramifications of the population growth remain, therefore, concentrated within the rural areas.

The fruits of development are taken away both by the disasters and the consequent unproductive expenditure to manage the responses caused by such natural hazards. The Government of Bangladesh is therefore forced to divert its limited resources, earmarked for overall development activities, to provide relief, rehabilitation and reconstruction of infrastructure which are ultimately leading to a negative impact on the country's economic growth and development.

Bangladesh's topography, formed by three of the largest river systems of the world, its funnel like coast and extensive rainfall enhance flooding and bring about natural disasters like cyclones and storm surges. Deltaic Bangladesh is crisscrossed by three giant rivers - Ganges, Brahmaputra and Meghna and their numerous tributaries. The physical landscape of Bangladesh appears as a vast plain, sloping gradually southeastward reaching the Bay of Bengal, formed by sediment deposits. As a result of the alluvial process, hundreds of chars emerge in these rivers.

The southeastern estuary, covering the area from coastal thanas of Barguna district in the west and Chittagong/Cox's Bazar coast in the east is actually a death trap in the context of cyclone and tidal surges. The country's coastal region, the worst hit by cyclone and storm surges, is the home of 15 million people who depend on the land for their livelihood activities. The poor and the landless are often forced into these most vulnerable portions of the delta where the land is very close to the sea and the emerging chars which have not yet stabilized.

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Dramatic increases in population size, distribution and density increase disaster risk. Natural hazards such as floods, riverbank erosions, cyclones and storm surges do not in themselves constitute disasters until they strike at human lives, livestock, crops and properties. Floods are part of the natural environment of Bangladesh and the success of local people in adapting their life styles to accommodate seasonal floods has resulted in high population densities throughout most parts of the country (ISPAN, 1992).

Ten major floods struck Bangladesh between 1954 and 1987. While 1987 flood was a combination of flood flow from across the border and very high rainfall within the country, 1988 flood, which in their severity and intensity surpassed all records, was mainly due to an unprecedented flood flow of the Brahmaputra that had a closest synchronization with the Ganges and the Meghna flood. Floods in 1987 inundated about 40 percent of the land area (57,000 sq.km), affected about 30 million people, and caused about 1800 deaths. In 1988, the floods inundated about 60 percent of the land area (82,000sq. km), affected 45 million people, and caused about 2330 deaths (World Bank, 1989).

Among the various kinds of flooding which occur in Bangladesh, the most intense type involves inundation of coastal areas by storm surges accompanying cyclones. According to Chowdhury (1991), the maximum value of storm surge can be as high as forty feet in the Bay of Bengal. A major disaster followed from the impact of such a cyclone and storm surge on 29th April, 1991 which was due to the inadequacies of flood mitigation measures in coastal areas. Winds gusting up to 225 km/hour, torrential rains and a tidal storm surge, up to 7 m deep in places, lashed a 150 km stretch of coast. Rising water submerged densely populated offshore islands and an estimated 140,000 people died, mainly by drowning. The cyclone affected a population of over 12 million people and damaged or destroyed more than 1.75 million houses, coastal embankments and other infrastructures (ISPAN, 1992).

1.2 Objectives and Scope of the Report

The objective of the report is to evaluate the impact and consequences of the various natural disasters namely cyclones accompanied by storm surges, floods and related riverbank erosions; more specifically, it will deal with:

- identifying the vulnerable groups and the causes of deaths;
- levels of people's perceptions and awareness;
- the extent to which different groups were aware of and understood the warnings issued;
- people's response to present warning systems and shelters;
- ways that individuals, groups, communities, and specialized organizations attempt to cope with natural disasters and its devastating impact;
- the coping mechanisms that operated within and between households and village communities, among different social and gender groups, and the factors which

- enhance or diminish individual and community capacities;
- lessons learnt from the experience of recent natural disasters about the state of disaster management;
- the specific needs of different groups for education and training, and actions to be taken to reduce human risks and minimize losses;
- the specific needs of community leaders, government officials, and NGO personnel for training in disaster related issues, particularly the social and gender aspects; and
- the policy implications and recommendations which follow from the consideration of the above issues including activities to be covered by FAP- 11.

The present report will highlight the above issues on the basis of evidence available. However, the analysis is essentially concerned with the social and gender issues in disaster management.

1.3 Sources of Information

The report is primarily based on evidence from secondary sources. These include published/unpublished materials, impact study reports, seminar papers, publications of different Ministries in the Government, and NGO's response studies in disaster situations.

Several meetings with Government officials, NGO personnels and donars were held which provided varied informations about strategies being taken in their respective fields of operation. These professional meetings also helped a lot in understanding their perspectives - their looking at things and how they wanted to run it.

In addition, there were personal meetings with individuals and organizations involved in disaster management, particularly the ones who were active during the recent April '91 cyclone.

Information from the above was supplemented by field reports of the cyclone affected belt, particularly of Sandwip, Sitakunda, Ramgoti and parts of Cox's Bazar. In addition, Islampur and Dewanganj unions of Jamalpur district were visited to investigate the effects of riverbank erosion on the displaced rural population.

CHAPTER 2

DISASTER AS A SOCIAL PHENOMENON

2.1 Introduction

The concept and definition of a disaster has altered over time, in accordance with the changing ideas and understanding of its various causes and effects. Sociologically, a disaster may be defined as an event, located in time and space, that produces the conditions whereby the continuity of the structure and processes of social units becomes problematic (Dynes, 1980). It reflects two fundamental characteristics of a disaster situation:

- disasters are social phenomenon; and
- even though the physical event may cause social disruption, it is not likely to cause social disintegration.

Seen as such, it can be expected that individuals and groups within a community continue to function after a disaster in approximately the same way they functioned prior to a disaster.

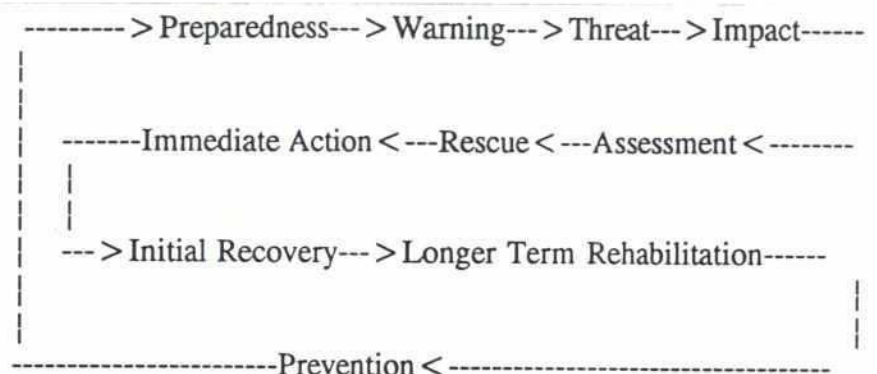
The approach of looking at disaster as a social phenomenon centres around four basic issues: causes, characteristics, consequences and human action. This approach provides us with a social science perspective on causes and consequences of disasters and secondly it gives feedback for social action at individual, community and national levels.

The same approach has been elaborated by Quarantelle (1981), who specified the different aspects and viewed disaster as:

- as a physical phenomenon, e.g. cyclone, floods;
- as physical impact which is the damage caused;
- by degree of physical impact;
- as social disruption from the physical impact i.e. threat as a stimulus;
- as a political definition which is based on political consideration; and
- as a special social situation relating only to certain demands and the ability to meet those demands such as collective ability to meet the requirements of a situation.

Analysis of the social issues in any disaster situation requires study of the various basic social units, such as individuals, communities, small groups, institutions, organizations and societies (United Nations, 1986). It is necessary to consider how these units operate, separately and as a composite whole, what problems each is likely to face, and ways in which the contributions of each one can be supported.

The disaster experience should be conceptualized as a process (United Nations, 1986) with differing phases:



The issues, actions and problems in each of the different phases encountered and the people involved may be quite different. Therefore, prior and better understanding of disaster situations requires the analysis of the issues involved, actions undertaken, and problems encountered in each of these different phases. Furthermore, disaster situations require intensive study of all the basic social units which includes individuals, communities, kin groups, institutions and organizations. At the same time, it is necessary to consider how these units operate separately as well as a coordinating whole whenever a disaster occurs.

2.2 Natural Disaster Response Mechanisms

In Bangladesh context, in spite of traumatic experiences during any major disasters like cyclones, storm surges, floods and riverbank erosions, human response to such crisis is most likely to act according to the needs of the situation. Most likely, people continue to stay in those potentially risk areas rather than leave. When people do decide to move, they usually do so as family units.

The immediate response of those who survive are likely to be search and rescue of other family members or kin groups. Actions undertaken are mostly self-initiative, rather than being directed from outside the community. There may be varying degrees of stress reactions in the aftermath of any devastating disaster like depression, fatigue, nervous breakdown, mental disorder, sleeplessness, loss of appetite, stomach upsets and diarrhoea, and other disturbing behavioural patterns.

Stress may be intense depending on the prolonged duration, timing of its occurrence, physical destruction, loss of human lives and injuries, and uncertainty. Some of these above mentioned reactions may stem from either the devastating effect of the disaster itself or the difficult living situation where even the basic needs are beyond the reach of the affected people. Sometimes a severe shock or a disaster syndrome may be observed among some persons who are at a loss of purpose or direction. Given the above scenario of people's behaviour, still people are likely to be resilient and act purposefully in life saving activities.

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Whenever a disaster is likely to occur, loss of personal possessions is a dominant concern especially among those who have very little resources. It is one of the cause for people to risk their lives unduly. Usually people may refuse to evacuate in order to protect personal property, or try to go to shelters at the last hour, or get a family member to remain behind with the property while other members have taken shelter for safety.

Often, it is found that people do not recognize the potential danger which are existing in certain disaster situations. People do not act as soon as they hear warnings unless they themselves are convinced that the situation will be life threatening.

Given the above assumptions based on experiences and observations in any natural disaster situations, individuals should be seen as human beings with needs and perceptions of their own. Thus disaster preparedness should be perceived as a family function or kinship function rather than involving a large body of community members, some of them may not know each other.

The family unit is the most basic coping mechanism, as disaster victims do not act as independent individuals, but rather their responses are influenced by the families to which they belong. Immediately after any disaster, it is the family which enables disaster victims to cope with the hazard situation. Family and kin-group are the most significant responding social units for the purposes of decision-making, economic, social and psychological support. Studies have demonstrated that priority for assistance of any type are provided to children, spouses, parents and other family members and kin groups.

Drabek (1986) expressed that in a disaster situation, family members move together and attempt to stay together. As such families are likely to decide collectively how to response to a particular disaster situation even if when there is disagreement among the members. The elders usually decide on strategies to be undertaken and by whom. Emotional stress may arise due to individuals, particularly children, being separated during the time of crisis from other family members and parents. Parent-child relationship is especially significant, as because children being left alone or separated from their parents after a disaster has occurred will be at a loss and may be exploited by known persons or strangers.

Whatever may be the response by different groups or families in a disaster situation, disasters do bring about changes. But experience has shown that there is an overwhelming tendency of individuals, family groups, and communities to try to return to pre-disaster normality. As such disaster is best perceived as a social interruption, (United Nations, 1986) with most social dynamics later returning to their pre-disaster norm.

In some situations, disasters do accelerate processes and changes already taking place within a community. But however, in most cases, communities usually resist efforts to make major changes, like livelihood activities, evacuation, housing settlements, etc., and attempt to return to pre-disaster normality, as far as possible.

CHAPTER 3

SOCIAL STRUCTURE OF DISASTER PRONE AREAS

3.1 Introduction

The coastal belt and the flood plains of Bangladesh with its numerous islands and accreted charlands, is marked by a distinctive socioeconomic structure and political organization. The agrarian communities of these disaster prone areas are dynamic, not static, in structure. Landlessness is a process; yesterday's small farmer is today's landless, today's small farmer is tomorrow's landless (Kramsjo and Wood, 1992). In a country where 90 percent of the population is rural, the significance of landlessness cannot be underestimated as more than half is effectively without land. Therefore, to own land or other assets beyond the utility of one's own family labour supply places that family in a powerful position over other families.

Char life is considered a special category of rural life having what is locally called a choura subculture which is belittle by people on the mainland because of the poor, tough, uncertain but necessarily repeated and habitual adjustment to the everyday risks of coastal and riverine hazards, erosion and displacement (Zaman, 1991). Therefore, terms of ownership and control of char land and tenancy relations are important to understand the dynamic of char life in the context of displacement and resettlement.

3.2 Land Tenure

In the coastal and riverine regions of Bangladesh, there is a continuous process of land erosion and accretion. Such a process results in non-sedentary human settlement. In 1972, the Presidential Order extinguished all rights of tenants and proclaimed that all newly emerged land previously lost by diluvion shall be considered as khas land and shall remain under the control of the government. But the content of the new legislation was not welcomed, particularly by the talukdars and jotedars whose local power base was threatened by the possible mobilization of the landless to form cooperative groups to control and utilize new depositional land.

In 1975, it was followed by an amendment which provided access to new land by the previous owners subject to the existing ceiling of 33 acres for individual ownership. Two types of ownership were recognized by the amendment. First, those who have lost the land may claim ownership of new land which reappears in the same place within a period of 20 years. Second, if new land comes up, preference will be given to those having land contiguous to the new depositional land. These provisions for individual ownership of accretion land further strengthened the local influential persons to regain more than they have lost - if necessary, through violence, and ultimately deprive the landless and displaced peasants from having access to new depositional land (Zaman, 1991).

The erosion and accretion process creates a class of powerful land grabbers who are locally known as jotedars (Jenkins and Ahmed, 1988; Elahi, 1990; Kabir, 1992). The land grabbers are in constant look out for land lost in erosion, not necessarily their own, and at re-surfacing of such land, they stake their claims by force or by producing fictitious documents, which they acquire through the connivance of the local land department officials (BUET and BIDS, 1992).

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The case of charland in Jamalpur can be cited to highlight the peculiar character of land ownership pattern, where erosion and accretion in the Jamuna river is widespread. People at large continue to pay the rent for land even if these go into the river. They are well aware of the existing law relating to erosion and accretion, especially land emerging due to accretion to be declared as khasland. But the char inhabitants do not want that their land to be declared as khasland. Field discussions with displaced families in Horindhara (Jamalpur) affirmed that people continue to pay the rent for the eroded land with a view to continuing their right of ownership. Similar findings have been documented in the Char Study Report of Jamalpur (1992) where owners have got back possession of the eroded land even if accession took place after 10/15 years later. This type of local practices has lead people to pay rent for eroded land and people themselves have managed to do the job.

The Multipurpose Cyclone Shelter Study (1992) found erosion and accretion to be prominent in the coastal area when major changes of river courses take place either by geological activities of subsidence or upliftment or by human interference, such as cross- dam, embankment, sluices, etc. Major stable accretions were found in the coastal belt of Patuakhali and southern part of Bhola district. The study estimated that erosion at the rate of 3 sq km and accretion at the rate of 15 sq km took place in the last 20 years and islands in this region may grow by silting up of small channels. But the major threat of erosion in the next 25 years may be in the region of northern part of Bhola, Lakshmipur coastline, north and northeastern parts of Hatiya, north and western parts of Sandwip.

Since erosion is endemic on the coastal areas and flood plains, most households in char villages have insufficient land for subsistence and survival. The scarcity and unequal distribution of land, together with limited access to depositional land, force peasant households to develop asymmetrical patron client ties with local landed elites. Of the multi-stranded relationships that bind the peasants with patrons, the most important one is their use as lathiyals by local landlords, who are constantly struggling with each other to secure control over new charland and to expand their agricultural frontiers. The battles for land resources permeate all social and political relationships between patrons and their dependent clients because ownership or use of land is the prime factor of adjustment to repeated displacement in the coastal and char areas (Elahi and Rogge, 1990).

One of the main problems of char land administration is unnecessary delay in survey and settlement of new chars. Delayed settlement operations again work to the benefit of the local jotedars and talukdars as land grabbers, because possession remains a crucial factor in the eventual determination of ownership. A new char once it has stabilized, becomes a target for encroachment, typically groups of landless families are moved onto the char apparently supported by powerful jotedars who make violence endemic in char areas (Zaman and Wiest, 1985; and Zaman, 1987). The Government of Bangladesh has reportedly lost control over many chars due to this delay in survey and settlementt operations (Ali, 1981). Furthermore, incomplete, fictitious and faulty records have turned up, according to one report (Alam, 1984), as sources of as many as 10,000 litigations annually in Bangladesh. It is evident from the above discussion that lack of timely and accurate survey operations is a contributing factor to land conflict in charlands.

3.3 Kinship Organization

In Bangladesh, a group of homesteads usually makes up a village neighbourhood known as the para. And within each para, there are paribars or nuclear households which are arranged into extended kin groups. Most households occupy a bari or homestead that might include more than one related family, and they share a common courtyard and other facilities like wells, tubewells, etc. There are varying degrees of cooperation and solidarity between these extended kin groups. A landless paribar may be part of a closely knit group of otherwise land owning paribar.

A household is likely to have many ties to others in the village through marriage or patrilineal descent called the gushti or bangsho. Networks of relations through married in women can be very important in crisis. Women typically move to their husband's homes after marriage. Indra and Buchignani (1992) demonstrated the importance of non-patriarchal ties while studying the relocation decisions of women in erosion uthuli or displaced families of Sirajganj. Most women of all age groups maintain contact with their natal homes, where they may or may not have property ownership rights.

The village neighbourhood is an important social resource during any type of disaster crisis. Village studies show that the neighbourhood often centres around patron-client ties to a prominent man, a leader referred to as a matabbar. Adnan (1990) refers to the social institution of the community group known as shamaj, which lie beyond the family and the kin group. They serve to coordinate activities of individual households which, generally are unrelated by kinship ties. Households belonging to a particular shamaj have reciprocal rights and obligations, and are expected to cooperate with each other at times of critical events and crisis situations. The shamaj also have roles to perform and resolve conflicts between its member households, whereby it is essentially a kind of indigenous court, presided over by the leaders of the shamaj concerned.

Decisions taken by household units cannot be understood without reference to the socioeconomic position of such households and their political alignments to village patrons. Most vulnerable in this context are those households that lack the necessary labour and internal structural requirements for self production. Many female headed households suffer from this dilemma, making them particularly dependent upon patronage. Kin-based domestic arrangements continue to reflect the dominant ideology of the community, while at the same time, adjusting to the political and economic realities that offer both opportunity and constraint (Elahi and Rogge, 1990).

3.4 Power Structure

Here the concept power means command over resources and command over men (Bailey, 1960). And the focus will be on the processes through which the local jotedars and talukdars acquire and maintain their power and control the dependent peasant households. Local control of depositional land by jotedars and talukdars is achieved through violence using patron tied dependents as private armies of lathiyals.

The economic and political stability of local jotedars and talukdars is largely dependent upon their control and exploitation of charland in terms of labour relations, employment,

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sharecropping, and appropriation of surplus. A diversity of contract relations exists between peasant households and local landlords which shows features of semi-feudal relationships in terms of peasant landlord relations of personal dependence and political services (Elahi and Rogge, 1990).

There are two main means of acquisition of power (Zaman, 1991):

- possession or control, directly or indirectly, of depositional land for cultivation; and
- having a strong lathiyal bahini to intimidate through threat or use of violence against property and persons.

In fact, the power and authority of a local patron largely depend on the number of lathiyals he maintains or can mobilize during a confrontation. A subtle but equally important source of power is contact with local bureaucracy and administration. This contact is critical both for manipulating local administration and continued dominance over the peasantry.

CHAPTER 4

IMPACT OF NATURAL DISASTERS

4.1 Introduction

Where two-thirds of the world's population live in conditions of economic poverty and limited resources, 95 percent of disaster related deaths have occurred in such developing countries. During the 20 years period from 1970 to 1990, the average yearly losses in the 17 most disaster prone countries, which includes Bangladesh as well, were greater than that of 2.5 percent of their GNP (Khalilullah, 1992).

Geographically, Bangladesh is vulnerable to cyclonic storm surges, floods, coastal and riverbank erosions and the traditional social structure of inequality pushes poor landless peasants into the most high risk areas. As such, the most vulnerable are at the greatest risk. Both the scarcity of land and poverty drive the poorest farmers and fishermen community to a point of desperation and gives them very little options except to face the hazards of nature. Moreover, the prospects of rich harvests from the land and the sea attract both settlers and seasonal migrants.

4.2 Cyclone of April 1991

The cyclone which hit the south-eastern belt of Bangladesh during the late hours of 29th April, 1991, was one of the severest cyclonic storms in the history of this disaster prone country. The 74 km eye of the cyclone levelled everything in its way - houses, property, cattles, standing crops and other infrastructures. The worst hit was Hatiya, Sandwip, Kutubdia, Moheshkhali, Bhola and Manpura. The environmental hazards caused by the cyclone and storm surge in the islands and coastal mainland were human casualties, loss of agricultural properties and products, inundation of land and ponds by saline water, loss of houses, breakdown of sanitation, non-availability of safe drinking water and food.

Thousands died, another thousands more were missing in the fury of the storm surge which affected the coastal belt and outlying islands in 47 upazilas of 17 coastal districts. It is extremely difficult to provide any reliable mortality figures of a calamity of such proportion as this cyclone. However, official figures put the death toll at nearly 140,000. Casualties were almost entirely due to the storm surge. Maximum deaths occurred along the sea facing exposed coastal belt, including the low lying char lands and unprotected islands. A large number of families were directly exposed to the tidal ingress since long stretches of embankments were washed away.

Breakdown of deaths by age and gender indicated that children, followed by adult women, topped the list of the casualties. A detailed account of mortality in Magnama and other parts of Chakoria, based on the number of corpses (Adnan, 1992) estimated that about 70 percent of the dead were children, another 20 percent were women while men - young and old - accounted for the remaining 10 percent. Many of the women were mothers who died trying to save their children. In one of the island south of Mognama, a survivor claimed that none of the women there had survived (Bari, 1991). Information from news media gave figures as high as 85 percent of the deaths were that of women and children (Hena, 1991). Eye

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witnesses had expressed the same views. Children, the most vulnerable, succumbed in large numbers and UNICEF estimated that 60,000 children had perished in the catastrophe.

In addition, deterioration of environmental and health conditions, resulting from the cyclone, led to further deaths during the subsequent weeks and months. Very few people actually died from injuries sustained during the storm. Most of the deaths were attributed to post cyclone diseases such as diarrhoea, blood dysentery and cholera (Adnan, 1992). However, reports of death from direct starvation were few, except in the remote tracts of the off shore islands, such as Kutubdia and Maheshkhali.

Another component of mortality pertained to the category of the missing. Many people were swept away or caught in the open sea, and failed to come back to their own homes. One report claimed that nearly 100,000 fishermen had failed to return home after the cyclone (The Bangladesh Observer, 7 May 1991). Recently, two children, Yunus and Rahim who were swept away by the nightmare storm surge of April '91 returned after 17 months to their homes in Kutubdia (The Bangladesh Observer, 30 September 1992). Yunus, who was swept away by the sea from village Gandapara at the age of four, could not remember his fisherman family. He was rescued by a Hindu fisherman family who found Yunus unconscious in Bashkhali coast, some 30 miles off Kutubdia, a day after the cyclone. Since then, he has been living with them. Rahim was also rescued by some fishermen two days after the cyclone from the Khulna coast. Incidentally, both the boys returned home on the same day.

Then there were those who were severely injured and consequently became disabled. Many such injuries seen by SARPV team in Chakoria were caused by flying tin sheets at the time of the cyclone. There was a tragic case of a mother who had lost both legs and her daughter one leg. Injuries and dislocations were also caused by people clinging to the trunks of trees - usually coconut trees. They witnessed a 15 year old boy's two legs virtually frozen in the position he held them round a tree as the storm passed (Francis, 1991).

The human settlements in the coastal areas and off-shore islands mostly developed in an unorganized, unplanned and rather isolated manner. Due to acute population pressure and the consequent economic crisis, mostly marginal people migrated to these vulnerable places and settled down occupying whatever land they could manage to get.

Report of cyclone damage by UNCRD (1991) reveals that most of the residents in the newly raised islands are landless migrants who had to leave their original place of residence because of poverty, landlessness and lack of employment opportunities. They settled there being fully aware that the coastal areas are within the high risk zone and are subjected to frequent flooding by storm wave, storm tide and sea surge. Population density, particularly in high risk out of bounds char lands therefore accounted for the highest casualties. Most of these chars were outside the embankment area, and settlement was usually discouraged.

These settlements were devoid of any opportunities and facilities provided by the government. Poverty has contributed to the emergence of such human settlements in areas where survival depends largely on the mercy of nature. The housing conditions are also very poor to withstand the fury of the cyclonic storm surge. As such, damages to housing were extensive. A large number of families in the affected areas were rendered homeless. All

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kutchha and semi-pucca houses were damaged. Only 'pucca' buildings in the affected areas withstand the onslaught. Faced with such adverse situation, it became extremely difficult to cope with natural disasters depending only on community efforts.

Social vulnerability is increased by the concentration of migrant workers on the southern parts of the country. Many landless people go south to find a job for sowing, harvesting and fishing. Especially, April, May, October and November are favourable months for getting a job at aman paddy fields, but these seasons also coincide with two cyclone seasons. Also, these migrant workers increased the number of deaths to 300,000 in the devastating cyclone of 1970. Islam (1974) pointed out that migrant workers during the sowing and harvesting seasons contribute not only to increase hazard potential but also to make it difficult to estimate the number of casualties. In the field sites of Galachipa, Char Jabbar and Hatiya, the migrant harvesters live in temporary sheds almost at sea level, and are the most vulnerable in the event of a cyclone striking the coast during the harvest season, as happened in 1970.

In spite of the many disadvantages associated with coastal occupancy, most residents expressed their willingness to continue living where they are now settled. This indicates their indifference to the cyclone hazard despite their recognition of it. Fatalistic attitudes towards the environment combined with the absence of any alternative choice, particularly the lack of better economic opportunities elsewhere, have been the main factors in determining their continuous habitation in the hazard zone. Similar reasons were given by the residents in Galachipa after the severe disaster due to the November 1970 cyclone. Islam (1974) interviewed sixty-six residents in Galachipa, where roughly half of the population, including migrant workers, were killed. The reasons why the victims did not want to move were:

- "Almighty Allah knows everything" was the prevailing mood;
- the local landless or small tenant farmers, being assured of employment locally, appeared not to be interested in leaving their community for a place with fewer cyclones; and
- accordingly, a traditional inborn fatalism, limited freedom of movement, and local availability of employment, were factors for not moving from hazardous places.

Abeyesundere (1991) has rightly pointed out that the history of disasters in Bangladesh is essentially one of fatalism versus preparedness.

Certain specific economic opportunities have induced others, particularly the upper class, to take risks in the uncertain environment. Such opportunities are associated with, for example, bumper rice production in the deltaic coasts and abundant marine resources in the Chittagong coast (Haider et al., 1991).

The above analysis clearly indicates that the effects of cyclone are not only a function of the intensity of the cyclone, but also of various aspects influencing the process of socioeconomic development and environmental change. In other words, human settlements and related activities also play a significant role in determining the dimension of natural disasters.

4.3 Floods and their Impact

The flooding patterns observed in Bangladesh consist of a variety of complex processes. In broad terms, the following elements can be analytically distinguished (Adnan, 1991):

- inundation resulting from rising water levels,
- waterlogging due to congestion and failures in drainage systems, and
- erosion of land and other property by river activity.

While these are interrelated facets of the flood problem, they do not necessarily go together. These distinct components of the flood problem vary in the short and the long runs, as well as in terms of their causes and consequences. One striking feature is that while inundation by rising flood waters is mostly confined to the rainy season, bank erosion can take place at any time of the year, while waterlogging can be a perennial problem, stretching for years together.

About 85 percent of the population in Bangladesh live in rural areas, and 60 percent of rural people are classified as landless who own less than 0.5 acres (0.2 ha) or no agricultural land. Furthermore, 12 percent of landless have no land on which to build their own house. Floods disproportionately affect landless people and reinforce their poverty. In rural areas, they suffer the most due to isolation, unwillingness to move to higher ground for security reasons, lack of transport to replenish potable water, lack of fuel, and lack of livestock feed (ISPAN, 1992).

The patterns and processes of 1990 floods observed by Adnan (1991) clearly indicated that flooding not only led to substantial destruction of physical infrastructure and land, but as a consequence to massive uprooting of people, many of whom became virtually destitute overnight. However, a small proportion of those affected were able to migrate to urban centres, while most of them continued to leave under the open sky, or make shift roofs, on whatever elevated land was available. Such displaced families were confronted with acute shortages of pure water and edible food. They were also afflicted with water-borne diseases such as diarrhoea and dysentery. Shortage of food was particularly distressing in respect of children.

Floods bring about disruption in the normal life patterns and there is resulting shortage of income generating opportunities which becomes a major problem for the rural and urban poor. In a predominantly agricultural economy, the death of vital livestock and poultry also compelled many poor peasant households to embark on the declining trajectory of indebtedness, possibly resulting in eventual destitution. Equally, damages to standing crops also led to consequential loss of other assets through indebtedness, usufructuary mortgage and, in some cases, eventual sale of land mortgaged as collateral because of debt default (Adnan, 1991). During severe floods of active floodplain areas, such disruption may continue for periods of 6-8 weeks.

Other interrelated consequences of flooding affecting health and the environment included (Adnan, 1991):

- shortage of fuel for cooking and boiling for purification;
- the putrefaction of corpses and carcasses in flood water due to lack of fuel and dry land;
- spread of water-borne diseases; and overall
- general deterioration of healthy and hygienic living conditions.

The most severely affected are the poor who have dwellings beside rivers and ponds, on embankments, near railway stations and landing places, as well as low lying areas that are flood prone. Initial estimates during the 1988 floods (UNICEF, 1988) indicate that over one million homes were completely destroyed and approximately twice as many were damaged. And for the vast majority of the poor, a house is the work place, particularly for women and the self-employed. The floods forced millions of people to seek temporary shelter in relief camps or remain marooned on available high ground, rooftops and tree branches. Furthermore, damages to dwellings during floods results in prolonged exposure to rain and heat which in turn result in an increase in acute respiratory infections. While mortality rates in the relief camps was estimated to be relatively low, the shortage of drinking water and sanitation facilities was acute and the number of cases of diarrhoea high.

Although it is difficult to assess the total impact of these extremely adverse conditions on families, still the loss is considerable. Since 70 percent of a poor's person's income is spent on food, the loss of even a few poultry and livestock can affect already precarious incomes and hence nutritional status of families, particularly women and very young children. Firewood or kerosene must be bought to substitute for dung cakes, and basic food from the open market instead of the homestead garden. Another effect is an increase in migration to the urban centres of those made destitute, thus exacerbating the already serious problem of squatter areas and slums.

4.4 Riverbank Erosion Affected People

The shifting of major rivers in Bangladesh has long been a dominant environmental problem affecting a sizeable population. As a deltaic plain, the country annually experiences riverbank erosion hazard due to the shifting or migration of river channels, drought, cyclone and storm surges, particularly in the major floodplain areas and coastal belts. When erosion by river is associated with a widespread flood, the magnitude of destruction is enormous. As a consequence, village settlements, markets and towns are destroyed, cultivable lands are lost, thus displacing tens of thousands of people.

Historically, the major three rivers: the Ganges-Padma, the Brahmaputra-Jamuna and the Meghna play a significant role in the lives of people by making the land fertile. For a population which is 85 percent rural and mainly dependent upon agriculture, the majority of Bangladeshis continue to remain dependent upon the rural land resource base.

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The predominantly rural population is wholly dependent upon land holdings as owner-occupiers, tenants, sharecroppers, or as landless labourers. With such a resource base, hazardous events like the riverbank erosion or floods, makes the life and living only too vulnerable for the affected people.

Destruction by river encroachment renders a large population landless and homeless each year in the Brahmaputra-Jamuna and Ganges floodplain areas, which consist of one of the most densely settled rural habitats in the world, ranging between 1,500 and 2,000 population per square mile (Haque and Zaman, 1989).

While erosion removes land, new and fertile lands reemerge every year from river bed in the midst of the river channels where they did not exist before. Thus, both erosion and accretion of land are the characteristic features of the courses of the major river systems of Bangladesh. The newly formed islands, known as 'chars' are usually unstable and parts of it are occasionally wiped out. But where they have remained stable, new agricultural settlements have taken place. The accretional land formed by this process is also subject to continual erosion and change.

It is estimated that about 19 million rural people residing on an area of 7,755 square miles are at risk from bank erosion alone in the Brahmaputra- Jamuna and Ganges floodplain (Haque and Zaman, 1989). Not only the massive rural population are at risk, but also the urban population residing on the banks of these rivers face the blunt of riverbank hazards. These are important river ports like Chandpur, Serajganj and Chilmari which are densely populated urban areas and house of numerous squatter households along the banks.

About 8,000 squatting households have been living on the BWDB embankments from Kazipur to Chouhali via Serajganj which alone testifies the magnitude of the problem (Zaman and Bablu, 1985). Similar findings of Elahi (1991) estimated about 70,000 households who have taken refuge on the BWDB embankment alone from Kaunia (Rahgpur) to Hurasagar (Pabna) - an stretch of 248 kms of the embankment. Recent estimates reveal that 300,000 households have taken shelter, many for several years, on roads, BWDB embankments and on some Khas land.

Unlike other natural hazards like floods, cyclones, storm surges, drought and earthquake, the damage created by riverbank erosion is unreplaceable as the affected people loose everything they had - their entire land and homestead, sometimes their only resource base for income, employment and habitation. Islam and Rahman (1987) came up with a figure as high as about one million people that are directly or indirectly affected by riverbank erosion every year in Bangladesh.

When erosion occurs it affects all - rich or poor, but it affects the poor the most. Natural hazard such as riverbank erosion uproot people from their settlements, cause unemployment, damage infrastructure and marginalize people with little resources. With the highly unstable nature of riverbanks and channels leading to land accretion, displaced peasants is limited by local level power structure. Small landowners consistently appear to be the losers while large landowners gain control of most of the accretion and charlands.

The poor and the destitute either resettle in embankments or leave the village for employment elsewhere where they can build their shelter. They usually choose the area near to a town or port where a wide range of work may be available. Sometimes they rebuild temporary shelters nearby, again to be displaced within one year. There have been cases where people have been displaced ten times until they leave for urban centres. A number of studies on squatters in Bangladesh have found that a sizable proportion of riverbank erosion affected population migrate to urban centres in search of shelter, employment and food. Hossain (1984) found that over 10 percent of the erosion displacees in Kazipur migrated to nearby urban areas and ultimately end up in squatter settlements.

The displacees usually become landless day labourers, share-crop farmers, depend upon relatives or neighbours, or migrates to nearby urban centres. Many women were abandoned by their husbands with promises of taking jobs in other areas and to return in due time. The capacity of an individual, family or village community to economically survive any crisis, be it a flood or riverbank erosion, depends on the resources they have at their disposal. It is therefore not possible to separate the issue of how a family or a community prepares for or cope with natural disasters without considering their resource base - may be economic or others available to support community based activities. It thus follows that those with the fewest resources to begin with are the most vulnerable to disastrous economic loss.

Government response to the problem has been limited to infrastructure development by having embankments which have not been very effective in withstanding flooding and riverbank erosion. On the other hand, there have been no intervention or development strategies for those displaced.

CHAPTER 5

WARNING SYSTEMS AND SHELTERS

5.1 Introduction

A disaster warning system is an information system. The main goal of a warning system is to influence people to take precautionary action. Therefore people's understanding, motivation and ultimately to take protective action are important considerations. As such all must receive the information they need within a very short time. As time is limited, careful assessment and planning is needed.

5.2 Present Warning Systems and its Effectiveness

Warning messages are generally not formulated in a manner which motivates response. Standard messages presented by the broadcast media motivate people to seek additional information, but do not induce protective action. Unless information is given in a way as to convince residents or the potential people to be affected in susceptible areas that they are at risk, disaster warning services lack the effectiveness.

For effective disaster warning services, analysis is needed mainly in the three areas of concern:

- whether the warning message contains the necessary information;
- whether the message was understood by receivers; and
- whether the warning message stimulated receivers to take necessary action.

Problems arising from disaster warning messages are social, involving people's perception and interpretation. They are:

- language in some warnings is too technical to stimulate people to act decisively;
- people are often unable to translate general weather conditions into specific dangers likely to occur at the local level;
- insufficient geographical information to provide meaningful reference points; and
- awareness of an approaching disaster does not necessarily lead to the adoption of appropriate precautions.

Currently, there are fifteen signal numbers for cyclone warning, eleven for the sea ports and four for the river ports. These signal numbers are meant for port authorities only. There is no warning system for the vast majority of the general public who reside outside the port area. Moreover, the highest signal number ten is raised even for a moderate storm. As the intensity of the storm increases from severe to very catastrophic, the signal number does not change correspondingly. Thus the present cyclone warning system fails to indicate the severity of the calamity (Khalilullah, 1992).

The dissemination of signals alone does not serve the purpose of alerting people to prepare for disaster. A separate warning system easily comprehensible to people, and a campaign for public awareness should serve to alert them better about the nature of impending disasters. Therefore, besides the existing system of warning for sea and river ports, a system needs to be evolved to warn people more effectively. Signals should be specific for the areas to be affected. Meteorologists should mention the particular places where people may be affected with a clear description of those areas.

Considering the above points, warnings should lay emphasis on:

- the timing of warnings must be assessed not too late or too infrequent;
- warnings will be better received if they are coming from local authorities with high status and credibility;
- disaster warnings stimulate more response if delivered in a face to face setting, for example, the door to door personal messages in addition to warnings by mass media;
- for conveying the disaster intensity, technical concepts should be supplemented with information about the likely physical consequences, e.g., the wind's speed and its effects on trees and roofs, etc.;
- warning systems should contain information about the specific community at risks, e.g., the fishermen, the landless labourers in the char areas; and
- precautions to protect property, emergency provisions to adopt, supplies to take when evacuating should be in the warning messages given.

To motivate people in the right direction, disaster warnings will be more effective if they include a combination of fear of consequences, factual information and personal accounts.

5.3 People's Response to Shelter Facilities

The purpose of shelters is to provide safe refuges for people during any natural disaster, be it river floods or cyclone surges. The main requirement is to give people a safe place above peak water level for the duration of the disaster. The only difference is that for cyclones, people need protection from high winds and storm surges over a period of hours, while the duration of river floods are longer as river floods tend to happen over a period of weeks or months. The total number of existing cyclone shelters is roughly 250 in the whole coastal belt

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of Bangladesh which can accommodate around 0.3 million people. Another 3 million people of disaster prone coastal areas need to be accommodated in the plan period of 5 years, for which a total of 3,273 cyclone shelters will be constructed. Out of the total, 2,000 shelters will be constructed in the area under Chittagong Relief Zone (Government of Bangladesh, 1991).

One major factor influencing the utilization of shelters was that people were unwilling to leave their possessions unguarded for fear of being looted and someone was usually left behind to guard their homesteads. Unfortunately, many of those left behind were subsequently unable to reach the shelters when the enormity of the cyclonic surge became apparent (ISPAN, 1992).

The devastating cyclone that hit the coastal belt of Bangladesh during the late hours of 29th April 1991, was not entirely unexpected. The potential threat of the approaching cyclone had made prominent news days earlier when a depression was detected in the Bay of Bengal. Prior to the cyclone, the Bangladesh Meteorological Department (BMD) issued the Great Danger Signal Number 10 which warned about the forthcoming severe cyclonic storm surge. The national press took it up and it was in the newspapers, radio and television, days before the actual storm struck. But to the vast majority of those inhabiting the remote areas of charlands and islands, lacked access to such warnings.

However, the threatened population was warned about the approaching cyclone mostly by volunteers. Bangladesh has jointly set up a Cyclone Preparedness Programme (CPP) with the Bangladesh Red Crescent Society (BDRCS) and the Ministry of Relief and Rehabilitation. Around 20,000 volunteers of the BDRCS, involved in the Programme disseminated the warnings and alerted the vulnerable population of the coastal belt by megaphone announcements and house to house visits. They also claimed to have evacuated about 350,000 people to cyclone shelters (Adnan, 1992) and various other safe places before the cyclone, although this amounted to only about one-tenth of the total number of people at risk from the cyclone, estimated to be at least 3.5 million.

In April 1991, cyclone disaster, due to timely warning, loss of lives were greatly minimized compared to half a million lost during the cyclone of 1970. On the other hand, responses of people to warnings to evacuate with their movable property and livestock to either cyclone shelters or other safe and secure places were that of indifference and disbelief. Many warnings had been issued, even the Great Danger Signal Number 10, on several previous occasions, but nothing that severe or devastating happened. Therefore people's belief in the warning was shaky and their preparedness to face the forthcoming storm was relaxed.

It is estimated that hardly 20 percent of the inhabitants moved to safe places (Caritas, 1992). Poverty is another factor for high death rate as people could not be convinced to go to shelters leaving their cattle heads and other belongings (Ferdous, 1991). The recent Multipurpose Cyclone Shelter Programme report (1992) found, particularly in Sandwip, only 5 percent women respondents have taken necessary action following the signal. They observed that loss of human lives is limited to landless and marginal landholding households due to kutcha or non-permanent types of their dwelling units.

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The pertinent question then arises: why do not people response and take refuge before being attacked by a natural disaster?

Matsuda (1990) discussed refuge seeking behavior during heavy rains in Japan, where it was found that refuge is not sought as a preventive action before circumstances become dangerous, but as a means of escape from danger; also many residents misjudge what will happen. Similar behavioural patterns could be noticed during the cyclone of April 1991. Government and non-government reports clearly indicate that lack of information did not appear to have been a problem, rather denial of the fact was the problem. In the event of the swiftness of the encroaching storm surges, people in their indecisiveness were totally unprepared to face a cyclone of that intensity.

Those who were aware as well as prepared, took refuge in the very few available cyclone shelters. Shelters were not only few in numbers but at the same time poorly maintained. Cyclone shelters were distant from people's homes and already over crowded. Shom Bala, 37 is a widow of Kutubdia said that there no cyclone shelter nor any public building in and around their village. After hearing the warnings, she with her two children went to a distant cyclone shelter, but a group of influential people refused them to stay. At the same time there were high risks involved in searching for shelter, so at last she came back home along with her children and instead took shelter in a neighbour's two storied house (Kafi, 1992). So for those who made the last minute decision to move to shelters could not find enough space and in certain cases had to return back home, finding no other alternatives.

A report from Kutubdia (Haider, et al., 1991) observed that 85 percent of all dead bodies belonged to women and children. They concluded that women depended on their menfolk to decide when and whether they should leave home for a safer place and were invariably in charge of looking after the children, particularly the younger ones. And in most cases, both the mother along with the children stayed home until it was too late. Another case was that of Nazrul Islam and his wife who had seven children. The wife took care of the four younger children, while the husband looked after the other three. They all took shelter on the roof top. After one hour, the seven year old daughter was swept away from the husband's hand, and the others luckily survived.

At the time of the cyclone and storm surge, people tried to save their lives by taking shelter on roof tops of the nearest buildings, community centers, schools, mosques, and other public buildings. In the process, many people were caught in the fury of the storm surge while on their way to such shelters and swept away. For those many, it was too late; the force of the storm surge with its height had made its way and it became too difficult to save their lives.

According to Saleh Ahmed, 50, Chairman of Kaiyer Beel Union, "When I heard Warning Signal Number 10 which meant that the tidal water would rise up to 6 metres, I tried to persuade people to go to cyclone shelters, but people did not believe me. In fact, I myself did not take it seriously as in baisakh there might be a storm but not a tidal surge." His son, Idris Khan reported that "around 11:00 p.m., the sea waves, which rose like mountains, hit the coastal embankment and that made people come rushing towards the cyclone shelter" (Haider et al., 1991).



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Most people decided not to leave their homes. In many cases, they were afraid of looting by vandals. They were the ones who took shelter on their own roof tops and trees, instead of going to a better and safe shelter. The squatters and settlers in guchchhagram did not move out of fear of being dislodged by local influential functionaries.

In the shrimp farms, hired labourers were required to work and remain in the field at the behest of their employers and managers. In fact, some managers and owners' representatives were in the field on the night of 29 April since it was a full moon night and a very important time for shrimp farming by capture of natural spawn (NEMAP Team Report, 1991).

Shelter is also of great importance to the most severely affected areas during floods, namely, chars, beels and haors. When evacuating the house during flood, the 30 sample villages' study of FAP 14 (1992) found that a majority of families chose to move together, although some members are left behind to guard possessions from thieves. An indigenous method of arranging shelter is uthuli, a sort of refugee identity that entitles a family to temporarily occupy others' property. Uthuli is however not considered a highly desirable option; but people displaced by riverbank erosion and other badly flood affected families are known to make much use of it (FAP 14 case study data, 1992).

However, people's behavior during floods seemed to be similar to that of cyclone affected areas; wherever possible people preferred to stay in their homes. Where alternative shelter may not exist at times of severe floods, building a macha was the most common shelter and evacuation response, with 29 percent of households building during average floods and 56 percent during severe flood (FAP 14, 1992). The study further revealed that in the char and beel areas, 26 and 30 percent of households respectively sheltered on boats.

CHAPTER 6

SOCIAL VULNERABILITY AND COPING MECHANISMS

6.1 Introduction

Dramatic increase in population size, distribution and density increase disaster risk. Natural hazards such as cyclones, floods and riverbank erosions do not in themselves constitute disasters until they strike at human lives and properties (United Nations, 1982). Since poverty is the overriding issue in a country like Bangladesh, human experiences of coping with disasters are best exemplified in the way the poor people cope with vulnerability due to external shocks like disasters. There may be a temporary panic situation, but individual resilience win and people take control of their situation, though not altogether. There are expectations of dependency, but ultimately there emerges self and group initiatives. People cope in whatever limited capacity they can and desperately try to achieve a semblance of normalcy.

In the coastal areas, there are groups whose livelihoods are at risk, living or working in densely populated areas, with low perceptions of risk, and without institutional support, the cumulative effect would be high social vulnerability for such groups. Records of past disasters indicate that groups of people who are particularly at risk are the single parent families, women, particularly when pregnant or lactating, mentally and handicapped people, disabled, children, and the elderly. Similarly, people living and working in remote coastal areas and seasonal migrant labourers may also be at risk.

If people are aware of potential hazards, their nature and their likely impact, and understand what actions need to be taken to reduce risks, then they become less vulnerable. There are likely to be three determining factors (Carter, 1991):

- poverty levels are important because the more the poorer people are exposed to everyday risks, the less they are concerned with infrequent hazards;
- risk perception relates directly to the level of public awareness programmes; and
- finally, the frequency of repeated hazards determines the perception of risk.

In sum, if there are groups whose livelihoods are at risk, living or working in densely populated areas, with low perceptions of risk, and without institutional support, the cumulative effect would be high social vulnerability.

The capacity of an individual, family or village community to economically survive any crisis, be it a cyclone, storm surge, flood, riverbank erosion or any other natural disaster depends on the resources they have at their disposal. It is therefore, not possible to separate the issue of how a family or a community prepares for or cope with natural disasters without considering their resource base - may be economic or others available to support community based activities. It thus follows that those with the fewest resources to begin with are the most vulnerable to disastrous economic loss. Natural hazards uproot people from their settlements, cause unemployment, damage infrastructure and marginalize people with little

resources.

To summarize, the implications of major types of disasters in Bangladesh are given below (Ahmed, 1992):

Type of Disaster	Vulnerability	Major Implications
Cyclones	Whole of Bangladesh.	Loss of lives, damage of human settlements and crops.
Floods	On average, one-fifth of the total area of Bangladesh goes under water every year.	Life and crop damages, damages to human settlements and physical infrastructures.
Storm surges	Coastal zones and upto 16 to 24 km inland.	Life and crop damages, high risk of human settlements.
Riverbank erosion	About 1 million people affected every year by erosion caused by 40 major and minor rivers.	High risk of human settlements, process of populerisation

In any disaster situation, the size of the affected population will certainly influence levels of awareness of the problem - the more people affected, the greater the awareness. But for Bangladesh, where natural disasters appear to strike with regular frequency, the numbers of affected populations are large because the situation is severe and considered abnormal and hence warranting special attention and intervention.

6.2 Cyclones and Storm Surges and its Aftermath

Those killed by the April '91 cyclone were silenced for ever. Survivors related their experiences, but with difficulty. No doubt their courage and determination helped them to cope with the aftermath (Akhter, 1992). Some termed it as the supercyclone.

"It was almost like keyamat," said the member of Harishpur Union, Sandwip, "I didn't think that I would survive, in fact, no one ever thought that he or she would live through it". People were crying and shouting, and they were praying to Allah and delivering azan (Haider et al., 1991).

People hit by the onslaught improvised survival techniques according to their ingenuity and means. In other words, since formal means to cope with the incoming disaster were extremely limited, people improvised their own means of survival and coping strategies. These included (Haider et al., 1991): drinking coconut water till first relief arrived, floating

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on bamboos, logs, branches and taking shelter in trees, sitting on rooftops of two storied buildings or on tin roofs or thatched roofs. The survivors said: "We survived miraculously. Allah saved us". In reality, they survived by taking refuge on the straw roof of their houses, by climbing a tree, by swimming until they reached the security of a concrete building, or by going to a formal cyclone shelter before the storm hit. Then there were some who did not know how they survived (Ahmed and Afreen, 1992).

Ayesha, 25, a fisherman's wife of Lamshikhali Union of Kutubdia took refuge along with her children on her neighbour's straw roof. Suddenly a solid wall of sea water washed the roof away. Ayesha with all her children fell and all her children was separated from her except the youngest daughter. She felt herself washed against a tree. As she grabbed a branch to climb the tree her daughter fell from her shoulder into the water. As another wave knocked her from the tree, she became unconscious. She recovered at dawn to find herself lying on a raised ground five km way from her house. A stranger came by and collected some straw and gave it to her to cover her body (Ahmed and Afreen, 1992).

Case studies vividly depict the desperate measures taken by people in the face of the onslaught of the cyclone. Md. Amanullah, 26, of Badarkhali while relating his experience said that people did not pay much attention to the warnings. But at midnight, the velocity of the wind increased and they were very anxious that their house would be damaged. But an hour later, when water entered their room, they all got on to the ceiling of the room. At that time, the wind was blowing very violently and the tin sheet over their head blow away and they all stood on the ceiling. Amanullah tied his two younger brothers, two sisters and their parents to the frame of the roof. His elder brother got off the ceiling to save their livestock and the tidal surge carried him away. The strong velocity of the wind suddenly blew away his sister who was not tied to the roof. At, after 3-4 hours, the water began receding, the wind velocity was falling and then it was morning. They found nothing in their house. They even did not find the bodies of their sister and brother.

Survival strategy of the same nature were taken by most families. The whole family of Muslim Khan climbed to the kitchen roof made of straw as all the tin roofs of their houses had been blown off. But when the speed of wind and water became too strong, the kitchen collapsed and they all fell into the water. Terrified families like Abul Kalam's climbed onto the dorma or loft which was usually used for storage. But the force of wind was so violent that the roof began to clatter and skewed in one direction. Then suddenly the tin roof collapsed on them and before the ceiling fell on the circling tidal waters, all but six of them emerged from the heap (Haider et al., 1991).

Fallen ceilings, corpses and dead animals and birds were swept away by the tidal waves. As a result of the rise in the air and water temperatures, there were trees whose green leaves were burnt and on whose branches were hanging dozens of men and women whose saris and lungis were torn and blown away by the storm. Their bodies were submerged under hot water, while their faces above the water were soaked by icy, cold rain and were simultaneously dried by the blowing hot wind. In such a situation, people lost all hope and waited for death to befall them (Haider et al., 1991).

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In the immediate aftermath of the cyclone, survivors were often not in a state to be able to bury the countless human corpses and animal carcasses littered around them. Shortage of able-bodied workers, coffin cloth, bamboo strips and other burial materials made the task even more difficult. Furthermore, rain and tidal inundation resulted in the scarcity of dry land where bodies could be securely buried. Hundreds, if not thousands, of bodies which had remained unburied began to rot in open spaces or water. Such processes of organic decomposition began to pose new health hazards by polluting the air and water in the vicinity (Adnan, 1992). Bari (1992) gives an account of Sheela, a seven year old, who knowing well that the water was contaminated by the bodies lying in and near it, still fetched the water as there was nothing else to drink. Her brother, three months old, died of diarrhoea that very night and it was very likely that Sheela may follow him.

Wounds gaped on survivors' bodies. Cut by the flying tin roofing sheets, or scraped by the branches as the wind howled past, people had no time or opportunity to care for their bruises and slashes because they were more concerned about food and survival. By the time medical help reached these people, it was sometimes too late. Wounds had led to death for many children, some adults had their limbs amputated, putting their livelihood at severe risk (Bari, 1992). Those who survived had struggled hard to save themselves. And having faced the cyclone and lost everything they had no time to mourn given their need to find food and clothes and remain alive.

6.3 Floods and People's Response

Floods can be defined as inundation that cause damage. Floods are perennial phenomena, borsha or normal floods are regarded as being beneficial. Only in times of acute disasters are significant levels of awareness generated, such as the exceptionally severe floods of 1987 and 1988. Flood affected people were observed to pursue a range of survival strategies under such conditions of extreme distress. These included shifts of occupation to forms of self employment suited to flood conditions, such as fishing. Others attempted out migration in search of shelter and security to urban and other rural areas. In certain severely flooded areas, the very structure of relative prices become transformed, with prices of foodgrains shooting up, and wage rates remaining low, given virtual lack of wage or self employment (Adnan, 1991).

During floods, rural and urban households response in the same way as far as housing is concerned. Many raise the level of the house or compound, and others install raised storage areas known as macha or move vulnerable goods to a higher floor. But in other matters, rural population suffer more due to isolation and lack of transport to replenish potable water, fuel, and livestock feed during floods, while urban residents have better access to water, fuel and public services, except for squatters who often are located in the most vulnerable sites. Households in flood affected areas have often cooperated with each other at the neighbourhood level during crisis; for example, in repairing each other's houses or providing emergency shelter (Flood Response Study, FAP 14, 1992).

The study further found that wherever possible people preferred to stay in their home. Therefore, building a macha was the most common shelter and evacuation response, with 29 percent of households building during average floods and 56 percent during a severe flood. The chars were the most vulnerable environment with 81 percent building a macha during

an average flood. But in severe flood situations, households found that a macha was insufficient, especially in the char and beel areas, where 26 and 30 percent of households respectively took alternative measures like taking shelters on boats.

Investigation on flood preparation showed that the most common method was storing fuel. Households in the haor and beel areas took the most active measures, particularly by making barriers against floods and wave action, and by preparing boats and raising floor levels. There was some variation in evacuation behavior between households in different flood environments. Higher land was an obvious destination, but in a severe flood, 38 percent of char and 24 percent of main river evacuees moved to embankments, whereas 43 percent of beel and 33 percent of breach location evacuees moved in with relatives. In addition, 31 percent of haor evacuees moved to a higher house in their village (Flood Response Study FAP 14, 1992).

A case study from Char Bhadrashan gives an account of the evacuation process at household level. When men are busy dismantling the house and putting the different components together ready to move, the women take their pots and pans, plates and utensils and clothes, pots of rice, lentil, oil, etc., and tie them all in different pieces of cloth. Their most immediate thinking centres round the new settlement in the new char which is on the other side of the river (FAP 14, 1992).

Female headed households displayed certain distinctive features from other households in terms of their resources or responsibilities during floods. Their husbands were either deceased or absent. During floods or other crisis they primarily depended on their own social and economic resources. If they were already poor, they risk becoming destitute in such a crisis. Case studies focused on gender issues in floods (FAP 14 Case Studies, 1992) illustrated the dilemmas faced by families and their coping mechanisms.

Severe flood strains marital relationships and increased the pressure on adult women. During one flood, Rahima's husband insisted that she join him in guarding the house and they used to leave their children with a neighbour each evening and stayed in their flooded house, where eventually she had a frightening encounter with a poisonous snake. In another family, a mother had to build a platform on which her daughter could give birth during flood. One divorced woman, Mamata, became ill during her stay on the embankment where she had to sit in the rain without any protection. Another woman's husband died of cholera shortly after their house was washed away by river erosion.

Noteably two studies summarized the coping strategies during floods by rural families and the ways in which they mobilized social and economic resources at such time of crisis. Ewert and Brockmueller (1990) reported of seeking loans, selling of excess or nonessential assets, work as day labourer, taking credit from banks, considering sale of essential assets also, and mortgage or sell of land. Hossain et al. (1987) also found similar struggle by the affected population to survive economically during floods by working as day labourers, using past savings, selling assets, borrowing money, doing odd jobs, use of skills in cottage industries, and lastly taking advantage of relief materials.



6.4 Response Strategies to Cope Riverbank Erosions

Riverine population is highly vulnerable to disasters like riverbank erosion because of low technological adjustments and weak economic conditions. Every year, hundreds of thousands of people become victims of sudden changes in the river courses. Such vulnerability to disaster is in part a product of long time processes of social class formation which resulted in the majority of rural peasants having only limited control over the means of production. The displaced add to the already large army of landless people, currently estimated to be over 50 percent of the total rural households of Bangladesh (Jannuzi and Peach, 1980).

Elahi and Rogge (1990) identified two variables as explanatory factors of contemporary responses by flood plain users to riverbank erosion, namely, displacement status (displacee or non-displacee) and displacement frequency (number of lifetime displacement). Differences in hazard awareness exists between displacees and non-displacees. The former feel more threatened by the tangible effects of disaster, such as, the damage to crops and the creation of food shortage, whereas the latter are more concerned with material threats, such as, the loss of land.

On the other hand, persons with higher displacement recurrence are more aware of the physical causes of erosion, but attempt dissonance reduction to eliminate the disaster threat. The greater the number of displacements, the greater the tendency to be pessimistic and not to take active measure to prepare for or mitigate the impact of disaster. A common sentiment encountered in the study's field interview was "...that the disaster is the will of Allah, but that Allah will provide for them."

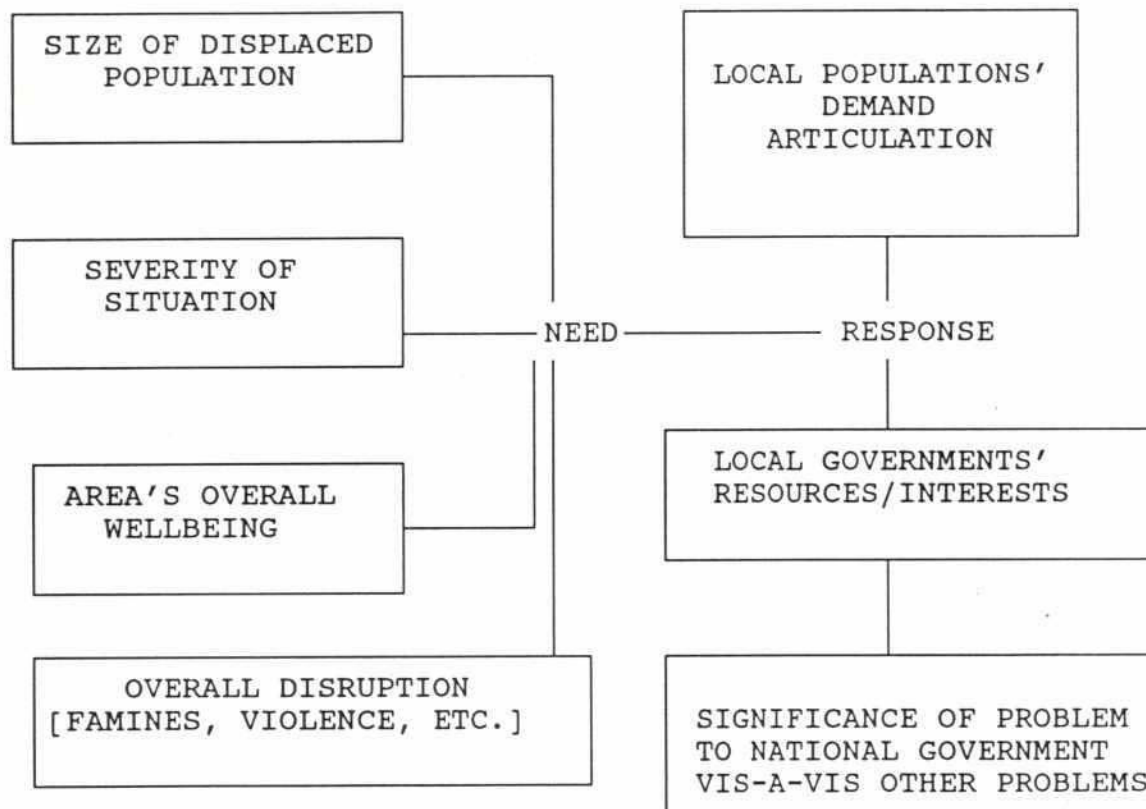
In the figure given below, two sets of variables are apparent on the response side; first, the extent to which people affected by hazards are themselves able to articulate their needs to governmental and non-governmental agencies, and second, the extent to which government, at all levels, perceives the seriousness of the problem and mobilize the necessary resources to mitigate the impact of disasters (Elahi and Rogge, 1990).

Given the scarce economic resource base, most displacees can draw upon the only limited ways in which they can reconstruct their livelihood without external help. On being displaced, they usually remain as a family unit, and if moving as a group, they still remain together with their bangsho or kin group. However, they face difficulties while resettling on embankments or other locations.

According to a survey in eight villages in Kazipur upazila in the Brahmaputra-Jamuna floodplain, 64 percent of the 619 sample households reported having displaced by erosion at least once - the mean number of displacement being seven (Zaman, 1986). The possible reason for this frequency of displacement was that people tended to move only short distances, as nearly 88 percent of the displaced households had remained within two miles of their previous place of displacement. Similar displaced households were found during field trips in Horindhara, Jamalpur who had resettled in embankments after riverbank erosion. Although whole villages went under water, still villagers stayed on along the riverside with the hope that their land will re-emerge. Nearly all households had been displaced more than once, with some households being displaced ten times in the span of five years.

Figure 1

Determinants of Responses to Population Displacement



Source : Rogge, 1991.

The displaced population of Horindhara gave several reasons for short distance migration. Many of them did not have enough resources to move to greater distances and relatives and kin support groups played an important role in such migratory decisions making. Majority preferred to remain close to their kins for immediate social and economic support. In some instances, kin groups provided their own land or space to resettle till they found a viable place to settle and earn a moderate income. Also, displacees have strong belief that their land will re-emerge soon. Looking at the Jamuna river, an old man related, with tears in his eyes, that he had 30 bighas of agricultural land, but now he is landless, with no assets, living in a temporary shelter on the embankment. Several families like him were well-to-do farmers, but now they are assetless. They did not think forsee the future, or else they would have at least educated their children.

When asked why they did not sell their land before erosion took place and buy new land in exchange; many said they tried but failed as people did not want to invest in land where there is no future guarantee of river course, however less they may pay for it.

In recent years, headlines in a newspaper reveal that due to erosion of the river Jamuna, 75,000 people are landless and homeless in five thanas of Sirajganj (The Daily Star, 21 September 1992). Even the embankment have been damaged by erosion. It further reported that during the current season, 18 villages have been washed away by the Jamuna, displacing 30,000 villagers who have taken shelter on different highlands like the flood control embankment popularly known as Kapda Bandh. People who have taken shelter in the bandh have been suffering from various intestinal diseases including dysentery and diarrhoea for want of pure drinking water. Besides, jaundice has also broken out and most people has to pass their days in half-fed condition as there is no work and other sources of income. Another report (Bangladesh Observer, 19 September 1992) revealed that the Padma has devoured more than seven villages and displaced about 10,000 people during the last two months. The displaced families have taken temporary shelter inb the adjacent villages without relief from anywhere.

For the majority of displacees, land and livestock are the sole source of livelihood prior to displacement. Once these assets are lost through displacement, few are able to rebuild their way of life without external assistance. It is common to sell livestock at the time of displacement. Elahi and Rogge (1990) found that 24 percent did so in Kazipur, 37 percent in Chilmari, and 29 percent in Bhola. A few sold title to their submerged land, at bargain prices, to those who can afford to wait for the land to eventually re-emerge.

At the same time, the survey found that few displacees had sufficient resources to purchase new land; 9.2 percent in Kazipur, 7.7 percent in Chilmari, and 6.4 percent in Bhola were in a position to buy any new land. In most of these cases, the amount of the land purchased was small; in Kazipur only 4 respondents had sufficient resources to purchase 100 or more decimals of land (0.4 hectares), in Chilmari 10, and in Bhola 3. However, they also asserted that nevertheless many displacees gained access to land through their allegiance and service to local landlords.

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Again, because of their limited extent to be able to help themselves, displacees become wholly dependent upon informal assistance from immediate kin, their shamaj, the local wealthy landowners, and village leaders, and formal assistance from local government officials, non-government agencies and national government authorities (Elahi and Rogge, 1990).

Haque and Zaman (1989) concluded that the adjustment to displacement in the active floodplains of Bangladesh has been conditioned by social, cultural and political factors. The adjustment choice is eventually the product of a complex set of factors including:

- the availability of land for resettlement;
- support from friends and gusthi people;
- the possibility of maintaining closer ties with the shamaj; and
- whether or not displacees have committed themselves to such patronage as sharecropping or free use of land for homesteads from relatives and/or locally powerful jotedars and talukdars who head shamaj organizations.

A large majority of displaced households were found to remain in the chars as patron-tied dependents of the village matabbars and locally powerful talukdars, who provide land and necessary support for resettlement, because the landless displaced destitutes are a cheap labour pool to work on their land. At the same time, these dependent peasant households are readily available as lathiyals to organize violent fights when necessary to gain control over newly emergent charland. Also they are the captive voters for local government and national elections.

CHAPTER 7

LESSONS LEARNT FROM FIELD VISITS ON DISASTER MANAGEMENT

7.1 Introduction

Some parts of the coastal areas, the most vulnerable and hard hit during the recent cyclone of April were visited to obtain information about the affected people, their response before and during the cyclone, in order to assess the felt needs. For riverbank erosion, displaced population living in embankments were also visited.

Field studies were done in Sandwip, Sitakunda, Cox's Bazar and Ramgoti for identifying people's awareness and information about disasters like the cyclones and storm surges, their preparedness and coping mechanisms during such crisis. Riverbank erosion in parts of Jamalpur district were observed and discussion with displaced households provided information on the nature of erosion, the displacement history, and survival strategies of such households when they are left with literally no land and assets.

7.2 Cyclone Preparedness and Management

The people of the off-shore islands and coastal areas, after hearing the warning signals, had their own interpretation of these warnings. Their experience, belief and encounter with the physical environment which is definitely most vulnerable played a pertinent role in their decision making to go to shelters or safer places before the cyclone started.

Group focussed discussions were held in Sandwip, Sitakunda and Cox's Bazar related to the climatic factors about apprehending a forthcoming storm surge of that intense. The wind was blowing from the north, clouds were not very dark, taste of sea water was not too saline and it was not the time of gona, which are the particular dates of the full and new moon influencing the nature of rolling water and waves. On the physical environment side, sea level was lower than mainland, there were some dobochars or chars lying below the sea level, and the existence of the 10-15 feet high embankments. Therefore, people's response was that of disbelief as past warnings did not always materialized.

Present warning systems and the way the signal numbers were given were not very well understood by men and women. The residents suggested that the language used in the warning should be simple and its applicability should be based according to the region it is meant for - intensity, exact location of the area to be hit, nature of impact, accurate route and time range, and height of tidal wave.

Hardly, 10 - 20 percent moved from their houses to cyclones shelters and safer places. However, those families who moved actually took the decision only after water had entered seaside villages, overtopping the coastal embankments. They were also afraid of looting if they left their houses and belongings. As such, most people moved to the well built or pucca houses of well-to-do people, nearer to their houses assuming that they will be safe. But while moving, most of the women and children were swept away by the strong surge and a few

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people could actually reach to safer places. As decisions were made at the eleventh hour, by the time they reached the place, houses were over crowded and failed to accommodate beyond its capacity.

Most of the houses in the coastal areas are built on slightly raised platforms, brick-built houses are rare. Sandwip being as erosion prone area, the well-to-do people are unwilling to construct pucca house as it has no resale value, although there are a good number of strong houses in each of the villages with tin roofs. Most of the mosques are pucca and well maintained, so are the primary schools and madrashas. Few primary schools are at present under construction, which could be used as cyclone shelters in future.

People usually preferred to go to the houses of their well-to-do kin groups who mostly had tin roofs and dorma or loft, apprehending it to be a safer place from the wind and the storm surge. But unfortunately, the tin roofed houses collapsed and in the process, people sheltered between the roof and the ceiling space could not come out and were pressed between these heavy structures. There was no way to come out, because there was no one to even rescue them as all of them were in the same position, and no outside help could be found at that time of emergency. As such, death rate was higher among families who took these types of measures in the coastal side villages.

Among those families living on embankments and seaside villages, their male members were mostly outside working at different places. Some went out to catch fish in the sea, others to work as hired labourers in the chars, salt beds and shrimp hatcheries. They could not stay with their families during the time of need. However, women and children of those families stayed at home and did not move to any safer places or shelters as they were anxious and waited for their menfolk to come home. Decision making of leaving the house was solely a man's domain, where a woman played a less significant role. As such, many women and children could not decide on their own whether to go to shelters or not.

Existing cyclone shelters, community centres and killas are located far away from neighbouring houses in Sandwip. Even though sufficient numbers of shelters or strongly built houses were not available, still people could not organize transport facilities to move to the few that were there. They also felt that the killas were not a safe place for livestock because the animals may not be able to withstand such adverse weather conditions under the open sky with no roofing support. The present conditions of these shelters and killas were found to be poorly maintained. Most of the shelters had broken windows and doors, walls were damp and wet, and roofs had cracks. Similarly, killas were full of bushes and jungles. Even the government buildings were not maintained properly. Many government, NGO and local people who took refuge in these pucca buildings during the storm surge reported that the structures trembled. As such, people preferred to stay in their own homes, apprehending that if the buildings collapsed nobody will be able to survive. On the other hand, in every village in Sandwip, one will find 8 to 10 strongly built bungalow pattern houses having tin roofs, which provided temporary shelters to people in the neighbourhood.

Most of the off shore islands in Cox's Bazar have no proper communication network with the shelters or other public buildings. All houses seemed to be floating and marooned. Most of the small villages were bounded by salt beds and shrimp hatcheries which made communication more difficult. Given the nature and conditions of roads, it was almost impossible to walk a distance of about a few kilometres in a stormy weather of that intensity.

Some old men and women were even superstitious about leaving the house unguarded as Allah would curse them and the house would also give them bardoa. People thought of assets as more valuable than the lives of their family members. They believed and had more confidence in warning announcements on radio and television. Actually the CPP volunteers did not respond at the initial stage; they came out into the village streets with megaphones after the forecast of number 5 - 6 or more signals were already announced in the radio and television.

Char areas of Ramgoti, Sonagazi and Mirsarai were also investigated as chars are the identified high risk zones. The people living in char areas have different coping mechanisms due to socio-political factors. Mostly, the poorest of the poor inhabit the most vulnerable areas where human settlements are not viable and unprotected as they are living very close to the sea.

Given the nature of the area, the migrant landless households have their dwelling units built on macha to protect them from the daily tidal surge that submerge the area. These are mostly build of bamboo poles and thatched walls and roofs.

In addition, they had built indigeneous mounds of earth similar to killas, which are used for cattles, goats and other livestocks. Another interesting aspect of these char areas is increasing amount of cattleheads and livestocks, compared to number of people living there. Also cows, buffalos, goats and sheep from the mainland are reared in these chars as there are rich and ample grazing fields for cattles. Apart from agriculture as a primary occupation, fishing and cattle rearing are undertaken as secondary occupations. As such, many migrant labourers are engaged not only as agricultural labourers but also work in cattle rearing, although they are not owners of these assets.

However, loss of human lives were comparative very less as people's response to the forthcoming cyclone was that of quick decision. Although, many of them could not foresee the intensity of the storm surge, still they took refuge in the existing embankments, macha, and earthen killas. For people living in accreted land which are connected with the mainland, cyclone shelters and other pucca structures were in close proximity to their kucha dwelling units. Thus they had convenient access to go to such safe places, although only 10 - 15 percent could avail these facilities.

Although people have taken whatever available measures they could afford, still they were submerged in waist level water. At that time, fortunately the direction of the wind changed from south to the north, which helped in the process of water receding towards the sea. If this had not occurred in due time, the coastal areas of Ramgoti, Sonagazi and Mirsari would have been the worst affected areas.

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Gradually accretion of land has affected the distance of cyclone shelters from near to the sea settlements which are recently been housed by migrants. This process further placed the existing cyclone shelters in less risk prone areas instead of high risk areas. Also people previously living inside the embankments are now living beyond the embankment limits as new lands are continuously emerging.

Why do people continue to live in the hazard prone charlands ?

It was evident that people rushed to settle themselves in the newly formed land due to accretion as these lands are comparatively fertile and cultivable, and scope for fishing as an occupation becomes more easier. During transplantation and harvesting, the numbers of hired migrant labourers are increased. They mostly work on seasonal requirements. Cheese processing has also provided a portion of those employed in the area.

The physical infrastructures like embankments, roads, public buildings, etc., are poorly maintained. Trees are more or less non-existent. Instead of coastal erosion, accretion of land which is more prominent, cause new dimensions to settlement and power structure.

People of all social classes are reluctant to move to other safer places because they do not want to be dislocated and at the same time afraid to loose possession of the land and other assets. Field reports on the voting behavior of char residents indicate this more clearly. During the recent Union Parishad election, not a single person from Gazariar Char, Char Thua, Char Chabas and Char Balua went to the polling centres. Even they do not go to the mainland markets, leaving their homes unattended, inspite of their wives staying in the homesteads. Insecurity and frequent char fractional violence and harassment add to this behaviour pattern of char people.

Women living in these charlands are very much dominated by their male counterparts. Within the household, consent of their male members play a prominent role for any decision making concerning their movements and social participation. Therefore, women are left out from any social gathering and are devoid of any information of the outside world. Thus women have very little knowledge about warning systems and its contents. Even if women were eager to go to shelter for the safety of their children, still they had to depend on male decision. Given the lower social status of dependency of women, harassment, family violence and related issues like divorce, separation, and second marriages of husbands are prevalent.

7.3 Managing Riverbank Erosion

Riverbank erosion occurring in some parts of Jamalpur by the Jamuna river has eroded a considerable portion along its banks. About a decade ago, it started devouring a considerable portion of Kulkandi union under the Upazila of Islampur in Jamalpur district. In Kulkandi, about 1,000 families residing in the villages have been rendered homeless and vast tracts of agricultural land have vanished under water or have become sand beds due to heavy siltation. Parts of the main road from Islampur Upazila to Kulkandi have been washed away. The worst affected areas of Kulkandi are Char Dhigalia, Harindhara, Berkusha, Jigatala, Belgachia, Shapdhori and Noarpara of which no trace is found now, and most of the villagers have been reduced to destitutes.

The process of such displacement of population had started as early as 1970. Till today, on an average, households were displaced five times. However, people could predict future erosions, but they are in a desperate and vulnerable situation to do anything about the coming hazard. Land which fall into high risk of erosion cannot be sold easily as people do not consider it as a long time asset. Even if some land could be sold to well- to-do families, prices are extremely low with which the displaced families cannot afford to buy a considerable amount of land in the erosion free mainland. The price of the land is determined by the years that land will provide agricultural crops till it goes under water.

As the price of land is very low, people selling such land are again buying land where the prices are still a bit lower. And one possibility to get lower priced land is to buy land again in the nearby riverside which is still in the risk prone area. The process has created a dimension for generating landlessness and papuerization. Those do cannot afford to invest in landed property takes either of the two alternative measures: to stay with kin and patron groups in the mainland or to resettle on embankments.

Riverbank erosion has made many land owning households landless in the process. About 40 percent of the homeless continue to stay in and around the villages in the mainland, but 20 percent have left the area and migrated to other places where they could find their kin family connections. The remaining 40 percent household male heads and other male members of the family unit left the district for urban centres like Dhaka, Savar, Syhlet and Gazipur to seek employment. Their female household members with their children remained behind in the risk prone areas, hoping that one day their husbands/male members will return after getting employed in the cities. But there is no sign of their whereabouts. The women takes over the economic responsibilities of running the entire households. They are the worst hit by erosion, being abandoned by their male counterparts and living in destitute conditions.

However, a few exceptional male members send some money back home. They are the ones who lost land due to erosion, still kept connection by sending money to their families back home, hoping that some day they will regain their land status through accretion or buying new land.

It was observed that floods and riverbank erosions are a continuous occurrence in Islampur. As a result, agricultural employment becomes scarce. Those who are still getting employment in the agricultural sectors are paid much lower than before and are marginalized, as most of these families are staying in the land of the kins or patrons who are their present employers. Among this group, women are the worst sufferers; they are made to work in exchange of two meals a day excluding cash at hand. These earned meals are the only source for feeding her children.

Among the displaced households living on embankments and on other people's compound, women's status in those households are comparatively getting lowered in the social milieu. As a consequence, divorce, separation, desertion, and prevalence of dowry demand have increased. Young girls are finding hard to get married, especially of the poor families.

Homeless and floating population of this nature receive less attention from all sectors; government as well as from NGOs. They are not considered as credit worthy to the government agencies because they have no collaterals. Although NGOs have credit

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programmes for the landless and assetless, but not for the people who are frequently in the displacement process. Although Grameen Bank, BRAC, Action Aid and other home growth organizations are working there for the poor of the poorest, still these organizations could not address the problem of displaced population by riverbank erosion.

In conclusion, it can said that erosion is not the only factor prevalent, accretion of land is also taking place. The only difference is that accreted land is still unstable and not feasible for settlement and cultivation purposes. People commented that the accreted land are more liable to be eroded in future and symptoms are already there.

CHAPTER 8

POLICY RECOMMENDATIONS: ISSUES TO BE COVERED BY FAP 11

8.1 Policy Implications

The disaster of April 1991 added a new dimension to natural disaster management in Bangladesh. A large amount of information flowed which had a variable degree of credence.

Post disaster is less of a problem as 'response' on humanitarian and obligation grounds from both government and non-government sectors takes place. Since Bangladesh is a disaster prone country and people have to live with disasters, considerable skill and management abilities have developed.

The main problem lies with pre-disaster organization and management which includes measures to reduce the impact of any disaster and the drawing up of a response plan in advance to cope with disaster. At the grassroot level, there is no setup to deal with disaster management. This is true for government agencies, non-government organisations and the people themselves.

8.2 Recommendations and Issues to be Covered by FAP 11

Pre-disaster management is however a large task and includes mobilization and organization at all levels. Natural hazards become a disaster only when people are affected in large numbers. Therefore, it is important that people in disaster prone areas should build up their own capacities through their own organizational set up - a neighbourhood based unit side by side, with a supportive group, consisting of local government officials, non-government personnel, informal groups and volunteers. As a coordinated group, they should work together to strengthen the neighbourhood based unit to cope with future disasters.

The government's contribution to disaster management should be focused on creating refuges in the disaster-prone areas among the people. This includes mainly infrastructure development like cyclone shelters, killas, embankments, roads, jetties, and telecommunications. Improved and informative warning systems are also a part of the government's responsibility. A specialized unit within the government's structure should be established to promote such activities.

Neighbourhood-based groups should be trained in such a way as to be competent to deal with disasters when they strike to enable people to respond to crisis, before any outside assistance is available. The groups should be well-organized and cooperate with the government services and outside agencies when an emergency arises.

Gender-related issues have to be recognized in order to assure real development in disaster preparedness. Special women groups should be set up at all levels. Emphasis should be given on the decision-making process at the household level recognizing that women's decisions as important as those of their male counterparts.

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Public awareness activities must expose and refute common myths and misconceptions about disasters like false refuge in ceiling spaces, embankments, trees, or any high raised spots in the high risk zones. Disbelief and indifference to warning of forthcoming disasters must be considered in developing disaster awareness at the grassroots level.

Both men and women in the local community should participate fully in the design and site selection process for shelters and other infrastructure.

Government should explore the possibility of encouraging private initiatives in building cyclone proof structures in their own neighbourhood. Credit might be made available to such persons who are willing to build structures on the basis of matching contributions from both sides.

Research should be undertaken on food preservation techniques, neighbourhood food grain storage, and safe water storage. Positive research findings should be demonstrated at the neighbourhood level to encourage local communities to adopt these practices.

Post disaster activities should not only emphasize relief for the victims but also should include measures to restore fisheries, livestock, and plantations, to ensure harmonious development.

Awareness raising-materials should be developed amongst people of all levels and all sections of the population. Mass media's positive role should be exploited.

For children and adolescents school curricula should include basic information about all types of disasters, and disaster preparedness and response activities.

Non-governmental organizations involved in informal or non-formal education for adults should include lesson sheets on disaster management.

Disaster preparedness planning in the coastal areas should consider three different areas according to their characteristics:

- Mainland coastal areas
- Off-shore islands
- Charlands

For country-wide disaster preparedness, government should declare a Natural Disaster Day (NDD) to highlight and mobilize a nation-wide disaster awareness.

8.3 Cyclones and Storm Surges

People are not aware of the real significance and implications of the different warning signals. Forecasts giving information about the expected height of the storm surge in a particular place would enhance their understanding of the intensity and severity of the surge and enable them to prepare accordingly.

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Continuous instructions should be issued by the mass media, particularly the radio and television, asking people to move to safer places and shelters. During these broadcasts, there should not be any entertaining songs or music or advertisements before or after announcement as these detract from the message and may delay people's response.

Simultaneously, local warnings through loud speakers (miking) should be announced by bazar committees, mosque committees, local government agencies, town committee, local NGOs, teacher's associations, Union Parishad, youth clubs, etc., to alert the neighbourhood units to undertake evacuation measures. During 'miking', messages should be simple, short, distinct and direct.

Similar continuous 'miking' should be undertaken by the local police station to alert people that stern and lawful action will be taken against any person engaging theft, looting or 'grabbing' land from evacuees. This announcement is essential to create confidence among the evacuees, and will encourage them to go to shelters.

For the people living in the isolated chars and accreted lands, specific messages should be broadcast through the mass media. Special instructions should be directed towards women and children.

Tenancy rights of charlands should be ensured by government officials, especially by the Ministry of Land and Revenue, according to the present legal provisions.

Post-disaster relief should be distributed through neighbourhood units, as neighbourhood leaders are better aware of immediate needs. To avoid unequal distribution of relief goods and discrimination against women, women relief workers should be deployed to carry out such activities. Remote areas should have higher priority in relief distribution. Disadvantaged women, orphaned children, elders and disabled persons should be in the frontline of beneficiaries. Provision of fodder for livestock should be made during relief activities.

The local administration should try to ensure that the price of essential goods like house building materials, food, medicines, and kerosine, are controlled and market supplies are sustained.

8.4 Floods and Riverbank Erosion

Government should prepare a plan for the displaced population living on embankments or temporary shelters after severe floods or riverbank erosions has occurred. Within the locality, 'khas' land should be made available for their settlement.

Skill development for both men and women to increase non-farm income earning possibilities should be undertaken. Credit facilities should be extended, and the provision for credit should be made for displaced people who have no collateral.

Plans should be developed for the distribution of land among displaced people in the event of the re-emergence of land. All extension agencies of the government at the village level should play an active role towards this end, particularly family planning and health, public health, and credit institutions.

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A well organized public awareness campaign should be initiated by the government targeted at people living on the embankments to explain how they can continue to live on the embankments without causing damage to these structures. At the same time, they should be prepared to carry out maintenance of the embankments on which they are living.

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GLOSSARY

aman	Cultivating season, usually used when referring to paddy planted during the monsoon and harvested during November and December.
azan	Call for prayer.
bandh	Embankment.
bangsho	Lineage
bardoa	Unauspicious
bari	A homestead, a cluster of agnatically related households usually consisting of an inner courtyard surrounded by housing units.
BDRCS	Bangladesh Red Crescent Society.
beel	Depressed water bodies like a lake.
BIDS	Bangladesh Institute of Development Studies.
bighas	Unit of land measurement, 30 decimals equivalent to 2,850 sq.ft.
borsha	Monsoon, rainy season.
BUET	Bangladesh University of Engineering and Technology.
BWDB	Bangladesh Water Development Board
CPP	Cyclone Preparedness Programme, BDRCS.
charland	Land formed by river activity involving sedimentation and accretion of silt.
choura	A term used to refer to people living in char village. In Bangladesh, living on chars is regarded as an inferior form of rural life - the inhabitants make up a choura subculture. Chars are considered uninhabitable by mainland bhadraloks (gentlemen); mainland villagers, therefore, look down upon char inhabitants.
dobochar	In the process of would be accreted land but still is not visible, chars lying below the sea level.
dorma	Storing space between the roof and the ceiling.

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guchchhagram	Cluster village.
gushti	Patrilineage.
haor	Large and depressed water mostly found in Greater Sylhet and Mymensingh.
jotedar	An independent land-intermediary and agent of a talukdar with rights to land for the purpose of collecting rent or for bringing the land under cultivation through the establishment of tenants on it.
keyamat	Doomsday.
khasland	Unused government owned land.
killas	Earth made mounds for providing shelter to livestock during cyclones.
kucca	Not paved or brick-built.
lathiyal bahini	Armed retainers or 'clubmen' used by local jotedar/talukdar in establishing control over charlands. Historically, lathiyals were 'private armies' controlled by the landlords of Bengal.
macha	A platform in the house.
madrasha	Institutions of religious learning.
mathbar	Village leader.
NGO	Non Government Organization.
para	A neighbourhood consisting of a cluster of households with defined geographic boundaries.
paribar	Family/household that comprises all blood and marriage related members taking meal cooked in the same kitchen.
pucca	Paved or brick-built.
shamaj	An informal village association based on neighbourhood or religious sects. They perform important social and ritual functions together.
talukdar	A land-intermediary between a zamindar and a jotedar; talukdars pay fixed sums to zamindars. They retain the difference for themselves between the rent collect and the fixed dues they are required to pay.
thana	An administrative unit composed of a number of unions (it was designated as upazila).

- union Geographical unit comprising several villages.
- uthuli A sort of refugee identity that entitles a family to temporarily occupy others' property.

ANNEX A

FIELD EXPERIENCES OF CYCLONE AFFECTED AREAS

ANNEX A

Experience from Areas Affected By the Cyclone 1991 Report of Field Studies in Sandwip, Sitakunda and Cox's Bazar (16-27 September 1992)

A.1 Purpose

The purpose of the field studies was to obtain information from the people affected by the cyclone and storm surge of 29 April 1991 in order to assess their 'felt needs'. On the basis of identified 'felt needs', proposals for the development of an awareness and information dissemination package to enable the people of coastal areas and off-shore islands to better cope with the disasters were prepared.

During the field studies, 11 unions in three thanas of two districts were covered. These were:

District	Thana	Union
Chittagong	Sandwip	Sontoshpur
		Urirchar
		Harishpur
		Kalapania
		Azampur
		Sarikait
Cox's Bazar	Sitakunda	Maghdhara
	Cox's Bazar	Bashbaria
		Pokkhali
		Saifuldandi
		Gumaitali



Efforts were made to gather information through field visits, observation, interviews, discussion and group meetings. Individuals, groups, agencies - both Government and non-government were interviewed on: their perceptions of the event, coping strategies, relief and rehabilitation measures; how things could have been done better; how could people be helped to develop coping strategies with greater chances of survival; and what kind of support and resources are required to enable them to help themselves.

A.2 Contacts in Sandwip, Sitakunda and Cox's Bazar

Meetings, interviews and discussions were held with men's and women's groups organized by Nizera Kori, Nari Progati Parishad, CARITAS; individual mothers covered by BRAC's programme; Red Crescent and government officials at thana and field level - BRDB, DAE, BADC, Health and Family Planning Welfare, Livestock, TCCA (Thana Central Co-operative Association); Local UP Chairmen and Ward Members; Primary School Teachers Association; School and College Teachers; Local journalists; Fishermen groups; Imams; Bazar Committee; Owners of Salt-belts, shrimp belts and prawn hatcheries; and people who are still

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living outside the embankment on the sea-side. Some of these meetings were with individuals, while in other places they were with groups.

A.3 Observations and Findings

A.3.1 Women in Sandwip

In Sandwip and Cox's Bazar, face-to-face meetings were not possible with the women, but discussions were held under purdah. A female worker of Nizera Kori office at Sandwip tried her best to hold face to face meetings but failed. However, the meetings under purdah organized by Nizera Kori were attended by a large number of women, and each meeting lasted for 3-4 hours.

During the five day visit to Sandwip, extensive travels to different villages from morning to dusk by rickshaw and on foot were undertaken. Five/six middle aged women pedestrians were seen wearing burkha and also holding two umbrellas, one in the left hand and one in right hand, to protect themselves from the eyes of male pedestrians. Most school and college-going girls were seen going to their respective institutions wearing 'burkha'.

About 60 mothers were met who came to health centres situated in different unions for immunizing their children under EPI organised by BRAC. They were asked why they had come to see a male doctor/health assistant', is it not a violation of purdha, and how their male counterpart perceive that a women is attended by a male medical practitioner? They stated that the Imams of their Masjids preached to the men, particularly the social leaders that, where there is no female doctor, women can be attended by a male doctor and women should discuss their ailments freely, even women's diseases, without hesitation as our Prophet approved it - termed 'jayej' (legitimate)

BRAC workers stated that initially they encountered acute problems with the men when organizing women for the programme. However, they had overcome this hurdle by motivating all the Imams of the Sandwip area. A large number of mothers along with their children visit government health centres and MCH clinics run by Nari Progati Parishad. They were very vocal and spontaneous. The workers of Nari Progati Parishad said that the same women, when they go home, would be very passive and introvert.

During the visit, a seminar on the 'Contribution of Sandwip Women in Development' organized by Community Development Library (CDL) was attended as observer/participant. The seminar attracted about 200 participants. There were 10 speakers of which four were women. They were from Local NGOs.

Together four local youths (one UP member) while travelling to Sarikait, the mostly devastated area on foot, the consultant saw 4-5 women lifting earth as RMC under VGD programme in the district. As they come close, the women hid themselves in road side ('dholkolmi') hedges.

A.3.2 Cyclone Warning System

On hearing the announcement of Great Danger Signal Nr. 10, the people of the offshore islands and coastal areas interpret it according to their own belief, experience and physical environment. They consider other factors:

- wind blows from the north
- warnings do not always result in cyclones/surges
- sea level is lower than the land, the people live inside a 10ft-15ft high embankment, tidal surge cannot be so high.
- there are some 'Dobochar' and 'Char' (Sandbanks) (in the sea nearer to their habitation, so tidal surge may not strike, if strikes it will not be so strong.
- clouds are not very dark
- this is not the time as it is not the time of 'Gona' (particular dates of full moon and new moon with special characteristics of rolling water and wave) therefore big 'Joar' may hit, not storm surge.
- taste of sea water is not too saline.

The present warning systems and the way the signal numbers are given are not very well understood by either men or women. The language used in the warning system should be simple and the information should be specific according to the region it is meant for - intensity, location of expected impact, accurate route, time of impact and height of surge.

Announcements should be reworded:

- Your area (mentioned specifically) will be hit by storm surge of a certain height, so you are requested to evacuate with your wife, children and other family members to cyclone shelter.
- Village leaders, matbars, Union Chairman and members are requested to mobilize their community and ensure their safety by sending them to the shelters.
- You are requested not to take shelter in the 'Darma' loft (space between the roof top and the ceiling) because you can get trapped when the tin roof collapses.
- Do not wait for male members or others who are not in the house. Instead you should try to save your life and the lives of those around you by taking shelter immediately
 - people living on the embankments should evacuate immediately
 - cattle and goats should be taken to nearby higher lands, e.g. roads, 'killas' and pond embankments.

A.3.3 Response of people to warnings:

Most people failed to move their family members to predetermined safer places. Between 10 to 20% moved from their houses to cyclone shelters or other secure places. They were afraid of looting.

Many of those who moved, took the decision only after water entered sea-side villages, overtopping the coastal embankment.

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Most people moved to the houses of well-off people near to their habitation, assuming that such houses were strong and safe. During their movement to safe havens, many children and women were swept away by the strong surge. Some people who reached the houses of well-off people, found that the houses were already over-crowded and failed to find safe shelter, thus the current swept them away also.

Houses owned by rich people were occupied by their kinship members. They climbed into the roof space but when the house collapsed nobody could come out from inside the roof.

Death rates were high in coastal villages among people who took shelter in the roof or who tried to move after the surge hit them.

Women did not move as they did not know the location of the shelters, community development centres, and other 'pucca' structures.

Most of the male members of families living outside the embankment and in seaside villages were fishing at sea, working in 'chars' as hired labourers, working in salt-bed or shrimp hatcheries and beds. They could not return to their families in time. As a result, women and their children did not move to safer places as they were waiting them.

Most of the off-shore islands of Cox's Bazar have no proper roads linking the shelters and other safe places to settlements. All houses appear to be floating and marooned. If the people want to respond to a warning, it is difficult for them to take shelter immediately. Most of the small paras/villages are bounded by salt beds, shrimp hatcheries and shrimp beds. The road network is so poor in the area that they find it difficult, given the mode of transport and the condition of roads, to walk a distance of even a few kilometres in stormy weather.

Some people, especially old women and men, believe that if they go to shelter leaving the house unguarded, 'Allah' will curse them, the unguarded house will give them 'Bardoa'.

Many family members think that assets are more valuable than lives.

The CPP volunteers do not respond at the initial stages. They come out into the village streets with megaphones after radio/TV announce Signal Nr. 5-6 or more. The people believe radio and TV warnings more than the volunteers.

A.3.4 Infrastructure

Sandwip has good telecommunication systems. T&T, IWTA, Police and Red Crescent, all have wireless and can speak with Chittagong and Dhaka.

T&T telephones are also available with connections at all bazars.

Most of the houses in the coastal areas are built on slightly raised platforms. Brick-built houses are rare. As Sandwip is erosion-prone, the well-off people are unwilling to construct 'pucca' houses as they have low re-sale value. However, there are good number of strong houses in each village with tin roofs. The earth road network inside Sandwip is quite satisfactory and a very good road network links each village and union. However, there are

few trees planted along the road verges, which is very uncommon.

Most of the Masjids are 'pucca' and well maintained. Primary schools and Madrashas have tin roofs and walls of bamboo sheet, erected on wooden poles. Two or three primary schools are being constructed by the MOE Facilities Department, and these will be used as cyclone shelters if required.

There is a BPDB generator which provides electricity to the township area only. Electricity is available for three hours during daytime and six hours at night. Most of the households in Sandwip and Cox's Bazar have their own radio sets. There are 10-15 television sets in each union, run on batteries or small generators. In Sandwip, there are two cinema halls although one was destroyed by the cyclone of 1991.

A.3.5 Cyclone Shelters

Existing cyclone shelters, community centres, and killas are located far from the settlements that they are supposed to serve.

There are insufficient shelters or strongly built houses and the people cannot organize transport facilities to move to those that there are.

Many people do not consider 'killas' as safe shelters for their cattle. They believe that their livestock will not survive bad weather on open-air killas.

Cyclone shelters, community centres and killas visited were found to be poorly maintained. Most of the windows and doors were broken; walls had fungus growing on them; the environment inside the shelter was wet; roofs were cracked. Most of the killas were full of bush/jungle. Government buildings were generally found to be very poorly maintained. Many government, NGO and local people, who took refuge in pucca structures, reported that, during storm surge the structures trembled. If the buildings were to collapse, nobody would survive. Generally, the people prefer to stay in their own homes.

In each village in Sandwip, there are 8-10 strongly constructed houses with tin roof of bungalow pattern. These are called locally 'American houses', 'British houses', 'Italian houses', as most of the owners of these houses live abroad. An interesting fact is that 70% of the total households of Sandwip have 1-3 income earning members living abroad.

A.4 Opinions, Issues and Suggestions on how to cope with Disaster

A.4.1 General

Weather forecasts giving the expected height of the storm surge in particular places would be of much help in explaining the severity of the situation and consequent need for precautionary measures.

Instructions should be issued continuously on radio and TV requesting people to move to cyclone shelters.

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When such instructions and warnings are being broadcast on radio and TV, there should be entertaining songs or music or advertisements before or after. These songs/music result in people taking the warnings less seriously. It would be good to suspend all entertaining programmes at such times.

Local warnings through loud speakers from various corners i.e. Bazar Committee, Mosque Committee, Local Government, Town Committee, would be more effective. Local groups, i.e. Teachers Association, Students Union, youth groups, TCCA, Union Parishad, can also make warnings. Each village has, mosque with loud speakers. Messages should be simple, short, distinct and direct.

The people of the coastal areas heard the warning signals in 1970, 1985 and 1991 but each time underestimated the severity and were indifferent. There should be widespread 'miking' from every 'nook and cranny' to warn the people about the imminent danger, otherwise they will not move to the shelter. This was suggested by many people.

The radio and TV should tell the CPP volunteers and local organizations when they should start 'miking'. Radio and TV can play vital role in mobilizing local Government and non-Government agencies, requesting them to undertake evacuation campaign through 'miking'.

Simultaneously, the local Police should announce through 'miking' that if any theft or looting is committed in unguarded houses, stern action will be taken and exemplary punishment will be awarded within 48 hours. This announcement will create self confidence for evacuation. Such announcements can be made by the Chowkider, Dafadar, constables.

Many people do not like to put men and women together under the same roof in the cyclone shelter. Crowding with men is considered violation of purdah. Cultural values and prejudices are often stronger than the need for survival. Putting men and women on separate floors may not be possible, but '**accommodation arrangement norms**' should be developed and announced widely so that the people feel confident. These norms should be developed with the participation of people (men and women) from all strata of the society (Imams, teachers, local leaders, women should be included). Chowkider, Dafadar constables, ansars, VDP should be deployed in each shelter to ensure respect for the 'norms'.

New cyclone shelters are to be constructed in sea side villages and 'chars'. They should be located by the side of roads, or adjacent to marketplaces. There should be latrine facilities. A small para-medical team should be deployed to respond promptly in case people who are in shelter develop ailments. People from all strata should participate in site selection for new shelters. Women should be invited to express their opinions in site selection. At the start of shelter construction, a simple inauguration ceremony should be organized inviting all people within the 'command area' of the shelter. Women's participation should be encouraged so that they know the location of shelter. In the same way, a function could be arranged with female participation during the handing over of the cyclone shelter on completion of construction.

Most of the damaged schools are being reconstructed by the donors, NGOs and government with a view to their use as cyclone shelters at disaster times. However, as most of these schools are not situated in the risk areas, the reconstructed schools will be of little help to

the inhabitants of risk-prone villages.

Response to a crisis requires mobilization, organization, decision-making, leadership and action. It has been reported that the people start thinking about ways of facing the crisis, but they cannot decide whether to stay at home or move to safer places, because of concern for safety of the cattle, other household assets, cash money, especially when male family members are absent.

Most people expressed the view that, to encourage active response to crises, considerable emphasis should be given to developing the human being, on forming or enhancing his or her capacity to make decisions, to learn, to manage, to communicate with others, to analyze the environment, to be a leader, to stand up to a crisis, to organise, and so forth - in other words 'human resource' development.

Government officials, local elite, leaders, and NGO workers expressed the view that for effective disaster preparedness, there should be two systems i.e.

- i) Active response system - pre-disaster
- ii) Active utilizer system - post disaster

To develop both systems, there is need for group formation Kinship-based groups are recommended. There would be two groups male and female. Kinship focused group leaders would undertake evacuation campaigns after hearing the announcement of the Great Danger Signal.

The same kinship group would prepare needs assessment and the action plan to obtain the services, support and relief from government and non-government agencies in the immediate aftermath of a disaster.

A special agency should be established named 'Disaster Preparedness and Development'. It should have three components:

- i) People of coastal areas, off-shore island, chars and their organizations
- ii) Intermediate group (Task force)
- iii) Capacity building, institution building and training

The agency should take care of the area in a comprehensive manner to develop sustainable solutions by institutionalizing the preparedness activities through the kinship groups.

To encourage effective information flow, a list of qualified disaster preparedness workers should be compiled together with the areas to which they should be assigned. It should be held at Dhaka.

Similarly, a map showing NGOs involvement in all disaster-prone areas of Bangladesh should be prepared.

Training should be given to the members of kinship groups. The training should be action oriented. Curricula should be evolved from the participating members. An organizer -

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trainer (motivator) should provide training and at the end of training the people should prepare an Action Plan. On completion of Action Plan the members should demonstrate it. Action Plans would differ from place to place. Three types of Action Plans might be needed:

- i) for coastal areas
- ii) for offshore islands
- iii) for 'Char' areas

These Action Plans should be printed in poster form and contain pictures of the actions. These posters should be displayed widely. Print media and electronic media should refer to these Action Plans while announcing warnings or instructions.

At each bazar/hat, bus station, launch/streamer station, rickshaw parking place, court, sub-register office, high school, college, there should be billboards portraying preparedness measures.

In the primary and high school before starting class, there is a practice of playing the national anthem, after that 2/3 '**must**' messages could be read out.

Government should declare a '**Disaster Preparedness Day**'. During the day government and NGOs could organize '**open days**' to educate people. The 'open day' should be organized around cyclone shelters, primary schools, government buildings. Open days should be entertaining like village fairs.

Imam/Purohit/Monk should be motivated to preach to the people in Jumma prayer (Friday) about pre-disaster preparedness. 'Jumma' is a very effective forum for muslims. The Imams should be trained by accepted religious leaders not by a formal trainer. Messages from the Holy Quran and Hadith with regard to disaster preparedness should be taught.

Orientation sessions should be arranged for support groups/individuals on techniques and organization of the Awareness Campaign and warning information dissemination. Such supportive groups include:

- Thana Central Cooperative Associations
- Primary School Teachers Association
- Madrasha Teachers Association
- Youth Clubs
- Block Supervisors (DAE) - stationed at village/union level
- TCCA Inspectors (BRDB) - stationed at village/union level
- Health Assistant and Family Planning worker - stationed at village/union level
- Social Welfare workers (Male and Female) stationed at village/union level
- Chowkider, Dafadar, Ansar and VDP - stationed at village/union level
- Veterinary Assistants
- Fishery Extension Assistants
- School and College Teachers.
- Mosque Committee Members
- Bazar Committee Members

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This orientation might take place over one day and involve classroom based discussion. A one page handout on organizing awareness campaigns and warning information dissemination technique could be designed for them. These support groups would complement the activities of the Task Force.

The multipurpose - concept is vague to people. It is not feasible in the context of local socio - cultural aspects. Government property is nobody's property, community property is nobody's property. It requires coordination, maintenance and a sound institutional framework to make it multi-purpose. Local people stated that all existing and to-be-constructed shelters should be used as primary schools. It would help to increase literacy and maintenance would be better. During discussions with well-off families, they indicated their willingness to develop their own kinship shelter which could accommodate 40-50 people and could be used for storing food, paddy and other assets. They advised that, such shelters could be constructed as they could afford to do it collectively.

A 'kinship shelter' might be designed and casted out. The standard design could then be distributed to interested people. There is much interest in this idea only motivation is required.

The people of Sandwip and Cox's Bazar considered that killas are not feasible as a refuge, and maintenance of 'killas' is difficult. The 'killa' is feasible only in 'chars'. Uttar Urirchar needs 'killas' for their cattle. It requires approximately two hectares of land to construct one killa. Land is limited and costly. Existing killas should be given to people who are poor and destitute and who lost their previous homestead and farm land due to erosion and are now living on embankments. People living on the embankments should be rehabilitated by constructing 'killas' on 'Khash' (government) land. It was learnt from local government sources that such land is available in each union.

It was observed that the intensity and severity of the storm surge was high nearer the coast and up to 1-2 km inside from the coast. Many people suggested that a few internal roads which are 2-3 km away from coastal villages might be raised 15ft/18ft high with compacted earth and appropriate slopes. These roads could be used as safe refuges for cattle during surges.

The cross roads between the coastal villages should be raised higher. These roads would create a barrier and reduce the severity of surge.

The present government has declared a '**canal digging programme**' on the mainland, but it is not applicable to coastal areas and offshore islands. The government could declare '**road raising programme for coastal areas and offshore islands.**'

Communities are constructing pucca and semi-pucca buildings to create community facilities e.g. Mosque, Madrasha, Shops, and houses etc. These structures are constructed without adherence to engineering standards. A simple 'Construction Manual' should be prepared for the masons. Training could be organised to upgrade the workmanship of masons in coastal areas. This type of training can also be given by LGED to Mosque and Bazar Committees and self-educated contractors.

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Most of the people stated that wooden and bamboo poles were affected by saline soils which weakened the structure of their houses. They prefer to use RCC columns and wanted know how to make low cost and saline resistant columns. They believe that houses with RCC columns will be able to withstand high winds.

Sandwip has many sweet water ponds. People suggested that 5-10 ponds should be kept as 'reserve ponds' in each union, particularly in vulnerable areas. These ponds should be 2-3 km from the coast and their banks should be raised 15ft high. People and cattle could take refuge on these high banks. There is a good example in that about 1,000 cattle and 2,000 people survived by taking refuge on the high bank of ponds of Tana Shaha Mazar Dighi at Kalapania Union. This kind of pond could be source of uncontaminated water for household domestic use, bathing and drinking after disaster.

Existing embankments are in a poor state of repair. Routine maintenance of embankments is neglected. Properly compacted embankments with an appropriate slope have proved to be useful barriers against storm surges. Most of the embankments are constructed to protect the land from inundation by saline water during normal tides. After disasters, no attempt has been made to improve the embankments. As a result, the crop is being affected by saline water. The people considered that trees should be planned on the embankment. The 'Dhol Kalmi' and 'Kewra' species are recommended as the most suitable for soil binding in coastal areas and on embankments, 'Kewra' on the sea side and 'dholkolmi' on the landside 'Napier' grass could be grown on the top of the embankment as fodder for the cattle. The people who are living in the embankment area should be made fully aware of the purpose of coastal embankments so that they do not remove grass from the slope or cultivate the land on top of the embankment.

Local people were of the opinion that coconut, date and palm trees are able to withstand the force of ferocious winds. However, if the height of trees was above 20 ft, they cannot stand and are uprooted or break. The people are searching for varieties of palm, coconut and other trees which are short, e.g. 20-30 ft. height, and have sound rooting systems which anchor them solidly into the soil. Member of kinship village groups should be encouraged to plant the area surrounding their house with coconut, palm and date trees.

Following the storm surge, all cropped fields were submerged by saline water and become polluted. Grazing fields are non-existent and straw too was damaged. The surviving cattle and goats suffered from a shortage of fodder. Relief supplies should include fodder for the livestock.

A.4.1 Awareness Forum and Materials

Awareness can be enhanced through various means including : posters with pictures; bill boards; writing 'Kabigan' and 'Jarigan'; village 'drama' writing episode in Puthi form; projection of slides in cinema halls; making social emotional video film containing the issues of disaster preparedness and arranging to display it to the people in general, particularly women. Information sheets should be distributed on 'Eid days' so that people recall their family and kinship members lost in disasters, that such disasters will again strike and, hence, the need to take shelter.

There is a monthly TV programme named 'Vara Nadir Banke'. This programme is very popular with the womenfolk of rural areas. Folk songs are collected from different regions, and presented on TV. The folksongs of coastal areas; offshore islands and 'char' lands could be collected and written down, especially those mentioning disaster preparedness issues and they could be presented through this programme. Mr. Mostafa Zaman Abbasi, a famous folk singer, who is in charge of this programme for BTV, might be contacted to explore the possibilities.

Training could be organized for Government and non-Government groups.

- NGO organized groups of which there are:
 96 groups in Sandwip organized by Nizera Kori
 48 groups in Sandwip organized by CARITAS
 70 mother groups organized by BRAC
 160 mother groups organized by Nari Progati Parishad
- GOB organized groups
 68 KSS (Male + Female) organized by BRDB
 42 groups organized by Social Welfare

Similarly, there are many NGOs in Cox's Bazar. They have different programmes with thousands of groups. A sound network of human infrastructure exists. This can be mobilised to increase the people's capacity to cope with disaster.

Some educated and well off people requested Government to initiate a system to:

- provide storage facilities for food items for first 10 days in the event of disaster
- provide kinship store house structures which could be used for storage of paddy, seeds etc. This should be low cost and able to withstand flood, storm and tidal surges.

Three months after the April disaster, Danger Signal Nr. 7 was raised, 70% of the people of Sandwip and Cox's Bazar moved to the cyclone shelters, pucca structures i.e. mosque, government buildings schools etc, but no cyclone materialized.

The people who did not move to shelters made fun, joke, laugh and taunt them when they come back home from the shelter. Such episodes will ultimately reduce the willingness of people to move to safe shelters. Training and motivation must address this problem.

Different GOB agencies are working at thana level:

Livestock
 Fishery
 Public Health Engineering
 Bangladesh Rural Development Board (BRDB)
 Agriculture Extension (DAE)

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Health and Family Planning
Project Implementation Office (MOR)
Social Welfare
Bangladesh Agriculture Development Corporation (BADC)
Bangladesh Krishi Bank (BKB)
Police Station
LGED

During discussions with the people, it has been suggested that each agency should have a 'Disaster Unit' at thana level with three components :

- Extension,
- Input support service
- Technical support service - so that they can respond quickly immediately after a disaster and not wait for external assistance or instructions from senior officers.

NGOs might also have such units.

Immediate after a disaster, priority should be given to the following to mitigate people's sufferings:

- housing materials
- water - repairing inoperative tube wells and the supply spare parts
- clothes for covering bodies of dead women
- cloths
- draining out the saline water from ponds
- medicine and medical teams for treating injured victims
- medicine and veterinary team for treating injured animals
- distributing seeds (vegetables+paddy)
('Haiddha' in 60 day Aush paddy crop and 'Kaligola Nona Shail' is 70 day Aman paddy crop is suitable for all coastal areas).
- power tiller service, fertilizer
- credit

Livestock and Health Complex should train youths on First Aid to ensure a wide coverage.

Public Health Engineering Department can train some private mechanics to repair tubewells.

BADC should train some farmers as LLP operator to drain out the saline water from ponds. Power tiller driving and maintenance training could be given to farmers.

The following diseases occur after disasters:

- diarrhoea
- dysentery
- common fever
- measles

- eye infection

A.4.3 Relief

Relief goods should be distributed through (both male and female) kinship groups. Kinship group leaders should be able to better assess the needs, with their knowledge of each and every household and their accountability to their own people. To avoid unequal distribution of relief, women workers should be responsible for distributing relief to women. Women cannot wait in line for a long time with their children for relief, and when purdah is prevalent, women would not go to the centres or stand in line to receive relief. Common norms for relief distribution should be established. Relief operations should continue for the first few days. Thereafter relief goods should be given in exchange of labour.

It has been reported that, after disasters the price of essential medicines, house building materials and essential goods, increase. The local administration should ensure that normal market prices prevail.

In the aftermath of cyclones, employment could be generated through:

- repairing local roads
- rebuilding boats and making nets
- repairing embankments
- repairing houses.

It has generally been found that the labour wage rate after disaster is high.

Coastal areas and offshore areas of Chittagong and Cox's Bazar were found to be conservative in their attitudes towards remunerative employment for women outside the home. Most of the women interviewed considered that they should be given a wage for constructing their own temporary houses and for their homestead cultivation. Women from fishing communities need wages while making nets.

Orphans and destitute women needs special attention. They should be accommodated in orphanages. Relief and credit should be given to widows to make them self-sufficient. The local administration should protect their land and property.

After disasters, some conflicts arises in connection with re-possessing lost household materials, particularly CI sheets, livestock, containers with stored paddy, and household utensils. Sometimes, this turns into a man-made social disaster. It can be solved by strengthening the local judiciary system. People do not want to go to court or approach the police as they tend to delay matters.

Most of the people and officials stated that government should introduce '**disaster preparedness savings schemes**' for the people of disaster prone areas. Such savings schemes would help them to rehabilitate themselves after disaster. An NGO organized group (Nizera Kori and CARITAS) who did save money said that their savings helped them to return quickly to normal after the disaster. The savings were about Tk. 4,000 - 12,000 savings/group.

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Religious leaders stated that the **Jakat Board** should give support to orphanages. Government should undertake awareness campaigns to mobilize well-off people to support these orphanages.

Salt beds, shrimp-beds, and prawn hatcheries are the source of employment for the poor people of Cox's Bazar. After disasters most of the people were unemployed for a long time. Owners of beds said that embankments should be repaired immediately after surges, and that credit should be provided under soft terms so that they can restart their operations.

During discussions, women group members said that they need 2-7 days old chicks, female goats, female sheep and female calves for rearing instead of relief.

The following possibilities should be explored to encourage income generating activities for the people of the coastal areas after disaster:

- poultry and duck raising (women)
- fish meal preparation (women from fishing communities)
- net making (women)
- cane work for local utilisation
- vegetable cultivation
- short term fruit tree cultivation
- fingerling raising and rearing
- cultivation of shrimps in fresh water ponds
- goat and sheep rearing
- dry fish processing

According to the local population, all existing government buildings which are now being constructed should be allowed to be used as cyclone shelters.

All new government buildings should be so designed that they can be used as cyclone shelters.

The 'grassroots' training outlined on **Table A.1** and **A.2** should be developed. Emphasis should be placed on using training methods that identify the clients problems and let him or her discover the solutions to their own problems without these being thrust upon them. Active mutual problem solving by trainer and trainee is preferred to passive counselling.

The training should be imparted by trainers who have experience of organizing and mobilizing the victims and the people of disaster-prone areas. If this is not done, the trainers/institutions will be unable to handle the issues emerging. Training is to address realities, and is not a simple cognitive exercise.



ANNEX B

EXPERIENCE FROM AREAS AFFECTED BY THE CYCLONE 1991

ANNEX B

Experience from Areas Affected by the Cyclone 1991 Field Studies in Sonagazi, Ramgati and Mirsharai (7 - 12 October 1992)

B.1 Places Visited

During the field trip, 12 villages in three thanas of three districts were visited. The villages are listed below against the respective thanas and districts.

District	Thana	Village
Feni	Sonagazi	Sonapur
		Char Darbesh
		Char Chadia
		West Char Chadia
Noakhali	Ramgati	Char Abdullah
		Char Gazaria
		Char Thua
		Char Chebas
		Char Balua
		West Falkon
Chittagong	Mirsharai	Char Sarat Osmanpur

Information was gathered through observation, individual discussions and group meetings. Individuals, groups, agencies, both government and non-government, were interviewed on their perceptions of the disaster, coping strategies, relief and rehabilitation measures; how things could have been done better, how people could be helped to develop coping strategies with greater chances of survival; what kind of support and resources are required to enable them to help themselves.

B.2 Contacts at Ramgati, Sonagazi and Mirsharai

Meetings, interviews and discussions were held with both male and female groups organized by Nizera Kori; Society for Economic and Basic Advancement (SEBA); CODEC; Comilla Proshika; BRDB organized groups; fishermen groups; government and NGO officials at field level and Union Parishad members.

B.3 Chars and Accreted Land

The Muhuri Irrigation Project was completed in June 1986. As a result of the Muhuri Dam, a large land mass has formed downstream to the south of dam. This new land is located between Sonagazi thana of Feni district and Mirsharai thana of Chittagong district. This land provides an area for settlement by a considerable number local households who lost their previous homesteads and land due to coastal erosion.

People from Ramgati have settled in different 'chars' in large numbers. This migration process was initiated by interested persons and groups. Most of the people were poor before their migration and the rest had lost their landholdings in the coastal areas of Ramgati due to erosion. The settlers serve the interests of 'Jotdar' faction groups as sharecroppers and farm labourers.

Each faction is led by a group of powerful people who have a substantial political following, administrative linkages and a private army of 'lathiyals'. Kinship, factional bondage, political disposition and neighbourhood relationships determine preference when selecting settlers. If accepted, settlers are termed 'allotment holding' tenants for their respective patrons. The patrons (faction leaders) are at the top of the structure, while the settlers are at the bottom.

Char Abdullah, Char Thua, Char Chebas, Char Balua and West Falkon are now connected to the mainland due to accretion, Char Gazaria is, however, bounded by water like an island.

In 'char' areas 'local nationalism' exists. One is 'Bholaiya' - migrants of Bhola and the other is 'Shahabajpuri' - migrants of Ramgati and Hatiya.

The Government has given land to some households whose land was destroyed by river or sea erosion. Some people occupied land which had accreted at sites which had, in former times, been subject to river erosion. They cultivate this land on the basis of a direct claim. They are self-sufficient farmers and become as self-styled 'jotdars' in 'char' area. Freedom Fighter groups also lease 'char' land which has been given to destitute people for sharecropping. There are also absentee landlords acting as progressive faction leaders. There are many households headed by destitute women who lost relatives in the cyclone of 1970 and who migrated to the 'chars' but could not manage the land.

Besides settled farmers, migrant labourers from different mainland regions come to the 'char' land for seasonal work. They remain for transplantation and harvesting. Many people also stay on a temporary basis to process cheese. Kinship bond and ties in 'char' lands are weak as most of the inhabitants are unsettled people who move from place to place and the likelihood of conflict between them is high.

There are large numbers of cattle and livestock in the 'char' lands. The chars are used to rear cows, buffaloes, goats and sheep from the mainland as there are ample grazing fields. Apart from agriculture which is the primary occupation, fishing and cattle rearing are important secondary occupations. Migrant labourers are engaged not only as agricultural labourers but also in cattle rearing, although they are not the livestock owners. Destitute women and children are engaged in cattle rearing, they in turn receive a small plot from the faction leaders to construct a homestead. These women are responsible for constructing the earthen mounds in which to keep the cattle owned by their patrons. There are some women who rear cattle on a share basis (barga).

There are abundant fish resources in the 'char' areas. Most of the fishermen are poor as they do not receive a fair price of their catch. They have to sell fish on the mainland through middlemen. They hire boats and nets from the richer class for mainland.

B.4 Cyclone of 29 April 1991

Although all 'char' areas were unprotected, human casualties were few. All the 'kutcha' and 'semi-pucca' homes were damaged. Some 95% of the household food-stock, utensils, ripe crops in the field, and straw stocks were destroyed. 40-50% of the livestock perished due to the surge. The people of these areas stated that the magnitude and intensity of the 1970 cyclone (water height, velocity) and the havoc created was greater than that of the 1991 cyclone.

B.5 Response of People to Warnings

Most of the people of 'char' areas received the warning message from the radio. Red Crescent volunteers warned the people through megaphones.

The people did not believe the warning as it occurred during the driest season (the month of Baishak). In the dry season, ponds, lands, canals and river dry up. They thought, that if there was a surge then these ponds etc would be able to hold the water.

People from a few 'chars' did not hear the warnings. They are very poor and most of the households do not own radios. 'Miking' by volunteers was limited because the internal road network is poorly developed which limits access by rickshaw to carry the volunteers from 'char' village to 'char' village to 'mike' the warnings.

Some educated people, elites, students and teachers stated that in the radio announcements there was no indication of the areas where the surge was likely to occur. The people of 'char' areas when asked the question : 'how do they perceive the different signals' - replied, 'the higher the signal number the greater the danger'. Some people of 'char' areas believe that, if the wind blows from the north, it will not cause damage. 95% of women did not hear the warning signal on the radio. They received warnings from male family members.

The languages used in the radio bulletins are not clear and understandable to the people of 'char' lands.

The people are not aware of the significance and implications of the different warnings.

If their menfolk were away, women cannot decide whether to go to safe shelters or not. The women in the charlands have to operate within the values and norms set by the male members. Purdah is strictly followed. Most of the women stated that, even if the government announced 'doomsday' on the radio, they could not abandon their responsibilities of looking after their children and the homesteads until the menfolk instruct and them to do so.

B.6 Local Coping System

All 'char' lands face routine tidal surges. During routine surges the 'char' lands are submerged for 2-3 hours. The water falls when the tide ebbs. To cope with the regular tidal surge, the people of 'char' lands have their own preparedness. They have built houses on raised earth mounds about 2-3 ft. high (macha) with bamboo poles and thatched walls and

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roofs. They construct many indigenous earth mounds to keep cattle and livestock, and build dikes around the crop land to protect it from saline intrusion.

At the time of the 1991 cyclone, when people found ankle-deep water in their compounds, they rushed to the nearest embankments for refuge, and climbed on the 'machas' and 'killas'.

At that time, gusty wind was blowing from the south, and the water level was raising, all were waiting for death as the water level rose breast-high, all 'machas' were trembling as if they would immediately collapse and would sweep away, when all of a sudden the ferocious southerly wind turned to the north and the water started to recede. The people started to climb down. People stated that no one thought that they would survive, if the south wind had blown for a few more minutes all would have died.

The people who were living on accreted land which was connected with the mainland took refuge in 'pucca' structures and cyclone shelters as such structures were close to the dwelling units, although only 10-15 percent of people could make use of such facilities.

The charland people are reluctant to move to cyclone shelters and safe places. They stated that they would never leave their houses and go to a cyclone shelter even if it was 'doomsday'. If they leave, they will be dislodged, their houses demolished and cattle looted. Once these have been lost, they would not be able to acquire them again in their lifetime.

During the recent Union Parishad election, not a single person from Gazarian Char came to the polling centres to vote. They do not even go to mainland markets or leave their homes unattended because of fear of losing possessions of the land and other assets.

In and around the 'char' belts, there are three cyclone shelters. However, accretion of land has generally increased the distance of the cyclone shelters from the settlements which house new migrants. This process has placed the existing cyclone shelters in lower risk areas. People previously living inside the embankments have now moved outside the embankment as new lands are continuously emerging.

Patarchar, a newly accreted 'char', is really not yet suitable for habitation. However, the 'char' is large and has good grazing and thousands of cattle are raised there. Adolescents, adult women and bonded labour rear cattle and are living there on 'machas'. For employment sake, they are forced to live there. However, some NGO workers stated that sometimes even routine tidal surges make the situation alarming in this char.

B.7 Issues Opinions and Suggestions on how to cope with Disaster

Weather Bulletins should be issued mentioning expected location of an approaching cyclone and the height of the surge in particular *Charlands*.

Weather Bulletins should be issued continuously from the radio requesting the people of *Charlands* to move to safer places and cyclone shelters.

In bulletins, the term *Charland* must be used.

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In the event of a Great Danger Signal, a separate bulletin should be delivered particularly for *Charlands*. The people become confused with the terms like:

- Island
- Coastal zone
- Off-shore island
- Sea-shore areas and port.

The language of bulletins should be simple and understandable.

Bulletins should address the womenfolk directly requesting them to move from chars and accreted areas to shelters and safer places with their children in the absence of their male family members.

- Bulletins should be disseminated through local informal channels such as:

- Union Parishad
- Market Committee
- Mosque Committee
- Youth Group

Continuous 'miking' is the effective means recommended by the people. The radio should tell CPP volunteers and local organisations when they should start 'miking'.

New cyclone shelters and killas must to be constructed within their catchment areas. Government tenancy rights and land reform are 'musts' to mitigate human casualties in the event of cyclone. If new cyclone shelters are not constructed within their catchment areas people will not move to them. Lack of clear title to land prevents inhabitants from moving to safer places at times of danger.

People are afraid of losing everything if they leave their houses as there are other people who try to grab their land and keep possession by force. There are numerous instances of this happening.

Effective warning dissemination, training and motivation will not persuade them to move to safer places when the surge is imminent unless these problems are solved.

People need 'killas' to save their cattle. Many people stated that, they can construct 'killas' on their own to serve 5-10 families, if they are provided with a suitable design of structure.

The people request that government puts pressure on absentee landlords to construct 'killas' in the charland for their sharecroppers tenants and their cattle, which are reared by their clients in the charlands. Similarly, they should be asked to construct 'pucca' structures to accommodate seasonal hired labourers so that they can take refuge at times of danger.

Many people said that since their areas are charland, many dead bodies and animal carcasses come from other areas (e.g., Char-Jabbar, Hatiya, Bhola) and lie in the charlands for days after the cyclone. Local government and NGOs can assist in removing the bodies for burial.

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The people of the charlands have to travel long distances for employment in different chars. After a disaster, nobody knows their whereabouts' hence they need boats to search their for missing family members.

The people are so poor that they cannot build houses which can withstand the fury of the cyclones and surges. They wanted to know about the improved *Macha* structure which could withstand hurricane force winds and tidal surges.

A manual on *Periodical Maintenance* of killas should be prepared and necessary training organised to enable the beneficiaries to undertake the required maintenance. Borrowpits could be used as fish ponds and for domestic purposes. 'Norms' for the use of 'killas' should be developing with the participation of users. A 'killa' can provide shelter to 100-200 livestock. Developing *norms* will help to avoid conflict. The land for killa sites should be registered in the name of *community utilizer group*.

Most of the existing embankments in the charland areas are in a dilapidated condition with cuts and many are partially or completely eroded. Due to accretion of land in recent years, the coastline has moved away, in some places up 5-6 km from the embankment and large numbers of people have settled outside the embankments. Hence, there is a need for new embankments throughout the coastal belt. Isolated chars should be protected by embankments (Beri bunds 3-4 m high).

False beliefs and a false sense of security are responsible for the loss of lives. In many places, people consider roof tops, Macha, trees and embankments high enough to protect them. However, in most cases it appeared that when the surge swept away the places where they took refuge, it was not possible to save all the members of the household. In most cases, women and children were abandoned. Training, motivation and public awareness campaigns could resolve these problems to a great extent.

Settlements in the char areas are scattered. The roads are bad. Due to the lack of a good local road network, the settlements became inaccessible and do not allow people to move to the mainland.

Many people suggested that existing embankments should be repaired and be used as embankment roads. Such embankment-roads would create a link with all accreted land and the mainland. Due to routine tidal surges, they cannot dry their crops properly the tops of embankments could be used for this purpose.

60 percent of drinking water is obtained from ponds. There are few shallow and deep tube wells. Most of the people said that contaminated ponds should be made fit for human use. Damaged tubewells should be repaired and new tubewells installed according to needs of the area.

People become the victims of various diseases. The incidence of diarrhoea, dysentery, common fever, worm, night blindness, scabies, cold and cough for children were reported to be common.

Timely treatment of diarrhoea is needed, particularly for children. Availability of OR saline solution and medical personnel to attend to critical cases is necessary. Adequate medical supplies are also needed to mitigate sufferings.

Provision of animal fodder through relief sources would be of great help.

Vegetable seeds, paddy seeds or seedlings, fingerlings, fertilizer, short term soft credit, power tiller services are the essential requirements to restart agricultural activities.

Relief should be given to remote areas of charland. Most of relief was distributed in the roadside villages. Due to bad communications, the people in the interior did not receive relief. Most of the vulnerable women and children did not receive relief as the programme was implemented and operated by male workers. Women cannot travel long distance to places of relief distribution with their children. Moreover, the weather remains bad for first 2-3 days after a cyclone.

According to the women of the charlands, they face a fuelwood crisis. Plant residues, leaves of big trees, and cowdung are not available after a disaster. Earthen stoves are also damaged. Initially, there is no need of firewood as they have no food. After receiving uncooked food as relief, there is a need for fuelwood. They have to live in the dark during the initial days following the disaster. Kerosene is not available and, if it is available, the price is high. They have no lamps and hurricane lamps in their houses. Most of the women suggested that there should be *Langarkhanas* (gruel kitchens) that these should continue for at least 15 days, especially for the children. *We cannot be mothers when our children cries for food and we are unable to cook and feed them.*

During the post cyclone period, unemployment increases. The people cannot replant crops on the lands damaged by the cyclone due to lack of money.

The people considered that there is scope to generate employment for both males and females if short term credit could be made available. The opportunities would be:

- poultry and duck raising
- fish raising
- par boils rice
- vegetable cultivation
- sweet potato and nut cultivation in sandy charland
- boat and net making
- small trading

The opportunities under Food for Works Programme would be to repair:

- embankments, roads, institutions
- killas
- houses

ANNEX C
CAUGHT IN DISASTER
LIVING WITH DISASTER

November 1992

Ishrat Shamim
Jahangir Kabir

CAUGHT IN DISASTER LIVING WITH DISASTER

Introduction

The cyclone which hit the south-eastern belt of Bangladesh during the last hours of 29th April, 1991, was one of the severest cyclonic storms in the history of this disaster prone country. The worst hit was Hatiya, Sandwip, Kutubdia, Moheshkhali, Bhola and Manpura. The environmental hazards caused by the cyclone and storm surges in the islands and coastal mainland were human casualties, loss of agricultural properties and products, inundation of land and ponds by saline water, damages of houses, breakdown of sanitation, non-availability of safe drinking water and food.

Breakdown of deaths by age and gender indicated that children, followed by adult women, topped the list of the casualties. A detailed account of mortality in Magnama and other parts of Chakoria, based on the number of corpses estimated that about 70 percent of the dead were children, another 20 percent were women while men - young and old - accounted for the remaining 10 percent. Children, the most vulnerable, succumbed in large numbers and UNICEF estimated that 60,000 children had perished in the catastrophe.

The extent of the April cyclone clearly indicates that its effects is not only a function of the intensity of the cyclone disaster, but also of various aspects influencing the process of socioeconomic development and environmental change. In other words, human settlements and related activities also play a significant role in determining the dimension of natural disasters.

Experiences of People Caught in Disaster

The people of the off-shore islands and coastal areas of Sandwip, Sitakunda, Cox's Bazar, after hearing the warning signals, had their own interpretation of these warnings. Their experience, belief and encounter with the physical environment which is definitely most vulnerable played a pertinent role in their decision making to go to shelters or safer places before the cyclone started. It related to the climatic factors about apprehending a forthcoming storm surge of that intense: the wind was blowing from the north, clouds were not very dark, taste of sea water was not too saline and it was not the time of 'gona', which are the particular dates of the cycle of the moon influencing the nature of rolling water and waves. On the

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physical environmental factors; sea level was lower than mainland, there were some 'dobochars' or 'chars' lying below the sea level, and the existence of the 10 - 15 feet high embankments. Therefore, people's response was that of disbelief as past warnings did not always materialize.

Most people failed to move their family members to predetermined safer places. Between 10 to 20 percent moved from their houses to cyclone shelters or other secure places. They were afraid of looting. Many of those who moved, took the decision only after water entered seaside villages, overtopping the coastal embankments. Most people moved to the houses of well-to-do people near to their habitation, assuming that such houses were strong and safe. During movements, many children and women were swept away by the strong surge. Some people who reached the houses of well-off people, found that the houses were already over-crowded and failed to find safe shelter, thus the current swept them away also.

Houses owned by rich people were occupied by their kinship members. They climbed into the 'dorma' or roof space but when the house collapsed nobody could come out from inside the ceiling space and were pressed between these heavy structures. Death rates were high in coastal villages among people who took such shelter in the roof or who tried to move after the surge hit them.

Women did not move as they did not know the location of the shelters, community development centres, and other 'pucca' structures. Most of the male members of families living outside the embankments and in seaside villages were fishing at sea, working in 'chars' as hired labourers, working in salt-beds or shrimp hatcheries and beds. They could not return to their families in time. As a result, women and their children did not move to safer places as they were waiting for the male members.

During the cyclone when men were away, women could not decide by themselves whether to go to safe shelters or not. The women in the 'charlands' have to operate within the values and norms set by the male members. Purdah is strictly followed. Most of the women told that, even if the government announce 'dqomsday' through radio, still they cannot abandon their responsibilities of looking after the children and the homestead until the menfolk instruct them to do so.

Most of the off-shore of Cox's Bazar have no proper roads linking the shelters and other safe places to settlements. All houses appear to be floating and marooned. If the people want to respond to a warning, it is difficult for them to take shelter immediately. Most of the small paras/villages are bounded by salt beds, shrimp hatcheries and shrimp beds. The road network is so poor in the area that they find it difficult, given the mode of transport and the condition of roads, to walk a distance of even a few kilometres in stormy weather.

Some people, especially old women and men, believe that if they go to shelter leaving the house unguarded, 'Allah' will curse them, the unguarded house will also give them 'bardoa' or curse. Many family members think that assets are more valuable than lives.

The Cyclone Preparedness Programme volunteers did not respond at the initial stages. They came out into the village streets with megaphones after radio/television announced Signal Number 5 - 6 or more. The people believe radio and television warnings more than the volunteers.

Existing cyclone shelters, community centres and killas are located far from the settlements that they are supposed to serve. There are insufficient shelters or strongly built houses and the people cannot organize transport facilities to move to those that there are. Many people do not consider 'killas' as safe shelters for their cattle. They believe that their livestock will not survive bad weather on open-air 'killas'. Many government, non-government and local people, who took refuge in 'pucca' structures, reported that, during storm surge the structures trembled. If the buildings were to collapse, nobody would survive. Generally, the people prefer to stay in their own homes.

In the 'charlands' of Ramgoti, Sonagazi and Mirsarai, the poorest of the poor inhabit the most vulnerable areas where human settlements are not viable and unprotected as they are living very close to the sea. Given the nature of the area, the migrant landless households have their dwelling units on 'macha' to protect them from the daily tidal surge that submerge the area. These are mostly build of bamboo poles and thatched walls and roofs.

In addition, they had built indigeneous mounds of earth similar to 'killas', which are used for cattles, goats and other livestocks. Another interesting aspect of these 'char' areas is increasing amount of cattleheads, compared to numbers of people living there.

Moreover, accretion of land has affected the distance of cyclone shelters from near to the sea settlements which are recently been housed by migrants. This process further placed the existing cyclone shelters in less risk prone areas instead of high risk zones. Also people previously living inside the embankments are now living beyond the embankment limits as new lands are continiously emerging.

However, loss of human lives were comparatively very less as people's response to the forthcoming cyclone was that of quick decision. Although, many of them could not foresee the intensity of the storm surge, still they took refuge in the existing embankments, 'macha', the earthen 'killas.' For people living in

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accreted land which are connected with the mainland, cyclone shelters and other 'pucca' structures were in close proximity to their 'kucha' dwelling units. Thus they had convenient access to go to such safe places, although only 10 - 15 percent could avail these facilities.

Lack of entitlement to the land prevents the inhabitants from moving to safer place in case of a hazard. They are afraid of losing whatever little they possess if they leave their houses unattended as there are people who would try to grab their lands and take possession by force. Such numerous instances could be found. Thus, the 'charland' people are reluctant to move to cyclone shelters and safe places. 'Charland' people asserted that they would never leave their houses for cyclone shelters even if there is a 'doomsday.' Once they lose their assets, they will never be able to acquire them in their lifetime.

Future Strategies for Living with Disaster

The disaster of April 1991 added a new dimension to natural disaster management and preparedness in Bangladesh. Since Bangladesh is a disaster prone country and people have to live with disaster, skill and management abilities are acquired in the process. But the main problem lies with pre-disaster organization and management. However, in the grassroot level, there is no organizational setup dealing exclusively with disaster management. This is true both in the case of government, non-government as well as people themselves.

Pre-disaster management is a gigantic task as it includes total mobilization and organization at all levels. Natural hazards become a disaster only when people are affected in large numbers. Therefore it is pertinent that people in those disaster prone areas should build their own capacities through their own organization set up - a neighbourhood based unit. Side by side, a supportive group should be established consisting of local government officials, non-government personnels, informal groups and volunteers. As a coordinated group, they will work together for strengthening the neighbourhood based unit to cope with future disaster.

The government's response to disaster management should be focussed on creating opportunities at the disaster prone areas among the grassroot people. This includes mainly the infrastructure development like cyclone shelters, killas, embankments, roads, and telecommunications. Improved and communicable warning systems is also a part of the government's initiative. To implement such developmental strategies with regard to disaster preparedness, a specialized agency within the government's structure is to be established.

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The neighbourhood based unit should be trained in such a way as to be competent to deal with disaster - the immediate effective response to crisis, before any outside assistance is rendered. Moreover, the unit should be well organized to provide a workable ground for outside intervention to properly operate in exigency.

With the government infrastructure at the grassroot level, a disaster preparedness unit with all agencies should be established so that just after any disaster, the neighbourhood unit can pull down support and services from all available agencies according to their immediate needs.

The issue of gender has to be recognized for assuring a genuine development in disaster preparedness. Women organizational unit is to be set up at all levels. Emphasis should be given on the decision making process at the household level, to recognize women's decision as substantial and important as their male counterparts.

Disaster myths and perceptions like false refuge in roof tops, embankments, trees or any high raised spots in the high risk zones are to be shattered by training and motivational work. Disbelief, indifference and ignorance to forthcoming disasters are to be considered in developing any disaster awareness raising at the grassroots.

Infrastructure development projects should be undertaken with the full active participation of both men and women in site selection and design of shelters. Government should explore the possibilities of private initiatives of building well protected structures in their own neighbourhood. Funds could be made available to such persons who are willing to build structures on the basis of equitable contributions from both sides.

Post disaster activities should not only emphasize the human components, but at the same time, should look into fisheries, livestock and plantations for ensuing harmonious development.

Research should be undertaken on food preservation techniques, neighbourhood food grain storage and safe water storage. The positive findings of such research should be demonstrated at the neighbourhood levels to encourage community participation.

Awareness raising materials should be developed for people at all levels and for all sections of the population. Mass media's positive role should be activated. For children and adolescents, curriculum at school level should be designed and include basic information about all types of disasters, disaster preparedness and post disaster activities to be undertaken.

Non-government agencies involved in informal or non-formal education for adults should prepare lesson sheets on disaster management.

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Disaster preparedness planning should consider three different areas according to their characteristics:

- Coastal areas;
- Off-shore islands; and
- Charlands.

Most people expressed the view that to encourage active response to crisis, considerable emphasis should be given for the development of the human being, on forming or enhancing his or her capacities to make decision, to learn, to manage, to communicate with others, to analyze the environment, to be a leader, to stand up to crisis, to organize and so forth. In other words, develop the human resource base.

For a country wide disaster preparedness, government should declare a NATIONAL DISASTER DAY (NDD) to highlight and mobilize a nation wide disaster awareness.



ANNEX D
PERSONAL REFLECTIONS ON DISASTERS

ANNEX D

PERSONAL REFLECTIONS ON DISASTERS (Jahangir Kabir, Sociologist)

1. THE PROBLEM

1.1 Introduction

Every year the people of Bangladesh suffer the wrath of natural disasters. Every year many people become homeless, jobless, and destitute. Every year many people die.

While the wrath of the disaster is inevitable, the consequences for the people are not. Ultimately, the people can make decisions and employ strategies based on not only their knowledge and experiences, but also that of others.

1.2 One Woman's Story

Fatema, a 32 year-old widow from Sandwip, for example, lost her husband and all four of her children to a cyclone. She heard about the Warning Signal Number 10 from her neighbours. But she did not pay any attention to it. She had heard this signal before, and no cyclone had followed. She was waiting for her husband who was working in the fields. Since she lived inside a high embankment, she believed she was safe from the tidal surges.

Eventually, the people in her village started talking about moving to safer places. But as a woman, Fatema did not know the location of the cyclone shelters, and even if she did, she could not leave without her husband. She prayed to Allah.

Soon after, however, Fatema left her home with about 200 other villagers, mostly women and children. They tried to reach a tin roofed house to take refuge, but there were too many people, and too many people panicking. They could not reach the roof. The strong storm surge separated her from her children. All of her children were swept away by the tidal waves. She remembers hearing her daughter calling her, and then she lost consciousness. She awoke the next morning lying on raised ground near what used to be her home. She had lost everything.

Fatema's story, unfortunately, is not unique. For a variety of reasons, only a few of which are mentioned in Fatema's story, many women and men will not leave their homes despite the impending devastation of a natural disaster. The consequences are tragic for nearly everyone.

1.3 Disasters are a social phenomenon

Disasters, regardless of the various responses by different groups, bring about changes, or accelerate changes already taking place. There is an overwhelming tendency, however, for individuals, family groups, and communities to try to return

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to pre-disaster normality. For this reason, disasters are best perceived as social interruptions, with most social dynamics eventually returning to their pre-disaster norm (United Nations, 1986).

The effects of cyclones are a function of not only the intensity of the cyclone, but also the various aspects influencing socioeconomic development and environmental change. In other words, human settlements and related activities also play a significant role in determining the dimensions, and devastation, of natural disasters.

The capacity of an individual, family, or village community to economically survive any crisis, be it a cyclone, storm surge, flood, riverbank erosion or any other natural disaster, depends on the resources they have at their disposal. Therefore, it is impossible to separate the issue of how a family, neighborhood, or community prepares for and copes with natural disasters without considering their resources, such as their economic base, their knowledge base, their ability to make decisions, and their support systems.

1.4 Understanding the people is critical

Understanding the people's coping strategies and decisions, and their reasons for such strategies and decisions, is critical for considering and implementing more effective strategies during the inevitable future disasters. To achieve the goals of saving lives and improving the quality of life for those who survive, pre, during, and post disaster management must be operating by and for the people of the disaster-prone areas.

2. PRE-DISASTER MANAGEMENT

2.1 Introduction

Response to a crisis requires mobilization, organization, decision-making, leadership, and action at all levels. To encourage active response to crises, emphasis must be placed on developing and enhancing the people's ability to make decisions, to learn, to manage, to communicate with others, to analyze the environment, to be leaders, to stand up to a crisis, to organise, and so forth. In other words, there needs to be development of human resources.

Pre-disaster management is a large task which involves reducing the impact of any disaster and creating a response plan to cope with these disasters. Natural hazards become disasters only when people are affected in large numbers. Therefore, it is important that people in disaster-prone areas strengthen their coping abilities through local organizations, i.e., neighborhood units cooperating with local government officials, non-government personnel, informal groups, and volunteers.

Gender-related issues have to be recognized in order to assure development in disaster preparedness. Special women's groups should be set up at all levels. Emphasis should be placed on the decision-making process at the household level, recognizing that women's decisions are as important as those of their male counterparts.

2.2 The people must be aware

Awareness of disaster management, and all that it entails, must come first. Awareness can be enhanced by addressing disaster preparedness issues through various means including: posters with pictures; billboards; writing Kabigan and Jarigan folksongs; village drama writing in Puthi (folksong) form; projection of slides in cinema halls; and social-emotional films. Women should be especially targeted. In addition, information sheets should be distributed during Eid so that people will think of their family and neighborhood members lost in disasters, and remember that such disasters will strike again; thus, they need to take shelter. Awareness-raising materials should be developed for people of all levels and all sections of the population.

2.3 Eliminating the myths, establishing the facts

Public awareness activities must expose and refute common myths and misconceptions about disasters, like false refuge in ceiling spaces, embankments, trees, or any high raised spots in the high risk zones. Disbelief and indifference to warnings of forthcoming disasters must be considered in developing disaster awareness at the grassroots level.

The school curriculum for children and adolescents should include basic information about all types of disasters, disaster preparedness, and response activities.

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For countrywide disaster preparedness, the government should declare a Natural Disaster Day (NDD) to highlight and mobilize nationwide disaster awareness. Government and non-government organizations should organize the day around cyclone shelters, primary schools, and government buildings, and be entertaining like village fairs.

In Jumma prayer on Fridays, Imams, Purohits, and Monks should preach to the people about pre-disaster preparedness. Jumma is a very effective forum for muslims. The Imams should be trained by accepted religious leaders instead of by a formal trainer. Messages from the Holy Quran and Hadith related to disaster preparedness should be taught.

Research should be undertaken on food preservation techniques, neighborhood food grain storage, and safe water storage. Positive research findings should be demonstrated at the neighborhood level to encourage local communities to adopt these practices.

2.4 Orientation and training for everyone

Orientation sessions should be arranged for support groups and individuals on the organization of awareness campaigns and the techniques of warning information dissemination. The orientation session should include the following groups and individuals:

- Thana Central Cooperative Associations
- Primary School Teachers Association
- Madrasha Teachers Association
- Youth Clubs
- Block Supervisors (DAE)
- TCCA Inspectors (BRDB)
- Health Assistant and Family Planning Workers
- Social Welfare Workers (male and female)
- Chowkider, Dafadar, Ansar, and VDP
- Veterinary Extension Assistants
- Fishery Extension Assistants
- School and College Teachers
- Mosque Committee Members
- Bazar Committee Members

Neighborhood groups should be trained to respond to crises without any outside assistance. The groups should be well-organized and cooperate with the government services and outside agencies when an emergency arises. The training should be action-oriented, helping the people prepare, and later demonstrate, an action plan. Action plans might differ from place to place; i.e., there may need to be separate action plans for mainland coastal areas, offshore islands, and char areas.

2.4 Additional training

In addition, training should be organized for government and non-government groups the Livestock and Health Complex should provide first aid training to youths; and the Public Health Engineering Department should train some private mechanics to repair tubewells.

Nutrition and health education should be provided regarding post-disaster conditions; e.g., salinity of water. A small manual on such issues would be very helpful.

BADC should train some farmers as LLP operators to drain out the saline water from ponds. Power tiller driving and maintenance training should be given to farmers.

A simple construction manual should be prepared for any building which is to be used as a cyclone shelter. Training should be organised to upgrade the masons' workmanship in coastal areas. LGED should also provide this type of training to Mosque and Bazar Committees, as well as self-educated contractors.

Training should be conducted by people who have experience organizing and mobilizing victims and people of disaster-prone areas. This will help ensure that the trainers will be able to handle the issues which emerge. The training needs to address the realities of the situation, and not be merely a cognitive exercise.

2.6 Addressing the needs and perspectives of the people

Overall, the awareness campaign must take into consideration the needs and perspectives of the people, addressing the various social needs and perspectives of the people, addressing the various social and economic factors which play a role in their coping strategies and decisions.

3. COPING DURING THE DISASTER

3.1 Introduction

The neighborhood unit, comprised of both familial and non-familial households, is the most basic coping mechanism during a disaster. Households belonging to a particular neighborhood have reciprocal rights and obligations, and are expected to cooperate with each other during critical times and crisis situations. In essence, everyone in the neighborhood is considered family. Consequently, disaster victims do not act as independent individuals, but rather their responses are influenced by this neighborhood support group.

Immediately after any disaster, it is this neighborhood support group which enables disaster victims to cope with the difficult situation. Neighborhood groups are the most significant responding social units for the purposes of decision-making, and economic, social, and psychological support. Thus, disaster preparedness should be perceived as a neighborhood function rather than as a general and all-encompassing community function in which some of the members may not know each other.

In a disaster situation, neighborhood groups move together and attempt to stay together. Neighborhood groups are likely to decide collectively how to respond to a particular disaster situation even if there is disagreement among the members. During the crisis, emotional stress may arise due to individuals, particularly children, being separated from parents and other family members.

Given the significance of these neighborhood groups, it is no surprise that the survivors' immediate response is likely to be searching for and rescuing other family or neighborhood members. Actions taken are mostly self-initiated, rather than directed from outside the community.

3.2 Improvising survival techniques

By depending on and working with their neighborhood support group, the people improvised survival techniques according to their ingenuity and means. In other words, since formal means of coping with the incoming disaster were extremely limited, people created their own coping strategies (Haider et al., 1991). The survivors said, "We survived miraculously. Allah saved us". In reality, they survived by taking refuge on the straw roof of their houses, by climbing a tree, by swimming until they reached the security of a concrete building, or by going to a formal cyclone shelter before the storm hit. There were some, however, who do not know how they survived (Ahmed and Afreen, 1992).

People usually preferred to go to their relatives' houses because they were financially better-off and had tin roofs and dormas, or lofts. They assumed that these houses would be safer from the wind and the storm surge. Unfortunately, the tin roofed houses collapsed, trapping people sheltered between the roof and the ceiling space. There was no way out because there was no one to rescue them as everyone was in the same position, and no outside help could be found during that time of emergency.

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Consequently, the death rate was higher among families who took these types of measures in the coastal side villages.

During floods, many raise the level of the house or compound, and others install raised storage areas known as macha, or move vulnerable goods to a higher floor. The rural population suffers more than the urban population due to isolation and lack of transport to replenish potable water, fuel, and livestock feed during floods. Urban residents have better access to water, fuel, and public services, except for squatters who are often located in the most vulnerable sites. During a crisis, households in flood affected areas often work together at the neighborhood level repairing each other's houses or providing emergency shelter (Flood Response Study, FAP 14, 1992).

3.3 Warning systems

Days before the actual storm struck in April of 1991, the national press conveyed the warning information via newspapers, radio, and television. However, the vast majority of those inhabiting the remote areas of charlands and islands lacked access to such warnings.

Those people in the offshore islands and coastal areas who heard the warning signals had their own interpretation of these warnings. Their experiences, beliefs, and encounters with the most vulnerable physical environment played a critical role in their decision to go, or not go, to shelters or safer places before the cyclone started.

In 1991, people responded to evacuation warnings with indifference and disbelief. This indifference stemmed from past warnings being issued on several occasions without the occurrence of an actual disaster. Thus, the people's belief in the warning was skeptical, and their preparedness to face the forthcoming storm was relaxed.

Problems arising from disaster warning messages are social, involving people's perceptions and interpretations. The following are some of the problems:

- language in some warnings is too technical to stimulate people to act decisively;
- people are often unable to translate general weather conditions into specific dangers likely to occur at the local level;
- there is insufficient geographical information to provide meaningful reference points; and
- awareness of an approaching disaster does not necessarily lead to the adoption of appropriate precautions.

Government and non-government reports clearly indicate that lack of information was not a problem; it was the denial of the information that constituted the problem. Refuge was not sought as a preventive action before circumstances became

dangerous, but as a means of escaping from danger. In the event of the swiftness of the encroaching storm surges, people in their indecisiveness were totally unprepared to face a cyclone of that intensity.

3.4 Warnings need to be informative and understandable

The current warning messages are generally not formulated in a manner which motivates response. Standard messages presented by the broadcast media motivate people to seek additional information, but do not induce protective action. Unless information is given in a way that convinces the potentially affected people that they are at risk, disaster warning services will be ineffective.

The dissemination of signals alone does not serve the purpose of alerting people to prepare for disaster. In addition to the existing system of warnings for sea and river ports, a separate warning system, easily understandable by the people, and a campaign for public awareness, are needed to better alert the people about the nature of impending disasters.

Warning should emphasize the following:

- the timing of warnings must be assessed early and frequently enough;
- warnings will be better received if they are coming from local authorities with high status and credibility;
- disaster warnings stimulate more response if delivered in a face to face setting; for example, door to door personal messages should complement the mass media warnings;
- for conveying the disaster intensity, technical concepts should be supplemented with information about the likely physical consequences, e.g., the wind speed and its effects on trees and roofs, etc.;
- warning systems should contain information about the specific communities at risks, e.g., the fishermen, the landless labourers in the char areas; and
- warning messages should include precautions to protect property, emergency provisions to adopt, and supplies to take when evacuating.

Disaster warnings will be more effective if they include a combination of fear of consequences, factual information, and personal accounts.

3.5 A exemplary warning

Announcements should be reworded so that they are clearer and more effective.

- Your area (mention specific area) will be hit by a storm surge of a

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certain height, so you are requested to evacuate with your family members to cyclone shelters.

- Village leaders, matbars, Union Chairman, and Union members are requested to mobilize their community and ensure their safety by sending them to the shelters.
- You are requested not to take shelter in the dorma loft, the space between the roof top and the ceiling, because you can get trapped when the tin roof collapses.
- Do not wait for other family members or others who are not in the house. Instead you should try to save your life and the lives of those around you by taking shelter immediately.
- People living on the embankments should evacuate immediately.
- Cattle and goats should be taken to nearby higher lands, e.g. roads, killas, and pond embankments.

3.6 Warnings need to reach the people

Continuous instructions should be issued by the mass media, particularly radio and television, asking people to move to safer places and shelters. There should not be any entertaining songs, music, or advertisements before or after these announcement for they might detract from the message and possibly delay people's response. The language needs to be simple and direct, and clearly understood by the people.

Simultaneously, local warnings through loud speakers (miking) should be announced by bazar committees, mosque committees, local government agencies, town committee, local NGOs, teacher's associations, Union Parishad, youth clubs, et., to alert the neighborhood units to undertake evacuation measures. During miking, messages should be simple, short, distinct and direct.

Similar continuous miking should be undertaken by the local police station to alert people that stern and lawful action will be taken against any person engaging in theft, looting, or grabbing of land from evacuees. This announcement is essential to create confidence among the evacuees, and will encourage them to go to shelters.

Specific messages should be broadcast through the mass media for the people living in the isolated chars and accreted lands. Special instructions should be directed towards women and children.

3.7 Shelters

Upon hearing a warning signal, the people decide to respond in a variety of ways. The people's experiences, beliefs, and interpretations play an important role in their decision to go, or not go, to shelters or other safer places.

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The purpose of shelters is to provide safe refuge for people during all natural disasters. For cyclones, people need protection from high winds and storm surges over a period of hours, while for river floods, people need protection for a duration of weeks or months. In the whole coastal belt of Bangladesh there are approximately 250 cyclone shelters which can accommodate around 0.3 million people. 3 million people still need to be accommodated.

Some people who were aware and prepared took refuge in the few available cyclone shelters. Shelters were not only few in number, and thus overcrowded, but also poorly maintained and far from people's homes. Even the government buildings were not properly maintained.

3.8 Searching for shelter -- a risky endeavor

Thus, searching for shelter was a risky endeavor. As such, many people preferred to stay in their own homes, deciding that if the buildings collapsed nobody would survive. Those who made the last minute decision to move to shelters could not find enough space, and in certain cases, finding no other alternatives, they had to return home. When the cyclone and storm surge hit, people tried to save their lives by taking shelter on the rooftops of the nearest public buildings, such as community centres, schools, and mosques. In the process of reaching shelter, many people were caught in the fury of the storm surge and swept away.

3.9 Lack of transportation

In addition to lack of sufficient numbers of shelters or strongly built houses, transportation was a major problem. People were unable to organize transportation to the available shelters, often because of a lack of a proper transportation network. Most of the small villages of Cox's Bazar, for example, were bounded by salt beds and shrimp hatcheries which made transportation more difficult. Given the nature and conditions of roads, it was almost impossible to walk a distance of even a few kilometers in stormy weather of that intensity.

3.10 Quick decisions are needed

In 1991, however, the loss of human lives was relatively low since the people responded to the forthcoming cyclone with quick decisions. Although many of them could not foresee the intensity of the storm surge, they still took refuge in the existing embankments, macha, and earthen killas. For people living in accreted land connected to the mainland, cyclone shelters and other pucca structures were in close proximity to their kucha dwelling units. Thus, they had convenient access to safe places, although only 10-15 percent of the people could use these facilities.

Often, people do not recognize the potential dangers of disaster situations. People do not act as soon as they hear warnings unless they themselves are convinced that the situation will be life threatening.

3.11 Fears keep people away from shelters

Whenever a disaster is likely to occur, loss of personal possessions and dislocation are dominant concerns of all social classes, especially among those who have few resources. It is one of the reasons why people risk their lives unduly. In order to protect their personal property, it is common for people to refuse to evacuate, to try to go to shelters at the last hour, and/or to get a family member to remain behind with the property while other members have taken shelter for safety.

Some old men and women were superstitious about leaving the house unguarded as Allah would curse them, and the house would give them *bardoa*. People thought of assets as more valuable than the lives of their family members. They believed, and had more confidence in, the warning announcements on radio and television.

3.12 Women and shelters

Women living in the charlands are very dominated by their male counterparts; the women must live according to the values and norms established by the men. Within the household, the male members' consent is central to all decisions about the women's movements and social participation. Therefore, women are left out of all social gatherings and have no information about the outside world. Thus, women have very little knowledge about warning systems and its contents, and they are unaware of the location of shelters, community development centres, and other pucca structures.

Making a decision to leave the house was solely the men's domain; women play a minimal, if any, part in decision-making. As such, many women and children could not decide on their own whether or not to go to shelters; they had to wait for the men to make such decisions. In addition, the women cannot abandon their responsibilities of looking after their children and homesteads until the menfolk instruct them to do so. Even if the women were eager to go to the shelters for the safety of their children, their lack of knowledge about the location of the shelters prevented them from seeking shelter. Thus, it is not surprising that in 85 percent of the dead bodies were women and children (Haider et al, 1991).

Many people do not like to put men and women together under the same roof in the cyclone shelter. Crowding with men is considered violation of *purdah*. Cultural values and prejudices are often stronger than the need for survival. Putting men and women on separate floors may not be possible, but accommodation arrangement norms should be developed and made known so that the people feel comfortable. These norms should be developed by both men and women from all strata of the society, e.g. Imams, teachers, and local leaders. The chowkider, Dafadar, Constables, Ansars, and VDP should be deployed in each shelter to ensure respect for the established norms.

The women, often abandoned by their male counterparts, and living in destitute conditions, are the worst hit by erosion.

3.13 Shelters need to be accessible

New cyclone shelters and killas need to be constructed within the vulnerable areas, such as seaside villages and chars. They should be located by the sides of roads, or adjacent to marketplaces. If new cyclone shelters are not constructed within the vulnerable areas people will not move to them.

The shelters should have latrine facilities. A small para-medical team should be deployed to respond promptly in case people who are in shelter develop ailments. Men and women from all strata should participate in site selection for new shelters so that they know the location of the shelters.

Most of the damaged schools are being reconstructed by donors, NGOs, and the government with the intention of using them as cyclone shelters during disasters. However, as most of these schools are not situated in the high-risk areas, the reconstructed schools will be of little help to the inhabitants of risk-prone villages.

The local population wants all existing and future government buildings to be used as cyclone shelters.

Well-off families indicated their willingness to develop their own neighborhood shelters which could accommodate 40-50 people and could be used for storing food, paddy, and other assets. Such shelters could be constructed as they could afford to do it collectively.

Communities should construct pucca and semi-pucca buildings to create community facilities, e.g. Mosque, Madrasha, shops, and houses, which can also serve as cyclone shelters.

3.14 Shelters on embankments, roads, ponds and trees

Gradually, accretion of land has moved the cyclone shelters further from high risk settlements near the sea. People previously living inside the embankments are now living beyond the embankment limits as new lands are continuously emerging. Hence, there is a need for new embankments throughout the coastal belt.

Many people suggested that existing embankments should be repaired and be used as embankment roads. Such embankment-roads would create a link with all accreted land and the mainland. The tops of embankments could be used for drying crops following routing tidal surges. The government should initiate a well organized public awareness campaign targeted at people living on the embankments to explain how they can continue to live on the embankments without damaging them.

Since the intensity and severity of the storm surge was highest near the coast, and up to 1-2 km inland from the coast, people suggested that a few of the internal roads, which are 2-3 km away from coastal villages, should be raised 15-18 feet with compacted earth and appropriate slopes. These roads would create a barrier to reduce the surge severity, and could also be used as safe refuge for cattle.

People suggested that 5-10 ponds should be kept as reserve ponds in each union, particularly in vulnerable areas. These ponds should be 2-3 km from the coast and their banks should be 15 feet high. People and cattle could take refuge on these high banks. This kind of pond could be the source of uncontaminated water for household domestic use, bathing, and drinking after disaster.

Local people were of the opinion that coconut, date, and palm trees are able to withstand the force of ferocious winds. However, if the height of the trees are above 20 ft, they cannot withstand such winds, uprooting or breaking. Members of neighborhood village groups should be encouraged to plant such trees in the area surrounding their houses.



4. POST DISASTER MANAGEMENT

4.1 Introduction

Few people actually died from injuries sustained during the storm. It was the cyclone's deterioration of environmental and health conditions during the subsequent weeks and months which increased the number of casualties. Most of the deaths were attributed to post-cyclone diseases such as diarrhoea, blood dysentery, and cholera (Adnan, 1992).

Each GOB agency should have a disaster unit at the thana level which includes extension services, input support services, and technical support services. This will help the people respond quickly, without waiting for external assistance or instructions from senior officers, immediately following a disaster. NGOs should also have such units.

4.2 Prioritizing and distributing relief

Immediately after a disaster, priority should be given to the following to mitigate people's sufferings:

- housing materials
- water; repairing/replacing inoperative tubewells
- clothes for covering bodies of dead women
- clothes
- draining out the saline water from ponds
- medicine and medical teams for treating injured victims
- medicine and veterinary teams for treating injured animals
- distributing seeds (vegetables and paddy)
(haiddha 60 day aus paddy crop and kaligola nona shail 70 day aman paddy crop are suitable for all coastal areas)
- power tiller service and fertilizer
- credit

Remote areas, such as charlands, should have high priority in relief distribution. Most of the relief was distributed in the roadside villages. Due to bad communication, the people in the interior did not receive relief. Disadvantaged women, orphaned children, elders, and disabled persons should also be considered high priority. Relief and credit should be given to widows to help them become self-sufficient.

Post disaster relief should be distributed through both male and female neighborhood units; neighborhood leaders are better aware of the people's immediate needs. Women relief workers should distribute relief to women to avoid unequal distribution of relief goods, in particular discrimination against women. Women with children cannot travel long distances to places of relief distribution, nor can they wait in line for relief for long periods of time. During purdah women will not go to the centres or stand in line to receive relief. Common norms for relief distribution

should be established.

According to the charland women, they face a fuelwood crisis. Earthen stoves are also damaged. Initially, there is no need for firewood since they have no food. After receiving uncooked food as relief, however, they then need fuelwood. Since kerosene is usually not available, and if it is, the price is high, they have to live in the dark during the initial days following the disaster. They have no regular or hurricane lamps in their houses. Most of the women suggested that there should be gruel kitchens for at least 15 days, especially for the children.

The local administration should try to ensure that the price of essential goods, like house building materials, food, medicines, and kerosine, are controlled, and market supplies are sustained.

During discussions, women group members said that instead of relief, they need 2-7 day-old chicks, female goats, female sheep, and female calves for rearing.

Post-disaster activities should not only emphasize relief for the victims but also include measures to restore fisheries, livestock, and plantations; this will help ensure harmonious development.

Timely treatment of diarrhoea is needed, particularly for children. Oral rehydration saline solution and medical personnel to attend to critical cases are necessary.

4.3 Protecting and Providing Land

Most of the residents in the newly raised islands are landless migrants who had to leave their original place of residence because of poverty, landlessness, and lack of employment opportunities. The people settled there fully aware that the coastal areas are within the high risk zone, and subject to frequent flooding by storm waves, storm tides, and sea surges. Population density, particularly in high risk out of bounds char lands, accounted for the highest number of casualties. Most of these chars were outside the embankment area, where settlement was usually discouraged.

In spite of the many disadvantages associated with coastal occupancy, most residents expressed their willingness to continue living where they are now settled. This indicates their indifference to the cyclone hazard despite their recognition of it. Fatalistic attitudes towards the environment combined with the absence of any alternative choice, particularly the lack of better economic opportunities elsewhere, have been the main factors in determining their continuous habitation in the hazard zone. The following are reasons why the victims did not want to move:

- the people believed that Almighty Allah knows everything (traditional inborn fatalism);
- they hoped, and believed, that their land would reemerge;
- lack of resources to move
- desire to remain close to support group for social and economic support;

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- local employment was available; and
 - the women had limited freedom of movement

4.4 Government Assistance

The government's contribution to disaster management should be focused on creating refuge for the people in the disaster-prone areas. This includes mainly infrastructure development like cyclone shelters, killas, embankments, roads, jetties, and telecommunications. Improved and informative warning systems are also a part of the government's responsibility. A specialized unit within the government's structure should be established to promote such activities.

The government should prepare a plan for the displaced population living on embankments or temporary shelters after severe floods or riverbank erosion. Within the locality, khas land should be made available for their settlement.

Plans should be developed for the distribution of land among displaced people in the event of the re-emergence of land. All extension agencies of the government at the village level should play an active role towards this end, particularly family planning and health, public health, and credit institutions.

Government tenancy rights and land reform are essential for mitigating human casualties in the event of a cyclone. Lack of clear title to land prevents inhabitants from moving to safer places in times of danger.

Some of the people requested that the government initiate a system to provide storage facilities for food items for the first 10 days following a disaster, as well as neighborhood storehouse structures which could be used for storage of paddy, seeds, etc. These storehouses should be low cost and able to withstand floods, storms, and tidal surges.

4.5 Eliminating post-disaster conflicts

After disasters, some conflicts arises in connection with re-possessing lost household materials, particularly CI sheets, livestock, containers with stored paddy, and household utensils. Sometimes, this turns into a man-made social disaster. It can be solved, however, by strengthening the local judiciary system. People do not want to go to court or approach the police since they tend to delay matters.

4.6 Creating income generating opportunities

Disasters disrupt normal life patterns resulting in a shortage of income generating opportunities. This is a major problem for the rural and urban poor. In a predominantly agricultural economy, the death of vital livestock and poultry compelled many poor peasant households to embark on the declining trajectory of indebtedness, possibly resulting in eventual destitution.

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In Cox's Bazar, salt beds, shrimp beds, and prawn hatcheries are the sources of employment for the poor people. After a disaster, most of the people are unemployed for a long time. Owners of beds said that embankments should be repaired immediately after surges, and that credit should be provided under soft terms so that they can restart their operations.

The following possibilities should be explored to encourage income generating activities for the people of the coastal areas after disaster:

- poultry and duck raising (women)
- fish meal preparation (women from fishing communities)
- net making (women)
- cane work for local utilisation
- vegetable cultivation
- short term fruit tree cultivation
- fingerling raising and rearing
- shrimp cultivation in fresh water ponds
- goat and sheep rearing
- dry fish processing

In the aftermath of cyclones, employment could also be generated through repairing local roads, embankments, and houses, as well as rebuilding boats.

Skill development for both men and women to increase non-farm income earning possibilities should be undertaken.

4.7 Credit -- a way to move beyond the victimization

Credit facilities should be extended, and the provision for credit should be made for displaced people who have no collateral.

Government should explore the possibility of encouraging private initiatives in building cyclone-proof structures in their own neighbourhoods. Credit might be made available to such persons who are willing to build structures on the basis of matching contributions.

Most of the people and officials stated that the government should introduce disaster preparedness savings schemes for the people of disaster-prone areas. Such savings schemes would help them to rehabilitate themselves after disaster, and quickly return to the desired pre-disaster normality.

Relief operations should continue for the first few days; thereafter relief goods should be given in exchange for labour.

5. THE SOLUTION

For any, and hopefully all, of these recommendations to be of service to the people, the thinking of the people must be taken into consideration, especially the numerous

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economic and social forces shaping the people's coping strategies and decisions pre, during, and post-disasters. Understanding the reasons people do not seek shelter, especially not within a reasonable period of time, is essential for mitigating the loss of human life and property.

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ANNEX E
PERSONS MET

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ANNEX E

Persons Met

Ms. Alison Barrett	Desk Officer, Asia	OXFAM
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Mr. John H. Morris	Director	Save the Children Fund (UK)
Mr. Saidur Rahman	Director	Bangladesh Disaster Preparedness Centre
Dr. Nasir Uddin	Director	Voluntary Health Services Society
Dr. Shapan Adnan		
Mr. Terry Jeggle	Director	ADPC
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