CYCLONE SHELTER PLANNING FOR DISASTER MANAGEMENT AND COMMUNITY DEVELOPMENT IN BANGLADESH: A CASE STUDY OF KHURUSHKUL UNION OF COX'S BAZAR DISTRICT.

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF URBAN AND REGIONAL PLANNING (HURP)

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CYCLONE SHELTER PLANNING FOR DIBASTER MANAGEMENT AND COMMUNITY DEVELOPMENT IN BANGLADESH : A CASE STUDY OF KHURUSHKUL UNION OF COX'S BAZAR DISTRICT.

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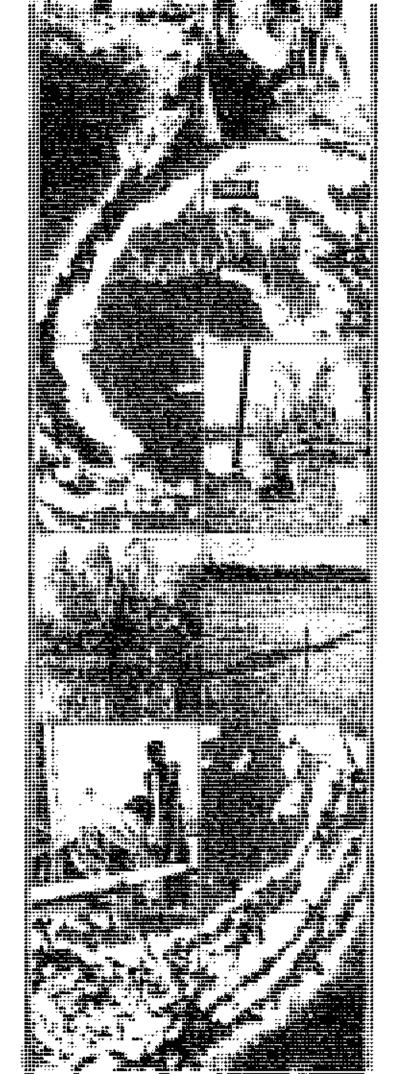
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DEDICATED TO THE MEMORY OF MY FATHER, LATE DR. A.K.M. OBAIDULLAH WHOSE PRESENCE I HAVE MISSED DURING THIS RESEARCH WORK

AND

TO THE MEMORY OF THOSE PEOPLE OF BANGLADESH WHO DIED IN THE DEVASTATING CYCLONE OF APRIL, 1991.

À

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May, 1994.

# ACRONYMS AND ABBREVIATIONS

ACI : American Concrete Institute BARC : Bangladesh Agricultural Research Council BBS : Bangladesh Bureau of Statistics BCAS : Bangladesh Centre for Advanced Studies BDRCS : Bangladesh Red Crescent Society BIDS : Bangladesh Institute of Development Studies BIWTA : Bangladesh Inland Water Transport Authority : Bangladesh Heteorological Department BND BRAC : Bangladesh Rural Advancement Committee BRDB : Bangladesh Rural Development Board BTV : Bangladesh Television BUET : Bangladesh University of Engineering & Technology BWDB : Bangladesh Water Development Board CID : centimetre CDL : Community Development Library CESR : Centre for Environmental Studies and Research CPP. : Cyclone Preparedness Programme DPP: Disaster Preparedness Programme DSS : Department of Social Services EDM : Enfants Du Monde EEC : European Economic Community ΈPΙ Expansion Programme on ImmunizationBeonomic and Social Council for Asia and Pacific ESCAP FAO : Food and Agricultural Organization FFW : Food for Works FGL: Finished Ground Level FWC : Family Welfare Centre GF : Ground Floor GL : Ground Level GOB : Government of Bangladesh HF : High Frequency HH : Household HQ : Headquarter HRA : High Risk Area IAB : Institute of Architects, Bangladesh IDA : International Development Association IEB : Institution of Engineers, Bangladesh iп : inch : kilometre km KPH : Kilometer Per Hour LGED : Local Government Engineering Department MCSP : Multipurpose Cyclone Shelter Programme : metre : millimetre OTO : mile per hour mph -MSL : Mean Sea Level NGO : Non-Government Organization 0&N : Operation and Maintenance PHC : Primary Health Care PL · : Plinth Level

: Public Works Department

PWD.

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psf : pound per square foot psi : pound per square inch

RCC : Reinforced Cement Concrete
RHD : Roads and High Ways Department
SDC : Swiss Development Cooperation

SDR : Swiss Disaster Relief SWC : Storm Warning Centre

sq.ft/sft : square foot
sq.km : square kilometre
sq.m : square metre
TP : Thana Parishad

UNCRD : United Nations Centre for Regional Development

UNDP : United Nations Development Programme

UNDRO : United Nations Disaster Relief Coordinator

UNEP : United Nations Environment Programme

UNESCO : United Nations Educational, Scientific & Cultural

Organization : Union Parishad

URC : Universities Research Centre

VHF : Very High Frequency

WB : World Bank

UР

WMO : World Meteorological Organization

# GLOSSARY :

Aus : A variety of rice sown in March-May and

harvested in July-August.

Amon : A variety of rice sown in July-September and

harvested in November-January.

Boro : A variety of rice sown in November-December and

harvested in April-May.

Caritas : An NGO

Char : Newly formed or reformed lands on the river bed.

Killa : Earthen mound, built for providing shelter,

primarily for livestock, during cyclonic period.

Kutcha : Earthen; temporary (house).

Kutcha Road : Unpaved Road.

Madrasha : Educational Institution with emphasis on Muslim

religious education.

Mauza : Smallest revenue unit.

Outmigration : Act of moving out of a geographically defined

area, involving change of residence, to anywhere

in Bangladesh,

Parishad : Council

Pucca : Permanent construction of brick and/or concrete.

Pucca Road : Paved Road

Thana : Administrative Unit above Union and below Zilla

(synonymous with Upazila, but discontinued in

view of GOB decision in July, 1992).

Union : Lowest administrative unit in Bangladesh which

comprises of several villages.

Union Parishad: Union Council (Lowest tier of local body).

Ganashastha : An NGO

CCDB : An NGO

World Vision : An NGO

Growth Centre : Important market place identified by the

government.

Village : A geo-social entity.

# UNITS, MEASUREMENTS :

1 Hectare = 2.4711 Acre

1 Acre = 3.025 Bigha = 100 Decimals = 0.4046858 Hectare

1 Bigha = 33 Decimals =  $\emptyset.3305785$  Acres =  $\emptyset.13378038$  Hectare

1 Foot = 0.3048 metre 1 Sq.ft. = 0.0929 Sq.m. 1 Nile = 1.6093 km

1 Nile = 1.8093 km 1 Sq.Nile = 2.590 Sq.km. 1 km = 0.8214 mile

1 Maund = 37.324172 kg. = 0.037324172 Metric Ton

i Crore = 10 million 1 Lakh = 0.1 million 1 US\$ = Taka 38.80

# ABSTRACT :

Bangladesh is a part of the humid tropics, with the Himalayas lying to the north and the funnel shaped coast touching the Bay of Bengal in the south. For this particular geography of Bangladesh, the Bay of Bengal is an ideal breeding ground for tropical cyclones and other natural disasters. Therefore, the history of cyclone in this country is very long and it is already well established that due to this common incident of cyclone, people of this country have to live with this disaster.

Man has little control over natural disasters, so the main purpose of disaster management is to minimise the loss due to natural disaster as low as possible. From the recent cyclonic incidents it is evident that, among all the structural measures to mitigate the loss of human lives cyclone shelter as a disaster management measure is the most effective tool. Again the traditional concept of disaster management, which considers only one way flow from natural phenomena to human activities has serious limitations. The new concept of two directional disaster management, on the other hand consider the effect of human activities on natural and socio-economic environment which, in turn influence the extent of natural disaster significantly. Again cyclone will not occur every year, so cyclone shelter will remain unutilized during normal period if it is not constructed for any suitable alternative normal time use, which will ultimately lead to poor maintenance of that shelter. Therefore, to create a coastal community which will ultimately secure its own safety by itself through its socio-economic improvement and to ensure regular maintenance of cyclone shelter throughout the whole year for its effective use during disaster period, integration of disaster management with community development at local level is very much necessary.

In such a circumstance this micro level study has intended to prepare a cyclone shelter plan with its proper size, location, design guidelines, normal time functions for community development purpose and methods to incorporate people's participation in planning, design and management of shelter. For this purpose, the socio-economic and physical condition of a particular high risk area of the coastal region of Bangladesh, cyclone vulnerability scenario and nature of responses of the people of that area have been investigated.

On the basis of this investigation, to implement the integrated approach towards cyclone disaster management and community development planning at grass root level first of all the author considered a cyclone shelter not only as a platform for survival but also as a centre for different types of community development activities, i.e. as a cyclone shelter-cumcommunity development centre. Thus by considering the basic requirements of a cyclone shelter-cum-community development centre plan of shelter has been developed.

For preparing the complete plan of shelter, at first normal time functions of the shelter have been identified on the basis of actual socio-economic condition of the study area where cyclone shelter will act along with its disaster period functions for community development purpose during normal period throughout Then to perform shelter's both normal and year. disaster period functions, different facilities have been identified and to accommodate those facilities different functional spaces with their required area have been defined, which ultimately has determined the size of proposed shelter. Next task was to find out shelter's optimal location, purpose certain locational criteria have been identified and on the basis of those criteria two alternative locations in the area have been evaluated to select the ultimate potential location for the proposed cyclone shelter of that area. Then certain design guidelines for that shelter have been given and on the basis of those guidelines a schematic design has been prepared with outline of its cost. Finally people's participation has been incorporated directly in construction and management of cyclone shelter.

The study therefore, has recommended institutional setup to implement this plan and to operate cyclone shelter activities smoothly throughout the whole year. For this purpose the author also recommended approval of this set up from national policy makers and allocation of fund for it from national annual development budget, otherwise implementation of cyclone shelter plan will remain in a stagnant position. At the end of this study the author pointed out the necessity of further in-depth study on institutional aspects of operation and maintenance of cyclone shelter.



ACKNOWLEDGEMENT
ACKONYMS & ABBREVIATIONS
GLOSSARY
UNITS, HEASUREMENTS
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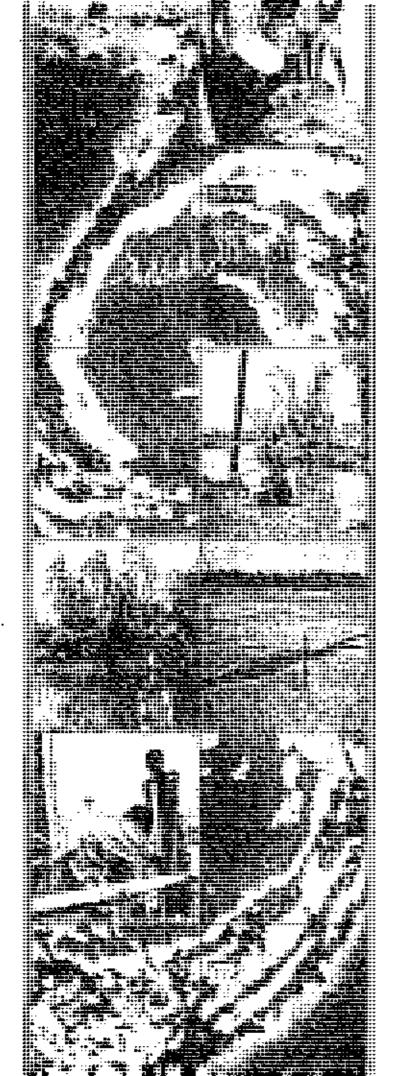
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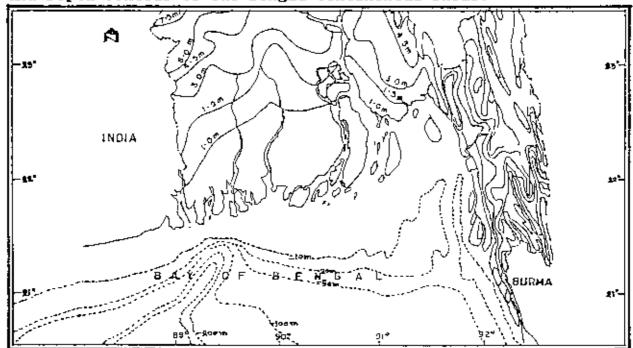
CHAPTER : 1 INTRODUCTION

#### 1.1 BACKGROUND :

Bangladesh is a country of 116.91 million people in the early part of the year 1994 (BTV,1994) and a land of fertile soil. The present territory of Bangladesh was a part of India before 1947 and a province of Pakistan upto 1971 when the country became independent after a war of liberation.

Geomorphologically, this country is formed by delta of three of the major rivers in the world : Ganges, Jamuna Brahmaputra and Meghna Rivers. A large part of the country is subject to severe annual floods, caused by: high sea levels due to cyclone and storms surges, excessive precipitation in the upper part of the major rivers and high precipitation in the delta itself (FEC, 1989). Bangladesh is part of the humid tropics, with the Himalayas lying to the north and the funnel shaped coast touching the Bay of Bengal in the south. The coastal zone of Bangladesh consists of sediments deposited by the main rivers, originating the Himalayas. This area is formed also by the from currents and the waves. מס the basis of physiographic characteristics, the coast of Bangladesh can be broadly divided into three distinct regions : the eastern, central and western regions (Pramanik, 1983). In the Western part, an outer belt of mangrove forest exists (The Sunderbans), and in the Eastern part, where such a mangrove forest is not predominantly available.

Figure: 1.1 Contours of Land Elevation in the Coastal Region of Bangladesh and Depth Contour of The Bengal Continental Shelf.



Source : MCSP, Draft Final Report, Volume IV, 1992,

Except the major rivers crossing the area, there are also many cross connections and tidal inlets dividing the whole coastal area in many small units. In this zone drainage is hampered by sea levels, while salt intrusion from sea plays an important role. Irrigation is only possible in certain parts of the year, when salinity levels are low. The coastal areas and off-shore islands are low lying and very flat. The ground height of the area within some 200 km from the coast is lower than 3 m (Matsuda, 1981). The land level of many places at the edge of the coastal zone is little above mean sea level and at some places even below it (see Figure 1.1).

This particular geography of Bangladesh produces not only the lifegiving monsoons but also the catastrophic ravages of cyclones, tornadoes, thunder storms and floods. The Bay of Bengal is an ideal breeding ground of tropical cyclones and other natural disasters. Cyclone is an atmospheric circulation system in which the sense of rotation of the wind about the local vertical is the same as that of Earth's rotation. Thus, a cyclone rotates clockwise in the southern Hemisphere and counter clockwise in the northern Hemisphere. In meteorology the term cyclone is reserved for circulation systems with horizontal dimensions of hundreds (tropical cyclones) or thousands (extratropical cyclones<sup>1</sup>) of kms (Parker, 1980). The effect of cyclone and storm surge over this country is tremendous, which is not at all comparable with any other natural disaster.

Table: 1.1 Classification of Tropical Storms.

Disturbance	Wind St	eed
	(Km/h)	(m/s)
Depression	32-5Ø	9-13
Deep depression.	5 <b>1-6</b> Ø	14-16
Cyclonic storm	61-89	17-23
Severe cyclonic storm	90-119	24-31
Severe cyclonic storm with	>120	>32
a core of hurricane wind		

Source : Bangladesh Meteorological Department.

#### 1.2 CYCLONES IN BANGLADESH :

Cyclones which lash the coastal districts of Bangladesh are of tropical nature. In the Bay of Bengal, the frequency of occurrence is highest during May and October. A tropical cyclone is generally born in warm moist air overlying the ocean south of latitude 20°. The depression first originates in small anticlockwise motion and rapidly changes its direction, which at last

becomes roughly circular in shape. It has no frontal structure and the elements of pressure, temperature, precipitation and wind velocity are distributed more or less uniformly about the centre or eye of the storm. The wind velocity varies from 24 to 240 km/hr. The duration of a tropical cyclone averages between a couple of hours to a week. The average rate of travel is about 400 kilometres a day.

Historical data on height of tidal surge vary considerably. Storm surges can inundate land or overtop embankment up to elevations of 9 to 17 meters above the mean sea level if it occurs at the time of high tide. Such tidal surges are devastating.A catastrophic cyclone usually takes heavy tolls of life, usually tens of thousands. Among areas of whole world which were affected by cyclone and storm surge maximum times, coastal area of Bangladesh is the most prominent zone (Sen, 1991). The Bay of Bengal cyclones also move towards the eastern coast of India, Mayanmar and occasionally into Sri Lanka, However, maximum damage occurs when the cyclones strike Bangladesh (See Table: 1.2), largely due to the low flat terrain, high density of population, high level of poverty and the low level of disaster preparedness. Most of damages occur in coastal regions of Khulna, Patuakhali, Barisal, Noakhali & Chittagong and the off-shore islands of Bhola, Hatiya, Sandwip,Kutubdia, Maheshkhali etc.

Table : 1.2 People Killed by Prominent Cyclones in the World.

Year	Country	Nos.of People (Died)
1978.	Bangladesh	390, 886
1737	india	300,890
1 <b>88</b> 1	China	300,800
1923	Japan	258,800
1976	Bangladesh	208,800
1897	Bangladesh	175,800
1991	Bangladesh	138,868
1882	India	188,888
1864	India	50,600
1833	Indla	50,881
1822	Bang Ladesh	40,888
1760	Antilace	22,888
1839	India	20,890
1789	India	20,800
1945	Bangladesh	19,270
1963	Bangladesh	11,520
1961	9angladesh	11,468
1985	Bangladesh	11,469
1971	India	10,000
1977	India	10,000
1983	Cuba,Haiti	7,196
1780	Texas	გ,₿₿₿₿
1960	Bang Ladesh	5,149
196 <u>8</u>	Japan	5,886
1973	India	5,890
	<b>-</b>	

Source : Weekly Desh, 1991.

The history of cyclone in this region is very long. There are some data of unknown reliability on the occurrence of cyclones in Bangladesh that date from 1870, and definitely incomplete information that dates as far back as 1584. Reference has been made about the storm-wave of 1584 by Abul Fazal, the noted historian during the Hughal rule of Emperor Akbar. The incidence has been cited in the District Gazetteers, Bakerganj. There were eight severe cyclones recorded in the period between 1980 and 1970 and three more in the period between 1985 and 1991. Major cyclones in Bangladesh are described in Table 1.3.

Table : 1.3 Major Cyclones and Storm Surges in Bangladesh.

Year of occurrence	Month and date of occurrence	Affected area	Nature of phenomena	Approximate loss/damage
1795	Hay-June	Chittagong	Severe gale blew from evening till midnight	Only 5 brick built houses survived
1822	Hay	Barisal	Most severe	40,000 people and 1,00,003 cattle lost
1897	October	Chittagong	Hurricane of high intensity	14,000 people were killed
1965	May 11-12	Barisal	Storm speed 120 ml./hr.	Total loss of life 19,270
1970	Nov.12-13	Meghna estuary	Storm speed 222 km/hr. and 33'high sorge	3, <b>00,00</b> 0 people died
1985	<b>Kay 24-</b> 25	Chittagong Noakhali coast	Storm speed 154 km/hr. and 14' high surge	11,069 people died with huge loss
1991	April 29	Chittagong Noakhali	Storm speed 225 km/hr. and 10′-20′ high surge	1,38,000 people died

Source : Bangladesh Meteorological Department.

# 1.3 CYCLONE OF APRIL 1991 :

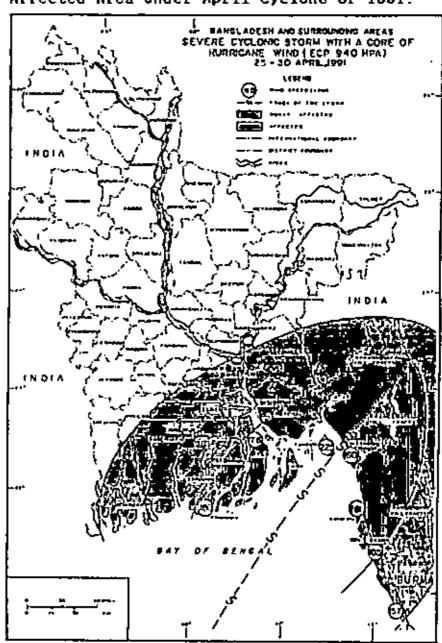
On the basis of high wind velocity and damages & loss, the cyclone that crossed the Bangladesh coast during the night of 29 April 1991 can be called a historical event in the context of world meteorology (Sen,1991). That cyclone can only be described as a supercyclone, it had a dimension more than two times the size of Bangladesh. The central overcast cloud had a diameter exceeding 6 hundred kilometers. The maximum wind speed observed at Sandwip was 225 km/hr. The actual windspeed could have been higher as the wind measuring device was blown away after this

speed was recorded. The maximum wind speed estimated from NOAA-11 satellite picture obtained at 1338 hours on 29 April was about 240 Rilometres per hour. The cyclone was detected as a depression

on—the 23 rd April first in the satellite picture taken at SPARRSO from NOAA -11 and GMS-4 sate1lites.It turned into a cyclonic storm on 25th April. The cyclone in its initial stage moved slightly north - westward and then northwards. Fron 28 th April it started noving in a northeasterly direction and crossed the Bangladesh coast north of chittagong port during the might of 28 April. cyclone started lashing the coastal islands like Nijhum Dwip, Manpura, Bhola, Sandwip from evening of that day. The maximum surge height during this cyclone was estimated to be 8-10 metre (Choudhury, 1991). Жe have found а picture of this cyclone from the persons who visited the affected area immediately after the disaster.

"The devastating cyclone of April 29-30th was unusual in many respects. Most of the cyclones which reached the shores of Bangladesh

Figure : 1.2 Affected Area Under April Cyclone of 1991.

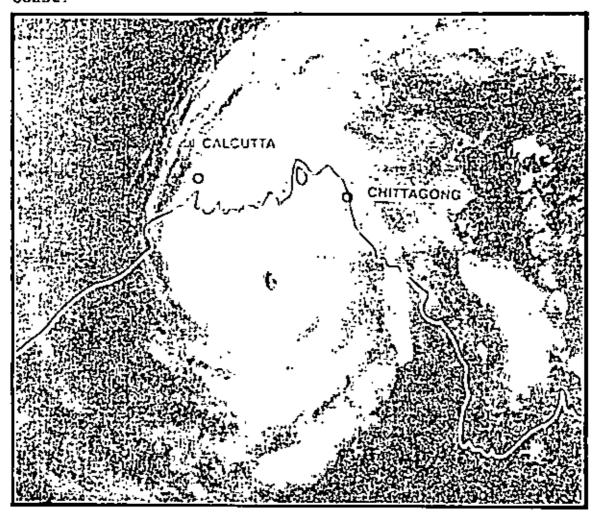


Source : Mabman et al. Cyclone '91, Obaka,1991.

during the past half a century have had paths which were well out in the Bay of Bengal and crossed the land over the former Noakhali district. This cyclone on the contrary came up very close to the eastern shore, thus raising a huge storm surge in

the Raaf river, and the Moheskhali, Kutubdia and Sandwip Channels. The wind speed reached up to 225km. per hour in places and wind damage was severest in western Chakaria, western Banskhali, central Anwara, western Patiya, and Chittagong City. The eye of the storm seems to have veered sharply to the northeast of Chittagong City and passed inland. The storm surge completely submerged the islands of Sonadia, Moheshkhali, Matarbari, Ujantia, Koriardia and Kutubdia. It also severely affected the western parts of Cox's Bazar, Chakaria, Banskhali, Anwara and Sitakund Upazilas<sup>2</sup>, the island of Hatiya and Monpura, and the mainland chars of Feni and Noakhali districts. Heavy damage has also been reported from Patuakhali, Bhola and Barguna districts from the lateral waves created by the main storm surge "(Rashid, 1991).

Figure: 1.3
Picture of Eye of the Storm Taken from the Satellite
INSAT-1D while the Cyclone of 1991 was near the Bangladesh
Coast.



Source : Keekly Desh, Calcutta, 1991.

Due to cyclone of 1991, the death toll was estimated officially at 138,888. According to government estimated, (840,000) rural homes in sixteen districts were completely destroyed another 910,000 damaged to some extent affecting 12 million people directly (Ahmad et al,1992).

In the following table sectoral damages by this cyclone have been discussed in detail.

Table: 1.4
Extent of Damages to the Economy by
Cyclone of April 1991.

Sector	Sub Sector	Estimated De	amage
	Milli	ion Dollars	(%)
Agriculture		363.57	26.86
	Crop production	78.88	21.71
	Forestry	28.20	7.75
	Fisheries	226.14	58.69
	Livestock	50,37	3.85
Industries		386.27	28.03
	Export pro.zane	16.77	4.32
	Public sector inds.	52.22	14.74
	Private sec. inds.	314.28	8Ø.94
Physical infi	restructure	360.01	26.00
	Rural infrast.	107.00	29.73
	Railways	28.22	7.85
	Chitt.port authority	41.91	11.64
	IWTA	52.05	14.45
	Post & T&T	128.42	35.67
	Others	2.43	.67
Socio-econ.ir	ofra.	267.35	19.30
	Education	132.Ø2	49.39
	Health & fam.plan.	78.74	29.47
	Science & technology	49.28	18.43
	Mass media	7.31	2.71
Other		5.72	0.41
 Fotal	1	,3 <b>46</b> .92	120.20

Source : Dr. Sarwar Jahan, UNCRO Field study and Investigation Report, December, 1991.

It may be said that such countermeasures for human lives as construction of shelters and issue of refuge warning were effective to decrease the number of casualties. For example, a 230 square meter shelter saved 3,000-4,000 people (13-17 persons/sq.m) in Kutubdia Island (BRAC,1991). They took refuge for eight to nine hours under the incredible density. Circumstances were similar for other shelters. Lots of people squeezed themselves into a narrow shelter. The Red Crescent Society reported that about 350,000 people had taken refuge in shelters. If shelters were not constructed, several times the human lives would have been lost (Matsuda, 1991).

After the cyclone of 29 April 1991, another cyclone of medium intensity crossed Bangladesh coastal areas in the early hours of 2 June 1991. The cyclone had a maximum wind speed of 100 km/hr & a surge upto 1.52 m. Adequate preparedness measures were taken and as a result loss of life and property was slight.

#### 1.4 REED FOR THE STUDY :

From the recent cyclonic incidents it is evident that, among all the structural measures to mitigate the loss of human lives, cyclone shelter as a disaster management measure is the most effective tool. After the cyclone of 1970, a number of cyclone shelters were built in the coastal areas of Bangladesh. These are not sufficient in number and are not properly designed and located. It is also observed in recent studies that, those badly maintained shelters are very bna local peoples participation in shelter design, planning and management process is virtually absent (IEB, 1991).

So well-designed, properly located and multipurpose cyclone shelters with all the emergency facilities are needed in the coastal areas of Bangladesh. Severe cyclone may not occur every year and the cyclone shelters may as well be utilized as community development centres for social, cultural and economic development purposes. There is also a necessity to incorporate peoples participation in planning, design and management of shelter for their effective utilization.

In this regard statement given by Marcel Fortier, Head of Delegation of the League of Red Cross would be relevant here:

"We must press ahead with the expansion of our infrastructure while ensuring that we do not neglect the community development side of things. Shelters have proved their worth in lives saved and we need more of them but we must continue to maximize their usefulness to these impoverished communities by ensuring their full use outside the cyclone seasons as schools, training centers, meeting places to discuss ideas for income generation and many other

activities. Community development is part and parcel of educating people about the need for disaster preparedness."

Therefore, it is felt that a micro level study is needed to prepare the physical and strategy plan of a cyclone shelter on the basis of its site characteristics showing its proper location, available facilities, its potentiality as a community development centre and methods of incorporating peoples participation in planning & implementation stage.

#### 1.5 OBJECTIVES OF THE STUDY :

d

The main objectives of this study are :

- a. To determine size and locational criteria of cyclone shelter.
- b. To determine design guidelines for the shelter.
  - c. To identify the potential of the shelter as a community development centre.
- d. To find out the methods of incorporating people's participation in planning, design and implementation of shelter.

#### 1.6 METHODOLOGY OF THE STUDY :

A proper methodology is always necessary for the successful completion of any research work. It will help to organize the experiences, observations, examinations, analysis of found data & information and their logical interpretation in a systematic process to achieve the ultimate goal and objectives of the research. Data which are the raw materials of a research work determine, to an appropriate extent the nature, success and limitations of the thesis.

At first the role of cyclone shelter has been identified for the coastal regions of Bangladesh on the basis of modern concept of disaster management and then according to that modern role of new generation cyclone shelter for Bangladesh major components of cyclone shelter planning has been identified. These components are:

- a. Identification of normal time use of cyclone shelter for community development purpose.
- b. Determination of size for cyclone shelter.
- c. Selection of location for cyclone shelter.
- Identification of design guidelines for cyclone shelter.

 Incorporation of people's participation in the cyclone shelter project.

Therefore, all the steps of methodology for this study were prepared by remembering the above mentioned major components of cyclone shelter planning. Different steps of this methodology are described below.

#### 1.8.1 <u>SKLECTION OF THE STUDY AREA</u>:

Preparation of plan for cyclone shelter covering the whole coastal region is a very huge task which is not possible within the limited time and resource constraints. So to simplify the task and to understand the nature of problems in selection of location for shelter and other site characteristics which influence the design guidelines at micro level, this study was based on parts of Khurushkul Union under the jurisdiction of Sadar Thana of Cox's Bazar District (see Figure 1.4). This study area was selected on the basis of the following factors:

- a. Khurushkul Union is situated within the High Risk Area (HRA) of coastal region in Bangladesh, which has been demarcated by BDRCS and MCSP.
- b. According to MCSP this union is also one of the most severely affected areas of Bangladesh by cyclone of April 1991.
- c. Khurushkul is a typical rural region of Bangladesh in terms of its communication system and way of life. At the same time it reflects all the socio-economic characteristics of a coastal region which is situated at the extreme coast line of the country.

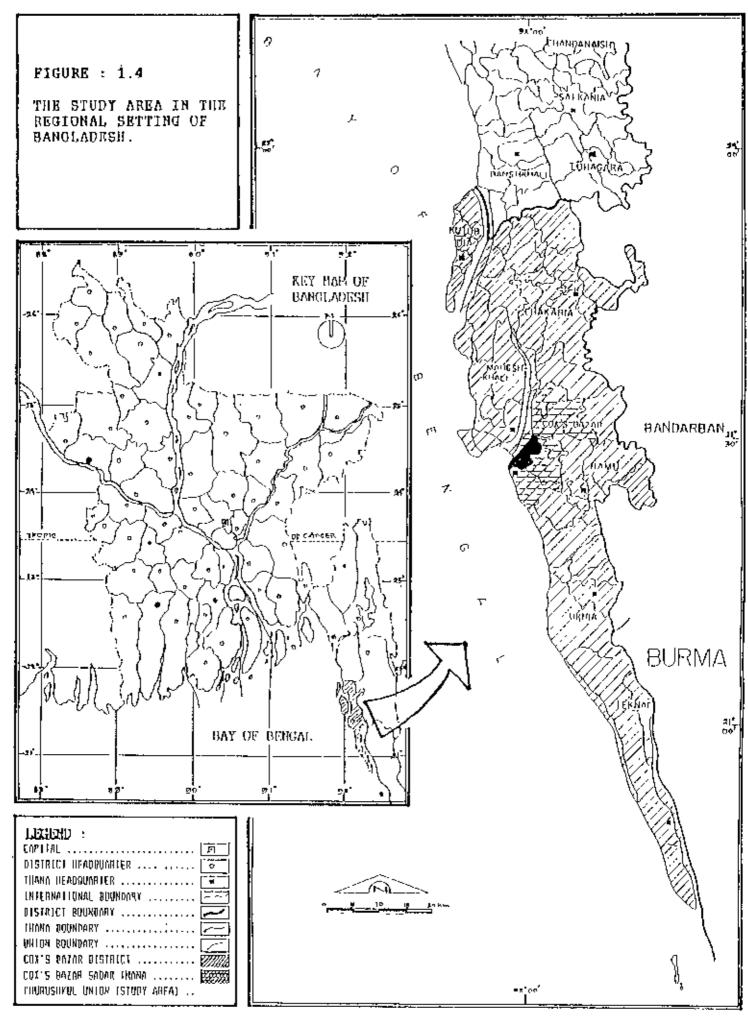
### 1.6.2 <u>DESIGN OF THE SURVEY</u>:

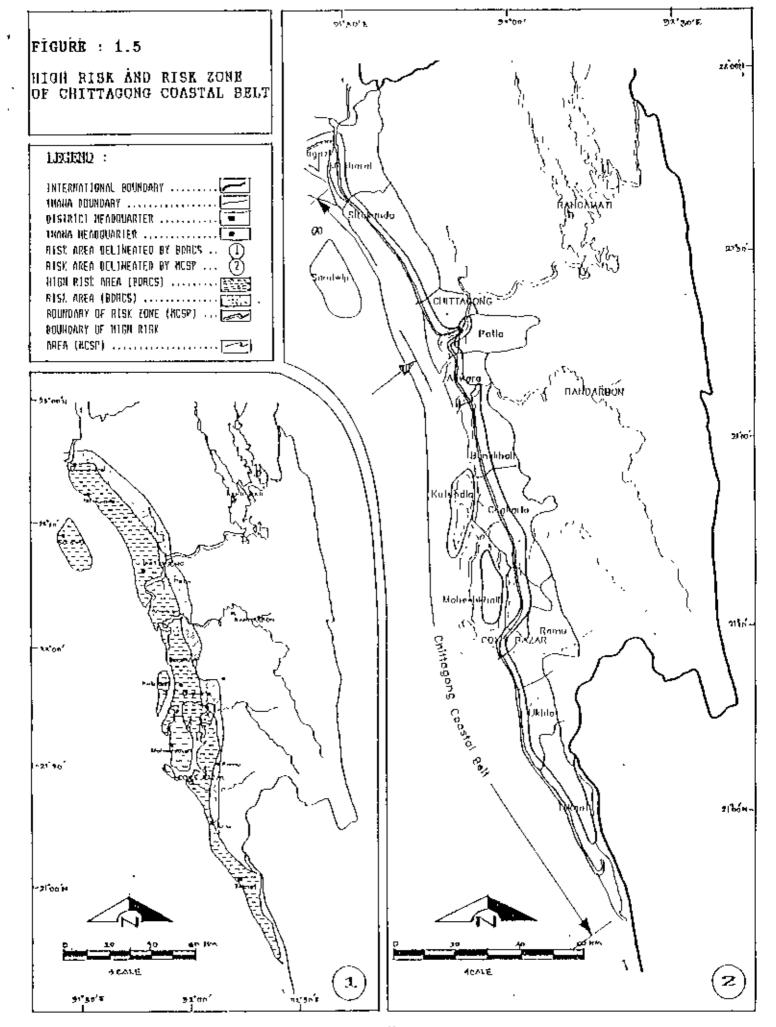
At first following activities were done to operationalize the main tasks of this study and research work.

#### A. Literature Survey :

An extensive survey of all the available and relevant literature was made to analyse the findings and recommendations of different study reports related with this research topic (See Bibliography). It was useful to collect opinions of experts in this matter and also to analyse the design and concept of cyclone shelters of following groups:

--- Existing and Proposed Cyclone Shelters.





--- Existing and Proposed Killas.

-- Cyclone Shelter Experiences in Selected Countries.

At the same time this tool of literature survey was used to ellect the following secondary data and information:

Geographical location, area and administrative setup. Soil profile, landform and hydro-climatic resources. Population distribution by age, sex, religion,

occupation and literacy.

Number of households by villages.

Number of bovine animal, sheep, goat and poultry birds.

Types of Dwelling units.

Land use pattern and agricultural practice of the area. Number of establishments in economic and social sectors and number of persons engaged there.

## B. Sample Survey in the Study Area:

A questionnaire survey and a reconnaissance survey were planned and conducted during pre monsoon period (April-May, 1983) when in the past many severe cyclones including April Cyclone of 1991 attacked the study area vigorously.

# B.1 Household Questionnaire Survey :

A pre-coded questionnaire (See Appendix Ø1) survey was conducted among the people of study area regarding:

--- Study on the socio-economic condition of the people within the study area.

--- Study on the vulnerability to cyclone and storm surge disaster in study area and the way people respond to this natural disaster.

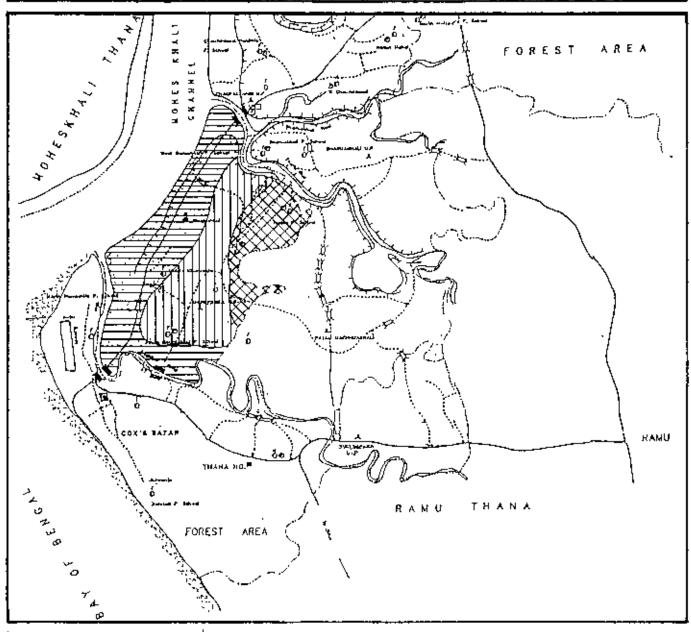
--- Study on the peoples perception in the case of possible measures and cyclone shelters for disaster management and community development programmes.

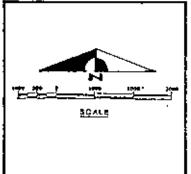
The total number of households who were taken as samples for the questionnaire survey was 220. During cyclone of April, 1991 all the villages of the study union were not equally affected by the cyclone and surge. So before selecting the samples of the household questionnaire survey, all the villages within the study union were classified into three groups according to the storm surge inundation level and damages due to high velocity wind in those villages during cyclone of April 1891 (see Figure 1.6),

--- Highly vulnerable to both cyclone and storm surge:
Where land level is almost equal to the mean sea level
(MSL) and entire area is totally exposed to sea side.

FIGURE : 1.6

DEGREE OF VULNERABILITY IN THE STUDY AREA.



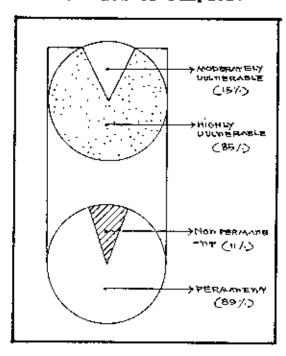


LEGEND :	
Thana Boundary  Union Boundary  Rural Road  Embantment  River and Large Canal  Steamer/Launch Shat  Bridge/Culvert/Stuice	Union Headquarter  Existing Shelter  Shelter waser construction  Sand Bant  Highly Vulnerable Study Area  Moderately Vulnerable Area  Less Vulnerable Area

- --- Highly vulnerable to cyclone, but not to storm surge : Where land level is reasonably higher than MSL.
- --- Not vulnerable to cyclone and storm surge: Where land is high and the area is protected from sea by hills.

Obviously first part of the study area was the major concern of the researcher. Second part was also considered, but 3rd part was totally ignored in survey process. So in case of sample selection, the villages/paras of those two parts of the study union were given priority. Among the 220 sample households, 187 samples (85%) were selected from first part & rest 33 samples (15%) were from second part of study union (Figure 1.7). Again there are two types of settlements in highly vulnerable area of the union. One is permanent settlement & another is non-permanent settlement of the seasonal migrated fishermen. Therefore, in collecting samples from highly vulnerable part, 167 samples (89%) were selected from permanent and 20 samples (11%) were chosen from nonpermanent settlements (see Figure 1.7).

Figure : 1.7 Distribution of Samples.



Source : Field Survey, 1993.

A list of selected paras/villages including sample households selected from those localities are given below:

Table : 1.5 Sample Villages and No. of Sample Households.

Village	Vulnera- bility	Settlement Type	No.of Samples
Uttar Rastarpara	High	Pe <b>rman</b> ent	20
Dakshin Rastarpara	High	Permanent	92
Pecharghona	High	Permanent	52
Rakhainpara	High	Permanent	5
Jaliapara	High	Non-Permanent	20
Kauarpara	Moderate	Permanent	15
Utter Mamunpara	${f Moderate}$	Permanent	16
Fakirpara	Moderate	Permanent,	2
		Total	 : 22Ø

Source : Field Survey,1993,

Instead of taking into consideration the entire households within the study area, the questionnaire survey was conducted by adopting systematic sampling in the following manner for each of the para/village:

First - Third - Fifth houses and so on.

# B.2 Discussion With Local Level Klites:

Direct discussions with the local level influential persons were made during the survey to understand their opinion, nature and functions regarding disaster and development. Following persons at local level were included in this discussion process:

- --- Social elites like, school masters, imams, rich farmers.
- --- Blected persons of the local level institutions like, Chairman and members of Union Parishad.
- --- Thana level Government officials like, sub-divisional engineer of BWDB & LGED, thana level agricultural officer, education officer, health officer.
- --- Local level NGO workers like, administrator of Gana Sastha, project officer of BDRCS.
- --- Local level leaders of the political parties like, member of the parliament.
- --- Leaders of professional organization like, fishermen association.

#### B.3 Reconnaissance Survey :

During post-monsoon period (November, 1992), a thorough reconnaissance survey was conducted within the entire study area and in pre-monsoon period (April-Hay, 1993) seasonal variation in different attributes of the study area were also observed to identify the following features of that area:

- --- General lifestyle of the people.
- --- Land profile and land level in relation to MSL.
- --- Nature of housing stock.
- --- Number of water bodies and their use.
- --- Drinking water and sanitation condition.
- --- Existing infrastructure including communication network, permanent, private and public buildings.
- --- Nature of local markets.

# 1.6.3 PREPARATION OF MAPS :

Maps showing the administrative boundaries, coastline, rivers and creeks, existing shelters and killas, location of educational institutions, other important public and private buildings, road and water way network, settlement pattern etc.of

the study area were essential inputs for preparing the cyclone shelter plan for that particular study area. Therefore, one of the first tasks of this study was to collect available country, regional and local level maps on various important aspects from different sources. Then base maps of the study area in different scale were prepared.

## 1.6.4 DATA ANALYSIS :

All the data/information received through questionnaire survey were analysed by using SPSS/PC+ Software. Tables of frequencies and percentages, cross tabulation and coefficient of co-relation for the various values of a variable were found through this analysis. Graphical representation of some of those results of analysis was done manually by creating bar charts and pie diagrams.

# TERMINOLOGIES OF THE STUDY :

#### Cyclone Disaster Management :

During the last two decades the international community has become increasingly alarmed by disasters, which have tended to be more destructive as they affect over larger concentrations of population. While the response of the international community has been focussed primarily on relief action, it is now realized that the actual and potential consequences of disasters are becoming so serious and increasingly global in scale, that much greater emphasis will henceforth have to be given to planning and prevention (UNDRO, 1977).

It is already well-established that cyclone in this region is a common incident and we have to live with this disaster. But now question has raised how we can reduce the huge losses by proper disaster management programme. The purpose of disaster management is to minimise the loss due to natural disaster as low as possible.

Natural disasters are a formidable obstacle to economic and social development. Moreover, in terms of percentage of gross national product, the losses caused by disasters in some disaster-prone developing countries more than wipe out any real economic growth. There has thus been a growing awareness by Governments of the need to focus more attention on disaster preparedness and prevention, and a recognition of the fact that disaster prevention and pre-disaster planning should be an integral part of national development policy (UNDRO,1977). Similarly, cyclone disaster management measures (mitigation, prevention and relief) needs to be incorporated with the integrated community development process.

### B. Community development :

Community development is an integral part of development. One important aspect of community development programmes which attract the planners, is the scope of people's participation in community development as well as in rural development Self-help construction programmes. programmes, organising voluntary services, raising volunteers for community services etc, can be integrated into the community development programmes. The community Centres play a vital role in implementing the community development projects. They serve as The focal point of all community development activities. Community centres can not only be used for social functions and community development activities but they may provide facilities for co-ordinating community related activities. The physical facilities needed for community development can produce ample scope for occupation by other uses during the time they are not in capacity use and at the same time, these activities themselves can be accommodated in unused physical facilities created for other purposes such as school buildings, playgrounds, stadium, etc.

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### 1.8 LIKITATIONS OF THE STUDY :

This research study has encountered the following major constraints:

- a. Field investigations were conducted after two years of the massive cyclone of April 1991. As a result, the local people's response was mostly from recall data as to what happened during that devastating cyclone.
- b. This study could not cover the entire cyclone affected population of the study area for questionnaire survey. Rather a sample was selected on a random basis from eight most low-lying localities and severely affected villages by cyclone of April 1991 in the study Union. So the researcher had to depend on the answers given by a small number of respondents to determine what actually happened during the disaster period of April 1991.
- c. As there was not too many safe places within the study area which were used as shelters during the cyclone of April 1981, so a few number of respondents outside the catchment area of those shelters failed to answer the questions related to explore the environment of shelters during that dreadful night.
- d. This study was entirely based at micro level, so the conclusions derived from the study may be true for areas with similar circumstances, but may not be

generalised for other areas of the coastal region. However, the methodology developed for disaster management may be equally applicable to other parts of Bangladesh.

#### 1.9 ORGANIZATION OF THE THESIS :

The thesis has been divided into eight chapters. Chapter one presents background of the study, history of cyclone in Bangladesh, detail description of cyclone of April 1991. Need for the study, objectives, methodology and limitations of the study are also discussed in this chapter.

Chapter two is prepared to present a review of different study reports on cyclones in Bangladesh, background of cyclone disaster management from historical perspective. This chapter also deals with design analysis of different existing and proposed cyclone shelters and killas together with an analysis of cyclone shelter approach of other countries.

Chapter three deals with the regional setting of the area along with the socio-economic condition of the people and their responses to cyclone and storm surge. Chapter four presents the cyclone and storm surge vulnerability analysis, geo-technical and hydro-meteorological analysis related to the study area. Chapter five deals with the analysis of local people's opinion on disaster management and community development related with the study area.

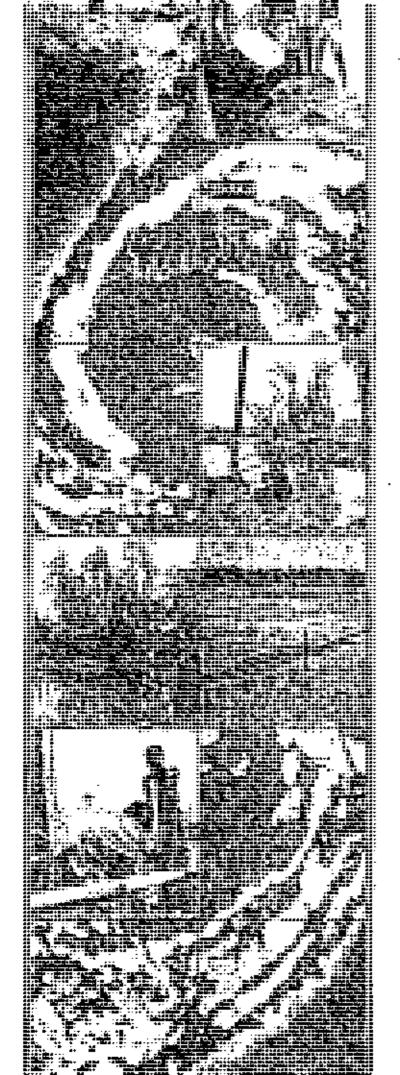
Chapter six presents the role of new generation cyclone shelter on the basis of modern concept of disaster management, its normal time use and size. Chapter seven presents proposed cyclone shelter plan for the study area including location, design guidelines, schematic design and rough cost estimate of the shelter. Here also the methods of incorporating people's participation in shelter construction and management has been discussed elaborately.

Chapter eight has come up with some recommendations for the successful implementation of cyclone shelter plan and conclusion of the study.

#### Notes :

Extratropical cyclones are the common weather disturbances which travel around the world from west to east in mid latitude.

<sup>2</sup> Upazila is now known as thana.



CHAPTER : 2 REVIEW OF CYCLONE SHELTER STUDIES, DESIGNS AND EXPERIENCES

# 2.1 INTRODUCTION:

Review of the related research and literature is necessary to provide ideas, theories, explanations or hypothesis valuable in formulating the problem, to suggest methods of research appropriate to the problem, to locate comparative data useful in the interpretation of results and to contribute to the general scholarship of the investigator (Carter et al,1941). Therefore, for the present study an extensive literature survey was done on books, reports and journals related to disaster management and community development.

# 2.2 REVIEW OF RELEVANT STUDIES:

The cyclone of 29th April 1991 created a serious concern among the government, international community and agencies of Bangladesh. As a result, immediately after that cyclone different national and international organizations sponsored and conducted some studies & research on the cyclone scenario of Bangladesh. An investigative review of some of those studies is presented here.

#### Study of IRB, 1991:

After the cyclone of April, 1991 the Institution of Engineers, Bangladesh decided to form a Task Force to investigate into the causes of huge damage by cyclone and storm surge, particularly from the engineering point of view and to suggest measures for mitigation of such damages in future cyclones. Although this report was prepared in a short time span, the task force of IEB tried to include all the major aspects related with this topic. As it was prepared by a group of engineers, so more emphasis was given on technical matters than socio-economic aspects of cyclone disaster management process. Again in the proposed cyclone shelter, cost reduction and development of a storm resistant structure were given more importance than other aspects, such as; location, normal time use etc.

# Study of Shelters by BRAC, 1991 :

A study was undertaken by BRAC<sup>2</sup> on the cyclone of 1991 immediately after the disaster. This study looked at the question of shelters, both formal and informal, that were used by the people to save their lives during the April 29 Cyclone and made some investigations into the question of cyclone shelters and their role in averting deaths. The broad objective of the study was to identify the different types of shelter that the people used for saving their lives during the cyclone and storm surge. An analysis of the formal shelters in the studied unions of Kutubdia (an offshore island) and Banshkhali (a mainland thana)

revealed that most of the shelters were used to their maximum potential at the time of cyclone, they were very crowded. But a few others were not equally used. Location of the shelters appeared to be the major reason for this. It is reported that the village power structure influenced PWD or the Red Crescent Society to build the shelter in a place of their own choice and convenience. However, in order to make best use out of their construction the study team of BRAC suggest that planners must consider other factors such as shelters location and maintenance. But the methods selecting proper location of shelter or its effective maintenance has not been identified in this study report.

# Study of BCAS (Rahman A Atiq et al. 1991) :

The Bangladesh Centre for Advanced Studies (BCAS) endeavoured to record the impact and people's perceptions of the event through a study immediately after cyclone of 1991. Regarding cyclone shelter building this study recommended that highest priority should be given to the construction of cyclone shelters. This study was done basically to evaluate the impact of cyclone on natural environment of the country. Therefore, analysis of structural measures to mitigate the loss of cyclone and storm surge was done briefly in this study, only to touch the overall factors related with disaster management.

# Study of UNCRD (U.N.Centre for Regional Development, 1991) :

UNCRD has been assisting the developing countries through cooperation in research and training on integrated approaches to disaster management and regional/rural development planning with people's participation. After the 1991 cyclone, UNCRD constituted a team of experts for field investigation which was undertaken from 9-18 August 1991. The study has pointed out the problems only and provided guidelines for possible solutions, the detail solution remained outside the scope of the study. UNCRD is basically interested for integration of regional development process with cyclone disaster management activities. Study team has suggested that on the basis of detail survey of actual state of the shelter at the time of the disaster, location and distribution of the shelter network must be planned.

# Study on Storm Surge and Disaster Preparedness by a Group of Researchers (Talukder J. et al. 1992) :

This study reveals another perspective of situation regarding existing cyclone shelters, that is the social perspective. An analysis of the existing cyclone shelters in South Sudharam and Ramgati thanas reveals that the decision for

selecting sites for the shelter facilities was mainly taken at the local level by the public representatives, members of the BDRCS, elites, political persons and government officials. Shelter facilities were constructed not on the basis of actual requirement. Rather a definite number of such shelters was fixed from the top. Later on, people were asked to donate land voluntarily for construction. Hany large landowners responded as it was considered to be a symbol of social prestige. Moreover, such sites are located near their homesteads. A few compounds of the private primary schools were also donated for the purpose. These shelters are now used as primary schools. Here instead of giving emphasis on one or two major aspects of cyclone, all the aspects were analysed, but instead of detail solution only some policy guidelines were suggested.

# A Local Level Study on Socio-Economic and Environmental Effects of Cyclone 1991 (Ohiduzzaman, Nd., 1993):

This study is an unpublised MURP thesis of Md.Ohiduzzaman. The study analyses the socio-economic and environmental effects of the April 29, 1991 cyclone through a questionnaire survey in the offshore island of Kutubdia. It also focuses on the disaster management system in the area including the cyclone system and its effectiveness. The study revealed that the 29, 1991 cyclone affected all aspects of human life and caused extensive damage to lives and properties. All categories of people suffered heavily. Economic losses, however, varied quite significantly across households because of the differences economic conditions. Intensity of the cyclone, lack of alertness the local people and the absence of a suitable disaster management structure have been found to be important factors determining the extent of damage. Therefore, the study suggests that sufficient number of multipurpose cyclone shelters is needed and their proper maintenance must be ensured, but detail solution was not included here.

# Study of Multipurpose Cyclone Shelter Programme :

After the cyclone and storm surge of 1991, the government constituted an Inter-Ministerial Task Force to draw up a plan for construction of multipurpose cyclone shelters and killas to protect population and livestock in the coastal areas during storm surges. It was decided by the Task Force that a consultancy service would be contracted with Bangladesh University of Engineering and Technology (BURT) and Bangladesh Institute of Development Studies (BIDS) to prepare a Master Plan for providing shelter to the population and livestock of the coastal area.

The broad objective of the study was to prepare a Master Plan for providing shelter to human beings and livestock during

storm surges in the coastal area of Bangladesh. The Master Plan includes, among others, repair and rehabilitation of the existing cyclone shelters and killas and construction of a number of new cyclone shelters and killas. The proposed number of cyclone shelters and killas is based on the estimated size of the population and livestock over the next 25 years in the High Risk Area (HRA) of the coastal zone. The Master Plan recommends that 145 existing killas be repaired and rehabilitated (R&R). A total of 226 existing cyclone shelters is recommended for repair and rehabilitation. The Master Plan recommends construction of 2,500 killas of various heights and 2,500 cyclone shelters of which approximately 1,500 will be located on killas and the rest will be on stilts (RCC columns) of various heights.

This Kultipurpose Cyclone Shelter Programme (MCSP) has initiated for the first time a full fledged national level study on different aspects of cyclone disaster management in country. Though the primary objective of this programme was prepare a master plan of cyclone shelters with their proper number, both architectural and structural design, cost and probable location in the High Risk Area of costal regions of Bangladesh. Sut it also has touched other structural nonstructural measures of cyclone disaster management, such as; afforestation, improvement of communication network in coastal regions, improvement of cyclone warning system and development of local level institution for cyclone disaster banagement purpose. Again economic study on MCSP has been done very elaborately. Another new aspect has been considered here, that is the ecological and human interest components of the environment and the likely impacts of MCSP on them. The master plan has proposed certain design for different types of cyclone shelter, but actual site condition may not match with this type of design. Again for shelter design the concept used in Master Plan reversed the order; schools have been designed such that they can be used as shelters during storm surges. But for community development purpose only development of educational institution will not meet the requirements of local community.

Therefore, it has been felt that MCSP fails to suggest an overall community development programme which will be integrated with mulipurpose cyclone shelter programme. But community development programme will ensure better living environment in coastal regions which will ultimately bring the vulnerability of coastal communities to cyclone and storm surge at minimum level like developed countries. That means construction of cyclone shelter according to MCSP without integrating those physical facilities with community development programmes will give only some evacuation places not a disaster resistant community. For this reason, in future when all the shelters of MCSP will be saturated with the continuous growth of population of the country, then problem of large investment in this sector will arise again. So further study is necessary on this aspect.

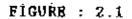
# 2.3 REVIEW OF PLANNING OF EXISTING AND PROPOSED CYCLONE SHELTERS:

Cyclone as a natural disaster is not a new phenomenon in Bangladesh. A number of cyclones hit coastal regions of Bangladesh in the last forty years. From the cyclonic incidents of sixties it was seen that huge storm surge was more destructive than wind. As there were few permanent structures with reasonable height at the coastal region, loss of human lives and livestock were huge. Again in case of disaster, evacuation of a large number of coastal people to the inner part of the country was time consuming, costly and also very complicated task.

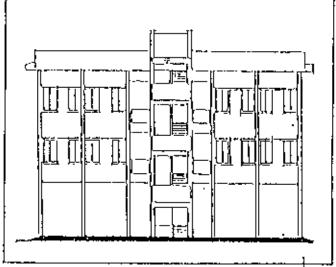
Therefore, in mid sixties several coastal community centres were constructed in some coastal areas of Bangladesh. Those were basically developed for community development functions, like school, library, auditorium etc., which could also provide shelter space to cyclone affected people of those areas. But in most of the cases they failed to serve their purposes, due to their improper location, use and design.

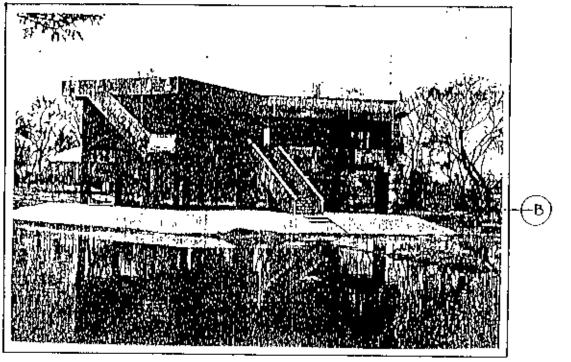
Some inovative efforts were seen after the cyclone of November, 1970. Then Red Cross¹ took the project to construct "Killa" to save both human lives and livestock. Those were earthen mound. Construction of Rilla is also a popular technique to survive for the settlers in the newly raised char areas (Karmaker, 1986). After the devastating cyclone of 1970 many cyclone shelters were also constructed. Majority of them were constructed by Public Works Department (PWD) of Bangladesh Government. Some were constructed by Red Crescent Society (BDRCS). A small number of them was constructed by CARITAS a leading NGO working in Bangladesh and some shelter projects were also completed by Enfants DU Monde (EDM) with the help of Swiss Disaster Relief.

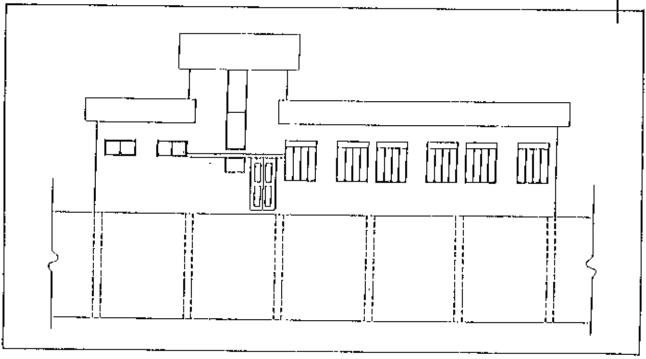
After the cyclone of April, 1991 various governmental and non governmental organisations came forward with the projects of cyclone shelters in the coastal region of Bangladesh. Among them the biggest project was taken by the Facilities Department2 of Ministry of Eduction. It was basically a project to reconstruct the cyclone affected schools and construction of new schools the coastal region with the purpose that they can be used cyclone shelter during the disaster. Local Government Engineering Department (LGED) also took a big project to construct cyclone shelters and they also develop different types of shelter design which can be used for various types of purposes to initiate the development of local level institutions. Apart from the two govt. organisations, different NGOs also took cyclone shelter projects and they developed their own shelter design. Again a massive and very elaborate shelter design proposal was given by the Multipurpose Cyclone shelter Programme (MCSP) of GOB.



- A ELEVATION OF PWD TYPE CYCLONE SHELTER:
- B PROTOGRAPHIC VIEW OF BDRCS TYPE SMELTER.
- C BUBYATION OF SHELTER OF LGED (PROPOSED).

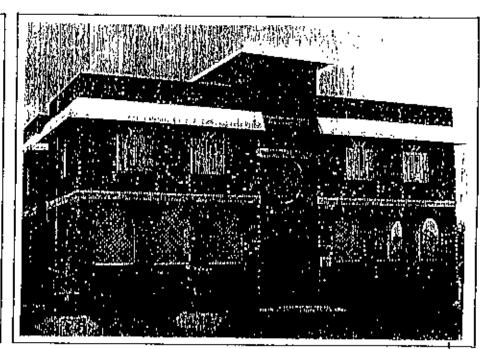


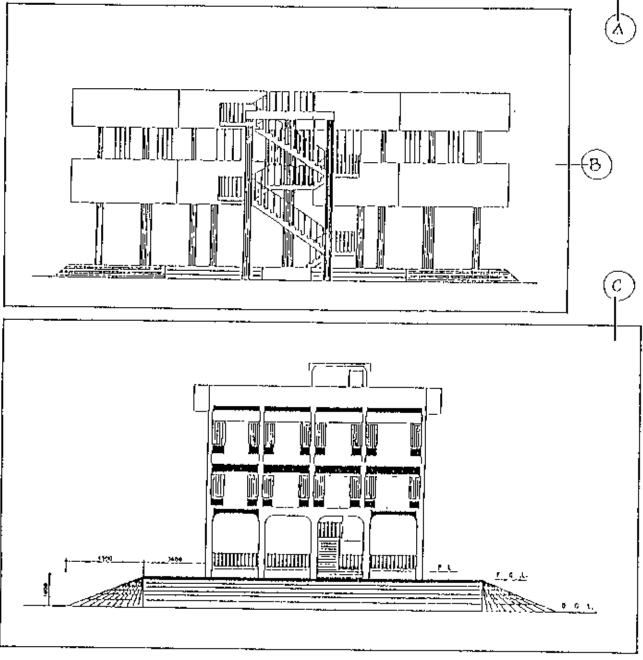




# FIGURE : 2.2

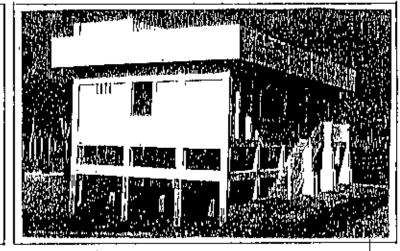
- A PHOTOGRAPHIC VIEW UF SERLTER COM SCHOOL OF CARITAS.
- B BLEVATION OF SHELTER OF GRAHEEN BANK
- C ELEVATION OF SHELTER OF FACILITIES DEPARTMENT.

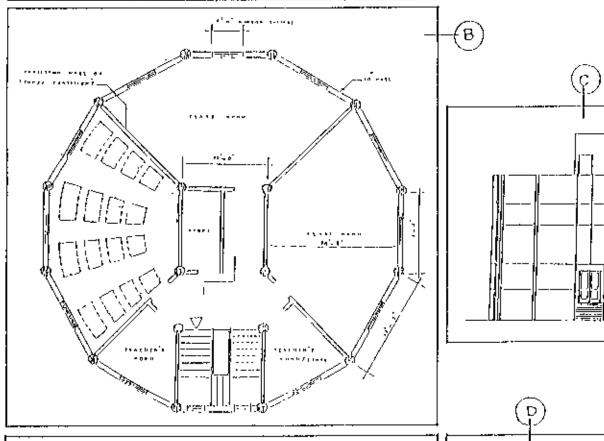


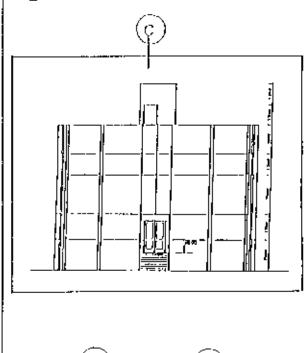


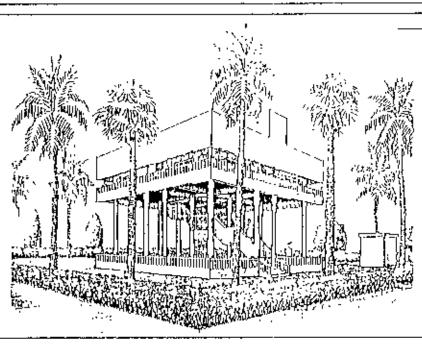


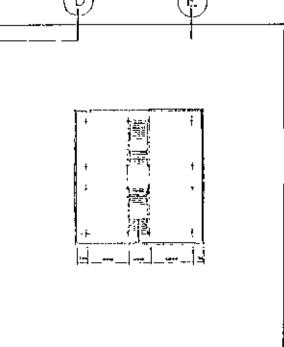
- A PHOTOGRAPHIC VIEW OF SHELTER OF EDM.
- B TYPICAL FLOOR PLAN OF PROPOSED SHELTER BY 1EB.
- C ELEVATION OF SHELTER OF BRAC.
- D PERSPECTIVE OF SHELTER OF MCSP (PROPOSED).
- E FIRST FLOOR PLAN OF SHELTER OF MCSP (PROPOSED).











All the recent studies on cyclone disaster management have pointed ont that, a cyclone shelter must be treated community service facility for its proper utilization by the local community during both normal and disaster period. In order achieve the said purpose the shelter should be located properly and at the same time should be designed in such a way so that it can serve effectively as evacuation space for cyclone affected people and for normal time use, otherwise shelter could not be used during pre and post cyclone periods. At present it is felt by the personnel related with disaster management in different countries that, as cyclone may not occur every year, so the physical facilities of cyclone shelters have to be utilised efficiently to serve the local community for any fruitful purpose during normal time and at the same time it will ensure shelters regular maintenance. Without this regular maintenance shelters will not be able to serve the distressed people efficiently during emergency period and it will discourage local people to take shelter in those structures. Again, currently it is assumed by the policy makers and planners throughout the whole world that without involving the local people in the planning process of any development project it is not possible to make that project universally acceptable to its target groups.

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Therefore, for review of design of existing and proposed cyclone shelters in Bangladesh, following information and aspects are considered as the criteria:

- a. Location of the shelter
- b. Architectural Design of the shelter
- Kultipurpose use of the shelter
- d. People's participation

## a. Location of the shelter :

Location was not considered as a serious matter for execution of any type of existing and most of the proposed cyclone shelters. During planning stage of different shelter projects little thought was given on different locational criteria of the shelter planning except availability of land. So all the shelters are either located within premises of existing primary schools or land has been collected through donation of local people.

PWD type shelters are located randomly along the coastal area without any proper study. Shelters were basically constructed on the land of primary and secondary schools of coastal districts which were destroyed by cyclone of 1970. In some cases govt, Khas land was also used for their construction. But no land was collected or arranged especially for this purpose. PWD constructed those structures where land was easily available. Some of them are located in the remote areas and even

do not have any access. Similarly premises of primary schools in cyclone prone areas of Bangladesh have also been taken as the location of cyclone shelters by CARITAS and Facilities Department.

In case of BDRCS type cyclone shelter, land is collected through donation from the villagers who want to transfer their land in the name of BDRCS authority. EDM, LGED, Grameen Bank and BRAC also followed the same way to collect land for their shelters without considering any other locational criteria.

tentative location In selecting the of a Multipurpose Cyclone Shelter (MCS), the premises of schools which were neither two-storied under-construction or proposed as cyclone shelters by different such as Facilities Department were given first preference. If the number of MCSs thus proposed was less than the number of MCSs required, then the difference, with an upper limit of the required number of additional primary schools needed in 2002, was chosen as MCSs which would be located as new primary schools. In areas where primary school did not exist, but based on the number of school going children (i.e. 250 children in 6-10 year age groups) such a school was required, location of a new MCS should satisfy the need of both school and shelter. number of MCSs proposed so-far was still less than the number of required MCSs then existing Madrashas and Secondary Schools, if they were not too close to the primary schools already proposed as MCSs, were given next preference. If still shelter capacity was needed, then MCSs were proposed as new secondary schools. But existing institutions may be already situated in wrong locations in terms of accessibility, so according to consultants of MCSP further local level study is necessary to place the shelters of MCSP in proper location. That means MCSP did not suggest actual location of proposed cyclone shelters in the proposal.

For locating the shelter in the proposal of IKB, certain guidelines have been given for site selection purpose. But in which way at the actual site, land will be chosen and collected in relation to those guidelines for shelter construction purpose, was not pointed out in this proposal.

#### b. Architectural Design of the shelter:

Architecturally the design of cyclone shelters by PWD, RDM, Facilities Department and LGED are similar to urban flat buildings and appears quite unfamiliar in the surrounding rural context where most of these shelters are located. All these type of shelters are rectangular in plan and ground floor is kept free to allow the surge water to pass, so in many cases this floor is unutilized. The width of stair in these shelters is narrow.

which are appropriate for normal time use but not manageable emergency period. In case of PWD and EDM type an open stair connects the floors and the roof with the ground. But in designed by Facilities Department and LGED, the main shelters stair in the building can be approached only through underneath the building. As the height of the water crosses a certain level shelter will be inaccessible as there will be no headroom clearance. At that time head injuries may occur if people try to into the shelter. At the same time, it would be equally difficult to come out of the shelter. In the planning stage of these types of shelter no consideration was given for evacuation space of livestock. The PWD type shelter provided with any service facility, there is no electricity, no water supply and no arrangement for toilet. In the shelter of Facilities Department there are three toilets in a row and a tubewell uext to the toilet block in the north west corner of the elevated earth platform at ground floor. But this block of toilets at ground floor will be of no use during the cyclonic period. In the shelter by LGED a toilet has been incorporated the design as a part of the main structure. Positive aspect of this toilet placement is that it can be used in the cyclone time. Its proper performance in normal time is questionable because of the absence of water supply and lack of toilet training among villagers to use such internal toilet facility. It could be a source of nuisance in normal time if cleaning and maintenance works are not ensured as the access to the toilet is directly from the central corridor, the main circulation space and entry to the building. Ventilation is not much of a problem because of the rural setting and the elevation of the building that allows air to pass through when the windows are open. But introduction of glass windows in all these types of shelters provides ample light and at the same time glare within the structure, but maintenance of steel and glass windows will be difficult in remote rural areas.

Architectural form of BDRCS type of shelter has a linear character and this architectural form gives a compatible characteristics with the flat rural surroundings and indigenous built form. The shelter is placed on an irregular pentagonal base, one meter above the ground. It is two storied and ground floor is open on all sides. A tail like stair of 1.8 m. wide is projected out from the angular point to meet the ground. It can be used as gallery for school children and also as a jetty when the snrrounding area is submerged with water. Two toilets are provided on the ground level, but detached from the main structure and will not be usable during disaster.

The most important feature of two storied school-cum-shelter building of CARITAS (which is not in High Risk Area) is that here ground floor has been used very efficiently. On the ground floor, introduction of perforated window screen creates an easy passage of flood water through this floor. So here ground floor is usable

during normal time which was not seen in any other cyclone shelter design, it makes the structure more efficient in its performance and it is a new approach in the cyclone shelter design. Otherwise, in the design process basic requirements of a shelter were not kept there. The closed space of the rooms inside the structure is not preferable for a school and also for an evacuation site.

Shelter by Grameen Bank is hexagonal in plan connected to a detached stair on one side of hexagon. The hexagonal shape is a good shape to protect severe wind force, but this shape will not give functional space inside the building for normal time use. The ground floor is open. The plinth height is 450 mm. The upper floor is raised to a height of 3.35 m. The structure is surrounded by a verandah all around. The stair is open and leads to the roof of the shelter. No provisions for toilet and water supply have been made inside or close to the shelter.

Shelter by BRAC is a boat shape two storied structure which will cost a large amount of money for its complicated construction. The technical or functional significance of this boat shape is hard to understand from the design. Total length of structure is 24.7 m. and maximum width is 13.6 m. It is entered from the tip of one end and stair is located at the tip other end. Here the circulation system is very bad. The central corridor will be a trapped space at the rush hour of disaster period. Due to the wrong placement of the stair, every body has to travel a long way unnecessarily through the central corridor to go to the upper floor. Toilet facilities have been provided at the upper floor. All the toilets are designed with sanitary fittings and fixtures according to urban standards. This toilet may be ineffective during the rush hours of disaster. This shelter design reflects special attention to aesthetic details.

Three types of designs of school-cum-shelters have prepared by MCSP, viz. shelter-on-killa, free-standing shelter and shelter adjacent to a killa. The preferred design solution is a shelter located on top of a killa, Architectural conceptual designs have been prepared for typical 250-student primary schools. The class room dimensions formed the basic module. module has been taken as 6m x 6m to accommodate 50 students in each class, which is close to the standard of 0.74m2 (8 sft) per student currently being used by the Facilities Department. The overall form, mass and volume may be regulated by the normal time but ⊯hen used as a shelter it must optimize accommodation capacity. Based on analysis of shelter occupancy during April 1991 cyclone, it has been assumed that, on the average, each person occupies  $\emptyset.186m^2$  (2 sft) floor area. Adequate storage area has been provided in the verandah as well inside the rooms. Access stairs leading to roofs have been provided. But internal stair will create a tight circulation

space like the shelters of other agencies. Shelters on killas are designed with two attached toilets intended for exclusive use in cyclone time. But their placement inside the building will create maintenance problem, as most of the evacuees are not used to that type of toilets. Rain water from the roof will be collected in water tanks placed on the lower roofs of toilets and excess water will be used to clean the toilet in a continuous flow. Tubewell water stored in a separate tank shall be used for drinking purpose during and after the cyclone period.

The proposed design of IEB is based on a twelve-sided polygon, closely resembles a circle and offers advantages from points of view of teaching and layout of desks and benches. But this shape of building is not at all suitable for any normal time use. The plinth area of building is 1750 sft (183m²). The height of the first floor should be above the highest surge level. This will depend on the location of the shelter, but a minimum height would be 10ft, above the surrounding terrain. It is proposed that some arrangement in the form of low height water tank with bigger surface area and removable cover may be constructed over stair roof to collect rain water during the cyclone. But no toilet is proposed in shelter design and the engineering concept of solving the solid waste disposal system has not been also identified.

#### c. Multipurpose use of the shelter :

The management authority for PWD type shelters are Zila Parishad and Ministry of Education. They were asked to find an appropriate use for the shelters during non-cyclonic period. It was, however, suggested in the design proposal that the shelters could be used during the normal period for community needs like primary school, clinic, community motivation programme etc. It was found from the field survey that the most common normal time use is primary school, But this normal time use does not ensure shelter's better maintenance throughout the whole year.

During normal time most of the BDRCS shelters are now being feeder schools in the locality. In some locations BDRCS started cyclone sheltsr based community development activities. The design has an open ended character that can be put to any use found appropriate in different context. But there are some limitations in its use as school, as there is only two class rooms in two wings. Host probably in planning stage its normal time use as school was not thought properly. The school-cum-shelter of CARITAS is primarily developed as school building, then cyclone shelter is considered as its secondary use. Shelter building of EDM has been developed as community development centre, which will be used by the local people as their meeting place, training centre and other community development activities.

The shelter of Facilities Department will be put to four different uses in normal time as it is suggested in the design. Due to different suggested normal time use of the shelter, conflicts may arise in their operation because of the specific circulation pattern.

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A variety of alternative uses have been suggested for shelter of LGED to accommodate different activities during the normal time. These alternative normal time uses of the shelter will be determined on the basis of the community need. For better management and maintenance purpose this type of proposed single use of building for normal time is obviously a better proposal. From this point of view flexibility should be more in the design to use the same shelter structure for different purposes.

The shelter building of Grameen Bank and BRAC will be used as their office in the coastal regions of Bangladesh, but it is not a good use. Because for these functional use lots of furniture will be needed, which will reduce the amount of open space to provide shelter of a large number of people in case of disaster.

Consultants of MCSP assumed that the most appropriate use of shelters can be ensured by providing schools in those shelters. Moreover, investment-wise, use of shelter as schools rather than offices is a better choice. This is so because given the same floor area, schools will have twice the capacity during cyclone than that of an office. This is due to the fact that offices will have more immovable furniture than schools. But existing school shelters of PWD already proved that by using them as school normal time, it is not possible to ensure their maintenance throughout the whole year. Under this circumstance, proposed MCS cum schools must create their own mechanism and fund to overcome the maintenance problem. Before selecting normal time use of proposed MCSs, a major element in the educational policy of the Government, that is to ensure Universal Primary Education by the year 2000 and the government legislation to make attendance in primary schools compulsory have been considered as the major guideline by consultants of MCSP. To achieve this target, a total of more than 3000 primary schools would be necessary in HRA. To achieve that target strong political will and strong institutional capacity are necessary, and at the same time local level socio-economic condition must be in favour of this universal primary education policy. But whether all these things are present or not that has not been evaluated before selecting school as the normal time use of proposed shelters.

For the proposed design of IEB school has been considered as its normal time—use. But why this particular use has been chosen that was not explained in design proposal.

## d. People's participation :

From design proposal of PWD type shelter it was found that designers gave little thought on the way of involving the local people with this shelter activity. Therefore, local people are not stall emotionally involved with these shelter buildings.

BDRCS has initiated involvement of local people through the management of shelters throughout the whole year by a local level committee and the community development activities of the shelter complex. The teachers are made responsible for maintenance and management of the shelter, where these function as feeder schools. BDRCS officials believe that by donating land at free of cost for shelter construction purpose, people of the local community automatically begin to think about it as their community property. The maintenance cost is funded by the BDRCS authority under the direct supervision of their unit office which has its own employees and volunteers. EDM has also followed this approach to ensure people's participation in shelter activities.

Though the shelters of CARITAS, Facilities Department and LGED have been considered as the community service facility like, school, mosque, clinic etc. But no definite way has been identified in the planning and design stage of these types of shelter to incorporate people's participation within the shelter project.

The shelter of Grameen Bank and BRAC will be their own property during normal time, which will be used as their village level working stations and Grameen Bank also has considered their shelter to provide residential accommodation for their local level staff. So there is no scope of direct people's participation in the design and implementation phase of these shelter projects.

From the very inception of the study of MCSP, Consultants were aware of the need of the involvement of the local people in the planning process. The success of the Multipurpose Cyclone Shelter Programme would depend largely on the cooperation and effective participation of the local people who will play a major role in the management and maintenance of these facilities. Cyclone Preparedness Programme (CPP) volunteers the area would play major role in shelter management at pre-disaster, during disaster and post-disaster periods therefore, their views were considered of importance in the planning process. It was envisaged that community development therefore, activities would be organised with the multipurpose shelter buildings as centres and to make it successful, opinion of villagers need to be incorporated during planning phase. Study Team organised several workshops, conference and meetings in the study area which were participated by local leaders (Members of Parliament, Union Council Chairmen and Members, and

other public representatives), concerned government officials, representatives of NGOs, volunteers of CPP, and local people. These meetings provided useful guidance to the Study Team in incorporating the views of concerned agencies and organizations in preparation of the Master Plan. This approach of MCSP to ensure people's participation will be effective to implement the proposed programme.

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Regarding people's participation shelter proposal of IEB suggested village level committee like Gram Sarker for regular management of the shelters, through which involvement of local people will be ensured in shelter activities and at the same time maintenance will be better.

# 2.4 REVIEW OF KILLAS:

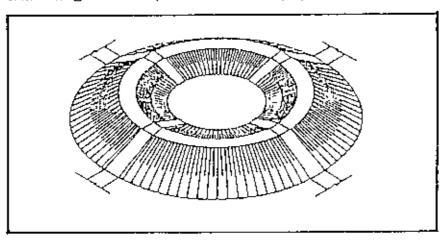
For protecting cattleheads, killas or raised earthen platforms were considered to be the only viable option and adequate space provision. Within newly raised char areas killa is very effective to provide residential accommodation on the top of killa for the settlers. This concept of killa has been taken by BDRCS to provide shelter space for livestock and a total of 148 killas were constructed by BDRCS for this purpose and 40 more are under construction by LGED.

#### 2.4.1 EXISTING KILLAS:

BDRCS undertook the construction of 180 earthen killas in 11 Thanas of 6 districts in the coastal areas. Subsequently the construction of 7 killas was abandoned. Among the completed and partially completed killas, 17 are reported to have been eroded. A typical killa is an earthen mound which is 6 m high with 45.7m x 27.4m base and 24.4 m x 18.3 m flat top. It normally covers an area of 1 to 2 hectares (2.5 to 5.0 acres) of land including the borrow pits. Another type of kills is also found, round in shape having 75m base diameter & 30 m top diameter (see Figure 2.4). It covers an area of 3.24 hectares and the borrow pits are planned to be used as ponds for the dwellers. These killas are suitable for the cattleheads during cyclones and surges. However, due to digging of earth from the borrow pits on all sides of the killas and due to the improper construction techniques used and maintenance works, many of the killas are now in deplor-able condition. Besides, the locations of some killas are not suitable as these are far away from settlements or cyclone shelters.

Although the physical condition of these kills is bad the existing plan of the kills is satisfactory and if these are constructed properly, located correctly and maintained regularly, these may be safe places for the cattleheads as well as for many people in case of emergencies.

Figure: 2.4 Existing Killa (round in shape).



# 2.4.2 UNDER CONSTRUCTION AND PROPOSED KILLAS :

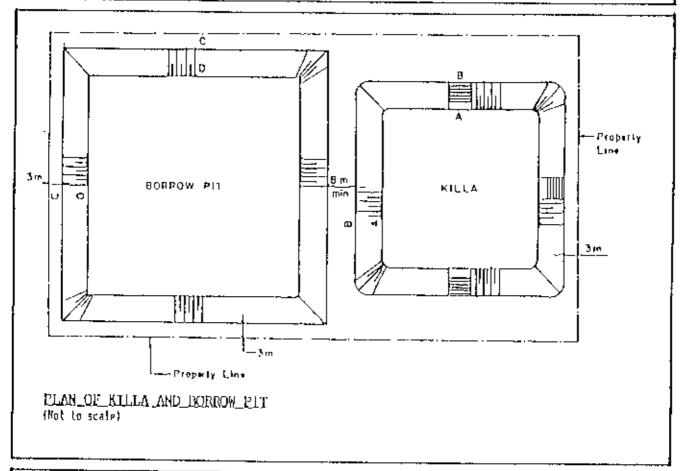
The local government Engineering Department (LGED) is constructing 40 kills in some districts of coastal areas. The kills is rectangular in plan with a top dimension of about 61m x 30 5m and height of 6.1m. The construction of these kills is satisfactory, however, adequate compaction of filling soil may not be obtained if proper techniques are not followed.

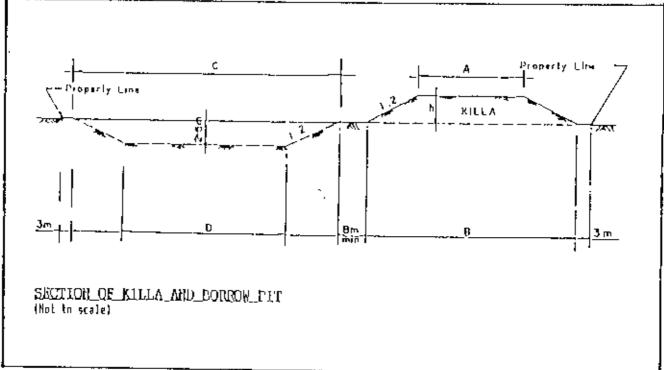
Two types of killas are being proposed for Multipurpose Cyclone Shelter Programme, viz. killas with shelters on top and killas adjacent or near to the shelters on stilts. For the two types of killas the top dimensions have been fixed at 43 x 43m and 38 x 38m respectively. For both the types of killas three different heights of 3m, 4.5m and 6m have been recommended depending upon the characteristics of the site based on storm surge inundation. The side slopes shall be 1:2 (vertical: horizontal). The borrow pits from where soil will be excavated for constructing the killas shall be located not closer than 8m from the toe of the proposed killas. These borrow pits shall preferably be located on one side but not more than on two sides of the killa due to land problem. The slope of soil excavation in borrow pits shall also be 1.2 (see Figure 2.5).

Intersections of rural road network could be raised as platform to be converted into "intersection killas". In order to establish the requirement of killa space, the number of bovine and goat/sheep were estimated for each union in the HRA. Several types of killas have been proposed by this study team each of different heights depending on probable storm surge height. Again, the dimension of killas having shelters on top and stand-alone killas were separately worked out. However, it has been proposed that each killa would have 1200 sq.m. at the top available for sheltering livestock.

FIGURE : 2.5

RILLA AND BORROW PIT UNDER CONSTRUCTION.





From the above review, it becomes clear that cyclone shelter may have many connotations - shelter alone, shelter on killa, killa near shelter. Therefore, it is necessary that the choice of the type suitable would depend upon local conditions- topography, land level, availability of land, existing and projected livestock population etc. So, there is a need for in depth study on size, location and design of cyclone shelter and killa.

# 2.5 CYCLONE SHELTER EXPERIENCES IN SELECTED COUNTRIES:

When storms or earthquakes strike the United States or Japan, damages are usually minor. However, when natural calamities of similar magnitude strike developing countries, the injury and death rates are often 100 times greater. For example, the average annual death toll from natural disasters in Japan is 63, while in Peru it is 2,900 (MCSP,1992), in spite of similar characteristics and overall disaster vulnerability. Although the number of disasters is remaining relatively constant, Japan has developed to the point where disaster-caused damage and loss of life has been reduced to a very low level.

In their response to the need for shelter during a cyclonic-type storm, different countries have used a number of approaches:

- 1. Building Shelters. Belize, Jamaica, and Caribbean nations as well as the Philippines have built some shelters, but these are generally built to protect from the wind only. India is the only other country which has built a significant number of public shelters to specifically address the danger of high water.
- Designating Public Buildings as Shelters. This occurs
  in all islands of the Caribbean, the Philippines, the
  U.S., India, and in almost every other country affected
  by cyclonic storms.
- 3. Designating Connercial Buildings as Shelters. In the U.S. and in the Virgin Islands, hotels which are built to specific engineering standards are often designated as hurricane shelters. In Europe, commercial buildings are designated for use as bomb or nuclear fallout shelters.
- 4. Building Houses on Stilts. Private housing in Thailand and Indonesia is often built a few meters above the ground. Recent programmes have emphasized building practices to improve the strength of housing built to avoid high water.
- 5. Roads and Bunds for Evacuation. In the U.S and the Caribbean, the government has developed programmes to

improve coastal road systems and bridges to assure evacuation routes.

- 8. Construction of Raised Earthen Hounds. This concept is used in India and Bangladesh. Most other countries have both high ground within a short distance from the coast and effective evacuation systems.
- 7. Rlevating Affected Areas on Island. The best example of this is the town of Galveston, Texas, U.S.A., site of the most devastating natural disaster in U.S. history (in terms of lives lost). After the 1905 hurricane, Galveston Bay was dredged and the fill used to raise the entire town of Galveston above the expected surge level.

# 2.5.1 THE CARIBBRAN EXPERIENCE:

One of the most storm-vulnerable areas of the world is the chain of islands found in Caribbean. The islands first joined together to form the Pan Caribbean Disaster Preparedness Programme (PCDPP) in order to improve warning and evacuation procedures, share a shelter management plan and in general reduce the vulnerability of their populations to storms. This organization has recently been replaced by the Caribbean Disaster Emergency Response Agency (CDERA).

In one major aspect, the situation there is significantly different from Bangladesh. The mountainous character of most islands provides plenty of high ground to which the people can evacuate. Damage to buildings tends to be caused by high winds and not water. Most housing damage is confined primarily to the roof. There is a risk to people high in low lying areas from storm surge and government awareness programmes concentrate on changing the local perceptions of the risk involved with staying in your own home during high winds.

The major problem faced by the island government in getting people to evacuate the low-lying area and to come to the storm shelters in a timely fashion. A recent study concluded that the main reason that people did not evacuate was the fear of loss of personal possessions. This fear was a factor in the decision making process of families across the economic spectrum: the researchers noted that even when families lived in concrete buildings which offered substantial security from robbers and looters, they were afraid to move to the shelters and leave their homes locked.

All Caribbean countries now have Designated Shelter programmes. This consist of the identification and use of public buildings for shelter purposes. Most often the Designated Shelter

is a school, although churches and health clinics are often brought into the overall shelter scheme in areas where the schools do not suffice. Schools are required by law to be constructed according to a special high-wind-resistant building code which makes them hurricane-safe. The storm shelter system in the Caribbean is managed by school headmasters. This responsibility is specified in their job description and written into their contract.

The country of Belize unsuccessfully tried another approach. Belize constructed a small number of buildings which were to be used exclusively as storm shelters. But Belize had so many problems with maintenance, vandalism and misuse in their dedicated shelters that they have been abandoned. Belize currently uses the Designated Shelter system like other Caribbeau countries (UNDRO, 1982).

# 2.5.2 INDIAN EXPERIENCE:

The east coast of India - the states of Tamil Nadu, Andhra Pradesh, Orissa and West Bengal - share the effects of the cyclones in the Bay of Bengal with Bangladesh. Frequency of cyclones is approximately the same as in Bangladesh. Although storms striking the Indian coast are comparable in severity to those which have hit Bangladesh, damages and loss of life have not been as severe as in Bangladesh primarily due to a more advantageous geographic situation. Most of this area is a narrow coastal plain extending one to twenty kms. inland, but usually rising several metres within the first five hundred metres from the sea. Small hills which provide some refuge from storm surge are common in the coastal plain. Much of the plain, particularly the land immediately adjacent to the ocean, is extremely sandy and cannot be profitably cultivated. Perhaps due to this, there is less agricultural attraction to this srea and the population density in the vulnerable area is typically less than in coastal Bangladesh. Because the coastal area is less suitable for annual crops, the area has some tree cover.

Previous to the devastating 1977 cyclone, some shelters were built, primarily in Andhra Pradesh. Some of these shelters collapsed during that cyclone. Experiences of the 1977 cyclone spurred the Indian national and state governments to develop projects aimed at reducing the vulnerability of the coastal population, particularly in Andhra Pradesh. International trade agencies, local NGOs, and the government of Andhra Pradesh began programmes to built shelters and started cyclone preparedness programmes. Most were built on an ad hoc basis, subject to variety of factors: need, population density, and identification of an additional use for the shelter. Many shelters were built as additional space for schools. Although a few shelters have been built with no other purpose but to provide shelter in a storm,

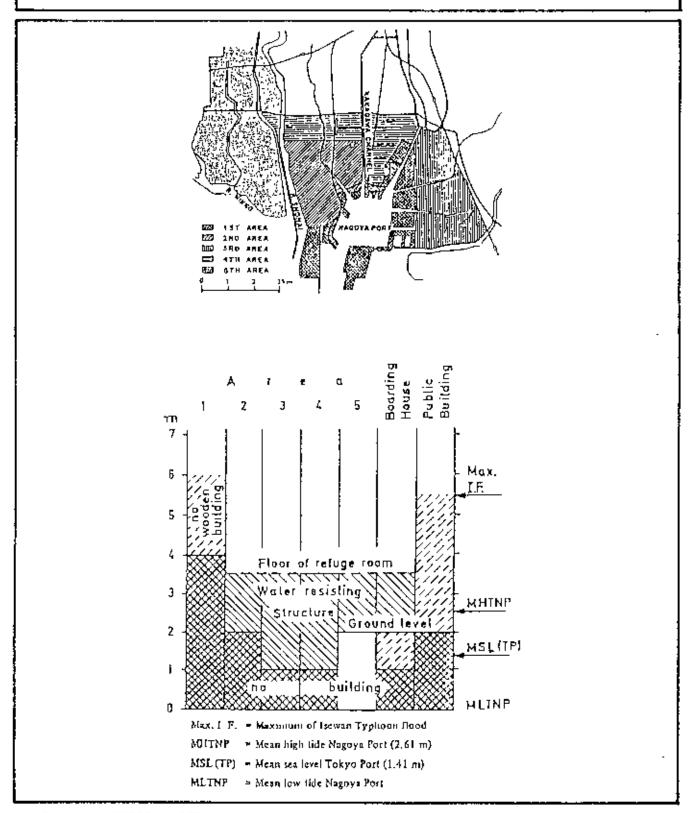
most are now being used for other purposes - schools, government agency offices, NGO programme offices, community centres, vocational education training, government guest houses, and warehouses.

After construction, usually with the help of a western and aid agency, the shelters are turned over to the organization will use them, and become responsible for maintenance. In some instances, it has been difficult to find organizations willing to assume this burden and 'ownership' of after the many of the shelters remains undecided years construction is completed. Officials and NGO workers report that maintenance of the shelters is a problem. Those shelters used as schools are not kept up due to inadequate government funding. Use of the shelters seems dependant on a number of factors. Govt. relief and NGOs officials indicated that traditionally buildings in normal uses (eg. schools) received much better acceptance than unconventionally shaped buildings (circular buildings). In addition, they felt that square or rectangular plans were more efficient and better lent themselves to normal In Andhra Pradesh, the plan offered by the Centre for Disaster Management and Rural Reconstruction placed the cyclone shelters in the centre of village for best access (Dangroup International, 1989).

## 2.5.3 THE PHILIPPINES EXPERIENCE:

The philippines is an island country that is often hit by typhoon, but topography makes it easy to walk to an area which is several meters above the probable surge level. Shelters to resist surge have not been a focus of government efforts. Recognizing that the best way to avoid large loss of life and disruption is to help the vulnerable population prepare themselves, the government of Philippines has concentrated efforts on organization of communities (known as Barangays) training for administrators and Barangay leaders and awareness campaigns for the general populace. In the Barangay Disaster Manual a general frame work and organizational structure suggested for using the creation of the Barangay Disaster Control Council. This community level preparedness and dependence on the Barangay leadership in developing plans for disasters has been effective in reducing losses in the various disasters to which the Philippines are prone. The Barangay emergency plan administrators have typically identified atrong public and buildings which can be used to shelter those members commercial the community without wind-proof housing. Often public structures are built with this in mind. There have also been programmes to encourage typhoon resistant house The recent Core Shelter Programme provides poor construction. families with one typhoon resistant room and own a 1991 UN HABITAT award (MCSP,1992).

FIGURE : 2.6
FLOOD ZONES AND BUILDING CODES IN NAGOYA, JAPAN.



Source: UNDRO, 1977.

#### 2.5.4 THE JAPANESE EXPERIENCE:

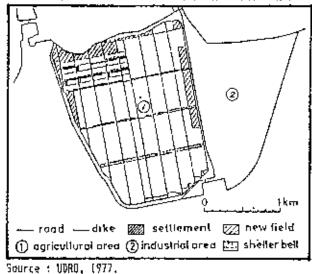
The coastal city of Nagoya, Japan, gives an example of the use of building codes to reduce flood damages caused by cyclone and save lives. In September 1959 Nagoya was devastated by the Isewan cyclone. Over 5,000 people were drowned in the city and surrounding region. Areal differences in flood and damage characteristics, due mainly to topographic differences, led the city authorities and the Ministry of Construction to divide the region into five flood zones and issue different building codes for each (see Figure 2.6). These controls applied in the immediate reconstruction period and for long-term development in the city. To reduce storm surge damages and danger to life, four measures are incorporated in Nagoya's building codes:

- Control of the elevation of the building site.
- Control of building materials and types of structural repairs.
- Control of the height of the ground floor and provision of refuge rooms.
- 4. Prohibition of houses, hotels and other residential buildings within a certain distance from the sea.

Such building codes are relevant where intensive development is required, as in Nagoya, which is a major port and industrial centre. On river floodplains, however, building codes alone will not suffice. In addition to the design of flood-proof buildings, an unobstructed floodway must be preserved free of all construction.

Development plans for Nabeta Polder near Nagoya illustrate another related point (see Figure 2.7), that land-use change and control are fairly easy when development is large scale & compréhensive. The Nabeta Polder is a reclaimed area at the mouth of the Kiso River, where construction of sea dykes started in 1946. There were 100 farmhouses more than on the Polder before the 1959 flood, mostly singlestoreyed and made of wood, strung out along the roads.

Figure: 2.7 Land-use on the Nabeta Polder,



All farmhouses and public buildings are now concentrated in the north-west corner, where higher ground gives access inland. Houses are of reinforced concrete and three-storeyed. Shelter belts of trees have been planted to complement the action of the restored sea dykes and to reduce soil movement, and in general far more modern land management techniques have been applied in post-flood period (UNDRO, 1977).

## 2.6 SUMMARY:

This literature review portion of the study report has been prepared to review the related studies which have already been done on the cyclone disaster management aspect, to review the design of existing and some important proposed cyclone shelters for coastal regions of Bangladesh and at the same time existing & proposed killas, and to review the shelter solution approaches of other countries of the world.

By reviewing the related studies, it has been found that all the studies expressed their opinion on cyclone shelter as it is of the major structural measure for coastal regions of Bangladesh to mitigate the loss of human lives and livestock. At present cyclone shelters are not properly maintained, they are located in wrong places, badly designed and are not serving the local communities for any fruitful purpose. At the same time people's participation is more or less totally absent in shelter Therefore, in many cases during cyclone of 1991, those cyclone shelters failed to serve the distressed people effectively. Through its study report BRAC pointed out that, along with formal cyclone shelters existing permanent public and private buildings in the coastal regions must be considered as informal shelters, so their number, condition and design have to improved, Another study revealed that in locating shelter at the village level, usually local elites and power structure influenced the implementing agencies to place the shelters in wrong locations, so those shelters failed to perform their actual purpose. UNCRD gave nore importance on integrated approach to cyclone disaster management and regional development planning. While MCSP more or less failed to integrate their proposed cyclone shelters with local community needs.

Among the existing cyclone shelters, shelter design of BDRCS has showed some potentiality to act as effective cyclone shelter, but not for normal time use. Shelters of BDRCS are also properly maintained, and recently BDRCS is trying to initiate people's participation through shelter management and their normal time community development activities. But all the proposed cyclone shelters including MCSP, more or less failed to suggest any comprehensive package plan for community development in coastal region of Bangladesh. But the researcher believes that without improving the coastal community's over all living environment

only some cyclone shelters will not be able to provide in long run the ultimate protection to people of coastal regions of Bangladesh from cyclone and storm surge.

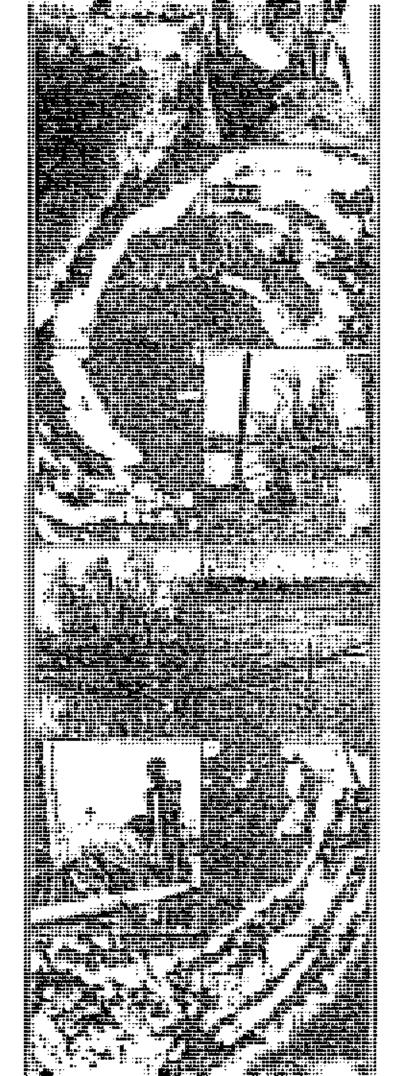
By reviewing the shelter solution approaches of other countries of the world, it has been found that, Indian approach is more or less similar to Bangladesh and they are also facing the same problem like Bangladesh for maintaining their cyclone shelters throughout the whole year. But Caribbean experience has revealed that their approach to designate public buildings as cyclone shelter is more or less effective as disaster management approach and now their neighbouring countries are also interested to follow that approach. Similarly Japanese approach towards land-use planning for creating risk free zone from natural disasters like cyclone is also an unique way to solve the problem, but it requires strong institutional set-up, managerial capability and general public consciousness.

The plan and design of cyclone shelter would depend upon local conditions— topography, land level, availability of land, existing and projected livestock population etc., that means for shelter planning purpose various diverse aspects has to be considered. Therefore, there is a need for in depth study on size, location and design of cyclone shelter and kills.

#### Notes :

Red Cross is now known as Red Crescent in Bangladesh.

Facilities Department of Hinistry of Education of GOB is responsible for construction and maintenance of all the secondary & higher secondary educational institutions of Bangladesh.



CHAPTER : 3 SOCIO -ECONOMIC PROFILE OF THE STUDY AREA This chapter is prepared to explain and analyse the socioeconomic condition of the people, cyclone vulnerability and physical characteristics of the study area.

# 3.1 INTRODUCTION :

The administrative boundary of Khurushkul Union under Sadar Thana of Cox's Bazar District demarcates—the spatial location of the study area (see Fig.3.1). It is situated in 21°-27'N Latitude and 91°-59'E Longitude on the banks of the Baghkhali (formerly known as Khurusia river) at southern side and Bay of Bengal—and Maheshkhali Channel at Western side.

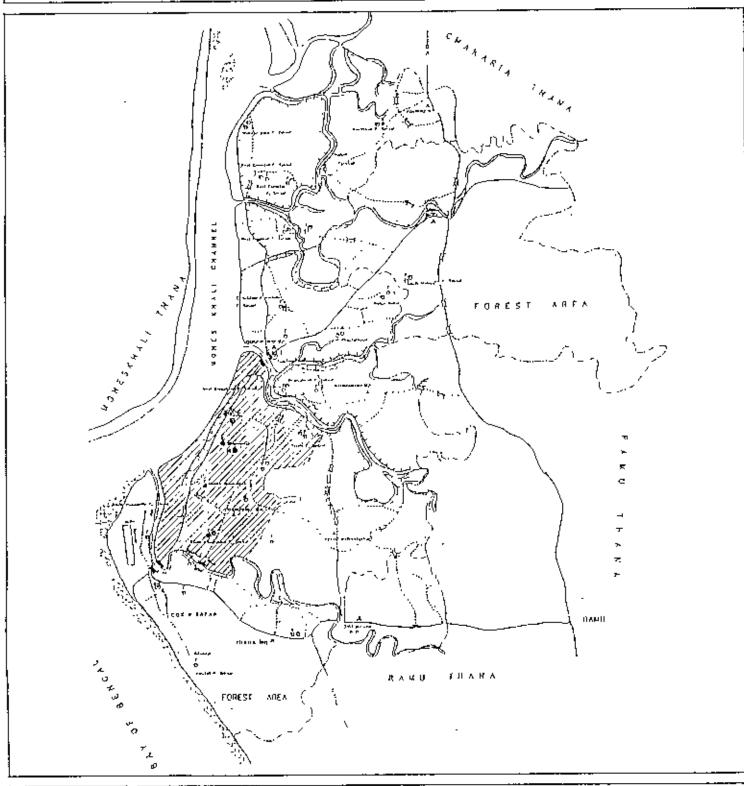
Now Cox's Bazar District is divided into seven thanas. Among them Sadar Thana of this district has seven unions and Khurushkul Union is one of them. Its nearest major urban centre is Cox's Bazar District HQ which is around 4 km away from Khurushkul Union. Cox's Bazar town was established by Lieutenant Cox of British army who died here in 1798. At first it was a colony of Maghs, who sought shelter in British territory after the conquest of Arakan by the Burmese. During World War II a British military cantonment was established here on the Northern bank of Baghkhali river, which is now known as Khurushkul Union. But the actual town was developed on the opposite (southern) bank of the river. After the end of British rule the military cantonment was removed from here and Khurushkul became a remote, backward rural settlement. Cox's Bazar town then became the country's only beach town and day by day its importance increased as a major tourist spot of this region. Although an important urban centre like Cox's Bazar is located nearer to Khurushkul, but due to very poor communication between Khurushkul and Cox's Bazar town, the northern bank of river Baghkhali still remains as a typical backward and remote coastal settlement.

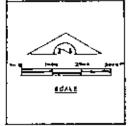
# 3.2 GRO-MORPHOLOGICAL BACKGROUND OF THE AREA:

Very little geological study has been done in the entire coastal region of Bangladesh. What has been done has proved the highly variable lithologic characteristics of the sediments, both in the lateral and in the vertical directions.

As noted by J.P.Morgan and W.G.McIntire (1959), the geology of the Bangladesh delta is complex in that it has been the site of sedimentary deposition by two of the worlds major rivers. The Bengal delta, like other major deltas of the world is composed of a number of overlapping sub-deltas and the deltaic region is assumed to be constantly subsiding, owing mainly to compaction of recent sediments and possibly to structural downwraping. The coastal and off-shore land area of Bangladesh is dominated by medium highland, which is over 1.156 million hectares, followed

FIGURE: 3.1 THE STUDY AREA IN THE REGIONAL SETTING OF COX'S BAZAR THANA.





Į	THANA BOUNDARY	STEAMER/LAUNCE GNAT/JETTY	SAND BAN	Ķ	
	YRADYWOO KOLYU	STUDY AREA			
	NATIGNAL/REGIONAL SIGNWAY 💻	DISTRICT HEADQUARTER 🗊	<u> </u>		
	RURAL ROAD	TIIANA HEADDUARTER	₩.	=	FWD/1DA
	BRIDGE/CULVERT/SLUICE ▶	URTON HEADQUARTEX	in.	2	BORCS
	ENBARMENT TYSHMARMS	EXISTING CYCLONE SHELTER	_C*	=	NG05
	RIVER AMD LORGE CANAL	SMELTER UNDER CONSTRUCTION	()F	•	FACILITIES

by highlands about 0.253 million hectares, 0.161 million hectares of medium lowland and only 5704 hectares lowland (BARC,1990). The geologically recent deposits of the char area consists of clay, silts and varying grades of sands. The deposits are alluvial rather than of marine origin. The available limited data on soil indicates that the sediments become progressively finer in a southerly direction until silts and clays are dominant in the southern part of the delta.

The study area of this research is situated in the Chittagong Coastal Plain. This unit comprises the generally narrow strip of land between the Chittagong Hills and the sea, together with the Halda, the Karnafuli, and the Sangu flood-plains and the offshore islands. The unit is known to be occupied by gently sloping piedment alluvial fans with mainly loamy soils. Tidal clay plains occupy most of the offshore island. This area is marked as grey piedment clay (see Fig. 3.2).

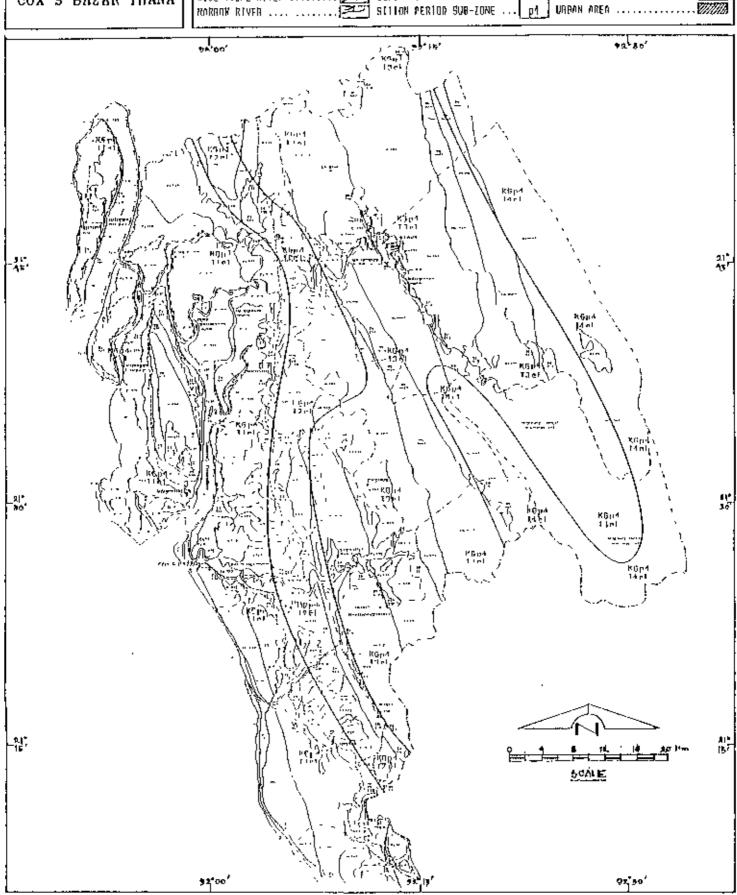
Khurushkul union of Cox's Bazar Sadar Thana has three types of land, these are, 264 hectares of highland, 148 hectares of medium highland-1 and 910 hectares of medium highland-2 (see Fig. 3.2). The parent material of all these type of land is Chittagong Coastal Floodplain Alluvium. The details of soil quality in this study area is given in Table 3.1.

Table : 3.1 Soil Type in Khurushkul Union.

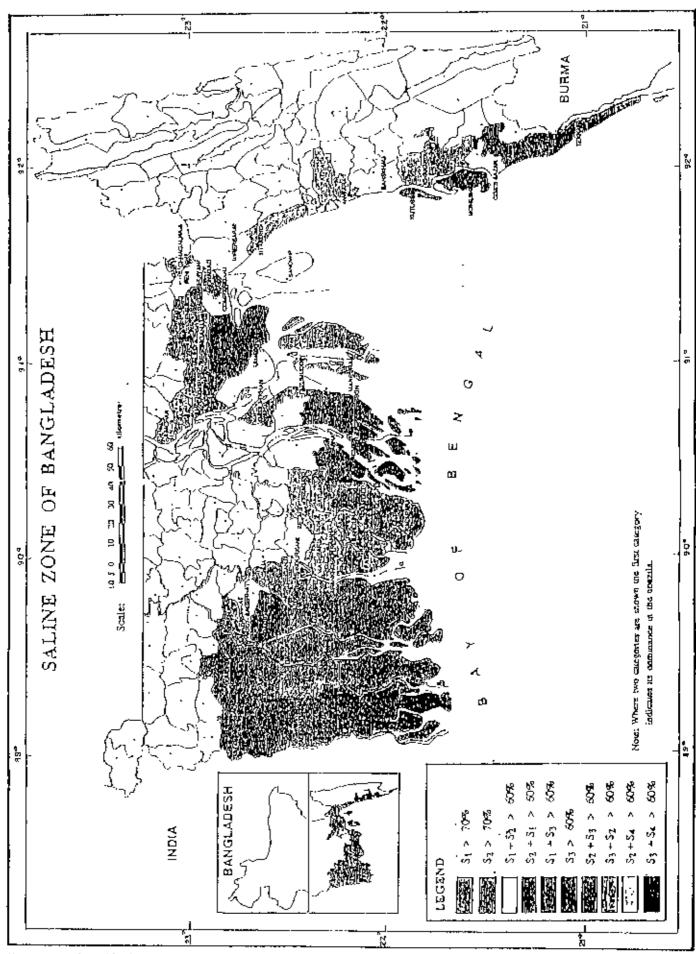
Soil Series	Land Type	General Soil Type	Extent(HA)
Harbang	Highland	Acid Sulphate Soil	264
Barabakia	Medium Highland-1	Noncalcareous Grey Floodplain Soil	145
Cheringa	Medium Highland-1	Acid Sulphate Soil	3
Badarkhali	Medium Highland-2	Acid Sulphate Soil	66
Barabakia	Medium Highland-2	Noncalcareous Grey Floodplain Soil	436
Cheringa	Medium Highland−2	Acid Sulphate Soil	11
Dhurung	Medium Highland-2	Acid Sulphate Soil	6 <b>6</b>
Kutubdia	Medium Highland-2	Acid Sulphate Soil	66
Nonachari	Medium Highland-2	Noncalcareous Grey Floodplain Soil	132
		Homestead & Water Total	133 1392

Source : Land Resources Inventory of Bangladesh by FAD/UNDP & GOB, 1985.

FIGURE: 3.2 LAND RESOURCES INVENTORY OF COX'S BAZAR THANA



Source : PAD, UNDP & GOB, 1985.



Source : Bangladesh Agricultural Research Council, 1990.

Soil salinity in this area is quite high. Mainly two categories of salinity  $(S_2 + S_4) + 60\%$  exist within the study area. Among them  $S_2$  is the dominant category followed by  $S_4$  category (BARC, 1990).

## 3.3 CLIMATE :

The study area is situated within the tropical zone and its location with a sea to the west and a range of hills to the east has neutralised the extremes of the climate to a considerable extent. The movement of the air from a comparatively cool region towards the more highly heated plains causes a uniformity of temperature more marked than in other parts of the country and another feature of these sea winds is the excess of moisture carried inland which gives rise, up to some distance from the coast, to heavy dews and occasional fogs. The position of this locality on the coast line of the north-east angle of the Bay of Bengal also helps to get the heavy rain as the moist winds of the south-west monsoon converge in this direction. This entire west coast region of the country is remarkable for its uniform temperature, high humidity and heavy rainfall from May to October. The climate of the study area is thus moist and warm.

As a rule January & February are cold and dry. March, April & May are hot, but have some wet days, and there are occasional storms from the north-west varied by breezes from the south and south-east. June, July & August are almost entirely wet, while September is wet and steamy with a hot sun. From June to September is the monsoon season. The monsoon season generally comes with a cyclone and ends with a cyclone. October has 7 or 8 wet days while November usually has 3/4 stormy days, but otherwise the weather is fine and dry and a northerly wind blows. December is cold and fine. The average maximum temperature is lowest in December and January, when it is about 26° C (78.8° F) and highest in April, when it is 31.56° C (88.8° F).

The humidity of the atmosphere is lowest in January and February, after which there is a steady and slow increase till May. In monsoon there is a large increase and humidity reaches its maximum in September, when there is 91% of saturation. During the whole monsoon it varies from 80% to 90%. Annual normal rainfall at Cox's Bazar thana is 3353.05 mm (132.01"). Honthly distribution of rainfall at Cox's Bazar is given in Table 3.2.

Table : 3.2 Monthly Distribution of Rainfall at Cox's Bazar Station.

Years Recorded Nov. to Feb. Mar. to Apr. May to Octo. Annual From 1920 123.19 mm 144.53 mm 3385.34 mm 3353.05 mm

Source : Chittagong District Gazetteers, 1971.

In October, the wind blows most frequently from the north, and during the next four months there is a steady, slow change of direction; the wind blowing from the west. In March, the wind is usually from the north during the night and from the south during the day, but as the month advances the southerly wind gradually increases until it prevails entirely. The cold weather winds being mostly land winds are comparatively dry, and the moisture in the atmosphere increases very little till the southerly winds set in. During the monsoon months, the wind blows from the southeast and the air steadily becomes more charged with moisture till September, which is the dampest month in the whole year.

#### 3.4 SETTLEMENT PATTERN :

The most common settlement pattern in Bangladesh is characterised by clustered homestead groups on raised land separated and interspaced by normal level agricultural land or by pond, river or low-lying land. But in the study area of this research a different type of settlement pattern is found, that is linear type of settlements where single or a group of homesteads are placed along the roads which are the major communication routes through the area and mostly all these routes are placed in north-south direction. These linear groups of homesteads are organised in the form of villages which are generally separated by wide stretch of agricultural land.

In the study area, human settlements in villages are concentrated in localities such as Pecharghona, Dailpara, Rastarpara, Fakirpara, Jaliapara, Uttar Hindupara etc. These villages are situated within 0.8 to 1.2 km far from one another in the study area. Within the study area the survey was basically conducted on seven villages and these are Uttar Namunpara, Fakirpara, Jaliapara, Rastarpara, Pecharghona, Rakhainpara and Kauarpara. All of them are located on the north-west corner of the study area, where land level is very low in relation to MSL and which is directly exposed to sea without any natural barrier like hills or rows of trees.

## 3.5 GENERAL LIFE STYLE OF THE PROPLE :

Life style of people of this study area is simple like other rural areas of Bangladesh but not very easy to maintain. A large portion of the inhabitants of this area live a very unsettled and hazardous life. The process of land erosion and cyclone and tidal surges pose constant danger to their lives and property. Yet, they do not consider these natural occurrences as threatening and accordingly they adapt themselves with the adverse environment. The social and economic realities of the majority of the coastal inhabitants forces them to accept and adapt this way of life and livelihood. A large number of people in this area depend for

their living on sea related professions like fishing, shrimp cultivation, fish business etc. A very small portion of people is engaged in cultivation as farmers and landless labourers. The nature of the occupation of majority people in this area requires them to be away from home for long periods of time, specially the fishermen have to go out to the deep seas for fishing. They operate in these situations in accordance with their beliefs and notions about the sea and the wind. For example many of the survivors of the April'81 disaster with whom the researcher has come in close contact during the field visit, said that the symptoms of the wind and the sea did not indicate a surge of this magnitude, and it was for this reason that they did not seek shelter in more safer places in the early hours immediately after receiving the danger signal.

The researcher found during the field visit that most of the settlements near the sea are more or less non-permanent in nature with few trees and scatteredly placed homesteads along the rural pathway. One of such village named Jaliapara which is located on the BWDB embankment is basically an unauthorised settlement. There, most of the inhabitants live temporarily for 6/7 from October to April/May and only the male members of the family there for that particular period of time for live fishing. The female and children of those families live in the in more safer settlements. Those settlements characterised by organised well-knit and integrated pattern of family life with a raised area of homestead where provisions are made for accommodation of cattle, poultry, space for food storage for the animals and family, vegetable garden, fruit bearing trees and occasionally a pond for meeting the water requirements of a number of families.

The local people of the area are basically very idle. As in the locality many easy earning occupations are available, so most of them are satisfied with small amount of income which can be earned very easily. While the people migrated here from the neighbouring districts like Noakhali, Barisal etc. are ambitious and hard-working. They are desperate for their daily earnings. Here women are more or less more conservative then the other parts of the country. So very few of them are found in the environment outside the homestead. They are also not engaged any type of home based income-generating activity. Also in of the schools of the locality, upper classes few female a students are found. Small children are not interested in school based education, because they can also earn taka 20/30 daily from fishing or collecting sea shells from the sea shore. Here also another peculiarity is found that is the negative attitude more investment on improving housing environment. So in the study permanent structures are very few in number. Like the general Bengali food habit, rice, fish and pulses are found to be the major diet of the people. People of the community usually wear lungi and shirt or punjabi in their daily life.

#### 3.6 POPULATION AND ATTRIBUTES:

Population data are recorded in the national Census reports by BBS, which indicate different population characteristics. These information on this particular study area were collected by the researcher from literature survey and then compared with the field survey data and finally analysed for different indicators. Village wise population data of Khurushkul Union according to the 1981 population census is shown in Table 3.3.

Table : 3.3 Village wise Population Data of Khurushkul Union.

Mauza Name	Village Name	House- hold		opulation		Lite	rate Pers	öhs
-104IC		HU10	Total	Male		Total	Nale	Female
Khurushkul		2,869	19,190	10,125	9,855	1,848	1,477	371
	Pecharghona	157	967	503	464	96	78	18
	Dailpara	142	983	461	142	60	49	11
	Rastarpara	132	879	489	390	79	62	17
	Monupara	234	1,647	854	793	210	166	44
	Fakirpara	132	893	457	436	72	60	12
	Palpara	203	1,201		611	163	114	47
	Xulalpara	374	2,867			234	184	50
	Hatkulapara	118	772	487	365	84	63	21
	Jaliapara	388	2,863	1,182	188	140	189	31
	Dakshin Hamunpara	489	3,154	1,675		202	171	31
	Uttar Mamumpara	137	1,031	582	449	162	129	33
	Charmanhat and		,				<b>4</b>	
	Ruhullardail	147	914	492	432	27	25	4
	Uttar Hindupara	265	1,681	855	825	291	244	47
	Panchayetpara	31	218	118	100	26	23	3
Tetaia		473	3,144	1,634	1,510	169	121	48
	Mayapara	170	1,170	416	556	73	55	18
	Drilpara	189	647	333	314	37	23	14
	Sikderpara	94	620	313		40	25	15
	Fazusikderpara	100	787	374		19	18	1
otal in Khur	reshkel Uaron	3,3 <b>4</b> 2	22,334	11,759	10.575	2,017	1,598	419

Source : Thana Series of BBS On Chittagong District, 1988.

It is found from Table 3.3 that within the Khurushkul Union, Khurushkul mauza is the largest and it has officially 15 villages, but during field survey, the researcher also found another two new villages within that mauza which are not present in the above table. The entire Khurushkul Union is not equally vulnerable to cyclone and storm surge. Tetaia mauza is almost risk free as it is located within the high land of Cox's Bazar hill range. Also within Khurushkul mauza all the villages are not

situated in high-risk zone, but some are located in such area where land level is almost equal or below the mean sea level. So the researcher gave more emphasis on those localities for collecting data during field survey. The results of that survey were tabulated and analysed in the following paragraphs.

#### 3.6.1 POPULATION DENSITY:

At the national level, population density of Bangladesh is 7.4/Hectare, but according to Table 3.4, in Khurushkul union it is slightly higher and specially Khurushkul mauza is more crowded due to its relatively close connection with Cox's Bazar Thana Sadar where major transport arteries and market centres exist.

Table: 3.4 Mauza wise Population Density within Khurushkul Union.

Hauza Name	Area in Hectare	Total Population	Density (Person/Hectare)
Khurushkul	1,715.6	19,190	11.19
Tetaia	823.2	3,144	5.04
Total	2,338.8	22,334	9.55

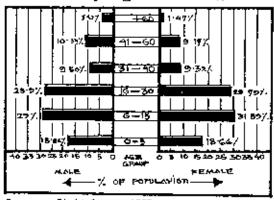
Source : Thana Series of BBS On Chittagong District, 1988.

Table 3.4 reveals that, during any type of mass evacuation in case of cyclone this high density of population will create tremendous problem.

### 3.6.2 POPULATION DISTRIBUTION BY AGE AND SRX

Among the total population of the study area, 54% are male & 46% are female & the Male: Female ratio is 1 : 0.87. Figure 3.4 reveals that 18.86% male & 18.66% female population are equal to or below 5 years of age; again 3.12% male and 1.47% female population are above 60 years of age. These child and aged persons are more vulnerable to cyclone and storm surge. Thus a significant portion of the population (21%) of the study area needs special attention for disaster mitigation program against surge and cyclone.

Figure: 3.4 Distribution of Household Members by Age and Sex.

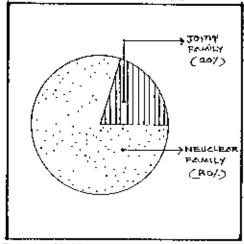


Source : Field Survey 1993.

## 3.6.3 FAMILY SIZE AND TYPE OF FAMILY :

Average family size within the study area is 5.98 persons. According to Table 3.3 the total number of households in study Union is 3,342. while the maximum number of households (489) are present in Dakshin Mamunpara of Khurushkul mauza & minimum number of households (31) are present in Panchayetpara of the same mauza. Figure 3.5 shows that within selected villages, majority of the families are neuclear in type. This contradicts to the long heritage of joint family in rural areas of this Asian region. At the same time this social factor also indicates like the urban areas typical social and family values are also changing in the rural regions.

Figure: 3.5 Distribution of Households by Family Type.



Source : field Survey 1793.

Table : 3.5 Distribution of Households by Income and Family Members.

Income Group	No. of Family Members					
(Taka)	1 - 4	5 - 7	8 - 10	10>	Total	
Upto 1999 1991 - 3999 3991 - 5999 5991 & above	10 (50%) 43 (32%) 6 (17%) 2 ( 6%)	8 (40%) 62 (47%) 8 (23%) 11 (34%)	2 (10%) 28 (21%) 21 (60%) 19 (60%)	0 (0%) 0 (0%) 0 (0%) 0 (0%)	20 (100%) 133 (100%) 35 (100%) 32 (100%)	
Total	61 (28%)	89 (40%)	70 (32%)	Ø (Ø%)	220 (100%)	
•		<b></b>	<b></b>	- <b>-</b>		

Source: Field Survey 1993.

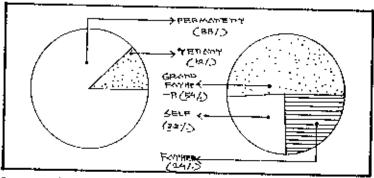
Table 3.5 shows that the maximum (60%) households of higher income group (Tk.3001 and above) have more family members (8-10). Its opposite explanation is that as those families have more members, so they have more earning persons and ultimately the earnings of those family members are contributing to increase the total household income.

## 3.6.4 RESIDENT STATUS & MIGRATORY BEHAVIOR :

According to Figure 3.6, a major portion (88%) of the inhabitants of the locality are permanent residents of the study area. This resident status for the people may be considered to

imply the less active and less mobile character of the villagers at large. But Diagram 3 4 reveals that only 54% of permanent families are living in this locality from their grand father's time & the rest 46% families are living here either from their father's period or they are the first generation family in this area.

Figure : 3.6 and 3.7. Distribution of Fumilies by Resident Status and Type of First Settler.



Source : Field Survey 1993.

For how long the first generation families have been living here, is also found from the field survey (see Table 3.6).

Table : 3.5 Distribution of Ist Generation Families.

	<b></b>	•
Category of Presence	No.of Households	Percentage
Less than 5 years	11	23
From 5 to 10 years	23	48
From 11 to 20 years	1Ø	21
Above 20 years	4	8
Total	48	100

Source : Field Survey 1993.

From Figures 3.6 & 3.7 and Table 3.6, it is clear that though in this area almost all (88%) families are now permanent, that means they posses less tendency to migrate to other localities, but about half (46%) of the permanent families are not living here for more than two generations, i.e. they are either second or first generation families. Again, 71% of the first generation families are living here for not more than 10 years. It means they are not the original inhabitants of this locality, they obviously migrated here from the nearby localities or districts or regions, most probably to avail the better economic opportunities of this area.

## 3.6.5 KARITAL STATUS :

From the field survey it was found that about 50% of the total population (both male and female) belong to 1-5 and 6-15 age group (see Diagram 3.1). As a result percentage of unmarr- ied people is quite higher than married people (see Table 3.7).

Table: 3.7
Population Distribution by Sex and Marital Status.

Sex	Married Unmarried		Total	
Male Female	275 (39%) 213 (35%)	43Ø (61%) 398 (65%)	705 (100%) 611 (100%)	
Total	488 (37%)	828 (63%)	1316 (192%)	

Source : Field Survey 1993.

Table 3.7 indicates the predominance of young population over the adult, thus affecting the dependency ratio and the size of working people participating in productive activities.

#### 3.6.6 RELIGION OF HOUSEHOLD MEMBERS :

In Khurushkul Union majority of the population is Muslim, but there are certain separate villages for people of other religion like Hindu and Buddhist, while Hindus are dominant.

Table : 3.8 Village-Wise Population Distribution by Religion.

Locality		Religio	n	
	Muslim	Hindu	Buddhist	Total
Pecharghona	967	 0	 g	967
Dailpara	893	Ø	Ø	893
Rastarpara	781	Ø	Ø	781
Monupara	1,619	Ø	28	1,647
Fakirpara	722	168	Ø	893
Palpara	252	<del>94</del> 7	Ø	1,199
Kulalpara	1,008	1,859	Ø	2,867
Hatkulapara	761	Ø	Ø	761
Jaliapera	1,678	22	342	2,042
Dakshin Hamunpara	2,285	832	Ø	3,117
Utter Mamunpara	945	Ø	Ø	945
Ruhullerdail	704	210	Ø	914
Uttar Hindupara	Ø	1,681	Ø	1,681
Panchayetpara	18	220	Ø	218
Nayapara	1,170	Ø	Ø	1,170
Drilpara	647	Ø	Ø	647
Sikderpara	620	Ø	Ø	629
Fazusikderpara	707	Ø	0	707
Total	15,777 (71%)	5,919 (27%)	370 (2%)	22,066 (100%)

Source : Thana Series of BBS On Chittagong District, 1988.

But within the selected study villages, the researcher found only one Buddhist settlement and the rest were Muslim settlements. Hindu settlements are not found in that particular area of the study union. The summary of the findings is given in Table 3.9

Table: 3.9
Distribution of Households by their Religion.

Religion	No.of Households		Fercentage
Muslim Buddhist	2 <b>15</b> 5		98 2
Total	220	•	100

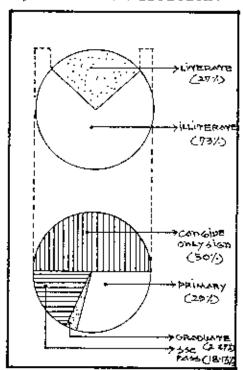
Source : Field Survey 1993.

It can be seen from Table 3.9 that within the villages of the study area, majority (98%) of the households are muslim and this type of common religion status of the residents is obviously a helpful factor of peaceful living environment in the community.

#### 3.6.7 LEVEL OF EDUCATION:

Figure 3.8 reveals that among the total surveyed population 27% are literate and rest 73% are illiterate. Within the literate population 50% can only sign, 29% read upto primary level, only 2.87% obtained graduation & the rest have education upto S.S.C & H.S.C.level.Illiterate people are normally less convinceable & are more vulnerable to natural calamities in case of taking decisions during emergency situation. Under this circumstance it can be said that without improving the literacy level of majority population, it would be difficult to motivate the inhabitants of locality to participate in disaster management process in order to reduce vulnerability of cyclone and storm surge. Under the existing socioeconomic context female portion of the society are more vulnerable to any type of natural disaster. So this female class of the society should be self-reliant and to become self-reliant education plays a vital role. Therefore, level of education for female is very crucial.

Figure: 3.8
Population Distribution
by Level of Education.



Source : Field Survey 1993.

But a very painful scenario of literacy rate is found when sex wise educational status is analysed (see Table 3.10).

Table: 3.10 Level of Education According to Sex.

Sex		Illit.	Only Lit.	Prim.	Sec.	High.Sec.	Hns.	Hest.	Total
Male	Case %	466 68	<b>1</b> Ø6 15	66 9.:	<b>34</b> 3 5	23 3.29	8 1. <b>1</b> 3	2 .28	725 122
Female	Case %	495 81	71 11.70	37 6	8 1.3	Ø Ø Ø	Ø	Ø Ø	611 100
Total	Case X	961 73	177 13.5	1Ø3 8	42 3	23 1.75	8 .602		1316 1 <b>20</b>

Note: Only literate means capable of giving only the sign and nothing more.

Source : Field Survey 1993.

Table 3.10 reveals that as social status of male members of the families are high in the society, so its reflection is also present in the education sector. Here also women are deprived, as a result 81% female are illiterate, while 66% male are illiterate. Again 4.7% male obtained education beyond secondary level, but none of the female was found to possess that level.

#### 3.6.8 LAND OWNERSHIP :

In the study area population density is high (see Table 3.4) and quantity of land is not large, so scarcity of agricultural land is very much obvious. But analysis of data shows that the percentage of land ownership and income group are positively associated, which indicates that income is based on agriculture.

Table : 3.11 Distribution of Respondents by Quantity of Agricultural Land.

Quantity of Agricultural	Number of	Percentage
Land (Rectare)	Respondents	(%)
Upto 0.20	23	26
0.21 - 1.00	47	54
1.01 - 2.00	11	13
2.01 - 4.00	5	6
4.01 & above	1	1
Total	87	1213

Source : Field Survey 1993.

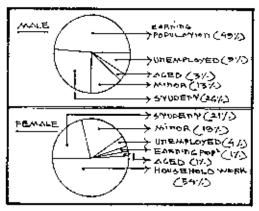
From Table 3.11 which presents landownership data, it is clear that, among the 25% households of lowest income group who have agricultural land, 80% of them are marginal farmers and all the large farmers belong to households of high income group. Which also indicates the unequal distribution of wealth among the different classes of the society.

#### 3.6.9 OCCUPATION AND INCOME :

In the study area 27% of the entire population have access to earning, that means they have some type of money earning occupation and it is their main source of income. At the same time 5% of the total population have secondary occupation and in this case the most important characteristic is that all of them are engaged in such primary occupation which continue only for a particular period of the year. For the rest of the period of year they entirely depend upon their secondary source of income to maintain their daily life.

In case of type of the main occupation not too many varieties are found. But when the inhabitants are distributed by occupation according to their sex then a variation is seen between the occupations of the opposite sex. Figure 3.9 reveaals that 1% female is employed, 54% of them are working as only house wife, who have no personal income. Social and economic backwardness the community is the ultimate consequence of this phenomena. Among both the male and female employed persons, a variety of occupations are present and these are described in Table 3.12.

Figure : 3.9 Occupation of Households According to their Sex.



Source : Field Survey 1993.

Table: 3.12 Distribution of Employed Persons by Sex and Occupation.

Sex				Q c	cupation			
	Own agri.	Rired agri.	Day labour	Service	Bueruese	Sishing	Others	Total
Male Female	35 (10%) 9 (8%)	19 (6%) 8 (8%)	34 (9,91%) 1 (14%)	41 (12%) 0 (0%)		116 (34%) 8 (6%)		343 (106%) 7 (108%)
Total	35 (10%)	19 (5%)	35 ({BX}	41 (12%)	98 (28%)	TIP (22%)	6 (2%)	358 (1682)

Source : Field Survey 1993,

From Table 3.12 it is clear that although there are enough agricultural land in the locality, farming as an occupation is not at all popular. As it is a coastal region, so fishing and fishing related business are more profitable and hence popular. Agriculture is considered as a secondary source of income. But majority of the occupations are vulnerable to cyclone and storm surge during pre-and post-monsoon period of every year.

But from monetary point of view all the households of different income groups are not equally vulnerable to cyclone and surge, because the same amount of loss of income caused by cyclone and surge has different impact on households of different income groups. Therefore, income of local people is an important factor to identify their actual vulnerability to natural disaster such as cyclone & storm surge.

Table : 3.13 Distribution of Households by Income.

Monthly Income Range (Taka)	Number of Respondents	
Upto 1000	71	
1221 - 3329	235	67
3991 - 4999	17	5
4001 - 5000	8	2.53
5 <b>0</b> 01 - 8000	11	3.01
8001 -1 <i>0</i> 200	3	.91
19231 -15230	4	1.18
15001 & above	1	.37
Total	351	190.00

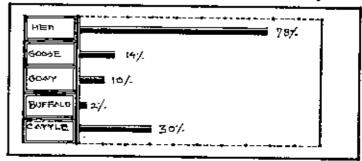
Source : Field Survey 1993.

The total monthly income of the households from study villages is shown in Table 3.13. It appears from this table that majority (87%) of the people belong to either lower or lower-middle income group. While these people need special attention in any kind of disaster, there are also a very few persons (5.47%) of higher income group, who are mostly self-reliant.

## 3.7 ASSESSMENT OF LIVESTOCK :

The possession of livestock & other belonging of the people of the study area is important for determining the nature and dimension of evacuation requirements during cyclone and storm surge. Figure 3.10 shows, that 19% households have no livestock/poultry and cattle & hen are possessed by maximum number of households.

Figure: 3.10
Distribution of Households by the Possession of Livestock & Poultry.



Source : Field Survey 1993.

Out of the total number of livestock & poultry (2362) in the selected villages, 8% are cattle and 82% are hen. Other types of livestock and poultry are very few in number (see Table 3.14).

Table: 3.14 Distribution of Livestock by Type.

Туре	Nos.of Livestock	Nos./Household
Cattle	182	Ø.83
Buffalo	21	Ø. 1Ø
Goat	53	0.24
Sheep	4	Ø.Ø2
Goose	171	Ø.78
Hen	1931	8.78
Total	2362	10.74

Source : Field Survey 1993.

It was gathered that except only one household all other households maintain livestock and poultry solely for domestic consumption and use. This indicates that proper motivation and training of the local people for commercial livestock rearing and poultry raising could benefit the community people financially.

## 3.8 SOCIO-ECONOMIC STATUS OF THE HOUSEHOLDS:

In the study area the surveyed households can be divided into different classes on the basis of their socio-economic status and the need for community development and disaster management effort. In this regard, assessment of different means used by the families to maintain their every day life will help to identify their status. Within the study area the entire households (220) use either wood or dry leaf as fuel. But in case of source of light, slight variation is found (see Table 3.15).

Table: 3.15
Distribution of Households by Income and Sources of Lighting.

Income Group	Hurricane	Kupi	Electricity	Total	
Upto 1000 1001-3000 3001-5000 5001 & above	Ø (Ø%) 8 (6%) 1Ø (29%) 5 (47%)	20 (100%) 125 (94%) 23 (66%) 14 (44%)	Ø (Ø%) Ø (Ø%) 2 (5%) 3 (9%)	22 (100%) 133 (102%) 35 (120%) 32 (100%)	
Total	23 (10%)	182 (83%)	5 (2%)	220 (100%)	

Source : Field Survey 1993.

Engaged in activ

Both electricity and hurricane as a source of light are costly and considered as a status symbol in the rural areas because majority of the households (56%) of higher income group use either hurricane or electricity as the source of light, while among the households of lower income groups, their use is almost absent. But in general majority (83%) of the households use kupi as their source of light.

#### 3.9 MAJOR ECONOMIC ACTIVITIES :

In the study area, the major economic activity is related with fishing and fishing related business. The majority (81%) of male labour force are involved in these activities (see Table 3.12). Agriculture is the second major activity in terms of both economic return and number of persons involved. Except these three activities, there are some establishments which provide economic activities in the study area.

Table: 3.16 Permanent Establishments and Persons Engaged in Economic Activities.

Activity and		Locality							
Data Item		Khurushkul Mauz	a Tetaia Mauza	Total					
All Sectors	Establishments	28Ø	22	301					
	Persons Engaged	583	34	617					
	Establishments	12	Ø	12					
turing	Persons Engaged		Ø	29					
-	Establishments	174	8	182					
	Persons Engaged		15	4/25					
_ • •	Establishments	84	14	108					
Personal services	Persons Engaged		19	183					

Source : Bangladesh Census of Non-Farm Economic Activities by BBS, 1986.

In the Khurushkul Union, the total number of active labour force is 14,081 (BBS,1981), but from the Table 3.16 it is found that among that number of active labour force is only 617 persons (4%) who are engaged in manufacturing, wholesale/retail trade, hotels and in community, social & personal services. It means that these sectors are performing very small role in the major economic activities of the study area.

#### 3.10 VEGETATION OF THE STUDY AREA:

Feasibility and Design Study of Cyclone Protection Project II-(FAP 7), observed that afforestation in the coastal area can play a very important role for improving the protection measures against cyclone and storm surge. But wrong type of tree for afforestation will not be effective against cyclone and surge. So an assessment of quality of vegetation will help in this regard.

Due to high rainfall and proximity to Bay of Bengal, this region has rich vegetation. The vegetation of the high forest areas can be described as a subtropical or tropical deciduous type or semievergreen type. On the other hand, different types of plants are found on the low-lying or marshy areas. Vegetation similar to Sundarban are found along the coast of this area which is now totally cleared for shrimp cultivation. From the household survey within the study area, the most common type of plants and trees which are present within and around the homestead land are identified and a list of that findings is given in Table: 3.17. From this table it is found that, among the fruit trees mango is most common along with banana. As big tree coconut and betel-nut are abundant within the study area, which are effectively resistant to wind of high velocity & at the same time coconut is an unique source of fresh drinking water during the periods of cyclone specially when all the normal source of drinking water are polluted. During field visit within the study area, many people of the locality reported to the researcher that many of them survived during the disaster of cyclone April, 1991 by climbing at the top of either coconut or betel-nut trees and coconut also provided them fresh drinking water. Other than these trees, bamboo is another common plant of the area, from which monetary return is possible.Krishnachura2 is also huge in number and during spring it makes the landscape of the area very bright & pleasant.

Table: 3.17
Type of Trees in & Around the Homestead Land.

Name of Tree	Number	(%)
Mango	115	4.00
Jackfruit	37	1.00
Jem	Ø	0.67
Ata	5	Ø.17
Boroi	15	0.50
Guava	15	0.50
Safeda	1	0.03
Lemon	7	0.23
Banena	77	3.00
Amlaki	2 1 2 1	0.07
Jalpai	1	Ø.Ø3
Amra	2	0.07
Date palm		0.03
Coconut	517	17.00
Betelnut	1413	47.73
Krishnachura	58	2.60
Koroi	5	Ø.17
Sisoo	15	0.50
Shunduri	2	0.07
Mahogony	1	0.03
Gamari	7	Ø.23
Shegun	4	Ø.13
Eucalyptus	7	Ø,23
Nim	1	Ø.Ø3
Tula	34	1.00
Bamboo	538	18.00
Chi <b>ba</b>	1	$\emptyset.\emptyset3$
Bhadi	4	Ø.13
Benn	29	Ø.97
Mender	16	0.54
Tetai	2	Ø.07
Tolabach	5	Ø.17
Bhalua 	2	0.07
Total	2988	120,20

Source : Field Survey 1993.

#### 3.11 NATURE OF LOCAL MARKETS :

There are two permanent markets in the study area, where daily necessities like, fish, meat, vegetable, stationary goods etc. are available. But these markets are not performing as the major marketing and trading centre of different locally produced products like pan (betel-leaf), pottery and sea fish. Those products are taken directly to the nearby wholesale marketing centre of Cox's Bazar district headquarters. Within these two markets there are some permanent structures which are used as shops. These two markets are managed by sadar thana parishad of Cox's Bazar and revenue from these markets are also collected by that thana parishad. Other than these two markets, there are certain isolated grocery shops, which are located scatterdly within the entire study area to meet the daily necessity of the inhabitants.

#### 3.12 LAND USK PATTERN:

The present pattern of land utilization in the area is the product of its physical condition and land use norm that has been developed by the local people. A general survey of the land use pattern reveals that two major types of use such as, homestead land and farm land are the dominant land use of the area. At present Cox's Bazar district has 87300 hectare of forest land which is about 38 percent of total area of the district. Farm land is basically used for cultivation of rice and pan, a large portion of this farm land is also used for shrimp cultivation and salt production (Biswas, 1992). Most of these land are private property. But the land on the hill range of western side of the area, belongs to government forest department and it is known as khas land. Systematic and planned development of forest possible in this land, but still it is unused and there is no initiative from the concerned authority about it.

#### 3.13 AGRICULTURAL PRACTICES :

According to the 1983-84 Agricultural Census, the total cultivated land in the study area was 2417 acres, that means 41% area of the locality. Influence of salinity and availability of irrigation water at deep ground water level has highly influenced the cropping pattern and agricultural practice of the study area. At the same time like other parts of the country, the entire labour force is not engaged in agriculture sector and involvement of relatively a small number of people in this sector has also a great influence on agricultural practice. Cropping season is broadly divided into Robi and Kharif, December to April is Robi and May to November is Kharif season. The cultivable area under different crops are described in the following table.

Table : 3.18 Area in Hectare Under Different Crops Within Study Area,

Туре	Locality						
of Crop	Khuruskkul Kauza	Tetaia Kauza	Total				
Net temporary crops	1551	614	866.77				
Gross cropped	1722	1332	1221.60				
Aus paddy	393	463	342.00				
Aman paddy	96Ø	348	523.20				
Boro paddy	117	493	244.00				
HYY paddy	112	598	284.00				
Wheat	1	1	.82				
Pulses	7	1	3.20				
Sugar cane	1	Ø	.40				
Vegetables	142	6	59.22				
Spices	65	18	33.60				

Source : The Bangladesh Census of Agriculture and Livestock by 800, 1903-84, p.113.

Table 3.18 reveals that aman paddy is the most common crop in the locality. Rice is cultivated in most of the land in Kharif season. Two varieties of rice, Amon and Aus are grown in Kharif season depending on natural rainfall. In Robi season, some Boro rice are grown depending upon tubewell irrigation or water from hill stream. Except rice, pulses, oil seeds, chilies, water melon, potato and other kinds of vegetables are grown in this area. In addition to these, Pan (belet-leaf) is another important agricultural crop of this area, which is also a major source of income for this area. Pan is grown mainly on foots of the hills.

The source of draft power for agriculture is cattle and buffalo. Deep tubewell and water from hill stream are the source of irrigation for dry season in winter. While during Kharif season natural rainfall is enough for cultivation.

#### 3.14 NATURE OF HOUSING STOCK :

Data from the field survey show that a great majority of housing stock of the study area consist of temporary buildings or structures with weak foundations. All the structures are single storied. Materials used in construction of those structures are of less durable nature. The traditional materials like rope, wire, nail etc are used for fixing the roof with wall and columns. The applied techniques and details for this purpose are not storm resistant. Table 3.19 shows the types of materials used for the construction of different components of the available housing stock of the locality.

Table: 3.19 Distribution of Homesteads by Construction Materials.

Component		(	Constru	uction	n Mater	ials (	Jsed in	% of Ho	omestead	ls
of House Structure	Wood	Clay	Brick	C.C	R.C.C	Stone	C.G.I. Sheet	Bamboo	Thatch	Other
Floor Wall Roof Column Door/Window	4 2.5 Ø 21 65	92 15 Ø Ø	2 3 Ø 4.5	1 Ø Ø Ø	Ø Ø .4 1.5		Ø Ø 42 Ø Ø	Ø 78 1.82 73 31	Ø 1.5 55 Ø 2	Ø Ø .73 Ø 2

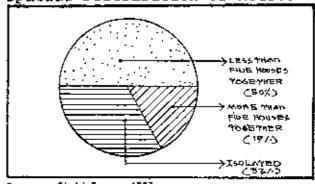
Source : Field Survey 1993.

Table 3.19 reveals that in most of the homesteads, floor is constructed by clay, wall by bamboo, roof by either thatch or C.G.I.sheet, column by bamboo and door/window by either wood or bamboo. There-fore, during the cyclone, sudden on rush of sea water with high velocity wind quickly and very easily destroy and wash away such houses creating dangerous situation for people.

Destruction of the housing stock immediately render the affected people homeless requiring provision for shelter. Figure 3.11 reveals that 83% houses are located either alone or in a small group of less than 5 houses. It means spatial distribution of the houses within study villages is more or less scattered, which will create serious problems in cyclone disaster management.

The plinth level (PL) of the houses in relation to the surrounding land level is another important aspect of the homesteads to assess the degree of vulnerability of these structures against storm surge. Table: 3.20 gives a picture of this aspect. The table shows that 89% houses are vulnerable to even annual local level flood during monsoon. Again any type of community based physical improvement in

Figure: 3.11 Spatial Distribution of Houses.



Source : Field Survey 1993.

Table : 3.20 Distribution of Houses by PL.

		·	
Range of	PL	No.of Houses	*
< .3248 < .6296 < .9144 <1.5240 >1.5240	m m	79 116 16 5 4	36 53 7 2.18 1.82
Total		220	123.23

Source : Field Survey 1993.

housing sector for disaster management against cyclone and storm surge require assessment of quality of housing stock in terms of available services and utilities within them. Table 3.21 reveals that assessment.

Table: 3.21
Distribution of Houses by Available Services & Utilities.

Pre	sent	Not I	Present	То	tal
22Ø	(120%)	0	(Ø%)	220	(100%)
195	(89%)	25	(11%)	220	(199%)
195	(89%)	25	(11%)	227	(120%)
6	(3%)	214	(97%)	220	(100X)
13	(6%)	207	(94%)	220	(1 <b>20</b> %)
1Ø1	(46%)	119	(54%)	220	(100%)
			-		
178	(81%)	42	(19%)	220	(120%)
	22Ø 195 195 6 13	195 (89%) 6 (3%) 13 (6%)	22Ø (1ØØ%) Ø 195 (89%) 25 195 (89%) 25 6 (3%) 214 13 (6%) 2Ø7 1Ø1 (46%) 119	22Ø (1ØØ%) Ø (Ø%) 195 (89%) 25 (11%) 195 (89%) 25 (11%) 6 (3%) 214 (97%) 13 (6%) 227 (94%) 1Ø1 (46%) 119 (54%)	22Ø (1ØØ%)     Ø (Ø%)     22Ø       195 (89%)     25 (11%)     22Ø       195 (89%)     25 (11%)     22Ø       6 (3%)     214 (97%)     22Ø       13 (6%)     2Ø7 (94%)     22Ø       1Ø1 (46%)     119 (54%)     22Ø

Source : Field Survey 1993.

From the above table it is clear that like the quality of houses in terms of services and utilities is not also up to the standard, which require improvement.

#### 3.15 WATER BODIES AND THEIR USE :

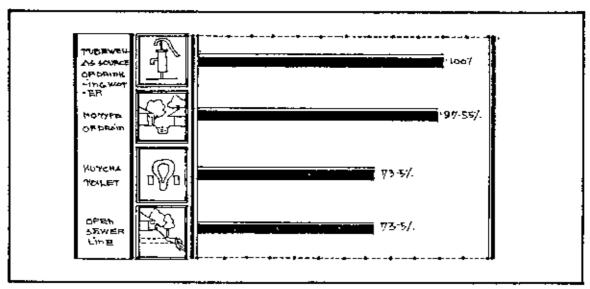
There are two huge ponds of more than 100 decimals within the selected villages of the study area. There is another pond of medium category with a total area of 40 decimals. Other than these small water bodies such as ditches which almost dry up during winter are present in the area. The use of all these water bodies is largely restricted to bathing and washing purposes. Fish culture is another casual use, but organised fish production effort was not seen among them, Again 12% of small water bodies are not being used at all.

#### 3.18 DRINKING WATER AND SANITATION CONDITION:

It was observed during the field survey that all the people (100%) in the community derive their drinking water from the them. In case of latrine, most of the households (73%) use kutcha latrine. Figure 3.12 reveals that presence of any type of surface drainage system among the surveyed homesteads is almost nil. In case of sewerage system, it is also found that use of hygienic concealed pit system is very little. Most of the households (73%) use open drain or big hole or open ditch as the fixed dumping ground of the solid waste. Again many homesteads in the area were found with no type of permanent waste disposal system (see Figure 3.12). Therefore, giving education on

personal health care and hygiene for both normal and disaster period can be an important component of the community development program for this locality.

Figure: 3.12
Type of Utilities Used by the Households.



Source : Field Survey 1993.

#### 3.17 SUMMARY :

The socio-economic profile of the study area provides a comprehensive description on different aspects of site condition. Assessment of the existing situation of the area and the community will be helpful to forecast the needs and priorities of cyclone disaster management and community development process within the study area. The major findings are:

- The area is highly vulnerable to cyclone & storm surge. Settlements are linear. General life style of the people is very simple. Here population density is quite high. Almost 25% of the total population of the area are either children or aged and they are found to be more vulnerable to cyclone and storm surge.
- -- Houses are built on raised grounds but in most of the cases plinth heights are not enough to resist possible surge water which may penetrate into the homesteads.
- -- Here 99% female have no access to earning, as a result they are deprived in all sectors of life and without improving their condition community development will not be possible.

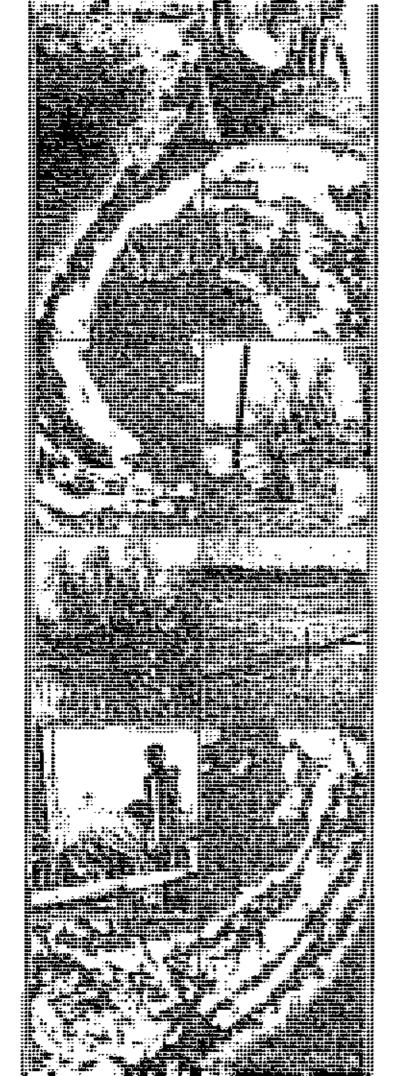
- The two local markets are not providing the marketing facilities of the locally produced goods. The existing situation of economic activities indicate prospects for development in multi-sectoral employment opportunities.
- -- Most of the people being illiterate are normally less convinceable, and are less active to community participation for the cyclone disaster management. So without improving their literacy level it would be difficult to motivate them to participate in disaster management and community development activities.
- -- Assessment of livestock indicates that the protection of livestock and other domestic animals is an important component of cyclone disaster management. Presently khas land on the hill range of the locality is left as unused, where planned afforestation is possible.

#### Notes :

Hurricane is a kind of lamp, where flame is covered by a glass dome.

<sup>&</sup>lt;sup>2</sup> Krishna-Chura is known as 'Poinciana'in botanical term.

PL determines the height of floor level of the homestead in relation to surrounding ground level.



CHAPTER: 4 CYCLONE AND STORM SURGE VULNERABILITY OF THE AREA AND PEOPLE'S RESPONSES

#### 4.1 INTRODUCTION :

The study area is situated in the High Risk Area (HRA)¹ of the coastal region of Bangladesh, where cyclone and storm surge are very common natural disasters and this area becomes vulnerable to cyclone and surge every year. Recently this study area faced the effects of the cyclone of 1891 and 1992. So data on different aspects of those two incidents were collected from both primary and secondary sources and then the discussions following in the present chapter is devoted to analyzing the degree and nature of vulnerability of the area, and responses of people to withstand that vulnerability of cyclone and surge.

### 4.2 LAND LEVEL AND LEVEL OF STORM SURGE INUNDATION :

From the broad contour map of Bangladesh it is found that the general land level of Bangladesh is between 6 to 9 metres above MSL. The general slope of land is from north to south. But in the south eastern part of the country slope is different as it is a hilly area. The study union is located in this area at the eastern bank of Moheshkhali channel and this is basically a part of Chittagong Coastal plain, between the Chittagong Hills and the Bay of Bengal.

At the Eastern Border of the union where a part of Chittagong Hill range is located, land level is 7.5 m (24.75') above the Mean Sea Level (MSL). But the average land level of the study area is 4.5 m (14.85') above MSL. The nature of land terrain is sloping in east-west direction and at the sea side the land level is only Ø.45m (1.5') above MSL. From the reconnaiss-ance survey a schematic view of the area's nature of land terrain has been prepared and presented in Figure 4.1.

East-West Vertical Section Drawn through the Study Area.

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Figure: 4.1

Kast-West Vertical Section Drawn through the Study Area.

Source : Field Survey, 1993.

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Figure 4.1 has been drawn by taking the coastal embankment of the area as the reference point. Vertical dimension of the embankment and height of its peak from sea level at both high & low tide was measured. Then in relation to the embankment's height location of different points at different levels of the land side was determined. Finally, ground level at those locations were found from the Mean Sea Level and presented in the Diagram.

Figure 4.1 reveals that different settlements of the study union are located at different land levels. Near the embankment scattered homesteads within agricultural land, which are located at land level of only 0.45 m (1.5') above MSL are directly exposed to the threatening of storm surge. Then along both sides of DC road permanent settlements are found, where land level is 1.37 m (4.5') above MSL. Next row of settlements are located on more higher land level i.e. 3 m (10') above MSL. Gradually this level of land increases towards the eastern side of the union and at the extreme eastern edge G.L. becomes 7.5 m (24.75') above MSL.

Obviously, the area which is located on the land of higher level in relation to MSL, there surge water will not reach. That means, ground level of an area is very much important criteria to determine that area's degree of vulnerability to storm surge flooding. Therefore, on the basis of general land level of the study area which has been found from Figure 4.1, it can be predicted that the settlements in the study area within 0.4 Km (0.25 mile) from the sea i.e. Moheshkhali channel are highly vulnerable to storm surge flooding. This assumption can be proved from the level of storm surge inundation and maximum distance of surge line from coast within the study area during cyclone of April, 1991.

Secondary data on this distance and depth of surge water is found from literature survey. According to HCSP, during cyclone of April, 1991, surge water entered into Khurushkul union from Moheshkhali Channel and travelled upto 1.5 Km ( $\emptyset$ .94 mile) of landside. Approximate surge depth/distance were 2.4 m/ $\emptyset$ .3 Km & 1.5 m/1.0 Km i.e. within first  $\emptyset$ .3 Km ( $\emptyset$ .19 mile) level of storm surge inundation was 2.4 m (7.87°) then for rest 1 Km ( $\emptyset$ .83 mile) depth of surge water was 1.5 m(4.92°) above the ground level ( $\emptyset$ .).

This data on level of storm surge inundation in the study area gives an overall view of storm surge flooding in that locality. But to understand the nature of flooding and its depth in specific locations within the study area, this overall view is not enough. So, primary data on inundation level by storm surge of cyclone 1991 at different specific locations were collected through the field survey in the study area and this data also helped to verify the accuracy of available secondary data on this aspect. Analysis of that data are given in Table 4.1.

Table : 4.1 Distribution of Homesteads by Level of Inumdation & Village.

Level of	Vill≥ges Covered woder the survey							
Inundation Above 6.L.(m)	Rastarpara	Pecharghona	Kauarpara	Jaliapara	Rakhainpara	Fakirpara	U.M.Para	Total
8.46 to 8.61 (Upto plinth level)	25 (22%)	8 (15%)	15 (100%)	-	-	? (100%)	10(62%)	59 (27%)
1.22 to 1.52 (half of the ground floor height)	67 (61%)	36 (69%)	-	-	-	-	6(38%)	110 (50%)
1.83 to 2.13 (almost upto the roof of ground floor)	13 (12%)	5 (19%)	-	-	-	-	-	18 (8%)
2 2,44 (the entire ground floor height)	5 (5%)	2 (6%)	-	20 (100%)	5 (188%)	-	-	33 (15%)
Total	110 (106%)	52 (1 <b>00</b> %)	15 (100%)	20 (196%)	5 (100%)	2 (100X)	16(1007)	220(180%)

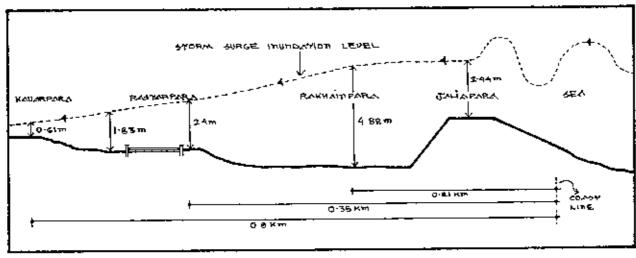
Source : Field Survey, 1993.

It can be seen from Table 4.1 that all the homesteads of different villages which were surveyed, were inundated by the surge water of April cyclone 1991, but level of inundation was different at different locations. Homesteads of Jaliapara and Rakhainpara were completely submerged by surge water. Jaliapara located above BWDB embankment at the coast line and according to local officials of BWDB during April cyclone of 1991 water completely washed away the embankment and water reached upto 2.44m (8') above this embankment. Rakhainpara is only 0.21 km (Ø.13 mile) away from the embankment, where surge water reached upto the roof of 1st floor i.e. 4.88 m (16') above G.L. and this level of inundation was marked by BWDB engineer on the wall of a three-storied structure. Then by entering at more interior of the land, level of surge water gradually decreased. homesteads of Rastarpara which is 0.35 km (0.22 miles) away from the coast line, were submerged upto 1.83 to 2.4 m (6' to 8') depth above G.L. Though Pecharghona is further away from the sea (0.61 km)(0.38 mile) than Rastarpara, but surge water not only entered here from the sea of western side but also from Joariakhal of north eastern side. So there 85% of total homesteads were flooded upto 1.83 to 2.4 m (6' to 8') above G.L. Uttar Mamunpara is located in more or less better position, 0.70 km ( $\emptyset$ .44 mile) away from the coast line where most of

homesteads (62%) were inundated upto 0.46 to 0.61 m (1.5° to 2°). Among the surveyed villages Kauarpara and Fakirpara are placed in relatively most safer locations. Kauarpara is 0.8 km (0.5 mile) and Fakirpara is 1.2 Km (0.75 mile) away from the coast line. Again ground level of these two villages in relation to MSL are relatively higher than other villages of the area. So though surge water entered into these localities, but all the homesteads (100%) were inundated upto only 0.46 to 0.61 m (1.5° to 2°) above G.L.

From the above analysis a complete picture of storm surge inundation level within the study area during cyclone of April, 1991, can be found and this picture is graphically presented in Figure 4.2.

Figure: 4.2 Storm Surge Inundation Level in the Study Area.



Source : Field Servey, 1993.

# 4.3 GEO-TECHNICAL & HYDRO-METEOROLOGICAL CONDITION OF THE STUDY AREA:

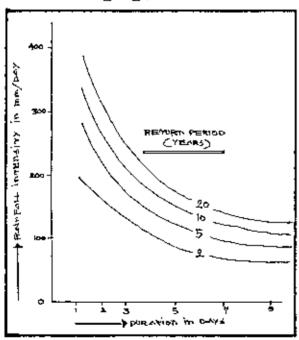
The study area is composed of grey piedmont soils. This soil is structured, grey sandy loams to clays and strongly acid. This type of soil is generally developed in piedmont outwash in the piedmont aprons and valleys in areas adjoining or within the north eastern hilly region. These soils are often affected by flash floods from the hills and liable to burial by fresh sandy deposits. Preliminary studies on soil quality of this coastal region have shown that poor foundation soil condition exists in many places and wide variation in soil condition may exist even within neighbouring localities. The soil in the study area appears to be highly compressible and soft. For foundation of any multi-storied structure, piling or other type of ground improvement may be required. Soil test result is available for

Magnama of Chakaria thana, but no boring has yet been done in khurushkul area. Therefore, it is necessary that no permanent construction should be undertaken in the study area without soil boring and testing, and without reviewing the foundation design.

number of hydro-meteorological data are necessary planning of cyclone shelter. Short duration and long duration are necessary to determine the type of drainage rainfall data facilities. Rainfall data during cyclone is required to verify the scope of reservoir for rainfall harvesting to be used as source of fresh drinking water during and after cyclone. Data on maximum wind speed in the study area will help to identify the type of structural system of shelter. Data on ground water level the study area is also required for determining a drinking water supply system which will extract ground water. At the same time extreme surface water level in the study area, amplitude of tidal wave along the coast of the study area, estimated design surge heights for different return periods at this coast line and relative sea level rise in this region in near future necessary to fix the floor height of a cyclone relation to the surrounding ground level.

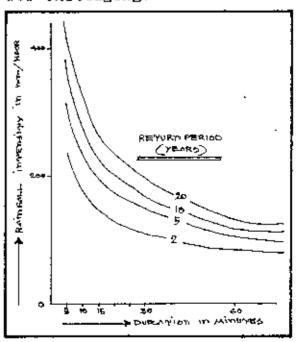
Intensity-Duration-Frequency (IDF) curves for the four key stations (Barisal, Hatiya, Sandwip & Chittagong) have been drawn by MCSP. In Figures 4.3 and 4.4 long and short duration IDF curves for Chittagong are shown.

Figure: 4.3 Long Duration I-D-F Curves for Chittagong.



Source : MESP, 1992.

Figure: 4.4 Short Duration I-D-F Curves for Chittagong.



Source : MCS2, 1992.

Figures 4.3 and 4.4 show that Chittagong region has the highest rainfall intensity for all durations and return periods among different coastal regions and this rainfall data is also applicable to Cox's Bazar district of south eastern region of the country. The total duration of rainfall (T in hr) and corresponding average rainfall intensity (I in mm/hr) during the cyclones at Chittagong station, along with the yearly maximum wind speeds measured by anemometer for Cox's Bazar station are given in Table 4.2.

Table: 4.2
Summary of Rainfall in Chittagong Station during Cyclones and Yearly Naximum Wind Speed Measured by Amemometer at Cox's Bazar Station.

Year	Rainfall at	Chittagong	Wind Speed at Cox's
of Cyclone	T (hr)	I (mm/hr)	(Km/hr)
1982	3	1.87	86
1983	18	2.Ø6	135
1984	, 33	3.26	61
1985	39	7.13	37
1986	3Ø	4.Ø3	117
1987	33	6.Ø3	37
1988	21	2.76	55
1889	N.A.	N.A.	N.A.
199Ø	24	1.42	N.A.
1991	N.A.	N.A.	N.A.

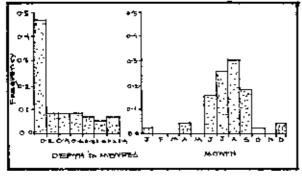
Source : Bangladesh Meteorological Department (BMD), 1991.

BMD anemometers can register a maximum of 100 knots (185.2 km/hr) wind speed. Since cyclonic wind speeds are much higher, therefore they are usually estimated from pressure difference. According to MCSP, on the basis of data of 1972-88 period, wind speed for 10, 20, 50 & 100 years of return period are respectively 135, 159, 190 & 214 km/hr for Cox's Bazar which are higher than any other station of the country.

Figures 4.5 and 4.6 show that, lowest water depth occurs in Chittagong coastal plain during April which is pre-monsoon cyclonic period, but then also water depth lies within 6 meter i.e. 20'. The desirable maximum lift for hand tubewells is 6-7m (20-22 ft) from ground surface. Therefore, operation of hand tubewells at ground surface will not be a problem during pre-

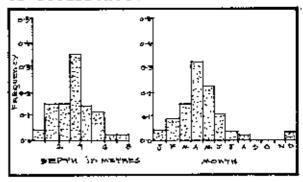
monsoon period, but if shelters are to be built on killas, then a deepset tubewell may be necessary. During post monsoon cyclonic period also ground water level remains much higher and therefore, hand tubewell operation during this period in the study area will not be a problem at all.

Figure: 4.5
Histogram of Highest Depth of
Ground Water Level and Time
of Occurrence.



Source : BW09, 1991.

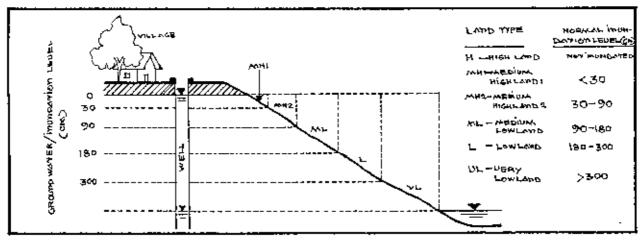
Figure: 4.6 Histogram of Lowest Depth of Ground Water Level and Time of Occurrence.



Source : BMDB, 1991.

Extreme surface water level within the study area during monsoon can be found from thana level data. According to MPO, extreme surface water level at Cox's Bazar area during monsoon for 20, 50 & 100 years return period are respectively 3.78, 3.84 & 3.88 meter above PWD datums i.e. MSL. (MPO, 1986). These surface water level for different return periods are relatively lower than other locations of high risk area, (see Figure 4.7) but these data do not include extreme water level due to cyclonic storm surge.

Figure: 4.7 Schematic Representation of Relationship Between Ground Water Level and Level of Inundation by Land Type.

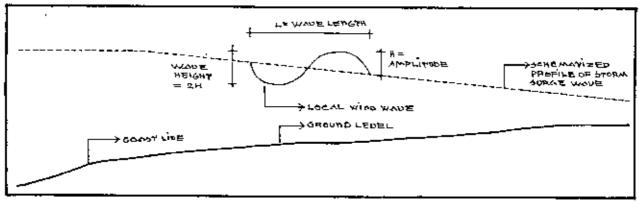


Source : Land Resources of Bangladesh, FAO, UNDP and BOB, 1985.

Tides<sup>2</sup> in the coastal waters οf Bangladesh are predominantly semi-diurnal. The principal semi-diurnal constituents are called Mz and Sz, relating to synodic tide of the moon and sun, respectively. Their amplitudes at the study area along the coast are  $M_2 = 1.08$  m and  $S_2 = 0.46$  m (MCSP,1992). The difference between high water and low water levels during a tide is called range of the tide. Along the coast of the study area, the mean range of spring tide is,  $2(H_2 + S_2) = 3.04 \text{ m}$ .

the basis οf storm surge heights during previous incidents of cyclones along different coastal regions of the country, MCSP prepared the design surge heights at the sea coast of different coastal regions of the country at 90% confidence limits. According to MCSP's prediction along the coast of Teknaf to Cox's Bazar, design surge heights at 90% confidence limits for 20, 50 & 100 years return periods are respectively 2.7 ± 0.7 m,  $3.7 \pm 0.8$  m and  $4.5 \pm 1.3$  m. Not only this surge height, but also the amplitude of local wind wave above the storm surge important to determine the height of storm surge inundation free platform. Now, there is no data on the height of local waves during inundation by storm surge wave. After discussion with local people MCSP's consultants found that the amplitude of local wave equals to 1/4 th of surge height but not less than 1 m. Again surge height decreases when surge water enters inner side of the land and the rate of decrease in surge height depends on the resistance as well as on the land slope. This rate is larger in the Chittagong-Cox's Bazar-Teknaf Coastal area compared to that in the remaining part of the whole coastal area. This is because the Chittagong Coastal plain has relatively steeper land slope compared to that of other coastal areas and according to MCSP for Chittagong-Cox's Bazar-Teknaf coastal region the rate of decrease is 1/2 m per km (see Figure 4.8).

Figure: 4.8
Profile of the Storm Surge Wave with Local Wind Wave.



Source : MCSP, 1992.

Numerous studies have concluded that the eustatic rise of sea-level will accelerate due to the increase in the earth's temperature as a result of the concentration of greenhouse gases. Scientists at the Woods Hole Oceanographic Institution of the USA made a long term projections of the relative rise of sea -level and its consequences for the Bengal Delta by the years 2050 and 2100, which are important to predict the storm surge effects in future within the study area. According to their predictions, the relative rise of sea level in the Bengal Delta will range from 0.8 to 1.5 m by the year 2050 and 3.4 to 4.6 m by the year 2100 (ESCAP, 1987). It means in near future vulnerability due to cyclone and storm surge within the study area will increase further (see Figure 4.9).

## 4.4 EXISTING PUBLIC AND PRIVATE BUILDINGS IN THE STUDY AREA:

From the field survey it was found that, there are 34 pucca buildings within the study area. Among them 12 are more than one storied and others are single storied (see Table 4.3).

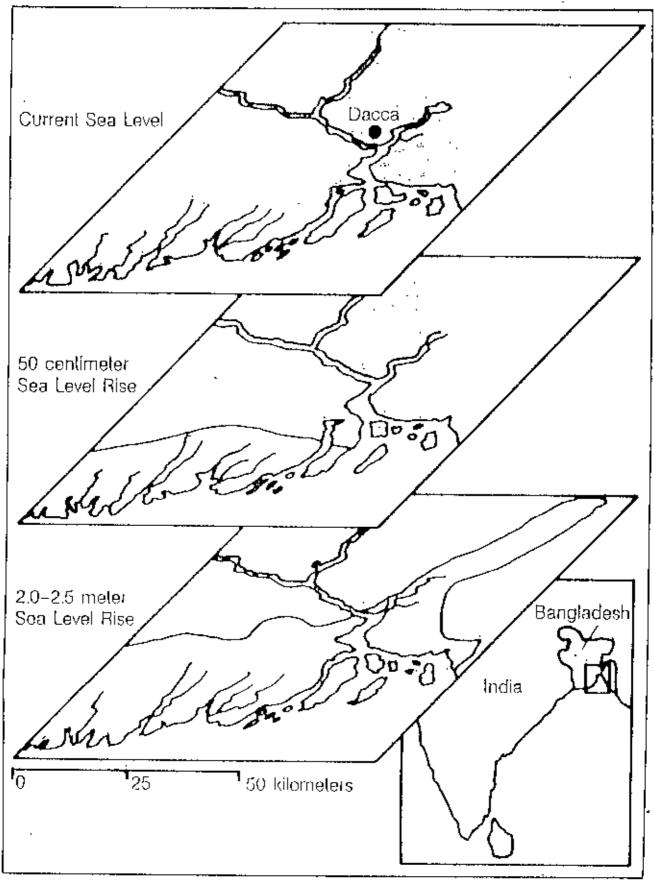
Table : 4.3 List of Multi-storied Pucca Buildings within Khurushkul Union.

Name of Building	Mauza	Normal Use	No. of Storey	Capacity as Shelter	Management
FWC	Kherushkul	Clinic	2	658	Public
Khurushkul High School	•	School	2	1600	Public
South Kharushkul P. School	•	Primary School	3	1588	Public
Middle Khurusbkul P. School	•	•	3	1500	•
East Khurushkul P. School	•	•	3	1500	•
North Khurushkul P. School			3	1588	•
Tetaia Primary School	Tetaia	•	3	1500	•
BDRCS Cyclone Shelter	Khurushkul	School	2	75 <b>e</b>	N60
Morld Vision Cyclone Shelter		Office	2	500	NGO
Kia∎	•	Religious functions	2	750	Community
Adudia Madrasha -		Madrasha	2	2886	Private
Aqua Fisheries Ltd.		Factory	2	758	Private

Source: Field Survey, 1993.

FIGURE : 4.9

COASTAL IMPACTS OF SEA LEVEL RISE IN BANGLADESH.



**Source:** United Nations Environment Programme (UNEP), *The Greenhouse Gases*, UNEP/Global Environment Monitoring System Environment Library No. 1 (UNEP, Nairobi, 1987), p. 31.

Strongly built multi-storied buildings can serve as cyclone shelter and can play an important role to reduce the vulnerability of the area due to cyclone and surge. Therefore, data on all types of pucca buildings will be helpful to assess the area's degree of vulnerability, number and size of shelters required for the area. Other than the multi-storied buildings, there are 22 single-storied pucca buildings in the area (see Table 4.4).

Table: 4.4
List of Single Storied Pucca Buildings in the Study Union.

PIRE OF SHIRTS SCOTTED				
Name of the Building	Henza	Use	Area (sft)	Ownership
Nur Md. Chowdhury's house	Khurushkul	Residence	3220	Private
Nagu Kiah's house	••	<b>#1</b>	8 <b>1</b> Ø	16
Hazi Abu Taher's house	1•		81Ø	
Amir Hamza's house	н	••	480	1•
Md. Bashir Ahmed's house		Dr.	135Ø	14
Dhirandra Pal's house	н	14	1500	
Abul Chahbir's house			122/3	n
Hazi Abdul Salam's Villa	••	•1	1200	1 e
Ranjit kumar Dhar's kutir			482	*1
Jaynal Brothers & Co.	••	Shep	48Ø	
Nezir Ahmed's shop	14	14	45Ø	••
Sultan Ahmed's building	••	Market	960	
Karim Dad's house	"	Shop	288	41
Subas Kumar Pal's house	•1	•1	800	he .
Nazmul Hoq's house		Residence	907	
Juhar Ahmed's house	••	14	1125	
U.P Bhaban	1•	Office	1522	Public
Bazlul Karim Market	•1	Market	1223	Private
Badsha Nia's house		Residence	922	**
Abul Kashem's house	Tetaia		753	
Abul Sattar's house			639	.,
Ferdous Ahmed's house	•1	H	770	11
Brothers Group	Khorushkol	11	480	•
Abul Bashar Bheban		Shop	35Ø	••
Momtaj Ahmed's house	P	Residence	832	**

Source: MCSP, Draft Final Report, Volume IV, p. D4-8-72, 1992.

Tables 4.3 and 4.4 show that only 2/3 storied buildings are capable to serve as cyclone shelter, while conversion of a single storey building into a multi-storied structure is not always possible due to various technical and social reasons. Among the permanent structures that exist in the union, FWC, high school building, Kiam and Hadrasha Building were used as shelter during April cyclone of 1991. Other buildings have been constructed recently and they are designed to serve as shelter during cyclone. Therefore, these structures will be able to provide shelter facility to 81% of the total population of the study area, which is relatively a good number in relation to the situation of other coastal regions of the country. But still 38% population of the study area have no place of evacuation in case of cyclonic disaster, so construction of new shelters will be helpful to reduce their vulnerability.

#### 4.5 SOCIAL AND PHYSICAL INFRASTRUCTURE OF THE STUDY AREA:

Among the social infrastructure, there are five primary schools, one high School<sup>4</sup>, two large madrashas, one family welfare centre in the study area. Cyclone shelter of BDRCS at Rastarpara is used as feeder School during normal time. Among different NGOs working here World Vision is operating from their permanent base station at Kauarpara and this station can also be used as cyclone shelter. Ganoshastha, Poush, CCDB and CARE are four other NGOs who are working here on social forestry, housing, road improvement and improvement of primary health care. FWC is the major health centre and there is another mini health centre which was established here by Kuwaiti aid immediately after the cyclone of 1991. UP building is the administrative centre of the area and it is located near middle Khurushkul market.

Table : 4.5 Distribution of Homesteads by their Distances from Community Service Facilities.

Distance		No. and X	No. and X of Homesteads from Community Facilities						
(K⊕1	Primary School	High School	FWC	UP Office	Cyclone Shelter	Bazaar			
Upto 0.2	88 (48X)	-	-	-	89 (48%)	-			
0.21-0.4	86 (397)	29 (13%)	25 (111)	-	77 (35%)	-			
0.41-W.B	-	84 (38%)	75 (34%)	9 (4%)	8 (41)	9 (4%)			
B.81-1.2	42 [19%)	-	-	-	-	-			
1.21-1.6	-	97 (44%)	109 (507)	94 (43%)	46 (212)	94 (43%)			
1.61-2.4	4 (2%)	•	-	-	-	-			
2.41-3.2	7	10 (5%)	11 (5%)	165 (48%)	-	185 (48%)			
3.21-4.8	-	-	-	12 (5%)	-	12 (51)			
Total	220 (188X)	220(100%)	220(100%)	220(180%)	220(188%)	228(198X)			

Source : Field Survey, 1993.

Table 4.5 reveals that a large portion of homesteads (79%) are located within 0.4 km distance from the primary school. High school's distance is relatively larger (1.21-1.6 km) for many households (44%) and the situation is same for FWC. UP office and bazaar are located at a distance of 2.4 km or higher from most of the homesteads. A cyclone shelter (BDRCS) is also located within less the 0.2 km distance from 40% homesteads. It means that community service facilities are located at a more or less reasonable distance from majority of the homesteads, but quality and quantity of those facilities in relation to the total household population are not upto the standard.

In case of physical infrastructure, roads, bridges and culverts are main components. Within the study area the major communication network is the road, but their quality are very poor. This road network is composed of three types of rural roads (see Table 4.6).

Table: 4.6 Classification of Roads in the Study Area.

Category of roads	Length (Km)		Pavement width (m)	Shoulder width	Definition
Rural Roads Type R1 (Thana Roads)	2	4.89	3.05	Ø.92	Road connecting union HQ and local markets with thana road system
Rural Roads, Type R2 (Union Roads)	4	3.66	No pavement	-	Road connecting villages with local markets and Union HQ
Rural Roads Type R3 (Village Roads)	_	2.44	No pavement	-	Roads within a village or between villages

Source : Field Survey, 1993.

The study union is not directly connected with the thana road network, as there is a river between Khurushkul union and Cox's Bazar thana HQ and there is no bridge over this river. People have to cross the river by boat. The ferry ghat at Khurushkul side is connected with Khurushkul UP office and south Khurushkul market by the rural road type R1, 1 km of this road from river bank is covered with brick soling. Then the rest of the portion of the road is earthen road. All other types of road in the study area are also earthen roads with many broken RCC culverts and, during monsoon these roads become muddy. Most of the homesteads of the study area are located far from the ferry

ghat. People generally travel from ferry ghat to market by hired tempo, scooter or jeep. There is a service of jeep from ferry ghat to Tetaia mauza during dry season. Within the union, people generally move by foot from one village to another village or to market. During dry season journey by foot takes 30 to 45 minutes to cross 1.6 km (1 mile), but during monsoon movement of automobiles becomes almost impossible through the muddy roads and travel by foot also becomes time consuming. Then to cross 1 km by foot 1 to 1.5 hours time is necessary. The study area is connected to Cox's Bazar by trawler, generally fish carrying trawlers travel between Cox's Bazar and the eastern bank of Moheshkhali channel at Khurushkul. But there is no fixed jetty as landing platform for water vessels on this bank of Moheshkhali channel, so communica-tion through waterway is not at all smooth, Electric line from Cox's Bazar sub-station goes through 2 km of Khurushkul union. So near the Bakkhali river 2/5 th of the study area is electrified, but the low lying villages of the area like Rastarpara is out of the area of this service line. Other than this electric line, there is no other service or utility line in the study area. CPP office of Khurushkul is connected to BDRCS's thana HQ office of Cox's Bazar by a VHF wireless set. So in case of cyclone quick information exchange between the study area and Cox's Bazar is possible, if CPP volunteers perform their duty sincerely. But overall condition of physical infrastructure within the study area is very poor and it increases the level of vulnerability of this area.

# 4.6 ASSESSMENT OF PROPLE'S RESPONSES TO CYCLONE AND STORM SURGE:

Information relating to what actually happened during the past cyclones, what types of disaster management operation worked, how the affected people reacted to the disaster, what was the inherent strength of the society to resist the natural disasters etc, are found to be important in cyclone vulnerability analysis. Therefore, the traditional means of responses of the study area's people to withstand the vulnerability of cyclone and storm surge are investigated here.

#### 4.6.1 SOURCES OF CYCLONE FORECASTING :

The cyclone forecasters of the Storm Warning Centre (SWC) of Bangladesh Meteorological Department (BMD) issue weather bulletins in connection with the depression, passages of storms etc. These bulletins usually reach to the people of coastal areas from different national and local level public and private sources (see Table 4.7).

Table: 4.7
Distribution of Respondents by Sources of Cyclone Forecasting.

Income Group (Taka)	up Cyclone		BDI	BDRCS		From other people		Self assess- ment		Not aware			
Upto	1991	-		3	(15%)	11	(55%)	6	(30%)	_			
1000	1992	_		1	(5%)		(50%)					_	
1001-	1991	_		71	(53%)	34	(25 <b>X</b> )	23	(18%)	1	(1%)	4	(3%)
3200	1992	-		59	(45%)	53	(39%)	20	(15%)	1	(1%)	-	
3321-	1991	_		22	(63%)	10	(29%)	3	(8%)	_		_	
5200	1992	-		19	(54%)	13	(38%)	3	(8%)	-		-	
5001 &	1991	1	(3%)	24	(75%)	7	(22%)	_		_		_	
above	1992	1	(3%)	22	(69%)	8	(25%)	1	(3%)	-		-	
Total	1991	1	(Ø.5%)	120	(55%)	62	(28%)	32	(15%)	1	(0.5%)	4	(1%)
	1992		(Ø.5%)									_	

Source : Field Survey, 1993.

Table 4.7 reveals that during cyclone of 1991 while 99% of the respondents became aware of the coming cyclone, 55% of the total respondents got the news from radio, 28% from volunteers of BDRCS and 15% received the news indirectly from other persons. Among the people of lower income group, while 85% respondents received the news either from BDRCS volunteers or from other people, only 15% people of that group got the news directly from radio. The situation was almost the same in 1992. That means access to radio is very much limited for the people of lower income group. Again while 28% of the total respondents received the news of coming cyclone from BDRCS volunteers in 1991, 38% got the news from the same source (BDRCS) in 1992. This indicates that after the disaster of April cyclone of 1991, in 1992 CPP volunteers of BDRCS were more active to inform people about the coming danger.

#### 4.6.2 NATURE OF DISASTER PREPAREDNESS:

Though majority of the respondents during both the cyclones of 1991 and 1992 knew that a massive cyclone was coming (see Table 4.7), but according to Table 4.8, their preparations to avoid the damages from the coming disaster were very much insignificant.

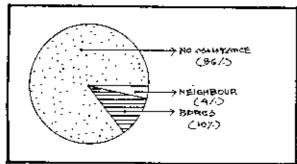
Table: 4.8
Distribution of Households by Nature of preparation Against Cyclone & Surge.

Income Group (Taka)	Year of Cyclone	No preparation		pro to	ntal eparation leave use	Preparing Survival items · like food		Transportation of Valuable goods		
Upto 1 <b>20</b> 3	1991	15	(75 <b>%</b> )	3	(15%)	1	(5%)	1	(5%)	
	1992		(40X)		(35%)		(20%)		(5%)	
1001-3000	1991	119	(89%)	13	(10%)	1	(1%)	_		
	1992	85	(64%)	35	(26%)		(10%)	_		
3001-5000	1991	23	(66%)	7	(20%)	5	(14%)	_		
	1992	18 (	(51%)	12	(34%)		(12%)	1	(3%)	
5001 &	1991	16	(50%)	7	(21%)	4	(13%)	5	(16%)	
above	1992	19 (	(59%)	5	(16%)		(6%)		(19%)	
Total	1991	173	(79%)	30	(13%)	11	(5%)	6	(3%)	
	1992	130 (	(59%)		(27%)		(10%)		(4%)	

Source : Field Survey, 1993.

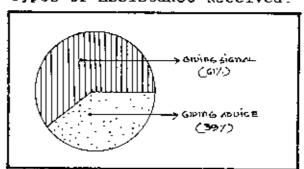
Table 4.8 shows that during the cyclone of 1991 people of lower income groups were more reluctant to take any preparation against coming disaster than people of higher income groups. Possibly this was because households of lower income groups had very little things to loose.

Figure : 4.10 Distribution of Households by Source of Assistance Received.



Source : Field Survey, 1993.

Figure: 4.11
Distribution of Households by
Types of Assistance Received.



Source: Field Servey, 1993.

Figure 4.10 reveals that 86% of the respondent households received no assistance from any source for taking preparations before cyclone attacked in 1991. Households who received

assistance informed that all the assistances came from CPP volunteers and neighbours, but households of higher income groups received more attention from the CPP volunteers. From Figure: 4.11 it is found that, among the types of assistances received by the households, signal and advice were the important types. For evacuation some households of higher income groups received assistance in the cyclone of 1992.

#### 4.6.3 NATURE OF EVACUATION:

According to CPP after receiving the danger signal no. 8, evacuation of people from high risk zone has to be started, but during the cyclone of 1991, picture was completely different. At that time even after the forecast of danger signal no. 10, evacuation process by different concerned agencies did not start. People of the study area were also more or less reductant to take any preparation against the coming danger, but when they saw sea water was coming with huge height then they vacated their houses as quickly as possible. Table 4.9 shows the nature of vacating by the households during both the cyclones of 1991 and 1992.

Table: 4.9
Distribution of Households by Nature of Vacating Houses.

Income Group (Taka)	Year of Cyclone	All members of Household	Only female and children	All members except 1/2	Nobody	Total		
Upto 1000	1991 1992	18 (90%) 20 (190%)	-	<u>-</u>	2 (10%) -	20 (190%) 20 (190%)		
1001-3000	1991	128 (96%)	-	-	5 (4%)	133 (1 <b>00%</b> )		
	1992	113 (85%)	6 (5%)	-	14 (10%)	133 (1 <b>00%</b> )		
3001-5000	1991	27 (77%)	1 (3%)	4 (11%)	3 (9%)	35 ( <b>192%</b> )		
	1992	19 (54%)	2 (6%)	6 (17%)	8 (23%)	35 (1 <b>20%</b> )		
5 <b>20</b> 1 & above	19 <b>9</b> 1	2Ø (62%)	2 (6%)	5 (16%)	5 (16%)	32 (1 <b>93%</b> )		
	1 <del>9</del> 92	18 (5Ø%)	8 (25%)	-	8 (25%)	32 (1 <b>93%</b> )		
Total	1991	193 (88%)	3 (1%)	9 (4%)	15 (7%)	220 (1 <b>00%</b> )		
	19 <b>9</b> 2	168 (76%)	16 (8%)	6 (2%)	30 (14%)	220 (1 <b>00%</b> )		

Source : Field Survey, 1993.

Table 4.9 shows that 88% of households vacated their houses during cyclone of 1991 and for 1992 this percentage was 76%. During cyclone of 1992, people were more or less reluctant due to the normal behaviour of the nature. Most of the people predicted that no major cyclone would attack them, though meterological department was forecasting danger signal no. 10. So, at the last

moment by the initiative of local level CPP volunteers concerned government officials, some of the inhabitants of the study area moved to safe places. However, among the households of lower income group, percentage of households who have vacated was relatively high (90%). The correlation their houses coefficient between the percentage of households who have vacated their houses during cyclone of 1991 and their level of income is -0.96 (this value of r is varified through t-test at 5% level significance), indicating a high degree of correlation between income and tendency to leave the house during cyclone, i.e. as income increase tendency to leave the house case of disaster decreases. Households of higher income groups most probably felt insecurity of their assets in case of vacating their houses completely.

Table : 4.10
Goods Taken by the Households while Vacating their Houses.

Income Group {Taka}	Year of Cyclone	Cloths	Bedd ing	Food	Pots and Cooking materials	Valuable goods	Nothing	Total
Upto 1988	1991	6 (33%)	_		_	-	12 (67%)	18 (1007)
	1992	13 (65%)	-	-	-	-	7 (351)	20 (1002)
1801-3868	1991	7 (5%)	-	-	_	-	124 (95%)	131 (1987)
	1992	58 (46%)	2 (21)	-	1 [17)	2 (21)	55 (49%)	113 (100%)
3891~5886	1991	4 (15%)	-	-	_	-	23 (85%)	27 (100%)
	1992	7 [371]	-	5 (281)	-	-	12 (63%)	19 (100X)
5001 & above	1991	1 (5%)	-	1 (5%)	_	-	19 (95%)	20 (100X)
	1992	7 (44%)	1 [6%]	1 (6%)	1 (6%)	-	9 (56%)	16 (1001)
Total	1991	18 (97)	-	i (II)	-	-	175 (91%)	193 (100%)
	1992	85 (51%)	3 (2%)	6 [4%)	2 (17)	7 (1%)	83 (49%)	168 (188%)

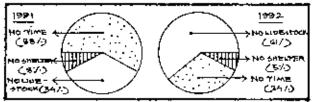
Source : Field Survey, 1973.

Table 4.10 reveals that in 1991, 91% of households failed to take anything with them as they left their houses at the last moment just before hitting the surge water when there was no time to take anything except their lives. But the situation considerably improved in 1992 when 51% households took cloths with them while vacating their houses. During both the cyclones nobody took any type of livestock in case of evacuation.

From Figure 4.12 it is found that, 58% of the households who vacated their homesteads did not take their livestock with them as there was no time. Again 8% of the households informed that taking of livestock with them was not possible because there

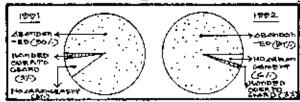
was no shelter in or around their locality where livestock can be kept safely and easily. But Figure 4.12 reveals that during cyclone of 1992 majority of households (61%) had no livestock and as a result it was not required for them to take livestock during evacuation of 1992. Livestock is a very valuable asset in rural area, but in case of disaster usually people fail to protect this valuable asset. In the coastal region where there are limited facilities to save human lives, preparation and provision of facilities to give protection to livestock may be thought by the inhabitants as an impossible task. So, during previous incidents of disaster it was seen that people generally abandoned their livestock during evacuation time (see Figure 4.13). But livestock and poultry are not only the personal asset, they are also the national assets of this country. Therefore, the provisions for livestock protection from natural disaster in the coastal areas are essential.

Figure : 4.12 Reasons for not Taking Livestock in Shelter.



Source : Field Survey, 1993.

Figure : 4.13
Way of Arranging the Livestock
Before Vacating the House.

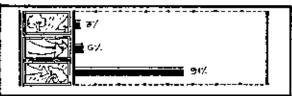


Source : Field Survey, 1993.

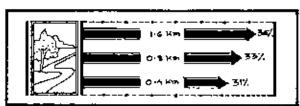
During both the cyclones of 1991 and 1992, all the respondent households travelled by foot from their houses to the shelter and nobody helped them for this journey.

4.14 reveals that Figure during cyclone of 1991 majority households (91%) οf faced tremendous wind flow with heavy rain while they were travelling. during the cyclone of situation was quite different, 71% of households informed that during their journey to shelter rain of moderate scale was continuing and there was no sign of cyclone. During the journey in both the cyclones of 1991 & 1992, majority of the households (36%) informed that they travelled upto 1.8 km for finding a safe shelter (see Figure 4.14).

Figure : 4.14 Weather During Evacuation.



Distances Crossed by Evacuees.



Source : Field Survey, 1993.

#### 4.6.4 NATURE OF SURVIVAL WITHIN OWN OR NEIGHBOUR'S RESIDENCE:

Although 88% (in 1991) and 76% (in 1992) of households left their houses to save themselves from coming disaster, but the researcher found that some households of the study area stayed in their houses even during the peak hour of the disaster (see Table 4.11).

Table : 4,11 Distribution of Households by Reason for not Leaving their Houses.

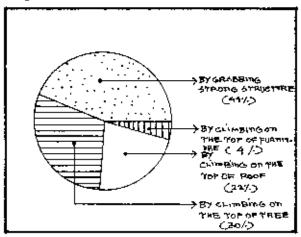
Income Group (Taka)	Year of Cyclone	Did Mot Consi- der the Disas- ter Seriously	Poor Communic- ation	Weather became violent	Lack of shelter	False Sense of Security®	Total
Upto 1889	1991	-	-	2 (100%)	-	_	2 (188%)
•	1992	-	-	- ' '	-	-	-
1881-3886	1991	-	-	2 (40%)	3 (681)	_	5 (18 <b>0</b> %)
	1992	14 (70%)	-	- ,	3 (15%)	3 (15%)	28 (180%)
3001-5000	1991	1 (13%)	1 (13%)	2 (26%)	3 (35%)	1 (13%)	8 (1861)
	1992	10 (63%)	-	-	4 (25%)	2 (12%)	16 (188%)
5 <b>001</b> & above	1991	3 (25%)	-	6 (50%)	1 (8%)	2 (171)	12 (100%)
	1992	12 (75%)	-	1 (6%)	1 (67)	2 [13%)	16 (186%)
Total	1991	4 (15%)	1 (42)	12 (44%)	7 (26%)	3 (11%)	27 (100%)
	1992	36 (70%)	-	1 (2%)	8 (151)	7 (131)	52 (180%)

Source: Field Survey, 1993.

Table 4.11 shows that 12% of total households did not vacate their houses during the cyclone of 1991 and among them most of the households (44%) failed to leave their houses because already storm started with its full intensity. During the cyclone of 1992 percentage of households (24%) who stayed at house was higher and 70% of them informed that they knew that intensity of cyclone would not be high, so they did not leave their houses.

It was found from the field survey that, though a small percentage of households of the study area did not leave their houses during the great disaster of 1991, but their way to survive from that disaster was quite interesting. These households informed that their houses were destroyed by high velocity storm and surge water and then most of them (44%) survived by grabbing some strong structures like pole of house or tree, 30% survived by climbing at the top of tree or roof of the house (see Figure 4.15). During this period they faced mainly two problems - continuous rain (52%) and lack of food (41%) (see Figure 4.16).

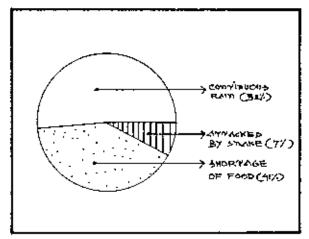
Figure : 4.15 Way of Survival.



Source : Field Survey,1993.

Figure : 4.16

Problems Faced by Households.



Source : Field Survey, 1993.

It was also found from the field survey that in both cyclones of 1991 and 1992, 30% of households took shelter in their neighbour's residences which were located on high land. Those households also faced several problems during their stay at other's house (see Table 4.13).

Table: 4.12 Problems Faced in Neighbour's Residences.

Problem	Cyclone	of 1991	Cyclone	of 1992
	Case	(%)	Case	( %)
Shortage of shelter space	37	(65)	56	(65)
Shortage of toilet	12	(21)	7	(8)
Shortage of food	1	(2)	_	(-)
Shortage of drinking water	12	(21)	7	(8)
Get wet by storm & rain	5	(9)	1	(1)
Faced misbehave from house owner	4	(7)	1	(1)
Total	57	(1203)	-:: 86	(100)

Source : Field Survey, 1993.

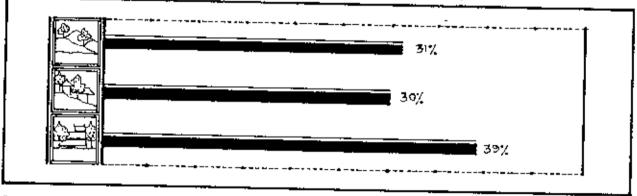
Table 4.12 shows that during both the cyclones of 1991 and 1992, the major problem faced by maximum households (65%) was shortage of space to stay in other's residence. The next major problem was shortage of toilet and drinking water. That means those houses were not at all suitable as cyclone shelter, but as households did not find any suitable shelter within their reach, so there was no alternative before them besides taking shelter in neighbour's residences which were at least free from surge water.



## 4.6.5 NATURE OF EVACUATION SITE :

During Pakistani period some coastal community centres were in different cyclone-prone coastal areas of country and it was assumed that in case of cyclone people of these areas could take shelter in these buildings, but those buildings were not designed and constructed to meet the general requirements of disaster period. During field visit it was seen that, one such community centre exist in the study area, which is now used as the only high school of the union. Though building has no quality to serve as a cyclone shelter, but there was no other big two-storied structure in the area during the cyclone of April 1991. So this building saved lives of people. From the field survey it was gathered that this building is not directly accessible from highly cyclone affected settlements like Rastarpara, Pecharghona, Rakhainpara So in the cyclone of 1991 people of these villages faced tremendous problem to fight against the high velocity of wind and surge water. They survived either by climbing at the top of nearby mountain or by taking shelter in their relative's house on high land. (See Figure 4.17). During the cyclone of effect was very negligible and many people then did not leave their houses also, so in this section only data of 1991's cyclone have been analyzed.

Figure: 4.17
Type of Shelter Selected During Cyclone of 1991.

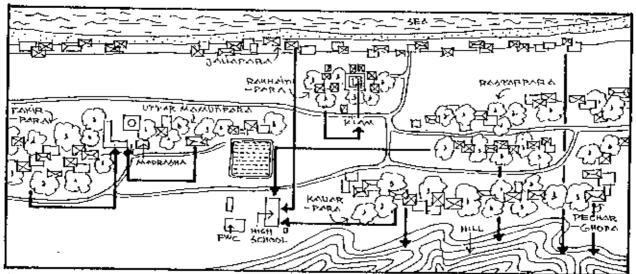


Source : Field Survey, 1993.

Figure 4.17 reveals that during the cyclone of 1991, 38% of the households took shelter in large multi-storied buildings, 31% on the hill under open sky and 30% in their neighbour's or relatives house. Among the pucca shelter, there were four buildings, high school cum community centre near Fakirpara, FWC (Family Welfare Centre) within the premises of high school, a madrasha building at Uttar Mamunpara and Kiam (Buddhist religious building) at Rakhainpara. Within these buildings kiam is 3

storied, high school is partially 3 storied, FWC and madrasha are storied. Except Kiam all other buildings are totally pucca structures and kiam is made of wooden floor, pole, wall, stair and roof of C.I. sheet. Kiam and madrasha are managed by private authorities, but school and FWC are public buildings. interview with local people it was found that during cyclone 1991 about 2,000 to 3,000 people took shelter in school madrasha buildings, while building of FWC and kiam gave shelter to 500-800 people. Other than these pucca structures people took shelter in the houses of their relatives or neighbours house on high land. All those houses were kutcha, one storied private property. In general 50 to 60 people took shelter in each of those houses and maximum 200 people took shelter in one house. It was reported that 31% did not get any type of physical structure as their shelter. They had to stay at the top mountain under the open sky throughout the whole night of cyclone even after that disaster before constructing their destroyed houses. Their experience of that night of April 29, 1991 was the most painful than the people who took shelter within different structures. Mostly inhabitants of Rastarpara and Pecharghona the hill top as they did not find any permanent suffered on shelter near by their settlements. Figure 4.18 also indicates this fact.

Figure : 4.18
Distribution of Households of Different Villages
by their Place of Shelter.



Source : Field Survey, 1993.

Quality of different types of shelter and the available facilities within them can be estimated from the opinion of respondents from their own experience of 1991 cyclone on different aspects of shelters. Table 4.13 reveals it elaborately.

Table: 4.13 Opinion of Respondents on Quality of Shelter During Cyclone of 1891.

Facility	Opinion		Permanent	·ė	Meighbour's	On hill	
		School	FWC	Kiam	Madrasha	Residence	tap
Toilet	Available	-		X83	1807		_
	Absent	3 <b>6</b> %	-	-	-	23%	100%
	Available but not						
	adequate	782	100X	407	-	77%	-
Source of	Available	-	-	1902	33%	14%	-
Drinking	Absent	-	-	-	-	11%	188%
иater	Available but not						
	adequate	100%	1901	-	67%	75%	-
Cooking	Available	-	-	-	412	-	-
Space	Absent	180%	1882	108X	-	59%	1907
	Available but not						
	adequate	-	-	-	592	417	-
Storage	Available	-	-	40%	-	-	-
Space for	Absent	100%	100%	-	100%	96%	189%
ព្ទិព១៤ទ	Available but not						
	adequate	-	-	6 <b>8</b> %	-	4 %,	-
Evacuation	Availab[e	100X	-	-	-	-	1001
site for	Absent	-	1801	100%	1667	100%	-
Livestock	Available but not						
	agedrafe	-	-	-	-	•	-
Cavered	Avaitable	-	-	-	-	-	-
Living	Absent	-	-	-	-	-	150%
Space	Available but not						
	adequate	100%	100%	1001	198%	100%	-
First aid	Available	-	180%	302	-	-	-
facility	Absent	100%	-	17%	32%	180%	100%
	Available but not						
	adequate	-	-	53%	189	-	-
lectricity		-	-	-	100%	-	-
	Absent	199%	100%	1007	-	100%	1007

Source : Field Survey, 1993.

From Table 4.13 it is found that hill top was the most worst type of shelter in all aspects. Private residences on high land also served as shelter, but those were not designed to give shelter to a huge crowd, so people suffered there. Large multistoried buildings have the potentiality to act as storm and surge resistant shelter space for a large number of people. But all those types of structure were ill-equipped and designed for their

normal time use, not for giving shelter space to a large number of people with different energency facilities (i.e. toilet, drinking water etc.). Only madrasha building provided some small scale facilities. So, though people could save their lives by taking shelter in those buildings, they faced tremendous problems like other types of shelter space there.

Assessment of different arrangements to maintain the daily life of evacuees and their activities will be helpful to understand the internal living environment of different types of shelter (see Table 4.14).

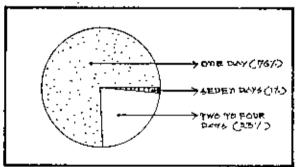
Table : 4.14 <u>Activities of Evacuees and Arrangements within shelter.</u>

î tes	Activity\Arrangement	School	FNC	Xiam	Madrasha	House	Hill
Situation	Cale and quiet	-	-	1001	-	26%	-
during entering the	Undisciplined	1867	100%	-	1007	747	83%
shelter	Puzzled	-	-	-	-	-	171
Activity during the	Crying and praying	1987	100%	1881	1881	1867	787
might of cyclone	Unnecessary shouting	-	-	-	-	-	3 <b>0%</b>
Law & order	Good	71	-	180%	_	232	_
situation	Moderate	897	188%	-	1007	687	631
	Bad	13%	-	-	-	91	37%
Arrangement for	Not possible	97%	1001	1001	982	91%	1881
cooking	Within living space	31	-	-	-	-	-
	Under the open sky	-	-	-	10%	92	-
Type of food	Not available	971	952	98%	941	867	1007
available	Rice	-	-	27	-	147	-
	Bread	-,	5%	-	-	_	-
	Pressed or fried rice	31	-	-	6 <b>%</b>	-	-
Arrangement for	Fixed toilet in shelter	2%	5%	71	18%	141	_
tailets	Mithin room	41	-	-	-	51,	-
	Outside under open sky	947	952	93%	787	81%	1 <b>0</b> 01
Arrangement for	No purified water	29%	28%	100%	187	51%	81%
<b>dr</b> inking	Purified water from tubewell	711	887	-	821	491	71
water	Rainwater	-	-	-	-	-	121
Arrangement for	Male female separate	-	-	-	_	321	-
staying	Mixed	100%	1007	1867	1881	183	1007
Arrangement for	Fixed space in shelter	-	_	48%	_	_	_
storing goods	Nithin room	27.	-	-	32	207	_
	Not necessary	981	-	68%	971	168	186%

Source : Field Survey, 1993.

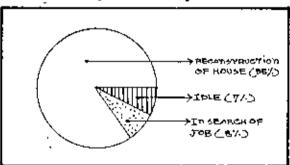
Table 4.14 describes that in case of all types of shelter majority of the respondents found highly undisciplined situation when they tried to enter into the shelter. All of them spent the whole night of the 29th April by crying and praying. Law order situation was very good in Kiam where no other people except the Magh community took shelter. On the hill, law and order situation was relatively bad than other shelters. Most of the families did not find any cooking arrangement in different types of shelter and most of them had to spend several days even after the cyclone without any food. Majority of the evacuees used the outside open space of the shelters as their toilet. Within high school and FWC a significant percentage of evacuees got purified drinking water from nearby tubewell. On the hill was no such arrangement for drinking water. Nearby the Kiam, there was a tubewell, but it was destroyed by surge water, evacuees who took shelter in Kiam suffered very much. Regarding staying arrangement, except some evacuees in private residences all other respondents reported that male and female had to stay together during their evacuation period in the shelter. For storing of goods along with the evacuees, except the Kiam there was no fixed place in different types of shelter.

Figure: 4.19 Staying Period of Respondents In Shelter.



Source : Field Survey, 1993.

Figure : 4.20 Activities of Respondents Immediately after Cyclone.



Source : Field Survey, 1993.

Figure 4.19 shows that 78% of the respondents stayed only one day after the cyclone of 1991. Only 1% said that they stayed upto 7 days and other 23% left the shelter within 2 to 4 days after the cyclone. 100% of those who stayed more than one day reported that as their houses were destroyed by cyclone, so they had no place to go and had to stay in shelter for a few days. According to Figure 4.20, during the days immediately after the cyclone, 85% of respondents were engaged in reconstruction of their destroyed houses, 8% were trying to find out a job for their survival and only 7% stayed as idle to get the help from relief team. It means period of stay of cyclone affected people in the shelter is relatively small.

#### 4.7 SUMMARY:

Cyclone and storm surge vulnerability of the study area reveals that this area is a cyclone prone area. In 1991 at the night of 29th April the area was attacked by a massive cyclone one of the biggest in this country. In November of 1992 another cyclone formed near the south eastern coast, danger signal No. 10 was also hoisted for Cox's Bazar sea port, but in the later stage of cyclone's path it became weak and struck the coast of Teknaf. Though its effect was not felt in the study area, but people were alert during the formation and movement stage of that cyclone. The major findings related with these recent cyclonic incidents of the study area will be helpful to formulate the policy and strategy for disaster management against cyclone & storm surge. Therefore, the major findings are:

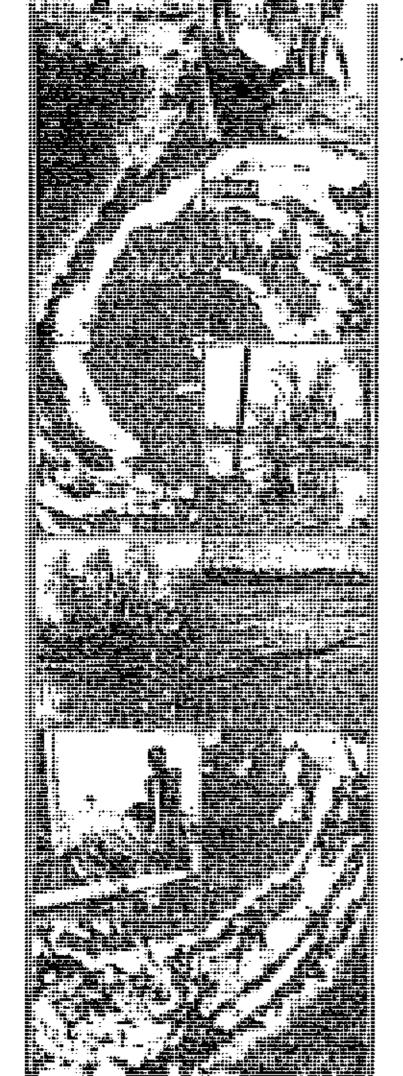
- -- The nature of land terrain of the study area is sloping in east-west direction. At the coast line land level is only 0.45m (1.5') above Kean Sea Level (MSL).
- -- During cyclone of 1991 entire study area was affected by tremendous cyclonic storm, but surge water entered upto 1.5 km towards eastern side of the area.
- -- Surge water from Joaria Khal inundated a major portion of the study area upto 2.43 m above G.L.
- -- Considering the highest and lowest ground water level at the study area during pre and post monsoon period it can be said that operation of hand tubewell in both the seasons within this area will not be a problem at all.
- -- Within the study area, now there are 11 multi-storied pucca buildings and combinedly these buildings can provide shelter to 13,750 people in case of cyclone.
- -- Poor physical infrastructure of this union makes the area more vulnerable to natural disaster like cyclone.
- -- In case of receiving the news of coming cyclone in 1991 access to radio was limited for lower income people.
- In 1991 though 99% of the respondents become aware of coming cyclone, but majority of them failed to take adequate precautionary measures.
- -- During cyclone of 1991, the persons who took shelter in the house of neighbours or relatives, were mostly

welcomed, but due to the large number of evacuees in a single house they faced tremendous problems.

- -- 39% of the respondents took shelter in multi-storied buildings like school, FWC, madrasha etc., but near the most severely affected villages there was no multi-storied building, so almost all people of those villages took shelter on the top of nearby hill.
- -- Internal environment of permanent pucca shelters were also very poor. Those buildings were not designed and constructed to serve as a shelter space for a large number of people for a particular period. The buildings were ill-equipped and there were no proper survival facilities, like adequate number of toilet, source of drinking water, etc. in those shelters.

#### Notes :

- The area where there is a possibility of loss of lives due to appreciable inundation by storm surges (depth of inundation greater than 1 metre) has been defined as High Risk Area (HRA) by MCSP.
- Tides in the sea is a result of the gravitational pull of the moon, the sun and the planets and local meteorological disturbances. The total tidal force due to the combined action of the sun and moon is greatest when sun and moon are as nearly in line with the earth as possible. This occurs twice a month, one at new moon and the other at full moon. When this happens, spring tides occur having a range of water surface displacement greater than average.
- To assess the capacity of these buildings as shelter, Ø. 185 m2 (2 sft) is taken as the minimum area required for a single evacuee.
- 4 High School building was originally constructed as the constal community centre. Now this building is also used as the union office of CPP of BDRCS.
- During the cyclone of 1991 many respondents considered that their houses would be able to resist cyclonic storm, but actually those structures were not storm resistant and it is described by the researcher as a false sense of security.



CHAPTER : 5
ANALYSIS OF
PEOPLE'S
PERCEPTION
ABOUT
DISASTER
MANAGEMENT
AND COMMUNITY
DEVELOPMENT

### 5.1 INTRODUCTION :

In any type of planning task, public participation has not only become a frequently mandated requirement but it generally is (or should be) an integral and constructive part of any planning endeavour. Again one of the major objective of this research project is to find out the methods of incorporating people's participation in cyclone shelter planning, so in this regard opinion of the people of study area were collected and analyzed in this chapter.

### 5.2 SOURCES OF PROPLE'S OPINION :

One of the major component of the household questionnaire survey of this research was to collect the opinion of households on different aspects of cyclone shelter plan and community development programme. So from that survey different general opinions were found. At the same time, the researcher personally talked and took informal interviews of different local level elites. Therefore, household questionnaire survey & informal interviews are the sources to determine the levels of public awareness, understanding and feeling toward disaster management and community development.

# 5.3 GENERAL PEOPLE'S OPINION ON DISASTER MANAGEMENT REFORT :

The memory of two recent cyclones (1991 & 1992) are still fresh in the mind of local people of the study area. So during household survey, people were asked to give opinion on disaster management effort on the basis of their experiences during these two cyclones (see Table 5.1).

Table : 5.1						
Distribution	of	Respondents	Ьy	Opinion	оn	Energency
Mitigation Me	Rsure:	s for Cyclone	and	Surge.		

Income Group (Taka)	Better Communic ation	Food & Medicine	Cyclone Shelter	More Embank- ment	Loan for house Improvement	Total
Upto 1000	12 (60%)	14 (70%)	9 (45%)	5 (25%)	3 (15%)	23 (100%)
1001-3000	57 (43%)	196 (89%)	92 (69%)	25 (19%)	21 (16%)	133 (100%)
3 <b>90</b> 1-5 <b>00</b> 0	13 (37%)	31 (89%)	20 (57%)	7 (29%)	6 (17%)	35 (120%)
5001 & up	9 (28%)	25 (78%)	13 (41%)	15 (47%)	11 (34%)	32 (100%)
Total	91 (41%)	176 (80%)	134 (61%)	52 (24%)	41 (19%)	220 (100%)

Table 5.1 reveals that 80% of the respondents demanded proper food & medicine to survive during the days after cyclone, 61% demanded proper type of cyclone shelter with all necessary facilities, followed by better communication system (41%), more embankment (24%) and loan for house improvement (19%). However opinion about loan for housing purpose mostly come from households of higher income group, who have loan repayment capacity. But during cyclone of 1991. respondents saved their lives somehow from the initial blow of then severely suffered after cyclone due cyclone and tremendous shortage of food and proper medicine. So most of the respondents (80%) suggested that storage and supply of adequate amount of food and medicine is essential immediately after the cyclone. From the opinion provided by the respondent households, one interesting thing is found that though both structural and non-structural components can contribute for the disaster management effort, but as structural components have physical existence so their contribution to mitigate the loss of disaster and to reduce the vulnerability of cyclone and surge can be understood even by any illiterate person (see Table 5.1).

In case of locating the cyclone shelter, all respondents suggested that it should be located in a relatively high land which is accessible not only in terms of distance but also in terms of travelling time especially during the disaster period. If shelter site is properly connected with the main road network, then accessibility to shelter site from individual homestead will be increased. Regarding accessible distance of shelter site, different respondents suggested differently (Table 5.2) and they gave suggestion on the basis of quality of existing communication networks within the area. But it was also found from people's opinion that, improved road communication with shelter site have great influence on preferable distance for a cyclone shelter.

Table: 5.2
Distribution of Respondents by Opinion on Desirable Distance
of the Cyclone Shelter.

Income									
Group (Ta <b>ka</b> )		Ø.2		0.4	Ø.8	_	1.2	1.6	Total
Upto 1 <b>200</b>	4	(20%)	5	(25%)	2 (10%)	1	(5%)	8 (40%)	20 (100%)
1991-3999	21	(16%)	49	(37%)	32 (24%)	3	(2%)	28 (21%)	133 (100%)
3 <b>99</b> 1- <b>5000</b>	3	(9%)	16	(45%)	7 (20%)	1	(3%)	8 (23%)	35 (120%)
5ØØ1 & up	2	(6%)	12	(38%)	9 (28%)	2	(6%)	7 (22%)	32 (100%)
Total	30	(14%)	82	(37%)	5 (22%)	7	(3%)	51 (24%)	220 (100%)

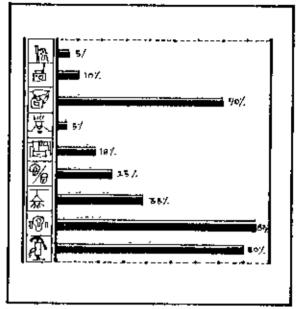
Source: Field Survey, 1993.

Though according to Table 5.2 most (37%) of the respondents preferred 0.4 km as the allowable distance of any cyclone shelter but interesting thing is that all the respondents (100%) suggested that if quality of existing communication network was improved then they could travel even upto 1.6 km in bad weather. Respondents gave various opinions on necessary facilities in a properly equipped cyclone shelter (see Figure 5.1).

Figure 5.1 shows that maximum respondents suggested to provide enough number of toilets & sources for drinking water and a storage of food and medicine for emergency period. Many of them gave suggestion electricity for lighting purpose, otherwise during the night of disaster dark environment might make the evacuées more frightened.

Regarding the management of a cyclone shelter, most of the respondents said that due to poor management, existing public buildings can not provide properly the shelter facilities and for a new shelter good management is essential. They suggested different authorities for management purpose (see Table 5.3).

Figure: 5.1 Distribution of Respondents by Opinion on Facilities Required in a Cyclone Shelter.



Source : Field Survey, 1993.

Table: 5.3 Distribution of Respondents by Opinion on Shelter Management.

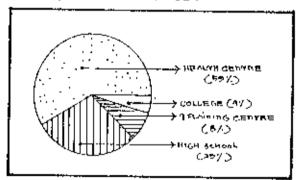
Income Group (Taka)	Union Parished	Thena Parishad	NGO	Separate Committee	Donor	Total
Upto 1000	1 (5%)	6 (30%)	-	13 (65%)	_	28 (198%)
1001-3000	14 (11%)	31 (23%)	3 (2%)	85 (64%)	_	133 (100%)
3001-5000	8 (23%)	-	_	25 (71%)	2 (6%)	35 (1 <b>9</b> 0%)
5001 & up	8 (25%)	<u> -</u>	-	29 (82%)	4 (13%)	32 (196%)
Total		37 (17%)	3 (1%)	143 (65%)	Б (3%)	220 (100X)

Table 5.3 reveals that majority (65%) of respondents gave opinion for a separate committee for the management of cyclone sheller throughout the whole year. This committee will be formed with the representatives from all classes and groups of people of community. Ιſ this opinion on management is analyzed according to income then it is found that people of lower income groups have little faith on union parishad than people of higher income groups. Again suggestion for making the donor of shelter site as its management authority, only came from people of higher income groups, because in that case it will increase the social prestige of the donor. So it can be assumed that this type of suggestion came from people of higher income groups to maintain their upper hand within the society.

Respondents also admitted that maintenance of any cyclone shelter entirely depend upon its continuous use. Cyclone may happen once or twice in one or two years or may not happen even for 2/3 years. So if shelter is used only in case of cyclone and it remains unused throughout the whole year, then it can not be maintained. Therefore, respondents also suggested different normal time use of the cyclone shelter (see Figure 5.2).

Figure 5.2 shows that many respondents suggested school as the alternative use of the shelter. One thing is clear that they are not getting enough and proper help from local FWC, so they demanded more effective health centre in new cyclone shelter. Interesting suggestions have also come up from them such as the normal time use of shelter as college which is not present in that union and use of shelter as training centre of cottage industry for women and youth.

Figure: 5.2 Distribution of Respondents by Opinion on Normal Time Use of the Cyclone Shelter.



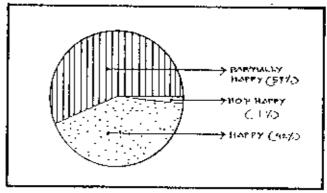
Source: Field Survey, 1993.

# 5.4 GENERAL PEOPLE'S OPINION ON COMMUNITY DEVELOPMENT :

According to Figure 5.3, 57% of the respondents are partially happy about the present community development activities which are going on within the study area, 42% are happy and only 1% is not at all happy. Now different nongovernmental organizations (NGO) are working on different projects of community development in the study area. That's why local people are more or less happy, though no organized and planned community development project was found by the researcher during field visit.

It was also found that general people are more concerned about. their rivo. economic development rather than development of living environment the community. So their opinion on community develop-15 ment limited within suggestion for few community service facility and according to Table 5.4 not a wide variety of suggestions were found to improve the inhabitant's quality of life in the area.

Figure: 5.3
People's Opinion on Present
Community Development Activity.



Source : Field Survey, 1993.

Table: 5.4 Distribution of Respondents by Opinion About Community Service Facilities.

Income Group (Taka)	Health Centre	High School	College	Training Centre for Cottage Industry	Loan Giving Agency	Roads & Bridges	Electri- city
Upto 1 <b>00</b> 0	13(65%)	3(15%)	_	1(5%)	3(15%)	15(75%)	1(5%)
1001-3000	82(60%)	44(33%)	-	2(2%)	21(16%)	68(51%)	14(11%)
3001-5000	15(43%)	6(17%)	1(3%)	1(3%)	6(17%)	14(40%)	1(3%)
5001 & up	21(66%)	11(34%)	1(3%)	-	11(34%)	26(81%)	3(9%)
Total	129(59%)	64(29%)	2(1%)	4(2%)	41(19%)	123(56%)	19(9%)
Source: Field	Survey, 1993.	_				<del>-</del>	

Table 5.4 shows that 59% of respondents expressed their preference for health centre and 56% for improved condition of communication network, a small amount of them (19%) also gave opinion for loan giving agency. Among these suggested community service facilities, health centre and road systems will improve the quality of life in community. While loan giving agency improve the economic condition of the community and ultimately improved economic condition will help the community attain better quality of life. As a result development οľ community will be possible and at the same time this development will help to accelerate the process of rural development in the region.

#### 5.5 OPINION OF THE LOCAL ELITES :

Opinion of local elites are more or less bold and direct on aspects of disaster management and development activities. Local union parishad chairman and members are not at all happy about the on going cyclone shelter projects of Facilities Department and some NGOs in the According to them the site of those shelters were chosen without consulting the local people and elected public representatives were not also included in the management of those projects. They think that without improving the internal road network of the area and its communication with the neighbouring Cox's Bazar town, only cyclone shelter can not reduce the volnerability of the area. UP Chairman also believes that if a big amount of house loan with low interest for multi-storied storm resistance structure are given then people will not take it, as people are more interested for investment in more productive sectors, but small amount of loan for low cost housing can be taken by solvent people. According to the local level elected persons, things required immediately after cyclone of 1991 were cooked food, proper medicine, C.I. sheet etc. They are also not happy about the community development programmes of NGOs in the area. UP Chairman informed that publicity of NGOs projects are more than their actual performance. Again their housing project, loan giving scheme etc. are helping rich people, while poor people of the area need more attention. He also described the social forestry programme of some NGOs in the area as a total failure due to mismanagement in this sector. UP members suggested that co-ordination among different community development and disaster management projects is must and for this co-ordination a separate committee comprising of local elites and thana level govt. officials can be formed.

According to Assistant Engineer of Cyclone Protection Sub-Division of BWDB at Cox's Bazar, without any embankment cyclone shelter alone can not save the people of the area from surge water. The existing embankment at Khurushkul was constructed in 1960's to protect the agricultural land from saline sea water not to protect the area from high surge water. Now the length of this embankment in the study union is 8.5 km and its height from G.L. is 3 m. This embankment was completely washed away by the cyclone of 1991. Now with the help of Saudi Aid, BWDB has taken a project to protect the entire Chittagong coast from Chittagong to Teknaf from surge water by compacted earth embankment, its height will be determined by considering the previous maximum surge water height of this coastal region. He thinks this embankment will be more effective to save the lives of local people from storm surge.

According to the sub-assistant engineer of the same division of BWDB, the major problem faced by them for maintaining the embankment is the local people's attitude. Generally shrimp

cultivators cut down the embankment without consulting BWDB officials to get sea water in their shrimp bed and this ultimately reduces the strength of earth embankment. Now in Khurushkul coast there are only two 0.91 m dia R.C.C. pipe within the embankment to drain out the rainwater from land side to sea side, but in new embankment BWDB will construct sluicgates at a regular interval especially where there are shrimp farms and these sluicgates will be operated according to the demand of local people by a committee of U.P. members, local farmers and shrimp cultivators.

Another Assistant Engineer of Cox's Bazar BWDB's O&M Division has described the situation of cyclone of 29th April. 1991, who was present at Cox's Bazar during that time and visited Khurushkul union immediately after the cyclone. According to him signal No. 6 was hoisted for Cox's Bazar at 2:00 p.m. of 29th April, 1991, then signal number 8 was hoisted after 8:00 p.m. and finally it increased to danger signal No. 10 at 8:00 p.m. At that time miking for evacuation started. Before 10:00 p.m. wind flow high velocity with rain of medium intensity was continuing, but at 11:p.m. tremendous wind flow started with rain of maximum intensity and it continued till 3:00 a.m. of 30th April. With tremendous cyclonic wind sea water began to enter into land side and surge water reached its maximum level at 1:00 a.m. of that night. He also informed that by that cyclone entire Khurushkul union was affected. Casualty was relatively lower than adjacent Moheshkhali island, but all the temporary structures of the area along with standing crop in the field were completely destroyed. Almost all the sources of drinking water were polluted and many people died by drinking that polluted water. Rastarpara, Pecharghona, Rakhainpara, Jaliapara etc. were highly affected villages of the area. Due to poor communication, supply of relief in those villages were also delayed. Level of surge water reduced after cyclone, but at Rakhainpara, Rastarpara & Pecharghona surge water with Ø.48 to Ø.81 m height remained for even 2/3 days after cyclone. There ₩8.S no embankment at the southern banks Joariakhal, SO surge water also entered from that khal and northern side of Rastarpara which was Pecharghona unpredictable to the local people, so they suffered very during evacuation process.

Project officer of DPP¹ of BDRCS informed that BDRCS constructed a cyclone shelter in Khurushkul union. This shelter is also a centre of community development activities of BDRCS and for this shelter land was collected from an interested donor. BDRCS believes that instead of purchasing land this type of land donation will make an intimate relationship between shelter and community. Shelter of BDRCS is managed by a committee of local people where land donor has no influence. But during field visit the researcher found that the person, who donated his land for the shelter of BDRCS at Khurushkul, was the key person of managing the shelter activities, though there was a committee to

look after those activities, Project Officer also said that for choosing, location of their shelter, at first highly villages near the sea of Khurushkul were identified then they asked the villages to donate people of those land constructing a cyclone shelter. When a donor was found then they investigated whether the land is properly connected by road with the nearby homesteads and after checking that they decided to construct their shelter on that land. For choosing its no other survey or investigation was done. BDRCS also believes that without improving the living condition of community people, their vulnerability due to cyclone and surge can not be reduced. So for community development purpose their shelter is now used as a community centre during normal time. In that shelter there is a health centre. a vocational training centre and a feeder school. The catchment area for these community development activities is area of 1.6 km radius around the shelter building. entire programme was run by German Red Cross and recently due to fund shortage community development activities have been stopped.

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The local workers of NGOs also gave positive opinion for collecting land by donation and they also have supported the BDRCS's process to choose the location of a cyclone shelter and its community development activities. BDRCS is also running its programme for mainly evacuation purpose during disaster. Local CPP official at Cox's Bazar informed that CPP volunteers are not paid and during normal time these volunteers involved in any BDRCS programme. DPP workers are completely separate and CPP has its own separate Centre in Khurushkul which has no connection with the local BDRCS shelter.

### 5.6 SUMMARY:

The field survey on the people's choice, regarding the potential measures of disaster management and community development have shown some interesting features. These features are analyzed in this chapter. The major findings of this analysis are described below:

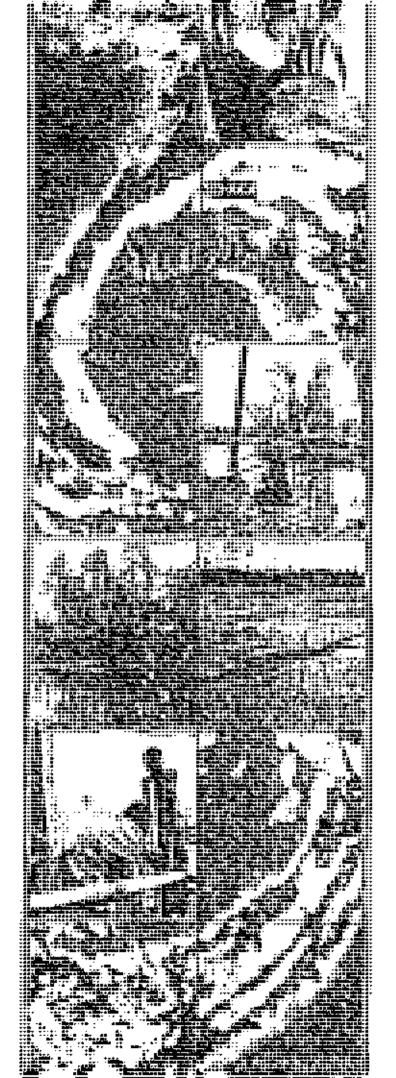
- -- To reduce the vulnerability of this area, local people believe that without improving the area's communication network only cyclone shelter will not be effective.
- -- In case of an improved communication network almost all the inhabitants will be able to move upto 1.8 km to find out a shelter during the disaster.
- -- According to general people the most necessary

facilities in a cyclone shelter are enough number of toilets, sources of drinking water and a storage of food and medicine for emergency period.

- -- Regarding the management of cyclone shelter, most of the local people have suggested for a separate committee comprised of the representatives from all classes of the society.
- -- Majority of people have given opinion for school and health centre as the normal time use of cyclone shelter.
- -- The locally elected public representatives like UP chairman and members are not at all happy about the current community development and disaster management projects in the area. According to them co-ordination among these projects and involvement of local people within those projects are not at all present.
- -- According to local elites, a big amount of house-building loan, even with low interest for multi-storied storm resistant structure will not be taken by the people, as people are more interested for investment in more productive sector, but small amount of loan for low cost housing can be taken by well off people.
- -- Both BDRCS and NGOs usually collect land for cyclone shelter from interested donor. Because they believe that instead of purchasing land for cyclone shelter, collection of land from donor will make an intimate relationship between shelter and community. But during field visit the researcher found that donors were taking additional advantages from the local cyclone shelter of BDRCS.

#### Note :

<sup>1</sup> Disaster Preparedness Programme is integrated with Community Development Programme of Bangladesh Red Crescent Society.



CHAPTER : 6 CONCEPT FOR NEW GENERATION CYCLONE SHELTER, ITS NORMAL TIME USE AND SIZE

#### 6.1 INTRODUCTION:

During the last two decades the international community has become increasingly alarmed by disaster, which have tended to be more destructive as they affect over larger concentrations of population. While the response of the international community has been focused primarily on relief action, it is now realized that the actual and potential consequences of disasters are becoming so serious and increasingly global in scale, that much greater emphasis will henceforth have to be given to planning and prevention. The effects of natural phenomena must be viewed not humanitarian and broad social terms, but also and primarily, in economic terms. Natural disasters are a formidable obstacle to economic and social development. Moreover, in terms percentage of gross national product, the losses caused by disasters in some disaster prone developing countries more than cancel out any real economic growth. There has thus been a growing awareness by Governments of the need to focus more attention on disaster preparedness and prevention, and a recognition of the fact that disaster prevention and pre-disaster planning should be an integral part of national development policy (UNDRO, 1977). The traditional concept of disaster management, which considers only one way flow from natural phenomena to human activities has, therefore, serious limitations (Sazanami, 1991). The new concept of two-directional disaster management, on the other hand considers the effect of human activities on natural and socio-economic environment which, in influence the extent of natural disaster significantly (Jahan, 1991).

# 6.2 NEED FOR AN INTEGRATED APPROACH TO CYCLONE DISASTER HANAGEMENT AND COMMUNITY DEVELOPMENT PLANNING:

Vulnerability due to natural disaster is different country to country, place to place and person to person. Basically vulnerability to natural disaster like cyclone storm surge depends upon the physical and socio-economic condition of a particular site. The analysis of the effects of the April 1991 cyclone in Bangladesh has shown that the extent of cyclone disaster is not only a function of the intensity of the cyclone disaster, but also of various aspects influencing the process of socio-economic development and environmental change. In other words, human activities also play a significant role in determining the dimension of natural disasters. So in case Bangladesh, the high population density of nearly 800 persons per km<sup>2</sup> and the high growth of population of 2.0 percent annually present potential scope for social vulnerabilities to storm surge and eyclonic disasters. Especially, the Chittagong and Cox's Bazar districts have the highest population growth (BBS, 1981). Again quality of community service facilities like communication network, utility and service lines, housing conditions etc. are also very poor in the coastal regions of Bangladesh. Therefore, the impacts of cyclones and surges of equal magnitude would be different in Bangladesh than USA or any other developed country. From the recent natural disasters in Bangladesh it is found that the existing disaster management system of this country is unidirectional (i.e. flow from natural phenomena to human activities) but also grossly inadequate in terms of such aspects as men and materials, legal instruments, spatial coverage, public participation and linkage with development planning. By analysing this situation it can be said that without improving the quality of life and living environment in coastal community of Bangladesh reduction of losses due to cyclones will not be possible.

Under these circumstances for improving the disaster management capability of the nation, policy makers must consider integration of disaster management with community development planning and involvement of general public at all levels and stages of disaster management process.

The major purpose of the integrated approach to cyclone disaster management and community development planning are :

- -- To increase the efficiency and capability of the cyclone disaster management system.
- To integrate the comprehensive counter-measures against cyclone and storm surge within everyday life of the people of coastal regions of Bangladesh.
- -- To create a community which secures its own safety by improving socio-economic condition of the people and developing physical infrastructure.
- -- To involve the general public at all levels and stages of disaster management activities.

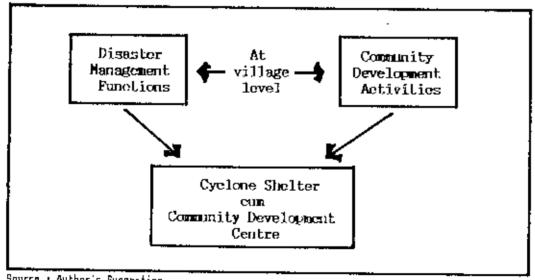
#### 6.3 ROLE OF CYCLONE SHELTER FOR INTEGRATED APPROACH :

The main purpose of a cyclone shelter is to provide evacuation space for a large number of people at a time during cyclone and storm surge. As the number of large scale permanent structures is very limited in the coastal regions of Bangladesh, so to reduce the loss of human lives, the 1991 disaster has proved cyclone shelter to be most effective. The approach of disaster management is likely to provide organised preparedness for facing possible natural disaster in future and ensure timely mobilization and efficient utilization of available materials and human resources. Therefore, considering this approach of disaster management it can be said that cyclone shelter is a very important structural component of disaster management. But, without introducing a better living environment in coastal

regions of Bangladesh only cyclone shelter will not be bring the coastal community's vulnerability to eyclone and storm surge at minimum level like developed countries.

The physical facilities provided by the cyclone shelter will able to provide the space to carry out the community development activities, social functions and at the same time to implement different stages of cyclone disaster management responsibilities, which will ensure the multipurpose use shelter and its continuous maintenance. It is important objective of the disaster management programme that counter measures against natural disaster like cyclone shelter in within every day life of coastal communities. to fit Functions for disaster prevention should be provided not only with work appropriate to disaster prevention, but also with those for long term community development and other improvement work community service facilities (Matsuda, 1991). It means cyclone shelter has to be considered not only as a platform to provide evacuation space to the distressed people, but also as a community development centre which will serve as the focal point of all community development activities. So the cyclone shelter will be able to play an important role to implement the modern approach of disaster management (i.e. integrated approach to cyclone disaster management and community development planning) at grass root level of coastal regions of Bangladesh.

Figure : 6.1 Role of the Cyclone Shelter within Integrated Approach.



Source : Author's Suggestion.

Again cyclone and storm surge may not occur every year and at the same time cyclone is such a natural disaster which may last for a few hours and its consequential effects like storm last for a few days only. Therefore, surge may the physical facilities and management capacities created for cyclone shelter

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may remain unutilized over a long period of time. Thus it is assumed that use of cyclone shelter as community development centre throughout the year may assist in capacity utilization of the physical facilities and other logistics created for cyclone shelter and shelter building's continuous maintenance.

Therefore, proper planning and design of cyclone shelter with appropriate location, size, proper service and facilities within it are very important to ensure the success of integrated approach to cyclone disaster management and community development planning.

#### 8.4 COMPONENTS OF CYCLONE SHELTER PLANNING TASK :

A cyclone shelter should not only be used as a platform for survival but also as a centre for different types of community activities, i.e. it will be used as cyclone shelter cum community development centre. By considering the basic requirements of the cyclone shelter cum community development centre its planning task has been designed and the major components of this planning has been identified as follows:

- 01. Identification of normal time use of cyclone shelter.
- 02. Determination of size of cyclone shelter.
- Ø3. Selection of location of cyclone shelter.
- **04.** Identification of design guidelines for cyclone shelter.
- Incorporation of people's participation in cyclone shelter project.

# 8.5 IDENTIFICATION OF NORMAL TIME USE OF CYCLONE SHELTER FOR COMMUNITY DEVELOPMENT PURPOSE:

Socio-economic and physical condition of different coastal communities are different within different coastal regions of Bangladesh. So identification of community development activities as the normal time function of proposed shelter will entirely depend upon the actual physical condition of the site of shelter, general life style of people of that area (see Section 3.5) and people's choice (see Figure 5.2). Ethnic conflict is not at all present in the study area (see Table 3.8 & 3.9), but local people are more or less not happy with the present community development works of this area (see Figure 5.3). Again from the field survey in the study area it was found that female, aged, children and specially people of lower income groups are highly vulnerable to natural disaster. Therefore, socio-economic development of these groups of people and overall improvement environment of the whole community will facilitate of living to form a better quality of life within the community and it ultimately help to create a community which secures its own

safety by itself against cyclone and storm surge. So the target group of community development activities are,

- Women
- Children
- Aged persons
- Households of lower income groups.

From the field survey in the study areas of Khurushkul union, socio-economic and physical problems of the community were found and to solve those problems, corresponding necessary actions were identified. Those problems along with the corresponding actions are described below:

ļ	Problems	Required Actions	Necessary Physical Facility
1.	Overall socio- economic status of the local people is very poor (see Table 3.15) and 87% of total population are present in either lower or lower middle income group (see Table 3.13).	1. The existing situation of economic activities (see Table 3.16) & land ownership data [see Table 3.11] indicate prospects for development in mutti sectoral employment opportunities like.  a. Connercial Livestock and poultry rearing (see Section 3.7).  b. Planced afforestation within private and khas land (see Section 3.18 & 12).  c. Organized sweet water fish production in local water bodies (see Section 3.15).  d. Development of fishing related enterprises like, fishing net & fishing boat manufacturing.  e. Special attention to increase production of famous agricultural products of the	1.a. A centre to operate the community based poverty alleviation programmes.  b. A centre to comordinate & organize the activities of village level extension workers on,  - Veterinary service Forestry Fishery.  c. A centre to conduct bunan resource development related training.  d. A centre to organize rural credit programmes.
2.	99% of female population have no access to earning (see Figure 3.9 & Table 3.12).	area (see Spection 3.13).  7.a. Improvement of female education level.  b. Provision of household based income sources.  c. Providing livelihood loans to women (see Table 5.4).	2.a. High School which will facilitate female eduction within their allowable movement area.  b.1. A village level centre to operate female development programmes.

Required Actions	Necessary Physical Facility
į	b.2. A training centre to train up female on,
	<ul> <li>Commercial livestock and poultry rearing.</li> <li>Social forestry.</li> <li>Specialized weaving.</li> <li>Sophisticated pottery.</li> <li>Fishing net manufacturing.</li> <li>b.J. A rural credit centre</li> </ul>
	with door to door service.
3.a. Development of a new market.  b. Improvement of nature of the present markets.	3. A warket place with necessary services and facilities for wholesale trading of locally produced goods, which is properly connected with neighbouring growth centers and economically active zones.
4.a. More emphasis should be given on family planning activities to reduce percentage of underage population.	4.a. A centre to operate family welfare activities at village level.
<ul> <li>Programme for adult education should be taken sperially to give them training on disaster preparation.</li> </ul>	b. A centre to conduct adult education programmes at village level,
<ul> <li>5.a. Motivational and monitoring programme should be taken for family planning purpose.</li> <li>b. Froperly equipped and dedicated village level extension workers should be employed for family planning purpose.</li> </ul>	5.a. A properly equipped village level centre to give door to door family planning service.  b. A community based centre to coordinate the activi- ties of village level ex- tension workers of family planning programme.
	3.a. Development of a new market.  b. Improvement of nature of the present markets.  4.a. More emphasis should be given on family planning activities to reduce percentage of underage population.  b. Programme for adult education should be taken sperially to give them training on disaster preparation.  5.a. Motivational and monitoring programme should be taken for family planning purpose.  b. Properly equipped and dedicated village level extension workers should be employed for family planning

	Problems	Required Actions		Necessary Physical Facility	
ь.	In case of personal health care and hygiene residents of all income groups are very much reloctant and careless (see Figure 3.12).	primary should b. Trainin communi	of village level beaith care services be improved.  g programmes at ty level should be n personal health care iene.	b.a. A properly equipped heal centre to provide primar health care services specially during disaster at community level.  b. A community level centre to conduct training programmes on personal health care and hygiene.	
7.	Most of the people being illiterate are normally convinceable tess active in community development activities and to community participation for cyclone disaster management (see Figure 3.8 & Table 3.10).	noreas. ral educ b. Primary a drill	s should be given on ing the level of gene- cation in community. school based training programmes on management should be	7.a. Proper institution to increase the level of general education within the reach of community people.  b. A community based centre to conduct the training & drill programme on disaster management.	
a.	The quality of construction of houses A their quality in terms of services and utilities are not up to the standard (see Table 3.19, 3.20, 3.21 A Figure 3.11).	unity sh tance,  b. Certain the plin maximum can be c communit c. Communit centre si provide i bving sei	y based service hould be developed to facilities for impr- rvices and utilities ne individual	B.a. A community based centre to co-ordinate housing improvement programme.  b. A community based credit centre to provide house building loan for low cost storm and surge water resistant house.	

From the above table it is found that, problems and corresponding required actions which are related to community development can be classified into the following three groups:

 Improvement of community's economic condition which will ultimately accelerate country's rural development process.

- Improvement of social consciousness in the community to facilitate disaster management and community development.
- Improvement of physical infrastructure within the community to prepare a risk-free living environment from cyclone and storm surge.

Therefore, for the above improvement purposes the physical facilities of cyclone shelter can be used for following community development activities throughout the whole year:

- Providing space for meeting and administrative works of community development committee.
- Functioning of social services like adult education, primary education, female education, informal education and education on primary health care and hygiene.
- Providing space to offer community services like mother and child health care service, emergency medical service and veterinary service.
- Providing space to conduct human resource development related training programmes like training on social forestry, fisheries, specialized pottery, commercial livestock and poultry rearing and specialized weaving.
- Providing space to conduct rural credit programmes.
- Providing space for wholesale trading centre of local products and short time accommodation for wholesale traders of other localities.
- Small scale shopping facilities to meet the daily necessities of the community.
- Providing space for manufacturing of fishing net, different components of sealed latrine and assembling of hand tubewells.

Along with the above facilities, cyclone shelter will provide office, storage and shelter space with enough toilets and sources of drinking water to operate and co-ordinate the pre, during and post disaster phase responsibilities of disaster management.

## 6.6 DETERMINATION OF SIZE OF CYCLONE SHELTER :

Size of a particular physical facility like cyclone shelter will ultimately determine its capacity to serve its main function. Size of cyclone shelter will depend upon the following factors:

- Size of the catchment area, i.e., the area for which cyclone shelter will be constructed.
- Population within the catchment area, i.e., number of people which will be served by cyclone shelter.
- The purposes for which shelter will be used and necessary facilities to serve those purposes.
- Required spaces for all necessary facilities within and around cyclone shelter.
- Total required space and allocation of space to different uses and locations.

The above factors are used in size determination task of cyclone shelter planning in the following sections.

# 6.6.1 IDENTIFICATION OF CATCHMENT AREA :

The catchment area of a cyclone shelter is the area from where people come to take shelter during cyclonic storms and surges. Identification of this catchment area is a complex matter and it actually depends upon the site characteristics of a particular area. In this research, catchment area of cyclone shelter has been determined on the basis of the following factors:

- a. The extent of the area within the study union which is highly affected by the cyclone of 1991.
- b. The distance which most families were willing to move during the recent incidents of cyclone.
- c. The density of habitations and settlement pattern.
- d. Communication network in the area.

The above factors are described below,

# a. The extent of the area within the study union which is highly affected by the cyclone of 1991:

The entire Khurushkul union was badly damaged by the cyclone of April 1991. But the north east portion of the union which is known as Tetaia mauza is basically a hilly area. Again the land level in the middle portion of Khurushkul mauza is quiet high (4.5 m above PWD datum) in relation to mean sea level. So Tetaia mauza and middle portion of Khurushkul mauza were not flooded by surge water of cyclone 1991. Within the study area, on both sides of DC road (which is within 0.45 km from that road) level of inundation was between 1.83 to 4.88 m. During that cyclone surge, water also entered in the north-western portion of Khurushkul mauza (see Table 4.1 & Figure 4.2). Therefore, it was found from the field survey that, a 0.8 km wide strip of land in Khurushkul union along the eastern bank of Moheshkhali channel was completely washed away by the surge water of cyclone 1991. This highly affected area

of the study union is 8 km along in the north-south direction, but in the extreme southern portion of that area no settlement was found. From Southern boundary of the union upto 3.2 km, the area is completely used for shrimp cultivation and salt production. Within the rest 4.8 km long portion of that affected area, following villages exist,

Pecharghona
Rastarpara
Jaliapara
Rakhainpara
Monupara
Hatkulapara

All the above villages are located in north-south direction along both the sides of DC road.

# b. The distance which most families were willing to move during the recent incidents of cyclone:

From field survey it was found that during the April 1991 cyclone almost all the people of the study area vacated their houses, because they properly anticipated the magnitude of the coming cyclone and the direction of the storm towards the Eastern coast. But due to deterioration of law and order situation during crisis period there was a risk of looting of empty houses and there was a shortage of proper type of cyclone shelter in the area during that time. So most of the families moved only when winds picked up gale, during that time outside environment was totally dark, it was raining with maximum intensity (see Figure 4.14) and at the same time communication network within the area was very poor. So people could not move too far from their houses to find out a suitable shelter. It was found that most of the families travelled 0.4 to 0.8 km to get a shelter space (see Figure 4.14). But during the household survey almost all the respondents reported that they could travel upto 1.6 km to reach a shelter site if they were properly informed about a proper cyclone shelter which was closely associated with this locality and accessible by a good road network.

### c. The density of habitations and settlement pattern1:

The density of habitations is obviously a major factor in determining the catchment area. Where density is high catchment area will be small, since the capacity population will be living close to the shelter. Density of habitation in the study union (9.55 per Hectare)(see Table 3.4) is relatively high than other coastal localities. In Khurushkul union, villages are of linear pattern (see Section 3.4). As

all the major roads of the area have gone through the area in north south direction, so villages also developed here linearly in that direction.

#### d. Communication network in the area :

Communication network especially the road network is a vital factor in shaping the catchment area. In the area where there is no proper road network, people will face tremendous problem to cross even a small distance during the time of cyclone. It is also found that people do not prefer to cross water way especially during the night of disaster. So poor communication within an area will reduce the movement capability of the people for taking shelter in case of disaster, that means in that particular locality the size of catchment area for a proposed cyclone shelter will be smaller.

In the study union, there is a defined road network which connects the union HQ with the adjacent growth centres and maintains interconnection between different villages within the union. But due to poor construction quality (see Table 4.6) and lack of regular maintenance, this road network usually fails to serve the inhabitants properly during both monsoon and disaster periods. So improvement of quality of this road network and its proper connection with the proposed cyclone shelter site will be obviously helpful for a large number of households located within a relatively wide area, to take the advantage of that cyclone shelter. That means size of the catchment area of proposed cyclone shelter can be increased.

On the basis of the above factors and their analyses in relation to the study area, the catchment area of the proposed cyclone shelter has been identified. This catchment area is located in Khurushkul mauza along the western bank of Moheshkhali channel, it is 4.8 km long in north-south direction and 0.8 km wide in east-west direction. This catchment area is extended from the northern boundary of the study union upto 4.8 km in southern direction, within which six villages of Khurushkul mauza of the study union are located and those villages are Pecharghona, Rastarpara, Jaliapara, Rakhainpara, Monupara and Hatkulapara.

## 6.6.2 DETERMINATION OF POPULATION OF THE CATCHMENT AREA :

The existing, under construction and already proposed cyclone shelters within the catchment area will serve the population of that area in case of any probable disaster in future. At the same time other multi-storied permanent structures which are now present and which are going to be constructed within the catchment area can also be used for shelter purpose. But the

present population of the catchment area will be increased in the next twenty years. If it is possible to serve the present total population of the area with the combined capacity of those present and future shelters within the area, then with the increase of population in the next twenty years those shelters will be over loaded. Now it is necessary to determine the number of people who will be left beyond the combined capacity of the existing and already proposed shelters of the catchment area within the next twenty years. After determining this surplus population it will be possible to find out the number of required cyclone shelters and their sizes to serve the surplus population.

According to the census of 1981 (see Table 3.3) the population of the catchment area in Khurushkul union is:

Rastarpara	_	879
Pecharghona	-	987
Jaliapara	-	1,730
Rakhainpara	-	333
Monupara	_	1,647
Hatkulapara	-	772
Tota1		6,328

By considering the 1981 census population as the base year population of the catchment area human population of the area at geometric growth is estimated at 8,402 and 13,475, respectively, for 1993 and 2013. For this population projection purpose annual growth rate of population for the study union has been calculated separately, because most of the people of this area migrated here in recent years from near by districts (see Table 3.6, Figure 3.8 3.7). But the existing, under construction and already proposed buildings in the catchment area (see Table 4.3), which can be used as cyclone shelter will be able to serve the following number of people,

Cyclone shelter of BDRCS
Total capacity of above shelters 9,000

So by considering the projected population of the catchment area in the next twenty years, it is found that, (13,475 - 9,000) = 4,475 will be the surplus population for whom additional cyclone shelter will be needed in that area.

#### 6.6.3 DETERMINATION OF NECESSARY FACILITIES :

During cyclonic period shelter building will be used different perform pre, during and post disaster phase responsibilities of disaster management programme in the grass root level. On the other hand, during normal period shelter to execute different activities building will be used community development programme. Again through the analysis of data found from field survey it has been seen that, there is a negative correlation between income and tendency to leave the house during cyclone, that means people of higher income group less interested to evacuate their houses during disaster. because they possess many valuable assets and due to present social condition there is always a chance of looting in totally empty houses.

At the same time, information gathered from field survey shows that there are some one storied pucca buildings in the study area (see Table 4.4) and people of higher income groups are interested to take small scale loan for improving their housing condition. Therefore, it is assumed by the researcher that, if small scale loan with low rate of interest for low cost storm and surge water resistent housing is available, then some households of higher income group of the study area will come forward to take the advantage of that housing loan. In that case along with large scale formal cyclone shelter, some individual houses of the catchment area can also be developed as the shelter space for those who do not want to leave their own housing environment even on the eve of a disaster. Therefore, in that case two types of shelter space are proposed by the researcher for the catchment area. These are:

- 1. Large scale cyclone shelter cum community centre, which will be used for,
  - Providing shelter space for cyclone and surge affected people and livestock.
  - Storage space for household belongings of cyclone affected people, storage of emergency medical aids and other supplies like food stuff, tents, blankets, firewood etc.
  - Landing platform of boats and trawlers to get outside relief items quickly.
  - Providing space for administrative works of disaster management at pre, during and post disaster period.
  - Assembly of volunteers.
  - Providing emergency medical services for the community immediately after the cyclone.
  - Providing space for meeting and administrative works of community development committee.
  - Providing space to offer community services like mother and child health care, emergency medical and veterinary service.

- Functioning of social services like adult, primary and female education and education on primary health care.
- Providing space to conduct human resource development related training programmes like training on social forestry, specialized pottery and weaving, fisheries etc.

- Providing space to conduct rural credit programmes.

 Providing space for wholesale trading centre of local products and short time accommodation for wholesale traders.

Small scale shopping facilities for the community.

- Providing space for manufacturing of fishing net, components of sealed latrine and assembling of hand tubewells.
- 2. Small scale house cum cyclone shelter, which will be used for,
  - Providing space to give shelter for those people who want to stay within the close range of their homesteads to look after their valuable assets during the cyclone period.
  - Providing space to meet the households' requirement of covered space for living and other family activities during normal period throughout the whole year.

Therefore, to perform the above activities within the cyclone shelter complex, following facilities will be needed in large cyclone shelter for disaster management purposes (see Table 4.13 & 4.14):

a. Space for evacuation site of cyclone affected people.

b. Site for emergency shelter of domestic animals.

- c. Storage space for materials carried by the affected people.
- d. Facilities to protect the evacuees against rain and storm.
- e. Toilet and source of pure drinking water.

f. Cooking facilities.

g. Drainage, waste disposal and lighting facilities.

h. Storage space for relief goods and equipments.

i. Office space for administrative and meeting purpose,

The physical facilities which are required for community development activities within the community cyclone shelter can be identified as follows,

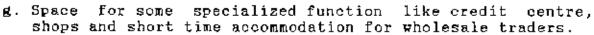
a. Office space for administrative and meeting purposes.

b. Storage facilities.

- c. Classroom facilities to conduct different educational and training programmes.
- d. Functional space to provide medical and health care facilities, and veterinary services.

5

- e. Toilet and infrastructure for supply of drinking water.
- f. Drainage and sanitation facilities



h. Site for wholesale trading centre, manufacturing of fishing net & components of latrine and assembling of tubewells.

For house cum cyclone shelter required facilities are :

- a. A covered space which can be used for giving safe shelter to a small number of people during cyclone.
- b. A space which can be used for living purpose during normal period throughout the whole year.
- c. A storage space for emergency survival items like, dry food, drinking water, firewood, fuel, etc.

# 6.6.4 REQUIRED SPACE FOR ALL NECESSARY FACILITIES WITHIN AND AROUND THE CYCLONE SHELTER:

From the identified activities in cyclone shelter and proposed physical facilities, following characteristics of use of space have been found:

- There are some common requirements for both community development and disaster management activities, such as office cum meeting room, storage space, health care facilities, source of drinking water and toilet. So the same space can be used to meet the demand of those requirements.
- 2. Some facilities will be provided for a particular use, but it can be used for alternative purposes, such as in time of disaster a large room can be used for giving shelter to the cyclone affected people and again it is possible to use the same space as classroom for different educational and training programmes during normal time or as short time accommodation space for wholesale traders.
- 3. Some physical facilities can be used for different, specialized functions during normal period, such as shops and credit centre. So functional space needed for those facilities will remain idle during disaster period.

On the basis of above characteristics and by considering the estimated number of people required to be served by the proposed cyclone shelter, space needed for different physical facilities of that shelter has been estimated in the following manner:

#### a. Number of people to be served by proposed cyclone shelter :

Number of people to be served by newly proposed cyclone shelter = 13,475 - 9,000 = 4,475

According to field survey, percentage of households of higher income group in the catchment area who are interested for taking house building loan = 5%.

According to 1981 census, number of households in the catchment area = 949

 $\therefore$  Assumed number of houses cum cyclone shelter in the catchment area = 949 x  $\emptyset$ . $\emptyset$ 5 = 47.45  $\blacksquare$  47

On the basis of the assessment of the experience of cyclone affected people in the catchment area, the required area of shelter space for one person in private residence = 0.28 sq.m (3sq.ft) (Researcher's Estimation)<sup>2</sup>.

. In a (3.03x3.03m) homestead cum shelter space, number of people can take shelter =  $\frac{9.03 \times 9.03}{0.28} \times 0.8 = 26.66 = 26$ 

(20% of the room area has been considered as circulation space, so 80% area of the room will be used as shelter space)

Therefore, total number of people in the catchment area which will be served by house cum cyclone shelter =  $26 \times 47 = 1222$ 

A The size of population to be served by the large scale cyclone shelter cum community centre = 4,475 - 1,222 = 3,253 i.e.3,300

# b.1. Area required for evacuation space of cyclone affected people:

It was seen that cyclone continues for a short period of time, so evacuees have to be accommodated in shelter for a short time. During that time evacuees normally remain in a tense position when there is no scope for leisure and they usually prefer to stay very closely to each other for sustaining their mental strength. Therefore, it is assumed that in that shelter 0.185 sq.m (2 sq.ft) area will provide a reasonable space for a single person to remain in sitting position.

Therefore, total area required in proposed cyclone shelter cum community centre for evacuation space of cyclone affected people of the catchment area = 0.185 x 3300 = 610.5 sq.m

This area will be used for different specified normal time functions of shelter building.

# 2. Area required for shelter space of livestock :

On the basis of information gathered from situation of shelter sites during past cyclonic incidents it is assumed that, one

bovine animal is equivalent to three sheep or goats in terms of shelter space occupied and each bovine animal needs 1.2 sq.m (12.9 sq.ft) of shelter space. Again from the field survey type of livestock possessed by households (see Figure 3.10) and average number of livestock per household in the catchment area has been estimated (see Table 3.14). Projected number of households for the year 2013 in the catchment area is 2253 and at present there is no killa within the catchment area to provide shelter space for livestock of that area. Considering all the above factors, area required for shelter space of livestock has been estimated as follows.

Area required in cyclone shelter for,

- -- Bovine animal =  $0.92 \times 2,253 \times 1.2 = 2,487.31 \text{ sq.m}$ -- Goat and sheep =  $0.26 \times 2,253 \times 0.4 = 234.31 \text{ sq.m}$
- ∴ Total area required for livestock and poultry in cyclone shelter = 2,721.62 sq.m = 2,722 sq.m (29,261 sq.ft).

This vast area will be used for developing an open air whole sale market of locally produced goods during normal time.

# 3. Area required for storage space :

According to Table 4.10, most of the evacuees came to the cyclone shelter space basically without any personal belongings and assets, when they had to vacate their houses in a very short notice and without any previous preparation during cyclone of 1991, but in case of preplanned evacuation like cyclone of 1992, people took their money, valuable papers, cloths, bedding, food and utensils with them while coming to the shelter. But evacuees normally liked to keep these things with them in their living space, not in a common space and all these things usually do not take much space for their storage. So no separate storage space is proposed within the cyclone shelter to keep the household goods. For keeping emergency medical aids like packets of oral saline, water purification tablets, a cupboard is enough. So for this purpose no separate storage space is necessary. But among the relief materials, can of drinking water, rice and other food stuff have to be kept in a secured, closed and covered space.

For keeping other relief materials—like C.I. sheet, tent etc. roof—of the shelter—building can be—used or a temporary store within the shelter complex can be constructed.

Quantification and prediction of relief items are not possible for a community during disaster, as it will depend upon actual situation. But for keeping relief items safely a minimum space is required within cyclone shelter.

Keeping it in mind, therefore, area specified for storage of relief materials =  $3 \text{ m} \times 4.5 \text{ m} = 13.5 \text{ sq.m} (150 \text{ sq.ft}).$ 

In this area minimum 
$$(\frac{150 \times 10}{3 \times 2 \times 2}) = 125$$
 mnd. i.e, 50 bags of

rice can be kept easily and during normal time this space also can be used for keeping different materials and equipments for community development works, like wheat of food for works programme, construction materials for sealed latrines, etc.

# 4. Area required for office space :

Office space can be used for both administrative purpose and meeting of community leaders at normal period. The same space will be used as control room for organizing pre-disaster period activities and co-ordinating post-disaster period relief activities within the community. The existing FWC is responsible and developed to provide health care services within the study union. But community health workers have to visit regularly different distant villages, so the office space of the cyclone shelter can be used by village level extension workers on primary health care, family planning programme and veterinary services as their base station at community level to provide their door to door services once or twice in a week during normal period.

Considering all the above activities in a office room, area specified for this space =  $(4.5 \times 4.5)$ m = 20.25 sq.m(225 sft).

This area will be able to provide meeting place of at least 12 persons along with their administrative work place and storage cabinet for emergency medical aid.

# 5. Area required for toilet and drinking water facility :

Provision of toilet considered = 500 persons/toilet (during both cyclone & normal time)

Number of users within proposed shelter = 3300

. Number of required latrine for evacuees = 7

Therefore, total area required for toilet space = 7 x 0.91 m x 1.22 m = 7.77 sq.m (84 sq.ft).

These toilets will be basically used by cyclone affected people and during normal time those toilets will serve as community toilets. This continuous use of toilets throughout the whole year will ensure better maintenance (which is very much

necessary for their smooth operation during disaster period) and will provide improved sanitation to community people.

Hanually operated deep tubewell is considered as the source of drinking water for evacuees within shelter complex. Provision of tubewell considered = 1 tubewell per 375 people.

A Number of required tubewells in shelter = 9

Therefore, total area required for this tubewell space =  $(1.22 \times 7.62)$  m = 9.30 sq.m (100 sq.ft).

This tubewell space will also serve as washing and bathing space for evacuees and it will help the community people to get purified water during normal time.

#### B. Area required for shops and rural credit centre :

Proposed area for one shop =  $(3.66 \times 3.05)$  m = 11.16 sq.m

Therefore, area required for shopping space of 5 shops =  $3.66 \text{ m} \times 3.05 \text{ m} \times 5 = 55.8 \text{ sq.m} (600 \text{ sq.ft})$ . Area required for office space of rural credit centre =  $(6.10 \times 6.10) \text{ m} = 37.21 \text{ sq.m} (400 \text{ sq.ft})$ .

The above office space can be used by 5 office personnel with storage space of file cabinets and customer service area.

#### 7. Area required for landing platform :

Area for proposed jetty (landing platform for small water vessels) on the eastern bank of Moheshkhali channel within catchment area =  $(91.5 \times 2.7)$  m = 247.05 sq.m (2700 sq.ft).

This jetty will be used as jetty for fishing trawlers and ferry boats from Cox's Bazar and Moheshkhali island. During disaster it will serve as landing platform for ships and boats with relief materials from main land.

# 8.6.5 TOTAL REQUIRED SPACE AND ITS ALLOCATION TO DIFFERENT LOCATIONS:

At present all the community service facilities of the study area are present scatterdly in different locations of the area (see Table 4.5). Therefore, to develop the proposed shelter as the focal point of all community development works of the area, all the identified facilities have been concentrated in one shelter complex instead of creating more than one cyclone shelter.

So by considering only one new cyclone shelter for the catchment area, first of all different functional spaces with their required operational area are identified and described below:

Area required for	(sq.m)	(sq. ft)
- Evacuation space - Shelter space of livestock - Storage space - Office space (administration) - Office space of credit centre - Shopping space - Utility space	610.50 2,722.00 13.50 20.25 37.21 55.80 17.07	29,261 15Ø 225 4ØØ)
- Landing platform	247.Ø5	2,7200
Total area required for differen functional spaces within and around cyclone shelter	t 3,723.38	40,120

For determining the area of above functional spaces for the proposed cyclone shelter within the catchment area of the study union, following factors were considered:

- Established architectural standards of different usable spaces for different specified functions.
- Suitable grid size for easy construction.
- Practice of space use in rural environment.
- Existing standards used for infrastructural facilities in coastal regions of Bangladesh.

From the identified normal time functions of cyclone shelter complex it is found that, some functions are contradictory to each other, such as when activities of a trading centre will be going on then at the same time and at the same location it will be very difficult to perform educational cum training activities smoothly in a peaceful environment. Again this co-existence of two different types of function at the same location will create circulation problem.

Therefore, to make the circulation pattern smooth and to ensure undisturbed working environment for similar type of functions, certain facilities have been divided into two different blocks of shelter, i.e., social block and economic block will be the two wings of the same cyclone shelter building, landing platform has been considered as outside facility of shelter site and evacuation space for livestock has been considered as the common space among the two blocks of shelter building. Through careful architectural design complete

segregation and isolation of different types of functional spaces within the same building is possible. Therefore, area for different functional spaces are distributed into different locations and for different uses in the following way:

Category of	Total area	required	Space distribution		Area	
functional spaces	59.4	sq.ft	Location	Use	Sq.a	Sq.ft
Evacuation space	610.50	6,688	a. Social block	Class room	331.5	368
			b. Economic block	a. Residential accommodation	723.2	248
				b. Business transaction	55.8	68
Shelter space for 1:vestock	27722.00	29,281	Common open space	Manufacturing and Market	2,722	29,261
Storage space	13.05	150	Social block	Store	J3.5	156
Office space	57.46	625	a. Social block	a. Administrative work b. Heeting place c. Health service d. Weterinary service	20.25	223
			b. Economic Block	Credit Centre	37.21	488
Shopping space	55.88	688	Economic block	Shop	55.8	<i>6</i> 00
Utility space	17.87	184	a. Social block	a. Toilet b. Tubewell space	4,44 5.17	48 56
			b. Economic Block	a. Toulet b. Fub <del>ewe</del> ll space	3.33 4.13	35 44
Landing platform	247.05	2,700	Outside the shelter	Jetty	247.85	2700
Circulation space	726,32	2,433	a. Social block b. Economic block	Circulation Circulation	112.46 113.64	1,209

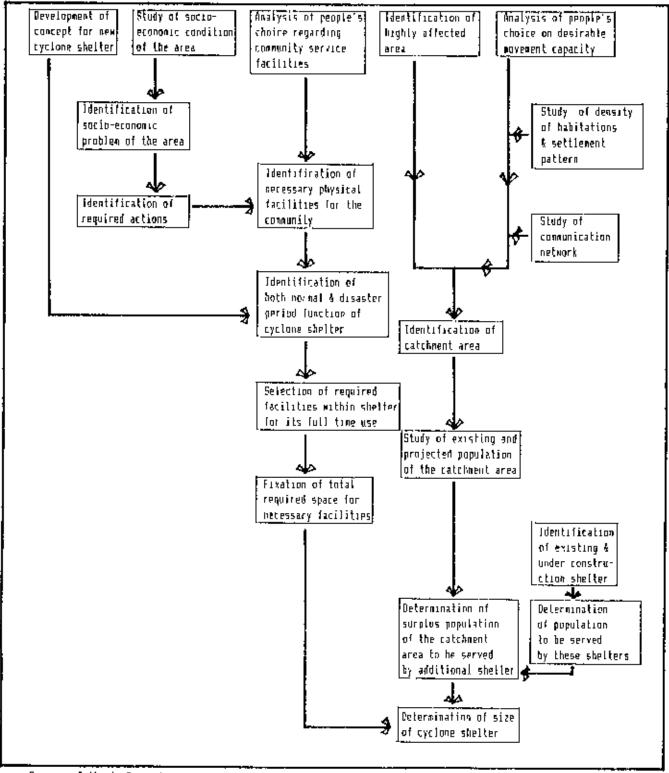
On the basis of above distribution of space, total area required for cyclone shelter complex = 3,702.63 sq.m (39,803 sq.ft)

This area is divided into three portion :

- 1. Floor space for social block = 487.32 sq.m (5,239 sq.ft).
- 2. Floor space for economic block = 493.31 sq.m (5,303 sq.ft).
- 3. Area for livestock = 2,722 sg.m (29,261 sg.ft).

These floor spaces of two different blocks have been used in design considerations for cyclone shelter building.

Figure : 6.2 Schematic Presentation of the Methodology for Determination of Use and Size of the Cyclone Shelter.



Source : Author's Suggestion,

## 6.7 SUMMARY :

The traditional concept of disaster management preoccupied with disaster management activities which were primarily focused on relief action. But natural disasters are formidable obstacle to economic and social development of country. Again to reduce the vulnerability of a community due to natural disaster, socio-economic condition of that community has to be improved and this improvement will be helpful to create a community which secures its own safety by itself. So community development is directly involved with disaster preparedness programme and the new concept of two directional disaster management considers the effect of human activities on natural and socio-economic environment which, in turn, influence the extent of natural disasters significantly.

Therefore, on the basis of the new concept of disaster management, it is essential to consider a cyclone shelter not only as an evacuation space for cyclone affected people during emergency period but also as a community development centre throughout the whole year. This new generation cyclone shelter will provide space to implement different stages of cyclone disaster management responsibilities and to carry out the community development activities at the grass root level.

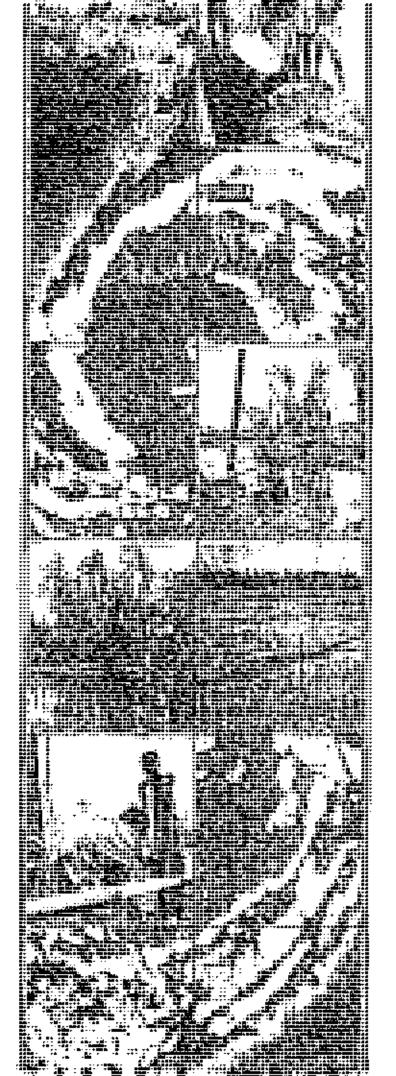
The major components of cyclone shelter planning have been identified on the basis of the concept of new generation cyclone shelter. On the basis of socio-economic profile of the study area, people's perception about disaster management and community development activities, the vital requirements for the area's community development activities and necessary components for a proper cyclone shelter of the area have been defined. According to that requirement shelter's normal time functions have been identified. Then size of shelter has been determined on the basis of,

- -- Size of the catchment area in study union.
- -- Population within the catchment area.
- -- Necessary facilities in the shelter.
- -- Required space for all necessary facilities.
- -- Total space and its allocation.

#### Notes :

Settlement pattern is the shape of the clusters of homesteads which make up the villages.

As most of the evacuees have to stay in cyclone shelter for a short period of time, so they will be able to spend their time in sitting position, therefore no sleeping space is necessary within a cyclone shelter.



CHAPTER: 7 LOCATION, DESIGN GUIDELINES AND MANAGEMENT OF CYCLONE SHELTER

# 7.1 INTRODUCTION :

After identifying the normal time use and size of the proposed cyclone shelter, the other major components of the cyclone shelter planning task are location, design of cyclone shelters and incorporation of people's participation in the process which are discussed in this chapter.

## 7.2 LOCATION OF CYCLONE SHELTER :

One of the major component of cyclone shelter planning task is to select the location of that shelter. For this purpose first of all certain socio-economic and physical characteristics of the catchment area, which have some connections with the probable location of a cyclone shelter have been taken into considerations and then entire catchment area within the study union has been analysed on the basis of those site characteristics. After that, depending on the major findings of that site analysis certain locational criteria of cyclone shelter have been selected. Then these locational criteria were used to evaluate the actual potentiality of two different alternative locations for proposed cyclone shelter.

#### 7.2.1 SITE ANALYSIS:

Site analysis of the catchment area has been done by considering the following site characteristics which are selected on the basis of recent experiences of the use of cyclone shelter, people's opinion and analysis of community service facilities:

- a. Land level.
- b. Centre of minimum travel.
- e. Existing communication network.
- focal point of the community.
- e. Nature of land use.
- f. Soil condition and ground water level.
- g. People's choice.

#### a. Land level :

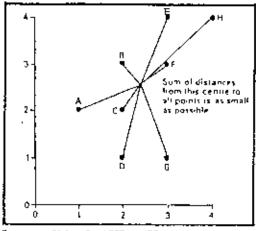
From the field survey it has been found that land slopes from east to west in the catchment area (see Figure 4.1). The DC road of the study union goes through this area which is parallel to the coast line and analysis of field survey also reveals that the level of storm surge inundation at the western side of DC road was 4.88 to 3 m above ground level during the cyclone of 1991. But this level of inundation was much lower at the eastern side of DC road as the ground level of this area is relatively higher than the western side of the road in relation to MSL. So

the eastern portion of DC road has been considered specifically to find out a suitable location of the proposed cyclone shelter during the preliminary level of site selection process. This portion of the catchment area is inside the coastal embankment and DC road is also giving an additional protection to this area.

# b. The centre of minimum travel:

The centre of minimum travel is the location from which the sum of the distances to all the points in a distribution is a តារំពារពេល (Ebdon; 1987). This is illustrated in Figure : 7 1. optimal location οf shelter may be judged primarily in relation to the location of the settlements at risk from flooding Ьγ surge water. The position of the centre of minitravel is therefore important to find out the optimai location of cyclone shelter.

Figure: 7.1 Centre of Minimum Travel.

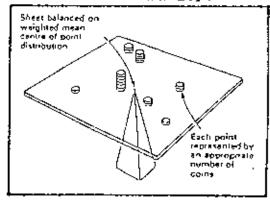


Source : Ebdon, D., 1987, p. 133.

The position of this centre of minimum travel can be found manually by a process of trial and error. By choosing a number of alternative trial locations and calculating the sum of from each trial centre distances to all the points, the true centre of minimum travel can eventually be found. But in most mean centre and centre of minimum travel are likely to cases the be fairly close to each other. Therefore, the mean centre of the settlements within the catchment area can be calculated by using Ebdon's minimum travel method to find out the optimal location of proposed cyclone shelter in that area.

The mean centre is the simplest measure of the centre of a spatial distribution. It is analogous to the mean of a set of data and is calculated in a very similar way. In the calculation of the mean centre each point is given equal weight. In some situations however, it may be clear that each point should not be given equal weight when calculating the centre of the distribution.In that case a mecentre is calculated in a way which is known as weighted mean centre (see Figure 7,2).

Figure: 7.2
The Weighted Hean Centre
As Centre of Gravity.



Source : Ebdom, D., 1987, p. 131.

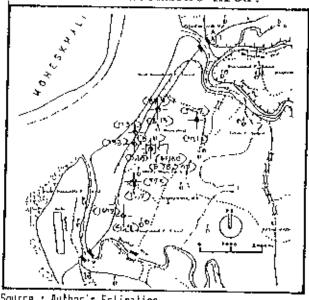
The equation for the weighted mean centre is

$$\overline{X}_{IJ} = \frac{\Sigma XW}{\Sigma W} \longrightarrow (1), \overline{Y}_{IJ} = \frac{\Sigma YW}{\Sigma W} \longrightarrow (2)$$

Where X and Y are the co-ordinates of the points, W denotes the numerical weight assigned to each point,  $\overline{X}_\omega$  and  $\overline{Y}_\omega$  are the weighted means of these co-ordinates & n is the number of points.

As a first step in calculating the weighted mean centre of the distribution of villages within the catchment area, it was necessary to quantify the locations of those settlements. This has been done by calculating the co-ordinates of locations of the villages according to an arbitrary system. calculation is given in Table : 7.1 & its position is marked in Figure 7.3. In this diagram figures in brackets are 1981 population of the villages within the catchment area of the study union. Co-ordinates followed by Y) are given beside leach centre point of the settlement. They are measured in hilometre.

Figure: 7.3 WHC in the Catchment Area.



Source : Author's Estimation.

Table : 7.1 The Melahted Hean Centre of the Distribution of Villanes in the Calchnent Area

Village	Co-ordinates		Meight (Population)	Meighted Co-ordinates	
	_  <u> </u>	Y	W	XH	7 <b>W</b>
Fecharghona		12	967	9670	11,50
Rastarpara	7	13	879	6153	11,42
Makhaiupara	5		333	1665	3,33
Jaliapara	5	11	1,738	8658	17,038
lunupara	4	4 _	1,647	6500	6,506
latku (apara	5	7	772	3060	5,494

Source : Field Survey, 1993,

ŁH = 6,328 EXW - 34,586

#### 5 From equation (1) & (2)

$$x_{\text{W}} = \frac{x_{\text{NM}}}{x_{\text{N}}} = \frac{36,586}{6,328} = 5.78 ; x_{\text{N}} = \frac{x_{\text{NN}}}{x_{\text{N}}} = \frac{57,383}{x_{\text{N}}} = 9.87$$

Therefore, MC (5.78, 9.07) is the centre of minimum travel in the catchment area and if this MC is selected as the location of cyclone shelter then sum of distances from this location to all the villages will be as small as possible.

#### c. Existing communication network :

To make the cyclone shelter accessible in terms of both the travelling time and distances covered by the evacuees, it has to be properly connected with the adjacent settlements through a good communication network. But for this purpose, creation of completely new road to connect the proposed cyclone shelter with the existing road network of the catchment area will increase the cost of the cyclone shelter project. Therefore, to reduce the project cost, it is necessary to locate the cyclone shelter adjacent to an existing major road of the locality and it will ensure shelter's, effective use in both disaster and normal time.

Now, the identified mean centre (MC) of the distribution of settlements of the catchment area is located at the eastern side of DC road, which is properly connected with a rural road (type Rz) of the area (See Figure 7.8). MC is not directly approachable from the sea side, but this direct approach is necessary for the proposed economic activities in cyclone shelter complex during normal time and to mobilize relief items quickly for distressed people during the disaster. Now, there is a rural road (type R2) at a distance of 0.3 km from MC in its north side, which connects the coast line and major villages of the catchment area with the main road network of the union. Therefore, in terms of better communication, any site near to this road in east-west direction has more potentiality to serve as the location of the proposed cyclone shelter.

#### d. Focal point of the community :

If a cyclone shelter is located in such a place towards which movement of the local people is maximum for their daily activities, then the physical facilities of that shelter will be used more effectively for community development purpose. The inhabitants of a community are usually very much accustomed and familiar to the site of the community's focal point. So at the time of disaster spontaneous movement towards their already familiar site for taking shelter will be seen if cyclone shelter

is available there. So from this point of view it can be said that, already established focal point of the community is an ideal location for the proposed cyclone shelter. Therefore, the researcher has given more effort to find out a focal point of the community within the catchment area during his field visit. As a result of this effort a place has been found which can be defined as one of the major focal point of the catchment area in terms of daily activities performed within it and its placement near the cross section of the area's two major roads. At the same time it is directly approachable from sea side and directly connected to all the villages of the catchment area by a rural road (type R2). Near this place there are some shops, a big pucca mosque & madrasha and the biggest pond of the area.

#### e. Nature of Land use:

Land use pattern within and around a particular site will determine the scope of any future development work within that area. Basically the premises of a cyclone shelter will become a public space which will perform different community development functions. This particular land use of cyclone shelter site will be conflicting to the residential environment, if this shelter site is situated very near to the homestead area of a village. So to maintain a peaceful living environment within the community, cyclone shelter should maintain a reasonable distance from community's homestead area. Again price of homestead land at level will be higher than the price of any type of agricultural land. Therefore, collection of land from homestead area for a cyclone shelter complex will be very difficult. At the same time a vast area of land for this purpose may not be available within the heart of the congested homestead area of a settlement.

In this regard the area adjacent to the mosque of Kauarpara has enough possibility to be developed as a cyclone shelter complex. This peripheral area will not disturb the residential environment of the settlements and at the same time it will not be too far to become completely isolated from the homestead land of different villages of the catchment area. Again, agricultural use of the adjacent areas of this piece of land will not conflict with the normal time functions of the proposed cyclone shelter.

### f. Soil condition and ground water level :

Quality of soil and its geo-technical behavior are very important factors to determine the potentiality of a particular land to be developed as a site for a large scale physical infrastructure. Though no soil test report has been found for the study union, but it is assumed from the nature of land form of the area (see Table 3.1) that, the western portion of the DC road is a

newly formed land, where the soil is structured, grey sandy loams to clays and strongly acid. This type of soil is very much unpredictable for any type of heavy construction. At the eastern portion of DC road specially along the periphery of Kauarpara land has been found in more or less stable form

Analysis of secondary data shows that within the study union during both pre and post monsoon cyclonic periods operation of hand tubewells at ground surface of the catchment area will not be a problem. But if shelter is located on kills, then a deep tubewell will be necessary.

Figure : 7.4 Groundwater Environment at Seacoast.

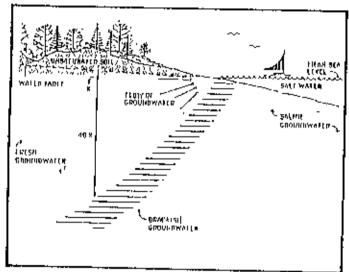
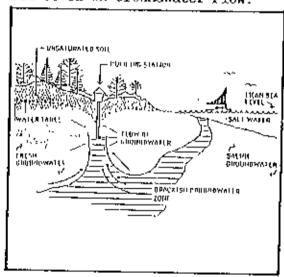


Figure : 7.5 Effect of Well Drawdown Below Mean Sea Level on Groundwater Flow.



Source : Narris, C.W. et al, 1988, p.p. 710-12.

Source : Harris, C.W. et al, 1989, p.p. 719-12.

But the development of high-yield well can lower water table significantly and draw water from considerable distances. this case the ghinnalq of a high-yield well (deep tubewell) specially in coastal area needs special attention. Figure shows the typical relationship of fresh groundwater to brackish groundwater in ideally homogeneous soils in sea coast conditions. Hero the fresh water, in effect, floats on top of the salt water its lower specific gravity. Figure 7.5 shows effect of lowering the water table with a deep tubewell. The area of the come of the depression will be such that the annual yield of the deep tubewell will equal the annual surplus of rainfall over runoff and evapotranspiration for the area of the come, and the depth of the cone will be whatever is necessary to provide steep enough gradient to move the water to the well. The more permeable the soil, the flatter the cone. The greater the yield, the larger the cone in all dimensions. In a sea-coast condition, if too high an annual volume is withdrawn, so that the water table falls to mean sea level, brackish water will enter the deep

tubewell, ruining it for water supply purposes. Therefore, location of the proposed cyclone shelter near the extreme eastern edge of the catchment area will ensure the problem free operation of both hand and deep tubewell for supply of fresh drinking water, by maintaining a reasonable distance from nearby coast line.

#### g. <u>People's Choice</u>:

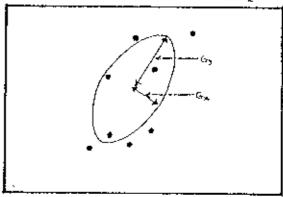
Planning has been defined as highly complex process. The making of decisions can be difficult particularly where vast amount of data are required, where many factors need to be weighted one against the other and with uncertainty about the outcome of other parallel trends and events (Hobbs, 1981). So today involvement of people in planning process for whom a plan will be prepared is necessary for successful implementation of that plan. From this point of view it can be said that in site selection process of a cyclone shelter planning task, people's preference and choice for the location of a cyclone shelter has to be considered seriously.

Therefore, primary data on desirable distance which can be covered by the inhabitants of the area to find out a proper shelter space in case of disaster has been collected. By analyzing this data it is found that most of the respondents preferred 0.4 km as the allowable distance of any cyclone shelter due to poor communication network within their locality, but in case of properly connected cyclone shelter with inhabitant's homestead by an improved road network, 1.6 km is considered by the local people as the preferable distance for the location of the shelter site (See Table 5.2).

Now, if centre of minimum travel of the catchment area, i.e., mean centre of the distribution of villages in catchment area is selected as the location of a proposed cyclone shelter, then it is necessary to determine the areal spread of villages of the catchment area around the mean centre (MC). And this measure of spatial dispersion of the settlements within that area will be helpful to verify whether local people's preferable distance for cyclone shelter is suitable to the distance between MC and individual village or not. For measuring the spread of villages around the mean centre, standard distance can be used. Standard distance, otherwise known as standard distance deviation or root mean square distance deviation is the spatial equivalent of standard deviation and it is a convenient measure of dispersion in point patterns since it summarizes the spread of points in just one value (Ebdon, 1987). However, it takes no account of the fact that the spread about the mean centre may be different in different directions. So in case of greater dispersion in a particular direction, the standard deviational ellipse as the name implies, is a measure which summarises dispersion in a point pattern in terms of ellipse rather than a circle.

The ellipse is centered on the mean centre, with its long axis in the direction of maximum dispersion and its short axis in direction of minimum dispersion. It is mathematically proved that the axis of maximum dispersion in a point pattern is always at right angles to the axis of minimum dispersion. In this standard deviational ellipse, standard distance in short and long direction can be found by using the following equations.

Figure : 7.6 Stundard Deviational Rilipse.



Source : Ebdon, D., 1987, p.137.

Standard distance in short direction,

$$\delta x = \sqrt{\frac{(\Sigma x'^2)\cos^2\theta - 2(\Sigma x'y')\sin\theta\cos\theta + (\Sigma y'^2)\sin\theta}{n}} ----- (3)$$

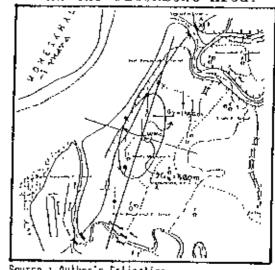
Standard distance in long direction,

$$6y = \sqrt{(\sum x^2)\sin^2\theta + 2(\sum x^2y^2)\sin\theta\cos\theta + (\sum y^2)\cos^2\theta} - ---- (4)$$

Here, 6x and 6y are the standard deviation parallel to respectively x and y axis of the ellipse,  $\theta$  is the angle of rotation, x' and y' are the transposed co-ordinates of the points, and n is the number of points.

From the spatial distribution settlements in the catchment area it is found that dispersion in settlement pattern about the MC greater in northeast-southwest direction.So a standard deviational ellipse has been fitted & according to Figure 7.7 four villages out of six in the catchment area (i.e. 87% of the total villages) are present within the standard deviational e1lipse about the MC of the distribution of villages in the catchment area.The standard distances in both the directions which are found from the ellipse are much lower than local people's preferable distance between their houses and location of proposed cyclone shelter.

Figure: 7.7 SD in the Catchment Area.



Source : Author's Estimation.

# 7.2.2 **EVALUATION OF OPTIONS OF LOCATION CONSIDERED**FOR CYCLONE SHELTER:

On the basis of major findings from the site analysis of catchment area following locational criteria have been determined to find out the best location of proposed cyclone shelter:

- Risk free land.
- Optimal location as the centre of minimum travel.
- Direct connection with existing communication network.
- Potentiality to become the focal point of community.
- Least contradiction with adjacent land use.
- Technically sound soil condition.
- Good quality and desirable level of ground water.
- People's acceptance.

Now, two possible options of location (MC & a site 400 m. away from MC) for the proposed cyclone shelter in the catchment area are evaluated on the basis of above criteria.

#### First Option :

Though MC possess the highest degree of locational advantage as it is the centre of minimum travel, but in this particular case MC within the catchment area has some serious limitations. The identified MC in the catchment area is situated in such a location, which is not connected with the existing road network and at the same time MC is not directly approachable from the sea side by any proper road. Again, as MC is located at the back side of an existing settlement, so its scope is limited to become focal point of the community. Though MC is situated at the eastern side of DC road, but it is very close to coast line, so availability of sweet ground water at this particular location will always be a problem and this will ultimately affect the water supply system in the proposed cyclone shelter complex.

#### Second Option :

It is another site which is only 400 m.away in northeast direction from MC for proposed cyclone shelter. The site is situated at the middle of two junctions of 3 major roads - one directly coming from the seaside, second one is DC road and the other one coming from union headquarter. The noticeable advantage of the site is that it can be developed as a major focal point of the community, because a big pucca mosque with madrasha and a big pend already exists there along with some shops. Due to the presence of these activities and two major intersections of roads near the proposed site, people of Rastarpara, Pecharghona, Rakhainpara and Jaliapara will come to a close contact with the shelter site for their everyday movement and function.

Through the near by DC road the shelter site can be directly connected to Cox's Bazar town and nearby Chaufaldandi union, and at the same time it is directly connected to sea side by an existing rural road (type Rz), so this site can be developed easily as an economically active place of the area. Within this site the land level is higher then the general land level of surrounding areas. Most of the land within the site is covered either by vacant or agricultural land, so number of displaced persons for creating physical infrastructures of cyclone shelter will be small. This area is protected by both the embankment and DC road from the high tide water of sea. Again, it is not the optimal location like the centre of minimum travel but this area is very close to MC, so it will also share the locational advantages of the centre of minimum travel.

Table: 7.2 Choice of Option for Location of Proposed Cyclone Shelter.

Possible Options Criteria	First Option (MC)	Second Option (400 n away from MC)
Risk free land level	Yes	Yes
Optimal location as centre of minimum travel	Yes	No
Direct connection with existing communication net works	No	Yes
Potentiality as focal point of community	No	Yes
Least contradiction with adjacent land use	Yes	Yes
Technically sound soil	No	No
Good quality and level of groundwater	No	Yes
People's acceptance	Yes	Yes

Source: Author's Estimation.

Therefore, by analysing the two alternative sites, second alternative is found with some extra advantages. So it can be described as highly potential in terms of advantages available at that site and it has been chosen as the location of proposed cyclone shelter within the catchment area.

	FIGURE : 7.8  FIGURE : 7.8  THE STUDY AREA OF POWER POWER TO THE STUDY AREA OF POWER TO THE STUDY AREA	
The state of the s	KITURUSHKUL MAUZA HELI PROPOSED CYCLONE SHELTER	]
	SCALE SCALE	
	TETAJA MAUZA	
	PATALI HACHHUAKHALI UNION	
	BACHEJIALI RIVER	
	COX'S BAZAR TOWN	

## 7.3 DESIGN GUIDE LINES FOR CYCLONE SHELTER:

In identifying design guide lines for cyclone shelter, first of all certain design considerations have been taken into account and then depending on those considerations some design criteria have been set. After that some possible design options different components of a cyclone shelter have been evaluated on the basis of selected design criteria to find out design proposals on different aspects of shelter. Finally a schematic design has been prepared depending on those specific design proposals. This schematic design has developed by considering specifically the actual site condition of the catchment area within the study union. In this schematic design along with an idea of architectural quality of space, form and view, a preliminary idea on structural cyclone shelter and a rough estimate of its cost are also given. Along with the cyclone shelter cum community centre, certain house cum cyclone shelters have also been proposed by the researcher and a schematic design with rough cost estimate of that shelter has also been incorporated in this study.

### 7.3.1 DESIGN CONSIDERATIONS FOR CYCLONE SHELTER:

For the design of the proposed cyclone shelter following considerations have been taken into account on the basis of actual physical condition of site and evacuees behavioral pattern.

# a. Use of Cyclone shelter during normal and disaster periods :

The proposed cyclone shelter of the catchment area has been identified as the community development centre for this area, which will be used for different socio-economic activities during normal time and in case of disaster it will provide shelter space for the local community. Therefore, the main issue in cyclone shelter design is to address the regular use pattern of the shelter in the first place and then to apply specifically defined design parameters to ensure its application and performance as a cyclone shelter.

Some specific community development activities have been chosen as the normal time functions for proposed cyclone shelter. Among these activities, some may conflict with each other due to their nature and time of performance, such as educational and training activities require a calm and quiet environment, but if class rooms are closely associated with the market place then activities of school and training programmes may be hampered. So to avoid conflict between two different types of function, more attention is necessary on circulation pattern and allocation of different functional spaces within cyclone shelter complex.

Again analysis of household data shows that as the cyclonic wind gathers speed, a large number of people usually rush to the within a short period, usually 5 to 6 hours before the cyclone hits the area. Therefore, to accommodate these people within the shelter and to avoid confusion and conflict in the crisis period, an efficient organization of internal and external spaces of cyclone shelter is required. During normal time shelter complex will be used by a relatively smaller number of people the disaster period. So if those functional spaces are designed by considering only the number of their normal time users, then in cyclone time it will create a suffocating internal environment for a large number of evacuees. Therefore, in case of designing internal and external functional spaces within cyclone shelter complex, the nature and demand for both the normal and disaster time functions of the shelter have to be considered.

# b. Evacuees behavioral pattern :

Evacuees behavioral pattern during recent cyclonic incidents have been found by analyzing household data on this aspect. This pattern shows that with the improvement in the techniques of warning and its dissemination more and more people move to shelters before the cyclone (see Table 4.9). But the decision to move to the shelter is always delayed (see Figure 4.14), resulting in the last moment rush to the shelter, due to this they usually fail to take their livestock with them (see Figure 4.12) and in that situation they generally abandon livestock (see Figure 4.13). The results of field survey revealed that food and clothing are the common items generally carried by the people to the shelter (see Table 4.10). In case of large shelters, male and female evacuees stay together in groups. Most of the people spent their time either in standing or squatting position in the shelter. When there were excessive rush all had to remain in standing position for long 8-9 hours. During the storm, the people inside the shelter usually cry and say prayers out of fear (see Table 4.14). Usually cyclone affected people stay in shelter for a very short time (see Figure immediately after cyclone they basically engage themselves in reconstruction of their houses (see Figure 4.20). Therefore, in designing more effective cyclone shelter all these behavior related factors have to be taken into consideration.

## c. Local value system :

Catchment area of proposed cyclone shelter is located in a rural region, where people's life style and living pattern is very simple and this type of life style and living pattern play dominant roles in shaping local people's values and concepts of living environment. The simplicity of rural life style which is casual as opposed to formal urban life is reflected by rural

architecture. Rural spaces are segmented by social domains unlike urban spaces which are compartmentalized according to function specific zones. Spaces are small and their organization is very simple in a rural built form and this type of organization of spaces is generally developed on the basis of easy circulation pattern. Therefore, to design an user friendly cyclone shelter, that means to make that shelter more acceptable to rural people during normal time use, the conceptual attitude and values which are deep rooted among local people with respect to built forms and spaces as opposed to urban values and attitude are important to be respected and given expression in the design shelter.

#### d. Structural form of cyclone shelter :

Structural form of a cyclone shelter is a very important component to ensure its effectiveness by providing resistance to a cyclonic storm of at least 250 km/hr and to keep the plinth height of the shelter building above the maximum probable surge height at the shelter site. To attain these qualities, the shelter must have a permanent built form either raised on pillars or placed on a high platform. However, the technology, material and method of construction available in remote coastal areas are mostly indigenous. The local structures of the study area are mostly temporary or semi-permanent in nature (see Table 3.19). Choice of structural form therefore is very crucial to recognize and to pay respect to the traditional relationship character of local people with nature and built spaces.

## e. Accommodation of certain specific demands :

A cyclone shelter has to provide certain specific services to its users during both normal and disaster period to increase shelter's effectiveness (see Figure 5.1). These services toilets and sources of drinking water, protection from sun rain, provision of ample day light and natural ventilation. Size and type of window, its location and construction details, all these are very much important to provide ample day light and natural ventilation within cyclone shelter. But the extreme climatic variation in cyclone time and in normal weether condition are the most conflicting and contradictory factors in design consideration of window openings for cyclone shelter to attain better natural ventilation—and day lighting. Large window opening may require for normal time activities in cyclone shelter, but on the other hand, this large window opening can be source of inconvenience from the point of its performance as a cyclone shelter. Again, provision of protection to shelter users during cyclonic period against rain water and wind is also an importent factor. Therefore, in determining the shape, material, detail and flexibility of window openings proper thought is necessary.

Sufficient number of drinking water sources and toilets are important factors to make a cyclone shelter more effective especially during disaster period and these facilities must be located at a risk free level from surge water. Most of the local people of the study area are not used to pucca latrine, maintaining a neat and clean toilet in shelter will be very difficult. Therefore, both the size and location of the service area are very important things to be considered in shelter design.

# 7.3.2 EVALUATION OF DESIGN OPTIONS:

On the basis of already identified design considerations, the following design criteria have been selected,

- Effective use of each functional space with its full capacity.
- Social acceptability and local value system.
- Easy circulation pattern.
- Simple technology.
- Maximum possible people's participation.
- Extension of existing infrastructure of locality.

Then different design options on the following aspects of cyclone shelter complex have been evaluated on the basis of above criteria:

### a. Major functional spaces within cyclone shelter complex :

Possible options for designing major functional spaces are,

- Combination of all internal and external functional spaces within single physical facility.
- Distribution of different functional spaces into different physical facilities on the basis of their use.

Here the first option is relatively easy to execute, but its operation will be highly difficult, when two opposite types of function will contradict with each other during their performance at the same location and at the same time. As two major types of opposite function (social and economic) have been selected as normal time activities of the proposed cyclone shelter, so in case of first option, complex type of circulation pattern will be developed and this type of co-existence of two opposite types of function under the same roof will not also be socially acceptable. But in this regard second option will provide enough freedom and simplicity in design. Therefore, the second option is more preferable in designing the major functional spaces for proposed cyclone shelter complex.

## b. Use of ground floor within shelter building :

In this regard possible options are,

- Reeping the ground floor completely open to ensure easy movement of surge water through it and to provide space for some informal activities during normal time.
- Effective use of ground floor for some specific normal time activities with proper physical facilities and provision for free flowing of surge water through this floor during cyclone.
- Construction of a sealed chamber at ground floor for storage of food grain and water.

Here, the first option is a very easy and risk free solution meet the requirements of highly adverse situation during disaster period. But as in this option, ground floor of shelter building will be kept completely free without any wall or enclosed space, so this floor basically will remain unutilized during normal time throughout the whole year, which major obstacle for capacity utilization of physical facilities of cyclone shelter complex. But the second option is a innovative approach in cyclone shelter design. According to this option ground floor of cyclone shelter can be designed in such a way so that it will be able to provide some enclosed functional spaces for certain normal time activities, like credit centre and shopping space, which will remain unutilized for disaster period activities within cyclone shelter and at the same time certain construction details and design features can be introduced in this floor design to allow the surge water to pass through it. Again for keeping the furniture and valuable goods of this floor free from surge water, certain architectural design solutions can applied (which are more elaborately described in schematic design section of this chapter). Again the third option is effective, but costly solution. Therefore, the second option is more preferable than the other options to ensure effective utilization of shelter's each functional space with its full capacity and it is also applicable to house cum cyclone shelter.

# Position and design of stair in evelone shelter:

For this purpose the possible options are,

- A broad stair directly form ground to upper floors.
- An urban type internal stair for vertical circulation.
- A broad open stair from ground to the first floor along with an internal stair for floor to floor connection.

From the above options it is clear that the second and third options are somehow reflecting the typical urban circulation space, though the last one is relatively better, but it will create a tight environment for floor to floor vertical circulation for a huge amount of people during disaster. While the first option will provide facilities for an easy vertical circulation during all the time. In this case the extended stair will serve as jetty in submerged situation of the surrounding land. Therefore, the first option will be able to ensure easy circulation within the shelter.

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## d. Toilet facility within cyclone shelter :

For this facility the possible options are,

- A normal layout of a public toilet like a service area of urban building.
- Grouping of toilets by keeping a reasonable distance from the living space of shelter with proper facility to keep them usable during normal and disaster periods.

Here, the first option is a very easy solution, if proper service lines are available, but it will not be socially acceptable and maintenance of this type of toilet will be very difficult especially during disaster period due to evacuees lack of proper knowledge on hygienic sanitation. Under this circumstance, the second option will work more efficiently during both normal and disaster period.

### e. Window openings of cyclone shelter :

For this purpose possible options are,

- Window with normal sill height (0.91 m from F.L.) and frame of steel angle with glass shutter.
- Window of wooden frame and shutter with 0.46 m sill height with deep rain protection device over it.

Here, the first option will fail to provide enough day light and natural ventilation while there is no electric line within the catchment area. This type of window will create danger situation by broken glasses during cyclone. But window of the 2nd option will help together in ventilation and lighting of the shelter building as they are customarily kept open during the day in suburban and village locations, and at the same time this type of window will resist strong wind and vandalism more effectively. Therefore, it will be able to ensure better environmental condition in cyclone shelter during both normal and disaster period.

# f. Certain specific facilities for disaster period in shelter :

In this regard, the possible options are,

- No special arrangement for storage of personal belongings, storage of rain water and use of roof,
- Special arrangements for storage of personal belongings, storage of rain water and use of roof.

Here, the first option totally has rejected the need for any storage space for evacuees personal belongings, possibility of rain water collection and effective use of roof. But the second option considers those facilities with due consideration and has provided innovative ideas on the use of furniture free functional spaces in rural environment, storage of rain water in a reservoir to use it for washing and drinking purpose (see Table 3.2, Figure 4.3,4.4 & Table 4.2), storage of evacuees personal belongings at the deep space over sunshades and the use of roof for female's washing, cooking and bathing purposes, when there will be no rain. According to this option in household based shelter, false ceiling below main roof of evacuation space can be used for storage of food, medicine, firewood etc. for disaster period. Therefore, the second option is more attractive.

# g. Structural form, construction material and view of cyclone shelter:

In this regard, the possible options are,

- Rigid RCC structure of urban office format with provision for vertical extension.
- A combination of RCC superstructure and brick built internal walls with due respect to rural built forms.

Here, the first option is developed entirely on the basis of structural rigidity required against differential settlement and to withstand wind forces of storms. But it totally ignores the local value system towards built forms and spaces. Therefore, the second option which suggests brick pointing exterior surface with more emphasis on horizontal expansion in future to give a more familiar look of the shelter to the local people is obviously an attractive design option for proposed cyclone shelter.

# 7.3.3 DESCRIPTION OF THE SCHEMATIC DESIGN :

The proposed cyclone shelter in the catchment area covers an area of 0.33 Hectares (0.81 acres) on the northern side of connecting road between Rastarpara and Kauarpara (see Figure

7.8). A big one storied pucca mosque, a big pond and some grocery shops are located near this site. For shelter complex, two separate but closely associated building blocks have been designed for two different types of function. Combinedly these two blocks posses a plinth area of 610 sq.m, while economic block is 2 storied and social block is partially 3 storied. A (6 x 9)m grid has been taken for layout of super structure, because division of spaces within this grid is possible easily for different functions.

Here, in both the two blocks, 2.88 m has been considered as surge water free height of evacuation space (for detail calculation see Appendix 07). Therefore, only upper floors considered as shelter space, while ground floor will usable during storm surge of maximum height. So instead keeping the ground floor completely unused, certain normal time activity areas have been proposed for this floor, like shops and credit centre. Here false ceiling has been introduced above 3m of G.L. for storing of goods of shop and office materials in case of cyclone. Classrooms have been placed at upper floors of social block and in economic block 4 rooms at first floor will be used for short time accommodation of 40 persons and 1 room will be used for business transaction purpose during normal period, while all these rooms will serve as shelter space during cyclone.

Toilets have been placed at all the floors of 2 blocks in a slightly isolated place from main usable spaces. A group of manually operated deep tubewell (see Figure 4.5,4.8 & 4.7) with a supplementary rainwater distern system will be installed for developing water supply system in proposed cyclone shelter. These tubewells have been proposed above killa, which are closely connected with toilet area. For emergency lighting purpose an electric line can be extended from near by Kauarpara, present electric supply is available. Stairs with enough width are placed in a central position in both the blocks which can be easily accessible for even new comers also. Two blocks economic) of the shelter complex are present within site, but they are not directly connected and two blocks are approachable from two different sides of the locality. Social block is easily accessible from homestead area of nearby villages economic block is closely connected to landing platform at sea-beach. A raised earthen platforms have been proposed as killa evacuation place of livestock and shelter building is partally located upon this killa (see Figure 7.9).

Private house cum cyclone shelter is nothing but a double storied house of one room at each floor. Dimension of each room is (3.03x3.03)m and one room can provide shelter for 26 persons in case of cyclone. Both the rooms will be used for household purpose during normal time, but room at ground floor may be affected by surge water, so this floor space is enclosed by temporary walls. The room at first floor is placed above maximum

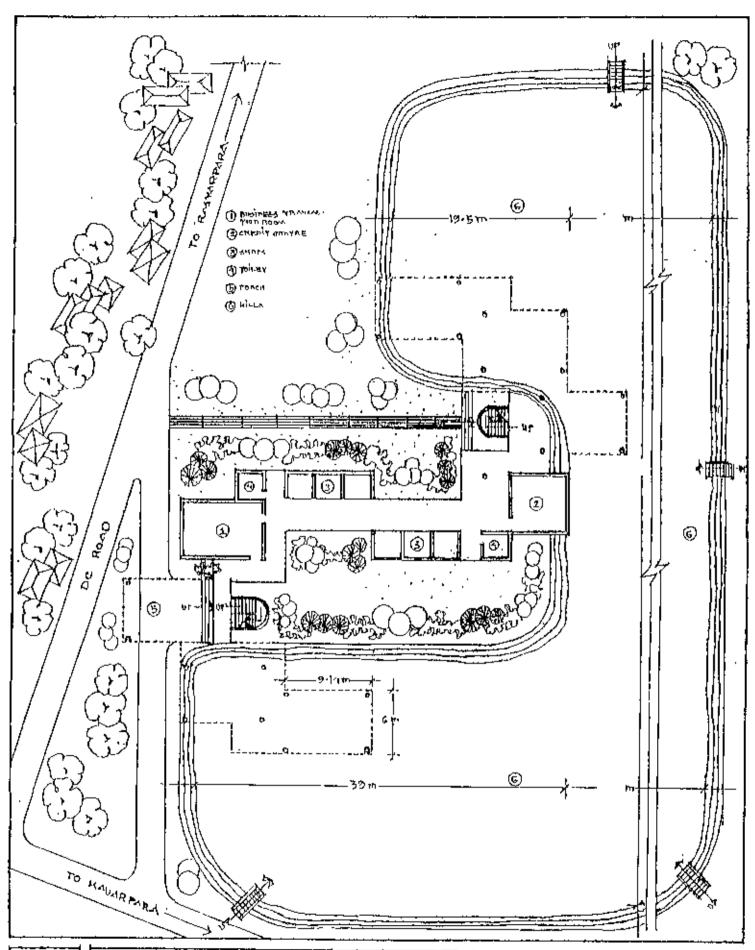
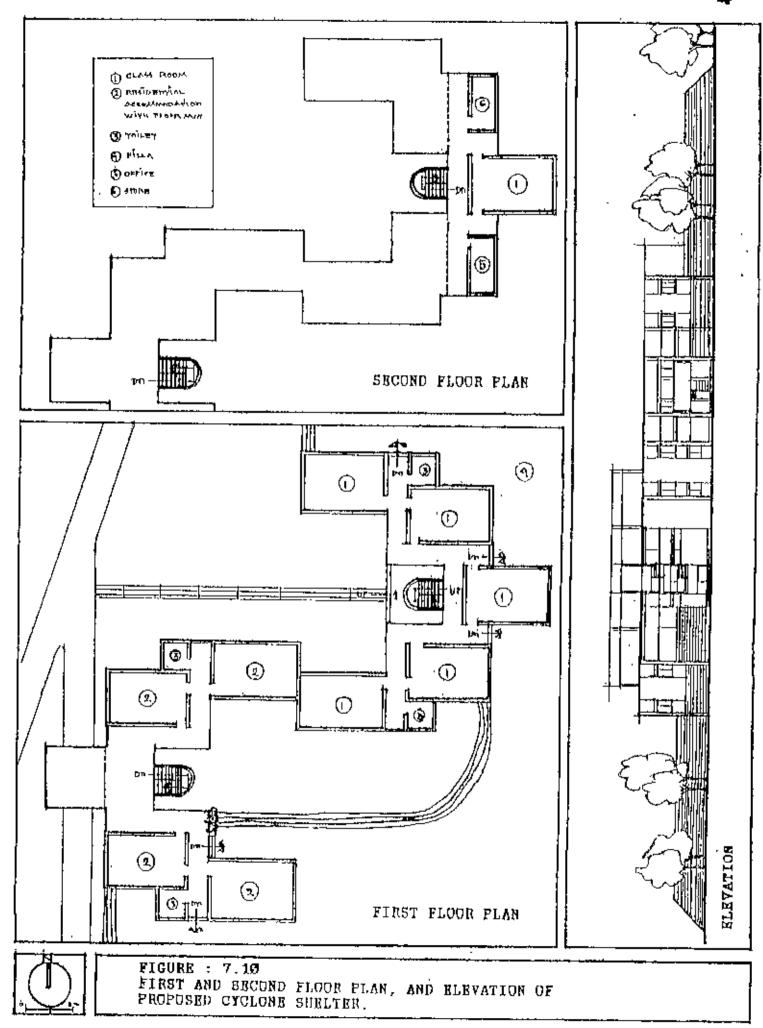




FIGURE: 7.9 GROUND FLOOR PLAN OF PROPOSED CYCLONE SHELTER FOR THE CATCHHENT AREA OF THE STUDY UNION.



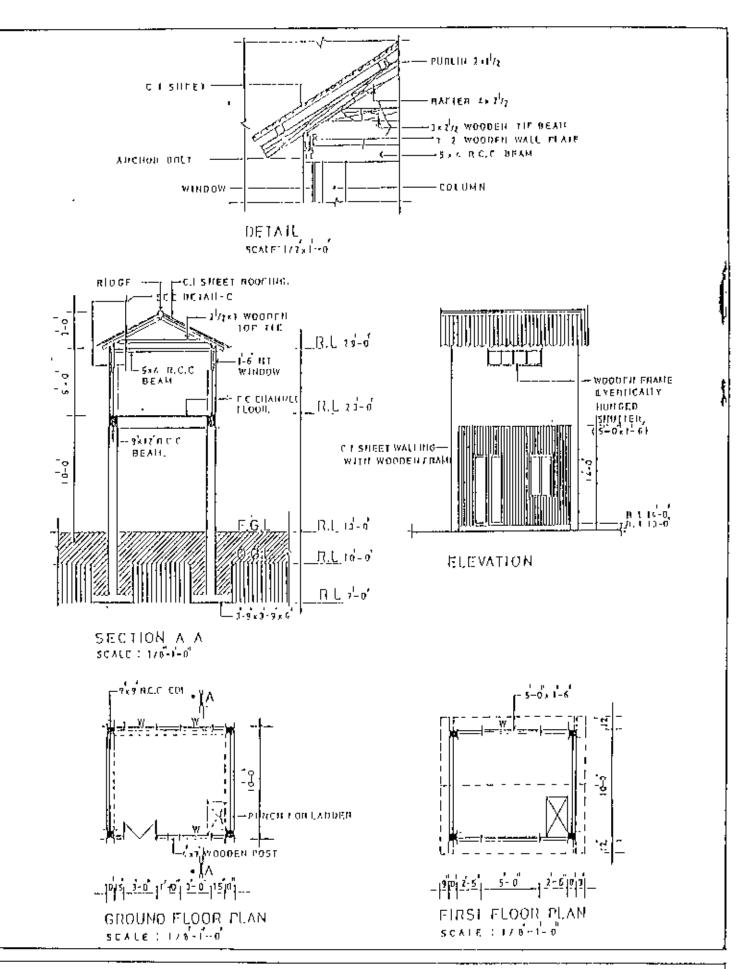


FIGURE: 7.11
PROPOSED DESIGN FOR HOUSE CUM CYCLONE SHELTER STRUCTURE.

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predicted surge height in that area, so it can be used as shelter space and this space is enclosed by 0.127 m brick wall with a roof of C.I.sheet strongly connected with RCC frame of the structure. In the upper floor false ceiling is introduced below main roof, which will provide storage space of survival items like fried rice, firewood, can of water etc. (see Figure 7.11).

From the design analysis it has been found that, most of the existing cyclone shelters and killas are at present devoid of trees. Therefore, programme of afforestation will be an integral part of construction of cyclone shelter within the catchment area. Managing committee of cyclone shelter will be assigned with the responsibility of raising, maintaining and protecting such afforestation. This afforestation would not only help in reducing the fury of cyclones, but also lead to overall improvement in the environment of the local area. Coconut and Krishnachura will be planted in large scale around proposed cyclone shelter and shrubs (e.g. Dholkalmi, Sada Akanda, Keya and Hoglapata) and trees (e.g.Babla, Shonboloi, Akashmoni, Ipil-Ipil & Coconut) would be planted around the edge of the proposed killa.

## 7.3.4 COST ESTIMATION FOR PROPOSED SHELTER:

Along with schematic design, an approximate cost estimate for the proposed design has been done on the basis of unit cost of different items of construction work. These unit costs of the items have been fixed on the basis of analysis of rates recommended by PWD and material/labour costs obtained from contractors who are presently involved with the development works in coastal regions of Bangladesh. This estimate will only give an idea of cost involved with this type of project. The actual detail and accurate estimate will be found after completion of detail architectural and structural design of the shelter, which is not included in this study. The estimated cost is given below,

Item	Unit cost	Anount	Cost (Taka)
Land acquisition for cyclone shelter complex	Tk.50,000/acre	Ø.81 acres	40,500
Land development and construction of Killa	Tk.215/sq.m (Tk. 25/sq.ft)		5,85,230
Earth outting, piling (if necessary) and foundation	Tk.4436/sq.m (Tk.410/sq.ft)	61Ø sq.m (6,5000 sq.ft)	27,018,000
Construction of ground floor including minor civil & carpentry work	Tk,2705/sq.m (Tk.250/sq.ft)	610 sq.m (6,6000 sq.ft)	16,50,000

Item	Unit cost	Anount'	Cost (Taka)
Construction of first			
floor including civil	Tk.4328/sq.m	61 <b>0 sq.m</b>	•
and carpentry work	(Tk.420/sq.ft)	(6,62727 sq.ft)	26,40, <b>00</b> 0
Construction of second			
floor including civil	Tk.45707/sq.m	6109 sq.m	
and carpentry work	(Tk.425/sq.ft)	_	5,10,000
Lime terracing	Tk.216/sq.m	6127 sq.m	
over top roof	(Tk.20/sq.ft)	(6,62727 sq.ft)	1,32,000
Water supply and	Tk.55,0000/		
sanitation work	point	8 points	4,40,000
Total		<u></u>	87,93,732

Therefore, the cost estimate presented above shows that the proposed cyclone shelter is a project of almost 8.7 million taka (if piling is necessary), otherwise the project cost will be about 8 million taka, which will be used for life saving purpose of the area's 3,300 people in case of cyclone and at the same time for socio-economic development of the community, and this will be able to meet the need of cyclone shelter of the catchment area for about next twenty years.

### 7.4 PROPLE'S PARTICIPATION:

People's participation is one of the important ingredients that are embodied in community development projects by almost all governments throughout the world (Weber.E. et al, 1988). But decision making is not made any easier in the face conflicts which any decision are likely to initiate between groups within the population, and between groups of the population and the planner (Hobbs.F.D.et al, 1981). circumstances for large scale community development project where there are many socio-political groups, planner has to make that local people's opinion is given due importance and proper priority in taking different vital decisions. For this purpose planner can evaluate different alternative decisions on the basis an criterion named people's choice. Otherwise implementation stage of that plan strong resistance may come from local pressure groups and ultimately the project will not be accessible to the target groups of that project. Therefore, cyclone shelter planning, first of all local people's opinion on different issues related to cyclone shelter have been collected and then major decisions on different factors were taken on the

basis of different identified criteria. Among the identified criteria, people's choice was one of the major criterion, but as those decisions were more or less technical so along with people's choice other major criteria were also given equal importance. Therefore, in choosing development community functions, size, location and design of cyclone shelter people's participation was incorporated indirectly. But in construction management of cyclone shelter direct involvement of local people is possible. This direct involvement will create an intimate relationship between the local people and shelter. Such close relationship will be helpful to implement the shelter plan successfully and this will ultimately help to keep the shelter complex in its full operation smoothly throughout the whole year.

Table : 7.3 People's Participation in Cyclone Shelter Planning.

Phases of cyclone shelter planning		Nature of people's participation
Planning	Identification of normal time use of cyclone shelter	Indirect
and design phase	Determination of size	Indirect
	Selection of location	Indirect
	Identification of design guide lines	Indirect
Implemen- tation	Construction of shelter	Direct
phase	Operation and maintenance of cyclone shelter	Dîrect

Source : Author's Estimation.

# 7.4.1 LOCAL PARTICIPATION IN CONSTRUCTION OF SHELTER:

In defining the design guidelines for cyclone shelter, more emphasis has been given on simple technology and locally accustomed building materials for the construction of the shelter to give proper respect to the local value system. This type of simple method of construction will not require many skilled labourer, high-tech construction equipments and materials. Therefore, huge local labour force (mainly unskilled) can be used for construction of cyclone shelter. Due to such participation of local people in shelter construction, some economic and social

benefits can be generated. Primarily it will help to acquire a first hand knowledge of the construction method and technology which is relatively advanced from the traditional methods. Secondly, local people will secure some economic benefit in terms of labour cost. Thirdly, since the structure would be built by themselves they are more likely to use it for their own survival in cyclone as well as for the normal time. These associations will help to develop a knowledge and a skill of local people's better maintenance of physical facilities of the cyclone shelter. Another positive aspect of this local participation is that, it will help to generate an army of skilled labourers as a by product of cyclone shelter construction project.

## 7.4.2 MANAGEMENT OF CYCLONE SHELTER:

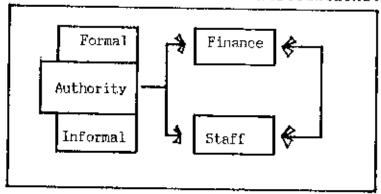
Construction of the shelter should provide opportunities for meaningful local participation in management and local leaders should be encouraged to explore opportunities for self-help before seeking outside assistance and funding. Successful mobilization and/or evacuation depends on coordination at the local level, taking advantages of all available resources, and an awareness programme which slowly increases local people's depth of understanding. As the cyclone shelter is going to be used by the people, it requires to be integrated into the local community, and therefore, a proper management is needed for it.

# 7.4.2.1 INSTITUTIONAL REQUIREMENTS FOR SHELTER MANAGEMENT :

Institution is an established way of doing things as well as organization to do them. It is the basis of organised action and it is the adjustment of diverse elements so that their mutual relations may exhibit some predetermined quality (Whitehead, 1967). Any existing or new institution needs three principal prerequisites for its success. These are:

- a. Authority, by which is meant the legislative and political means to establish and manoeuvre institutions.
- b. Staff, are the operators of the system. If an institution is to have a prolonged existence it is essential that it is the responsibility of local, suitably qualified staff.
- c. Finance, which is of two main kinds: provided from the outside sources or generated by the institution itself. Without sustainable funding, institutions are unable to perform successfully. Institutions are urged to raise innovative sources of finance in order to release some of the burden on governments.

**Figure : 7.12** Performance Parameters of Institutions.



Source : MCSP, 1992, Vol.VIII, p.F3-2.

It may be noted that the failure of new institutions is sometimes due to lack of clear delineation of responsibilities and problems of coordination. Agencies are expected to cooperate, but the mechanisms that are required to bring such cooperation have yet to be devised. For cyclone shelter management help from one of the existing local level institutions can be taken or a new institution can be created for this purpose.

Study performance of on. the existing localinstitutions (LLI)(see Appendix 03) in the study area shows that except a few examples they are more or less very weak and ineffective to carry out any large scale development work. Though during field visit local people did not directly accuse any LLI their poor performance, but according to indices of satisfaction, local people were relatively satisfied with the performance of individual development committees like shelter committee of BDRCS than other LLI (see Table 7.4).

Table: 7.4 Index of Satisfaction With Local Level Institutions.

Local level Institution	Index (i	Ranking n order of satisfaction)	,
Separate committee like BDRCS Thama parishad Union parishad Non governmental organizations Union level govt. authorities Educational institutions Local professional organizations Local political parties	+Ø 32 -Ø.66 -Ø.73 -Ø.96 -1.ØØ -1.ØØ -1.ØØ	1 2 3 4 5 5 5	

Note: +1.00 means full satisfaction & -1.00 means gross dissatisfaction

Source: Field survey, 1993.

Table 7.4 reveals the index of satisfaction of the local people with various local level institutions for their services provided for the community. This index of satisfaction has been calculated using the following formula:

Where, IS = index of satisfaction

fs = frequency of respondents satisfied

fd = frequency of respondents not satisfied/dissatisfied

and

N = total number of respondents.

Findings from Table: 7.4 suggest that any type of existing formal institution in its present form alone will not be able to satisfy the local people by its community development and disaster management activities.

Therefore, to find out a suitable institution for cyclone shelter management purpose, capability of the existing local level institutions (LLI) of the study area to handle the community development and cyclone disaster management (CDCDM) activities are judged on the basis of certain identified criteria in the following ways,

Table: 7.5
Level of Strength of Local Level Institutions.

Local level inst.(LLI) (directly related with	Strength of LLI according to criteria						
CDCDM activities)	Authority	Staff	Finance	Choice	Access		
Thana Parishad	High	Moderate	Moderate	Moderate	Low		
Union Parishad	Moderate	Low	Low	Low	Moderate		
Local NGO	Low	Moderate	Moderate	Low	High		
Local Govt. Offices	High	Low	Low	Low	Low		
Informal Institution	Low	Low	Low	Low	High		
BDRCS	High	Low	Low	High	Moderate		

Notes: I. As local govt.offices, FMC. thana based agriculture, livestock & fishery, education & forestry office have been considered.

As local informal institutions, schools, madrashas, mosques, kiam, clubs, bazaars, political
parties and professional organizations have been considered.

Source : Author's Estimation,

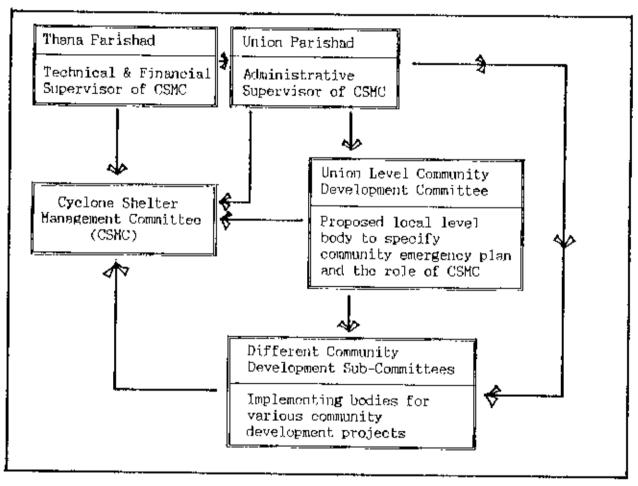
Table 7.5 shows that, none of local level institution has proper strength in all respects to meet the requirements of community development and cyclone disaster management (CDCDH) at grass root level. Though than a parishad (TP) and BDRCS have some potentiality, but TP is too far from catchment area of the study union and BDRCS has some organizational problems to take a vital role for CDCDM. In this circumstance, it can be said that if an institution with administrative, financial and operational strength like TP and BDRCS is available at grass root level then it will be able to perform properly for CDCDM. Though from the field survey it has been found that due to absence of proper administrative power, source of income and manpower, the union parishad (UP) of the study union is totally inactive at local development activities, but the Ordinance of 1983 has already defined certain specific community development functions for union parishads of the country (see Appendix 02). This implies that the ground has already been prepared for union parishad to be developed as a highly potential local like thana parishad. But due to severe negligence institution from the highest body of the country throughout a long period, union parishad is now nothing but a paper tiger. Therefore, by improving the present form of UP and by ensuring its co-operation, co-ordination and cordial connection with other local level institutions, UP's administrative, financial and operational strength can be enhanced for implementing community development and cyclone disaster management activities at village level. Basically for CDCDM purpose UP will take a role of co-ordinator among different village level committees comprised of representatives from all concerned local level institutions and different social groups of the community like committee for improvement of housing, primary health care programme etc.

#### 7.4.2.2 CYCLONE SHELTER HANAGEMENT COMMITTEE :

different local level community development committees, for managing shelter based different pre, during and post disaster period activities of cyclone disaster management, a separate committee will be needed and this committee will be designated as the shelter management committee, which will work under the guidance of local UP and participation of catchment area's population and local people will also prefer it (see Table 5.3). Before starting the operation of shelter management committee, a community emergency plan has to be prepared by the co-ordination committee of local UP and other concerned committees on different specific aspects. This plan will be approved by local thank parishad (TP) and for implementation of that plan local level fund of UP will be generated by using different income sources of community based commercial production sectors and a portion of this fund will be allocated to cyclone management committee to carry out its different activities and maintenance work. This fund allocation and other

technical matters linked with shelter management committee will be supervised by TP and its associated concerned governmental or non governmental organizations. Within the community emergency plan, roles and responsibilities of different concerned committees at the local level must be clearly specified.

Figure: 7.13
Linkage Between Shelter Management Committee and Different Concerned Institutions at Local Level.



Source : Author's Suppostion.

Cyclone shelter management committee will be formed with the following members from the catchment area of the union :

 Senior primary school teacher	1
 Senior imam of one local mosque	1
 Representative from fishermen community	1
 Representative from Magh2 community	1
 CPP volunteer assigned for catchment area	1
 NGO staff working within catchment area	.1
 Representatives from local women	4
 Local ward member of UP	1

This committee will be headed by a Convener. The Convener and the cashier of the committee will be appointed through democratic process from among the members of the committee and elected by them. Works of this committee will be supervised by UP chairman and committee will take help from local NGO workers, village level extension workers on health care, agriculture, forestry, livestock and fishery and CPP personnel for its proper functioning. Functions of shelter management committee will be,

#### a. Normal time functions :

- -- Co-ordinating and ensuring different shelter based community development activities by maintaining a monthly schedule of activities of different village level committees for providing community services to the people of the catchment area.
- -- Assisting the shelter based community development activities by providing physical facilities and services to different local level committees for their activities and storage of necessary materials.

### b. Pre, during and post disaster time functions :

At present majority of the local people depend on radio to get warnings (see Table 4.7), but only a few of them have their own radio, so usually they get late warnings. Again most of the people do not take any early preparations against cyclone (see Table 4.8), usually they do not get any proper type of assistance regarding their preparation (see Figure 4.10 & 4.11) and many people depend upon their own prediction about weather to take necessary actions in cyclonic periods (see Table 4.11). During disaster people adopt various techniques to survive (see Figure 4.15) and they also face different types of problems (see Figure 4.16 & Table 4.12). During evacuation people generally try to move along their previously known path (see Figure 4.18) and they take shelter in various places, which are not proper shelter (see Figure 4.17).

Under these circumstances, pre, during and post disaster time functions of shelter management committee will be,

- -- Disseminating the warnings in a timely manner.
- -- Mobilization of the area residents in case of an emergency.
- Shelter operation during a crisis period.
- -- Assisting trapped families and injured individuals to bring to the shelter.
- -- Maintaining order and hygienic conditions in the shelter, handling communication by radio, providing water source in the shelter.
- -- Working with property owners to reduce wind and water damage.

- c. All time function throughout the year :
- Inadequate resources for the operation and maintenance of infrastructure for public services have resulted in a deterioration and low utilization of valuable capital assets. Therefore, operation and maintenance (O&M) cyclone shelter is an important task of shelter management committee during all the periods throughout the whole year, A considerable amount of expenditure is involved in this operation and maintenance task (yearly about Tk.40,000.00 will be necessary for this task) and for this purpose shelter management committee can raise fund through shelter based economic activities like wholesale trading centre. accommodation of wholesale traders, shopping space office accommodation for rural credit centre (from these activities yearly about Tk.50,000.00 can be earned).

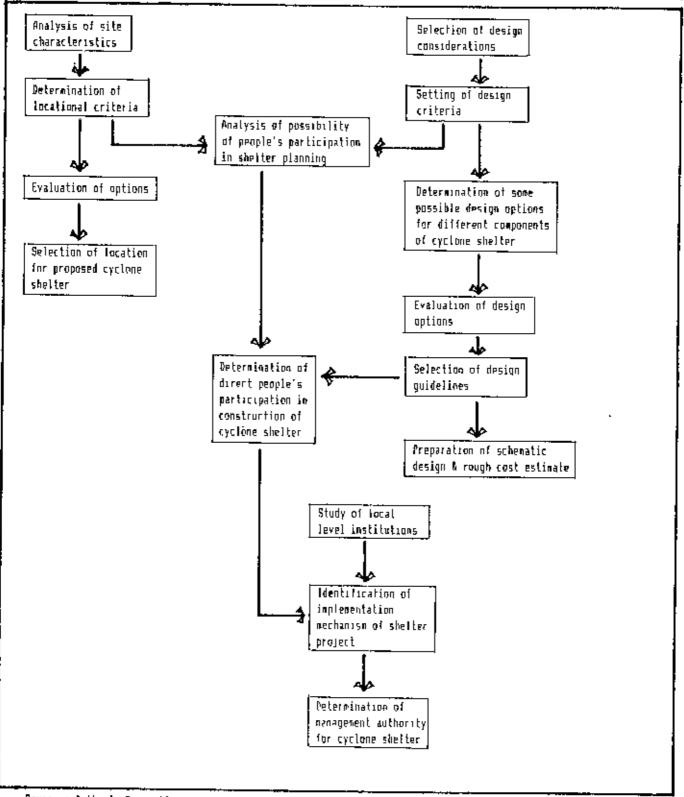
#### 7.5 SUNNARY:

For selecting the location of proposed cyclone shelter, first of all certain socio-economic and physical characteristics of the catchment area have been taken into consideration and then entire catchment area has been analysed on the basis of those site characteristics. After that depending on the major findings of that site analysis, different locational criteria of cyclone shelter have been selected and then these locational criteria have been used to evaluate the actual potentiality of two different alternative locations for proposed cyclone shelter and to identify the best probable location within the catchment area.

In identifying design guidelines for cyclone shelter, first of all certain design considerations have been taken into account and then depending on those considerations some design criteria have been set. After that some possible design options for different components of a cyclone shelter have been evaluated on the basis of selected design criteria. Finally, a schematic design and a rough cost estimate have been prepared.

Finally, people's participation has been incorporated directly in construction and management of cyclone shelter. To ensure large scale involvement of local people in construction process basically as unskilled labourer, structural form of cyclone shelter has been selected as simple as possible. To meet the institutional requirements for cyclone shelter management, UP has to function properly and for its active participation in community development activities, structure of UP has to be reorganized. Then under the guidance of UP a community emergency plan will be created and to implement different components of that plan several separate committees will work at village level. Cyclone shelter management committee will be one of such

Figure: 7.14
Schematic Presentation of the Methodology for Determination of Location,
Design Guidelines and Management of the Cyclone Shelter.



Source : Author's Suggestion.

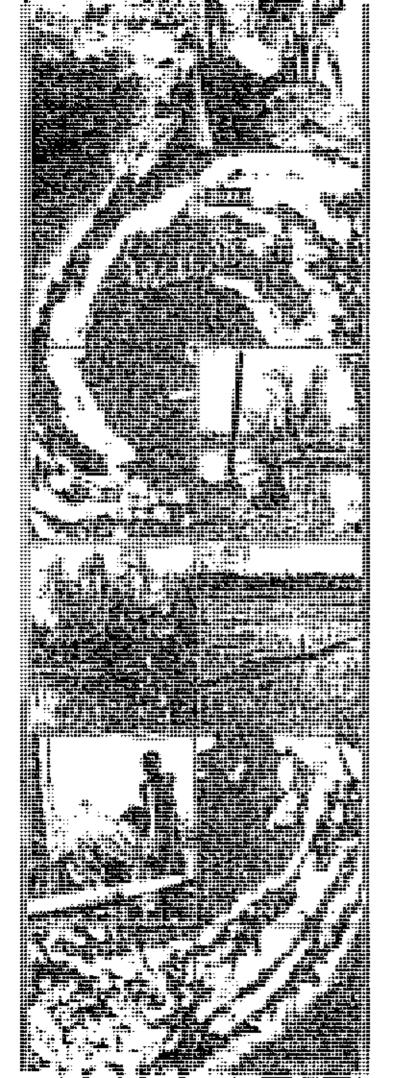
committees. This committee will be formed with the concerned people of the catchment area and it will be responsible for different normal and disaster period operation and maintenance tasks of cyclone shelter.

#### Notes :

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<sup>&</sup>lt;sup>1</sup> Zila parishad is responsible for development works within a district. But Zila Parishad Bill (which defines the form and responsibilities of Zila parishad) is not still passed by the National Parliament.

<sup>&</sup>lt;sup>2</sup> 'Magh' is one of the important tribal community of Bangladesh, which is formally known as 'Rakhain Sampradai' and in the catchment area of the study union there is a separate village for this tribal community.



CHAPTER : 8 CONCLUSION AND RECOMMENDATIONS

## 8.1 INTRODUCTION :

From the recent cyclonic incidents it is evident that, cyclone shelter as a disaster management measure is the most effective tool. But the existing cyclone shelters in the coastal regions of Bangladesh are not sufficient in number, they are not properly located, designed and maintained. Again, no micro level in-depth study on cyclone shelter has been done yet in Bangladesh and there is a need to reflect the modern concept of disaster management, i.e. integration of cyclone disaster management with community development planning, in cyclone shelter planning. Therefore, a micro level study has been done by the researcher to prepare the physical and strategy plan of a cyclone shelter on the basis of its site characteristics showing its location, size, its potentiality as a community development centre and methods of incorporating people's participation in its planning and implementation. At the end of this planning process certain recommendations have been made for proper implementation of cyclone shelter plan. In this chapter, those recommendations are included along with some general findings and a conclusion of this study.

#### 8.2 GENERAL FINDINGS :

The general findings from this study are summarized as follows:

- a. Cyclone in this region is a common phenomenon and people have to live with this disaster. People of the coastal regions are also accustomed to it.
- b. From the recent cyclonic incident it is evident that, among all the structural measures to mitigate the loss of both human lives and livestock/ poultry, cyclone shelter as a disaster management measure is the most effective tool.
- c. Existing cyclone shelters in the coastal regions of Bangladesh are very much inadequate in number comparing to the population of the coastal regions and they are located randomly along the coastal area without any proper study. They are not properly designed to meet the general requirements of disaster period, they are also very badly maintained and there is no scope of people's participation.
- d. Vulnerability to cyclone and storm surge is very high for the coastal people of Bangladesh because of their poor living environment, which is a result of their poor economic condition. So to reduce this vulnerability, quality of life in coastal communities has to be improved. At the same time severe cyclone may not occur every year. Therefore, a cyclone shelter may as well be utilized as community development



centre for socio-cultural and economic development of the coastal communities.

- e. To initiate community development process through physical facilities provided by cyclone shelter, disaster management must be integrated with community development and this will also ensure proper maintenance of shelter throughout the whole year and involvement of local people in shelter activities.
- f. On the basis of modern concept of disaster management, normal time activities of cyclone shelter for community development purpose have been identified. Size has been defined on the basis of required spaces for specific functions of shelter complex during both normal and disaster period.
- g. In choosing location and determining design guidelines for proposed cyclone shelter people's choice and acceptance have been considered seriously as a major criteria. Through construction and management of cyclone shelter, direct involvement of local people in cyclone shelter programme has been ensured. This will create an intimate relationship between shelter and local community, which will ultimately ensure shelter's best utilization during both normal and disaster period.
- h. Analysis of primary data shows that, as during disaster there is always a chance of looting in a completely empty house, so generally households of higher income group hesitate to vacate their houses completely even on the eve of a disaster. By considering this reality, along with large scale cyclone shelter-cum-community development centre, some private house-cum-cyclone shelter have been proposed by the researcher. These shelters will be constructed by taking small scale housing loan with low interest by local people of higher income groups. Those houses will be used for usual household activity during normal period and during cyclone they will provide shelter for 12 to 15 persons who want to stay close to their houses to ensure security of their household property.

#### 8.3 RECOMMENDATIONS :

The following specific recommendations are given for the successful implementation of local level cyclone shelter plan,

a. Integrated approach of cyclone disaster management and community development planning has to be recognized and approved by national policy makers<sup>1</sup> and fund has to be allocated for this approach from annual development budget<sup>2</sup>.

- b. For the implementation of integrated approach at grass root level, institutional requirements has to be met by improving the present form of union parishad and increasing its administrative and financial strength instead of creating a new institution. Activities of this union parishad has to be supervised regularly by thana parishad. For this supervision purpose, thana parishad has to incorporate different thana based line agencies (governmental and non governmental organizations) into its supervision task. In community emergency plan, role of all these organizations has to be specified clearly.
- c. For preparing cyclone shelter plan national level concerned agencies will act only as supervisor and guide. Construction budget of cyclone shelter has to be allotted from national level and from this level certain design guidelines has to be also given.
- d. On the basis of design guidelines and budget approved from national level, size, location and normal time function of cyclone shelter have to be selected at local level on the basis of particular site characteristics. Local level committee will take all these decisions by collecting people's opinion and then ultimate plan has to be approved by experts nominated from national level. Local level committee will work under the direct supervision of UP and TP will monitor the local level activities in this sector.
- e. Cyclone shelter alone will not be able to provide the total protection against cyclone and surge and local people also believe it (see Table 5.1). Therefore, along with shelter construction project equal emphasis should be given on construction of embankment, coastal afforestation, improvement of housing condition and communication network in the area.
- f. If in the proposed location of cyclone shelter of the study area, a vast land is not found for killa purpose, then nearby hill can be used for this purpose and it will reduce the project cost.

#### 8.4 CONCLUSION :

Vulnerability of the coastal communities of Bangladesh due to cyclone and storm surge is basically a function of very poor socio-economic and physical condition of those communities. Along with poverty and under-development, the present form of power structure within coastal communities and the lack of access of the poor people in the development process are also the causes of high degree of vulnerability. This is why the impacts of natural disaster like cyclone of equal magnitude is different in Bangladesh than in USA or Japan.

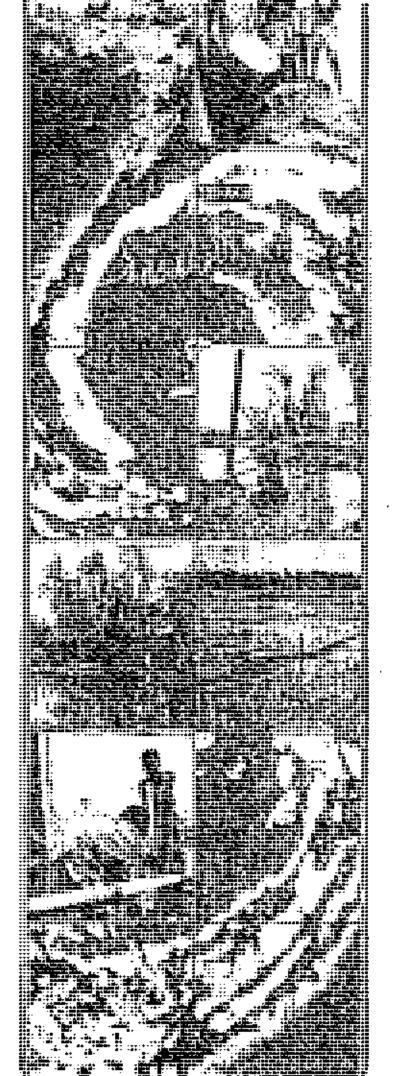
Under this circumstance, attempts to bring the victims back to normal with temporary disaster relief does not make much sense in such a context as it plays only a marginal role. At the same time, disaster have the potential of retarding progress by diverting scarce resources, men, material and money from development process to immediate requirements of relief and rehabilitation. Therefore, cyclone disaster management measures must be integrated with community development process at the local level. Community development is part and parcel of educating people about the need for disaster preparedness.

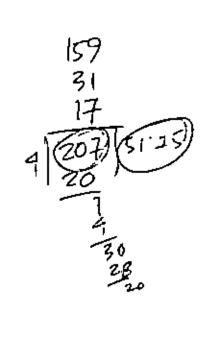
Cyclone shelters have proved their worth in lives saved and coastal regions need more of them, but the best utilization of physical facilities provided by cyclone shelters during all the periods throughout the whole year will ensure their usefulness to impoverished coastal communities of Bangladesh. A cyclone shelter can be used outside the cyclone seasons as schools, centres, meeting places to discuss ideas for income generation and many other activities. But for this purpose, right type of functions have to be selected as shelter's normal time activities and it entirely depends upon the socio-economic condition of the shelter site. Similarly location, size and design of shelter are also important to make the shelter facilities most effective for both disaster management and community development activities. Therefore, to ensure cyclone shelter's best location, size, normal time activities, design and local people's participation in shelter programme, proper planning of cyclone shelter is very much necessary. But without proper institutional support, fund and recognition from national policy makers to consider this plan as a part of national development plan, proper implementation of cyclone shelter plan will be very difficult. Again further study is necessary to find out proper and effective institutional setup at both micro and macro level which will suit with the existing socio-economic environment of coastal communities Bangladesh.

#### Notes :

Policy makers of the ruling party has to consult on this issue with opposition political parties and national parliament can be a debating platform on this issue.

Pilot projects can be taken in some selected coastal settlements with the help of foreign donors under the direct supervision of GOB.





# APPENDICES

# QUESTIONNAIRE OF ROUSEHOLD SURVEY FOR THE RESEARCH PROJECT ON :

	TER PLANNING IN BANGLADESH					
Locatión	Khurushkul Un: District of Ba		nana i	n Coxí	s Baz	ar

( All the information provided here would be of this research only and be kept secret )	used for the	purpose
DESCRIPTION OF THE RESPONDENT	Card No.	1-2
House No. Name of the household head (Code No.: Name of the father of household head Name of the respondent Respondent's relationship with household head	)	□ 3-5
ADDRESS OF THE HOMESTRAD		
Village (Code No.: ) Mauza (Code No.: ) Union (Code No.: ) Thana District		☐ 6-7 ☐ 8-10 ☐ 11-12
Date:	anature of Su	
PART : A QUESTIONS REGARDING SOCIO-ECONOMIC CONDITION		
01. Description of the family :		
A. Type : Single family-1, Combined family-2, No re	esponse-9.	☐ 13
B. Religion: Muslim-1, Hindu-2, Christian-3, Buddhist-4, N	lo response-9	. 🔲 14
<pre>C.1.Resident's status :     Permanent-1,Tenant-2,No answer-9.</pre>		☐ 15
C.2.Settled in this locality 'Since grand father's time-1, Since Father Since own time-3, No response-9.	's time-2,	<u> </u>
C.1. If answer is 3 then tell how long have yo	ou been stayi	ng here.
Years.	ſΉ	17-18

# 02. Description of the family members :

Serial		1	2	3	4	5	Б	7	8	9	10	
Age				!								19-38
Sex	'					•						39-48
Education		•	!									<b>49</b> -58
Marital s	tatus				-							59-68
Primary	Туре											13-32
occupa- tion	Period											33~52
	Location											53-62
Secondary	Туре				'							13-32
occupa- tion	Period											33-52
_	Location			-								53-62
Household (month)												13-62

Sex: Female-1, Male-2. Education: Illiterate-1, Only capable of giving sign-2, Primary-3, SSC-4, HSC-5, Graduate-6, Masters-7. Marital status: Married-1, Unmarried-2. Occupation: Self employed in own farming-01, Own farm+ day labour-02, only day labour-03, Service-04, Business-05, Fisherman-06, Student-07, House keeper-08, Household work-10, Unemplo-yed-11, Aged-13, Child-14, Other-15, No response-99. Work place: Own village /union-1, In the sea-2, In the distant island-3, In than a head guarter-4, In the big city-5, Beyond country-6, Other-7, No resp- onse-9, Working period: Month(write in number). Age: (write in number)

#### 03. Description of the land :

#### A. Type of land

Agriculture	63-66
Homestead	67-70
Pond	71-74
Orehard	75-78
Horticulture	13-16
Fallow	17-20

В.	Agricultural land according to irrigation	
	Irrigated agricultural land	21-24
	Non-irrigated agricultural land	
Ø4.	Description of the livestock and poultry :	
	Cow Buffalo Goat Sheep Pig Chicken	Duck
	Number	43-44
Ø5.	Standard of living :	
Α,	Fuel: Fire wood/leaves-1, Kerosine-2, Cylinder gas-3, Electricit Nothing fixed-5, Other-6, No response-9.	y−4,
В.	Source of light: Electricity-1, Hurricane-2, Kupi-3, Nothing fixed-4, Other-5, No response-9.	☐ 46
С.	Household asset :	
	Clock Radio TV Khat Bedding  Luxury goods	47-51
	Cowki Almirah Table Chair Alna Tin/leather/wooder	n box
	Furniture	52-57
	Boat Cycle Cart Motorcycle Rickshap  Transport	58-63
	Code : Have-1, Do not have-2, No response-9.	
Ø6.	Description of the homestead :	
Α.	Type: Isolated-1, Less than five together-2, More than five together-3, No response-9.	64
2.	Area of homestead land decimal. Plinth height of the house feet.	65-68 69-70 71

С.	Source of dring River/channel-: well-5, Water :	l,Pond-2,	Kutcha we	ell-3, P r-7,No r	ucca well-4, esponse-9,	Tube 72				
D.	Drainage: Kutcha-1,Pucca-2,No arrangement-3, No response-9.									
Ε.	Sewerage: No arrangement-1, Pit-2, Open drain for waste disposal-3, No response-9.									
F.	Latrine: No fixed arrangement-1, Kutcha-2, Pucca-3, No response-9 75									
G.	Electricity : Yes-1, No-2, No	response	-9.			<b>7</b> 6				
Н.	Arrangement for Yes-1, No-2, No	erop stor response	rage : -9.			77				
I.	Homestead's dir Yes-1, No-2, No	ect connec response-	ction wit -9.	h areaís	main road	; 78				
J.	Building materials used for house construction :									
	Component of House									
	Structure	1	2	3	4					
	Floor		<u></u>			13-20				
	Wal1				<del>-</del>	21-28				
	Roof	_	- <u>-</u> -			29-36				
	Column			<u>-</u>	-	37-44				
	Door/window		<u>-</u> .	_	<u> </u>	45-52				
	Code : Straw-01 Brick-07,Iron-08 -14, No response	в, ксс-тю,	amboo-03 CC-11,St	, Wood-Ø one-12,P	4, Tali-05, lain sheet-1	Clay-06, 3, Other				
Ø7.	Description of B	Plants and	trees w	ithin an	d around hom	estemd :				
	Name of tree (max.eight) Number Use in disaster period									
				1						

13-36

37-68

53-88

Name of the tree: Keora-Ø1, Goran-Ø2, Jhau-Ø3, Coconut-Ø4, Kea-Ø5, Dhol-kalmi-Ø6, Hoglapata-Ø7, Babla-Ø8, Ipilipil-1Ø, Shishu-11, Shirish -12, Mahogany-13, Karai -14, Shimul-15, Palm-16, Mango-17, Jam-18, Amra-2Ø, Bamboo-Z1, lemon-ZZ, Tetul-Z3, Guava-Z4, Starfruit-Z5, Bel-Z6, Other-Z7. Use in disaster period: Life saving by climbing at the top of the tree-1, Resistant to high velocity wind-Z, Alternative source of drinking water-3, Resistant to severe current of surge water-4, No use-5, Other-6, No response-9.

# 08. Community service facilities :

			_			
	UP Baza	ar P.School	H.Schoo!	l FWC Ghat	C.Shelt	er
Distanc from homeste (mile)						13-26
Usual mode of transpo	rt					27-40
Travel time (hour)						41-61
Mode of mobile~	transport 4, By cart	t: By foot-; t-5, Other-6	l,By boat- 3, No resp	2,By ricks onse-9.	haw-3,By	auto-
PART: B QUESTIONS INCIDENTS.	REGARDING	PEOPLE'S	RESPONS	E <u>TO</u> REC	CENT CYC	LONIC
1.A.How did	you get t	he first si	gnal of t	he coming o	yolone ?	>
1991/		62-6	3 1992	/		84-65
BDRCS-10,	on/Th <b>ana p</b> , Politici	n-01, Radio arishad-06, an-11,Self- No response	Governm observati	ent officia	a1⊸07 NO	$\Omega_{m} Q R$
B.How many highest	/ hours be intensity	fore starti did you ge	ng the se t the gre	vere cyclon at danger s	e with i signal no	ts .10 ?
1991	hours	ago.				66-67
2.A.When did	the stor	m become vi	olent ?			
4554						
1991	pm/am					68-69

3.A	1991 <b></b> p Did you take		tion befo	ore the disas	ster ?	70-71
	1991/		72-75	1992/		76-79
•	(No preparatio costly goods leaving the h	into a safe	r place-C	3,Took mental	l preparati	Moved on for
B.1	From whom did	you get su	pport in	taking prepa	ration ?	
	1991/		13-18	1992/		] 19-24
(	Nobody's help strict/Thana/ Relative-7, S	Umion paris	had−5, Po	olitical part	eer-3, NGO ies-6,Neig	-4,Di- hbour/
B.2.	If you got and was the type	y help duri: of that help	ng the pi p ?	eparation pe	riod then	what
	1991/		25-29	1992/		] 30-34
(	Giving warning advice to take to combat with	f e safety pr	ecaution-	3,Supplying	necessary	things
4.A.	Did any member life saving pa	r of the hou	usehold e	vacuate the	homestead	for
	1991/ Yes-1, 1 1992/ Yes-1, 1	No-2, No res NO-2, No res	sponse-9. sponse-9.			] 35   36
B.1.	If the answer	is Yes, the	en who ha	d left the h	omestead ?	
1	991/		37-40	1992/		41-44
,	All members-1 1/2 to guard t body except si	the house-3,	, Everybo	children-2, dy except se hing else-6,	rvants-4.]	Every-
В.2.	When did you ]	leave the ho	ouse ?			
	1991 p 1992 p	om/am. date om/am. date		, 		45-51 52-58
В.З.	Where did you	go after le	aving th	e house ?		
	1991/		59	1992/		6Ø
	Cyclone shelte school/madrash Nearby bill-5	ma/college/d	)ffice/sh	op/factory-3	ca building , High tree	of -4,

B.4.W	hat were t	he things di	d you tal	ke while va	cating the	house ?
1	1991/		61-66	1992/		67-72
-2	16,Hurrican	Clothing-02, e/torch/matc oultry-10, C	h-07,Valu	able goods	/papers/ n	-05, Fuel noney-08,
B.5.I	f you did	not take liv	estock th	en why?		
1	991/		73-77	1992/		13-17
p 1	oor-2,Weat ivestock a	no shelter t her was very nd poultry w ek and poult	r bad-3, T ras not <b>v</b> e	here was nery signific	o time-4, h cant-5,Fors	Number of tot about
B.6.I	f you did rrangement	not take liv did you mak	estock to e for the	shelter t eir safety p	hen what purpose ?	
1	991/		18-19	1992/		20-21
t	o arrangem he guard-3 e-9).	ent-1,Set th , Handed ove	em free-2 r to neig	, Responsil hbours-4, (	bility was Other-5, No	given to respon-
C.1.1	f you did	not leave th	e house t	hen why ?		
1	991/		22-27	1992/		28-33
h s t a 0	omestead a helter nea o go-04,No t home to ;	sider the cos storm resing the storm resing the storm resident to such that the storm is shelter buses.	stant-02, ad-03,The go-05,No -07,Unabl	There was more was a since was a since to move to	no proper o helter but rk to go-08 because of	yclone no time 3,Stayed illness-
C.2.I	f stayed a	t house then	how did	you survive	e from dise	ster ?
1	991/					34-36
1	y staying o ong tree-2 esponse-9)	on the roof By grabbing	of house- some str	1,By elimbiong thing-3	ing at the 3, Other-4,	top of No
C.3.I:	f the house t was subme	e was attack erged by wat	ed by sur er ?	ge water th	en how muc	h of
1	991/				]	37
វាព	pto plinth ear roof of o response	level-1,Hal ground floo 9).	f of the or-3,Comp	ground floo lete ground	or height-2   floor-4,0	, Almost ther-5,

C.4. If you took shelter on the house roof or top of the tree or hill then what problem did you face?	
1991/	10
(Getting wet by rain water-1, Attacked by snake/other ferocious animal-2, Shortage of food/drinking water-3, Faced no problem-Other-5, No response-9).	
PÁRT : C QUESTIONS REGARDING EVACUATION SITE.	
1. What was the condition of weather while vacating the house	?
1991/ 41-42 1992/ 43-6	14
(Normal-1, Storm was going on-2, Wind was blowing violently-3 Sky was completely covered with cloud but environment was calm and quite-4, It was drizzling-5, Something else-6, No response-9).	3,
2.A. What was the distance of the cyclone shelter from your house?	
1991 mile. 45-6 1992 mile. 47-4	
B. How did you go to the shelter ?	
1991/	50
(By foot-1,By rickshaw-2, By cart-3, By cycle-4, By boat-5, Be car-6, By other way-7, No response-9).	Зу
C.From whom did you get vehicle to go to cyclone shelter ?	
1991/ 51-54 1992/ 55-5	58
(Nobody give vehicle-1,BDRCS-2,District/Thana/Union authority 3, Political party-4, NGO-5,Someone else-6, No response-9).	rQ
D. How much time was spent to reach the cyclone shelter?	•-
1991 m/h. 59-6 1992 m/h. 61-6	
3. If you took shelter in your neighbour's/relative's house then what kind of difficulties did you face while staying there ?	
1991/ 63-68 1992/ 69-7	74
(Congested living space-1, Lack of water and lack of latrine-2 Shortage of food-3, Faced misbehavior-4, Attacked by storm-5 Faced no problem-6, Something else-7, No response-9).	

4.A.If you took sh relative's hou	elter in a pl se then how l	lace other long did y	than ne ou stay	ighbour's there ?	*
1991 1992					75-76 77-78
B.If you stayed shelter after reason ?	for a relation the completion .	ively lon on of disa	ger perio	od in cyc n what was	lone
1991/					] 13-15
(No place to go relief-2,Becaus after the disa	se of illness	-3, Left	the shelf	ter immedi	get ately
5.A.Give the descr	i <u>ption of eve</u>	lone shel	ter.		
Overall constr	uction : 1991	/	<b>1</b> 6	1992/	17
(Kutcha-1, Pucc	a-2, Partial1	y pucca-3	, No resp	ponse-9).	
Number of floor Ownership of si				1992/ 1992/	☐ 19 ☐ 21
(Private-1,Non-)	governmental-	2, Govern	mental-3	, No respo	nse-9).
Number of evacu	uees : 19 <b>91</b>	nos.	22-25 19	992 no	s.26-29
B. <u>Give descripti</u>	on of facilit	ies avail	able_in_i	the shelte	r.
Latrine Source of drint Electricity Cooking space Storage space Shelter for liv Enough living :	king water : : : : vestock : space :	1991/ 1991/	30 32 34 36 38 40 42 44	1992/ 1992/ 1992/ 1992/ 1992/ 1992/ 1992/	31 33 35 37 39 41 43 45
(Adequate-1, Pre No response-9)	esent but not	adequate	−2, Not p	resent-3,	
C.Give the descri within shelter	iption of act site.	ivities a	nd experi	ience of e	vacuees
C.1.What was the fi shelter ?	irst day's ex	perience n	while ent	ering into	0
1991/	46-4	8 1992,	/		49-51
(Chaotic situati puzzled situati	ion-1, Everyb ion-3, Other-	ody was d 4. No resp	iscípline ponse-5).	d-2,Confu	sed and

C.2. How did you s	pend the night of	disaster ?	
1991/			52-54
(By sitting or unnecessary s	sleeping-1, By s houting-3,By goss	aying prayer-2, iping-4,0ther-5,	By reaming and No response-9).
C.3.What did you the cyclone ?	usually do duri	ng the days imm	ediately after
1991/			55-57
shelter-1,Spe hout doing	rch for job and t nt the whole day anything spent w er-4, No response	for repairing ow hole day at shel	n house-2. Wit-
C.4.What did you	eat most of the t	imes while sta <b>y</b> i	ng at shelter ?
1991/	58-59	1992/	60-61
(Rice-1, Bread response-9).	-2, Pressed/fried	rice-3, Nothing	-4, Other-5, No
C.5.Where did you	usually cook with	hin shelter ?	
1991/	62-63	1992/	64-65
In verandah/r	not required-1, In pof/corridor-3, W. n sky-5, Other-6,	ithin living sp	e in shelter-2, ace-4, Outside
C.B.From where did staying at she	i you usually get elter ?	t fuel for cooki	ng while
1991/	66-67	1992/	68-89
friend's stoc	s store-1, From c k-3, From relief ther-7, No respon	$team-4$ . Found $n_0$	m relative's/ o fuel-5, Not
C.7.From where did staying at she	you usually collecter?	lect drinking wa	ter while
1991/	70-71	1992/	72-73
(Tubenell-1, No Other-5, No res	purified water-2 ponse-9).	2, Relief team-3	,Raîn water-4,
C.8.Which place di	d you usually use	e for toilet pur	pose ?
1991/	74-75	1992/	76~77

	(Shelter's specified verandah-3,0utside t No response-9).	toilet-1,L: he buildi	iving space- ng under op	2,Corridor/ en s <b>ky-4</b> , 0	roof/ ther-	/ -5,
C.9.	Where did you keep at the cyclone shelt	your house er ?	ehold belong	ings while	stayi	ing
	1991/	78	1992/			79
	(Not much belongings Within living space- No response-9).	-1, In sho 3, In vers	elter's spe idah/corrido	cific store r/roof-4, 0	-2, ther-	-5,
C.10	.Where did you keep ; shelter ?	your livest	tock/poultry	while sta	ying	at
	1991/	82	1992/			13
	(No livestock or poul site within shelter- the building in open	3, In ver <b>a</b> r	idah/corrido	r/roof-4,	Outsi	ide
C.11	.What kind of prepara women while staying	ation for . At shelter	sleeping di ?	d you take	for	
	1991/	14	1992/			15
	(Did not make separate in separate place-2, Others-4, No response	<b>Making</b> tem	ent-1, Male porary wall	and female with cloth	stay -3,	red
C.12	.What was the law and	order situ	ation in ey	clone shelt	er ?	
	1991/	16	1992/			17
ı	(Good-1, Not bad-2, Ba	ad-3, No re	≈ <b>s</b> ponse-9).			
PART QUES	: D F <u>LONS REGARDING PEOPLI</u>	S OPINION	ι. χ			
	Are you happy with to still going on your l	the communi	,	ent activit	ies	
	Not at all happy-1,Pa	rtially ha	ippy-2,Very	happy-3,	]	18
В.	If not happy then its	reason.			] 19-	24
	Corruption among deve tion is present here Lack of efficient and response, sincerity and fund-5, Other-6, No r	for conduc l trained m d dedicati	ting develop anpower+3, I on-4, Shorts	ement active Lack of comm	ities nunit	-2 y

C.	What are the community service facilities do you think should be present in your locality?
	Improved health centre-01, More schools-02, Training centre of cottage industry for female workers-03, Specialized training centre for farmers & shrimp cultivators-04, Training centre and necessary facilities for youth's self-help programme-05, School for non-formal education for adult & working children-06, Training centre for community disaster preparation and primary health care-07, Library-08, Improved communication network-10, Rural credit centre-11, Improved marketing facilities-12, Other-13, No response-99.
1.B.	Are you satisfied with the community development & disaster management activities of the following institutions?
	Union parishad. Yes-1, No-2. 35 Thana parishad. Yes-1, No-2. 36 Local NGO. Yes-1, No-2. 37 BDRCS. Yes-1, No-2. 38 Union level govt. offics. Yes-1, No-2. 39 Local informal institutions. Yes-1, No-2. 39 Local professional organiz. Yes-1, No-2. 42 Local political parties. Yes-1, No-2. 42
2.A.	Do you think that cyclone shelter has the potentiality to act as centre of all community development activities in the area,
	Yes-1, No-2, No response-9.
₭.	Whom do you prefer for cyclone shelter management purpose?
	Union parishad-Ø1, Thana parishad-Ø2, NGO-Ø3,BDRCS-Ø4,School authority-Ø5,Govt.officials-Ø6, Landless/Professional organization-Ø7, A separate committee comprised of members from all groups of the community-Ø8, Other-1Ø, No response-99.
Ø.	Which distance do you $% \left( 1\right) =\left( 1\right) +\left( 1$
	mile47-48
D.	What are the arrangements and facilities do you think should be present in a proper cyclone shelter?
	Source of pure drinking water-01, Latrine-02, Electricity-03, Separate living arrangement for female evacuees-04, Storage space for household belongings-05, Evacuation space of lives-tock-06, Separate cooking space-07, More specious living space-08, Storage of emergency supply for medicine, Fuel and food-10, Other-11, No response-99.

## FUNCTIONS OF UNION PARISHADS:

The 1983 Ordinance divides the functions of Union Parishads into five categories; (a) Civic functions (b) Police and defence functions (c) Revenue and general administrative functions (d) Development functions (e) Transferred functions (which may be transferred by the government and Upazila Parishad). Although the 1983 Ordinance enumerates 38 civic functions for the Union Parishads, it lays down that these shall, in particular, undertake the following ones:

- -- maintenance of law & order and assistance of administration in the maintenance of law and order;
- -- adoption of measures for preventing disorder and smuggling;
- -- adoption and implementation of development schemes in agriculture, forestry, fisheries, animal husbandry, education, health, cottage industries, communication, irrigation & flood protection for the economic & social upliftment of people;
- -- promotion of family planning;
- -- implementation of such development schemes which is assigned by Upazila Parishad;
- -- development of local resources and their use;
- -- protection and maintenance of public property, such as roads, bridges, canals, embankments, telephones & electricity lines;
- -- review of the development activities of all agencies at the union level & the making of recommendations to the Upazila Parishad in regard to their activities;
- -- motivation and persuasion of the people to install sanitary latrines;
- -- registration of births, deaths, beggars and destitute;
- -- conducting of census of all kinds.

# LIST OF LOCAL LEVEL INSTITUTIONS WITHIN THE STUDY AREA AND THEIR FUNCTIONS IN THIS AREA.

Name of institution	Activities	Comment
1.Cox's Bazar Sedar Thana Parishad.	a.Collects revenue from two local markets.  b.Manages ferry ghats of both the sides of river Baghkhali.	Not directly involved with local development works.
2.Khurushkul Union Parishad.	a.Co-ordinates & supervises construction work of coastal embankment in union with the technical help from BWDB.  b.Supervises road improvem- ent work within Union under food for works programme.	Not active in the area and local people are not cncerned about it. Chairman is not at all familiar with local problems.
	c.Supervises family planni- ng works of FWC. d.Provides support to road improvement work of CARE.	·
3.Local NGO :		
a.Genashastha.	<ul><li>a.Providing housing loan of 22,000 taka.</li><li>b.Constructing a cyclone shelter oum health centre at Rastarpara.</li></ul>	Occassionally active in local development works.
	c.Providing door to door health care service.	
	d.Conducting road side tree plantation work.	
b.CARE,	a.Conducts road improvement work by female workers through UP in dry season.	

	<u> </u>	<del></del>
Name of Institution	Activities	Comment
c.CCDB.	a.Developing a shelter.	Small scale work.
d.World Vision.	a.Operating a cyclone shel- ter cum primary school at Kauarpara.	Has permanent base station at village level, but local people are suspic-
	b.Providing housing loan.	ious about their activities.
<u>.</u>	c.Working to improve lives— tock and poultry of the area by supplying high quality cattle & chicken.	
e.POUSH.	a.Organizing social forest- ry programme in the area.	Not yet successful in coastal affor- estation.
	b.Involved in coastal afforestation programme on embankment.	
f.CPP of BDRCS.	a.Responsible for warning dissemination of cyclone within study area.	More or less active but volunteers are not happy with their present
	b.Organizes evacuation of local people during cyclone with the help of district authority.	status.
	c.Distributes relief materials among affected people after cyclone.	
g.DPP of BDRCS.	a.Operating a cyclone shelter cum primary school through a local level committee.	Though it is a new programme, but it is suffering from shortage of fund and administration
	b.Providing health service by 2 village health workers & traditional birth attendance (TBA) within an area of 1 mile radius about cyclone she- lter with the supervision from Moheshkhali.	is weak due to lack of man power.

Name of the Institution	Activities	Comment
	d.Providing functional education to adult  c.Supplying sealed latrine & tubewell at low cost. male & female people.  e.Providing credit of 2003/= for each person with a very easy repayment process.	
4.Local Informal Institutions.		
a.Azad Samity (local voluntary organiza- tion).	a.Organizing community development activities like housing, primary health care & social forestry with the help of Ganashastha.	Not very active and weak organizational setup.
b.Adudia Madrasha.	a.Providing religious education & shelter space with necessary facilities to local cyclone affected people.	Strong organizat- ional setup, enough man power and big fund, but politic- ally biased.

LIST OF EXISTING AND SOME PROPOSED CYCLONE SHELTERS FOR COASTAL REGIONS OF BANGLADESH.

#### PND TYPE CYCLONE SHELTER :

Following the 1970 cyclone and surge, the world bank signed a 25 million dollar cyclone reconstruction project with the Govt. of Pakistan in 1971. Although a high power board was formed for its implementation, work could not be started due to liberation war. After the liberation of Bangladesh which was executed by a newly constituted board under the Planning Commission. Then the programme was renamed as Coastal Area Rehabilitation & Cyclone protection project. It comprised of 7 sub-projects and 7 govt. agencies were entrusted with their implementation. Out of the seven sub-projects Multipurpose Cyclone Shelter was 1 and Public Works Department (PWD) was the implementing agency (IEB, 1991).

The architectural design was prepared by the Chief Architect's office under the Buildings Directorate (Presently Department of Architecture, Ministry of Works). The final design was approved by World Bank's Engineering Consultant M/S Amman & Whitney. All the shelters followed a single type design, Commonly known as PWD type. A total of 238 such shelters were built between the period 1972 and 1979 in various locations coastal belt of Bangladesh. After the completion, the shelters were handed over to the Zila parishad and the Ministry of Education for maintenance and management. It was suggested in the design proposal that the shelters could be used as primary school and in some cases as community center or clinic. The average cost of each shelter was Tk. Ø.93 million (MCSP, 1992).

During the Cyclone of April, 1991 most of these shelters were filled upto their capacity and saved many lives. Many of the shelters served as relief distribution centres in the post cyclone period. But their location are not correct and design has some sever limitations. Their utilization during cyclone is largely contributed by the lack of any other alternative available in the remote areas.

## BORCS TYPE CYCLONE SHELTER :

The Bangladesh Red Crescent Society (BDRCS) with assistance from the League of Red Cross undertook an ambitious project of building 500 shelters in five years commencing from 1986. The target could not be achieved because of financial constraints. However, through its Shelter-Cum-Community Development Programme 82 shelters in fifteen thanas of sixteen different districts have been constructed between 1986 and 1990. All the shelters were

built on the same type of design. Many new shelters are being built on the same design. The design has been followed by other NGOs e.g. by CARITAS which has built 12 such shelters, 6 at Sandwip Thana and 6 at Manpura Thana. Many of the on-going shelter construction of BDRCS and CARITAS is based on the same design. The design was developed by a local consultant, MHR Consulting Engineers and built by local body appointed by BDRCS.

## SCHOOL CUM CYCLONE SHELTER BY CARITAS :

Among the many programmes launched by CARITAS after the devastating Cyclone of 29th April, 1991, the construction of school building is also a massive one. Accordingly 49 school cum cyclone shelters are to be constructed. The total cost estimate for construction of single building is about taka 1.5 million.

#### FLOOD-CUM-CYCLONE SHELTERS OF EDM :

After the floods of 1987 and 1988 EDM, in collaboration with the Swiss Disaster Relief (SDR), planned to construct flood shelters in some of the worst affected areas. A total of 8 such Centres have been constructed in different extremely flood and cyclone prone RFCWP project areas with the direct supervision of SDR. Each of the Flood-cum-Cyclone Shelters is utilised as a community centre during normal times and can provide shelter for approximately 250 people in times of distress, due to flood or cyclone.

#### SHELTERS BY FACILITIES DEPARTMENT :

A project of cyclone shelter cum school was initiated by the Facilities Department of Ministry of Education in July, 1991 with Saudi Grant of 368 crore taka. The design of this multipurpose cyclone shelter was prepared by the in-house architectural design of Facilities Department. This department is charge of the execution, maintenance and management of shelters. After the completion of the shelter design the construction of 306 such shelters is still going on. The design of this type of shelter suffers from some fundamental drawbacks. The drawbacks are important to be recognised as those only impair its performance as a shelter but even shelter inoperative in some situations.

## SHELTER BY LGED :

Local Government Engineering Department (LGED) has recently developed a cyclone shelter design very similar in concepts to that of Facilities department. The only difference is that their shelters are mostly designed for single purpose use in one floor with provision for vertical extension.

#### SHELTER BY GRAMEEN BANK :

Grameen Bank is an internationally recognized institution of this country which is engaged to provide access to credit for the most deprived section of rural community for income generating activities. Recently the bank has undertaken a programme of building cyclone shelters and has developed a design for shelter. The special significance of other Grameen Bank projects is in their determined efforts to merge the indigenous tradition with modern techniques, whereas in this cyclone shelter project such efforts are not visible.

#### SHELTERS BY BRAC :

The Bangladesh Rural Advancement Committee (BRAC) is a non-government development organization started in early 1972. BRAC's cyclone shelter programme is a relatively recent one. The design is prepared by a local consultant. Construction of some of the shelters is already under way in Kutubdia area.

# SHELTERS BY MULTIPURPOSE CYCLONE SHELTER PROGRAMME :

A study to prepare a Master Plan for Multipurpose Cyclone Shelters in the storm surge prone areas of the coastal belt of Bangladesh was commissioned on the basis of a recommendation of the Interministerial Task Force on Cyclone Shelters, set up by the planning Commission, Government of Bangladesh, after the disastrous cyclone and storm surge which hit the coast on April 29-30, 1991. The Consultants carried out the study over a period of six months commencing February, 1992 and submitted their Draft Final Report in August, 1992. The study area covers the coastal zone prone to the risk of storm surge inundation due to tropical cyclones and gives design proposals of additional shelters and killas with their locations in Risk zone.

#### CYCLONE SHELTER PROPOSED BY IEB :

After the cyclone of 1991, Institution of Engineers, Bangladesh conducted a study on cyclone and storm surge. Then on the basis of that study IEB has also proposed a cyclone shelter. It is only a proposal and nobody is going to implement this proposal. But due to academic interest this proposed design is also reviewed in this study.

# COMPARISON OF BUILDING COMPONENTS AND ELEMENTS OF SHELTERS (EXISTING & PROPOSED).

	-		<del></del> .	_	===	<del>-</del> :	-		_		W	_			_		_		_										_	_						
GRAKEEN BANK	Ш	7m	2.895m		2 895m	17 374m	15248			m29', 5 m 67 +		ביים ביים	254 x 547mm	254 x 405mm,	304 x 457 mm	120mm	184 m2	184m2	\$1air - 26.68m2	CHACCE & CALCAST	71.000			1.015 m		E 241	763.00	-		753000		יייי פייי פייי	1	889 x 2134600 (5 223)		
650		# #5 B	E		= 1	16.2844	12 2m	20	- 25 and - 77 & base 2	14 0'9 Leo '11 17 + 19 A	300 , 001		250 x 300 mm			114 mm	Z23m2	223m2	39m2	_	8 0 E	7.2 H x		1.5 m	2 4 7 0	= 213	1016 mm			914 90		191	170x2130mm	(10\$, 2)	single-91412130mm	(3 to 7 nos.)
SACILITIES		E ^-	E	£ 120	1 77 67	13 ** 61	. H 06.7:	•	S030 5 m bay 2.75 m		457 x 381.20m and	381 x 305 mm	254 x 381mm			102 mm	173.36 m2	520 m2	Corridor • 63,54 m2	Stair = 35.94	class room 6.3 m x S.5m	other rooms 3.15 m x 2.75 m		η.22 π	2 OS III		1016 mm			1055 mm	760 x 1320 mm	(nas 48)	1015 x 2134 mm	(nos. 6)		
SCHOE	7 03 m		E	33	24 m	7.69 7.	111 201	6 rectangular and 7 frigatoritae	38 14 48 3		upto 1st lt. 500 mm dia	then 450 mm dia	250 mm x 275 mm			153 mm	145,76 대2	159-61m2	versondah = 38,35 m2,	±13 ir − 15 m2	one L shaped room	sizem 107,41 m2		main stair =1500 mm; 1st floor to root = 900mm;			main slzir & .oof stair	= 825 mm.	cavidor +875 mm	_	.524 mm	(12 nos )	1000 mm	(\$ nos)		
PWD	e 13.41 ta	[ u**		4 12 m and 5,18 m	172 F	691.0		<b>.</b>	2,62 m & 6,4 m		310 x 510mm		254 x 762mm and	254 I 4576M	1.00 mm	127 721	-27 184	204W2	76 m2		5 69 m x 5 59 m	6.415 54m, 5.6412,90m	304 x 4.1/m	1,4; E	5 64 z Jm and	5 64 x1 55qq	915mm			į			2130mm	(\$ 000 \$)		
Building Dala	Total beight of the structure 13.41 m	Floor to cention heads to See 2 25 C	6 second floor	Ground to liest Book height	Total langth of the structure 17.2 m	Total width of the structure 6.91 m	Joint number of base		Span and bay length		Size of columns		ore of beams:		Thickness of floors				# (4.5)		Koom \$128s		İ		Wideh of corridor		37. Height of railing			Height of parabel	19. JSRd and number of windows 350 x1370mm	7	20. Size and number of doors	<del></del>		
	-	2		r.	7	8			~		е́ •	$\neg$	n n		10.	_	_	Т-	_		¥		1 2	$\overline{}$	16.	-	<u>¥</u>		_		5	-  :	й 2			

## SUPPLEMENTARY TABLES.

Table: A6.1 Distribution of Households by their Possessions.

Item of Possession	Househo	olds Have	Househo)	lds Not Have	Total			
Watch	85	(39%)	 1 <b>3</b> 5	(61%)	220	(100%)		
Redio	36	(16%)	184	(84%)	220	(100%)		
Television	3	(1%)	217	(99%)	220	(100x)		
Kot	62	(28%)	158	(72%)	220	(100%)		
Quilt/Mattress	90	(36%)	140	(64%)	222	(120%)		
Chowki	89	(40%)	131	(80%)	220	(100%)		
Almirah	73	(33%)	147	(67%)	220	(100%)		
Hanger for cloth	65	(32%)	155	(70%)	220	(120%)		
Table	78	(35%)	142	(65%)	220	(100%)		
Chair	84	(38%)	136	(82%)	220	(100%)		
Leather/wooden box	173	(79%)	47	(21%)	220	(100%)		
Boat/Trawler	20	(9%)	200	(91%)	220	(100x)		
Bicycle	6	(3%)	214	(97%)	220	(100%)		
Rickshaw	1	(.45%)	219	(99.55%)	220	(100%)		

Source : Field Survey, 1993.

Table: A6.2 Irrigation in Agricultural Land According to Income.

Income Gro	qu	Level of Irrigation									
(Tk.)		120%	5Ø <b>%</b> >	<50%	0%	Total					
Upto 1 <b>000</b>	Case %	3 6Ø	Ø B	0	2 4Ø	5 190					
1001-3000	Case	18	11	6	8	43					
	%	42	26	14	18	100					
3001-5000	Case	13	3	2	1	19					
	%	68	16	11	5	100					
5Ø01&up	Case	11	3	4	2	20					
	%	55	15	23	1Ø	120					
Total	Case	45	17	12	13	87					
	%	<b>5</b> 1	20	14	15	100					

Source : Field Survey, 1993.

Table: A6.3
Type of Latrine Used by Respondents According to Income.

Income Group	Kutcha	Pucca	Not At all	Total
Upto 1202 1201-3220 3201-5200 5021 & up	15 (75%) 105 (79%) 21 (60%) 20 (63%)	2 (10%) 13 (10%) 9 (26%) 10 (31%)	3 (15%) 15 (11%) 5 (14%) 2 (6%)	29 (199%) 133 (199%) 35 (199%) 32 (199%)
Total	161 (73%)	34 (15%)	25 (12%)	220 (100%)

Source : Field Survey, 1993.

Table: A6.4
Type of Drain Present in Homesteads According to Income.

Income Group	Kutcha	Pucca	Not At all	Total	
Upto 1020 1021-3002 3001-5020 5001 & up	Ø (Ø%) Ø (Ø%) 2 (6%) 3 (9%)	0 (0%) 0 (0%) 1 (3%) 0 (0%)	20 (120%) 133 (100%) 32 (91%) 29 (91%)	2Ø (100%) 133 (100%) 35 (100%) 32 (100%)	
Total	5 (2%)	1 (.46%)	214 (97.54%)	220 (100%)	

Source : Field Survey, 1993.

Table: A6.5 Homesteads' Sewerage Type According to Household Income.

Income Group	Open	Pit	Not At all	Total
Upto 1982 1281-3228 3281-5282 5321 & up	15 (75%) 1Ø5 (79%) 21 (60%) 2Ø (63%)	2 (10%) 13 (10%) 9 (26%) 10 (31%)	3 (15%) 15 (11%) 5 (14%) 2 (6%)	29 (199%) 133 (199%) 35 (199%) 32 (199%)
Total	161 (73%)	34 (15%)	25 (12%)	220 (100%)

Source : Field Survey 1993.

# SUPPLEMENTARY CALCULATION : A7.1

Following Table has been developed for fitting the standard deviational ellipse about the mean centre in the catchment area.

Table : A7.1
Fitting the Standard Deviational Ellipse

Settlement	Original Co- ordinates		Transposed Co-ordinates				
	×	y	x-x = x'	y-y	x'2	y'2	<u>x'y</u> '
Pecharghona	18	12	1.80	3.5	1	12.25	3.50
Rasterpara	7	. 13	4.08	2.5	16	6.25	16.88
Rakhainpara	5	18	-1,00	6.5	1	<b>0.</b> 25	-0.50
Jaliapara	. 5	11	-1.85	1.5	1	2,25	-£.50
<u>Hat</u> kulapara	5	_ 7	-1.00	-2.5	1	6.25	2,50
Monupara	4	4	-2.80	-5.5	4	30.25	11.00

n=6 
$$\Sigma x=36$$
  $\Sigma y=57$   $\Sigma x'=0$   $\Sigma y'=0$   $\Sigma x'2=24$   $\Sigma y'2=57.5$   $\Sigma x'y'=25$   $x=6$   $y=9.5$ 

$$\tan \theta = \frac{(\Sigma \mathbf{x}'2 - \Sigma \mathbf{y}'2) + (\Sigma \mathbf{x}'2 - \Sigma \mathbf{y}'2) + 4(\Sigma \mathbf{x}'\mathbf{y}')2}{2\Sigma \mathbf{x}'\mathbf{y}'}$$

$$= \frac{(24-57.5)+(24-57.5)+4(25)2}{2 \times 25} = \emptyset.32328$$

$$6x = \begin{cases} (\Sigma x'2)\cos 2\theta - 2(\Sigma x'y')\sin \theta\cos \theta + (\Sigma y'2)\sin 2\theta \\ - (\Sigma x'y')\sin \theta\cos \theta + (\Sigma y'2)\sin \theta\cos \theta \end{cases}$$

$$= \sqrt{\frac{24 \times .9054 - 2(25).2928 + 57.5 \times .0946}{2}} = 1.45$$

$$6y = \int \frac{(\Sigma x'2)\sin 2\theta + 2(\Sigma x'y')\sin \theta \cos \theta + (\Sigma y'2)\cos 2\theta}{n}$$

$$= \int \frac{24 \times .0946 + 2(25).2926 + 57.5 \times .9054}{n} = 3.39$$

Therefore, from the unit of arbitrary grid,

$$6x = 1.45 \times 400 \text{ m} = 580 \text{ m} = 0.36 \text{ mile}$$
  
 $6y = 3.39 \times 400 \text{ m} = 1356 \text{ m} = 0.84 \text{ mile}$ 

#### SUPPLEMENTARY CALCULATION: A7.2

Height of ground floor of cyclone shelter has been determined by using the following formula (MCSP, 1992),

Where,

H= = required height of surge water free floor level of the shelter in m.

x = distance of the shelter from the spring tide high water limits on the sea-beach in km.

hr = design surge height in m corresponding to a return period of T years.

k = rate of decrease in surge height in m per km.

 $h_w = amplitude$  of local wave in m from mean water level.

yr = elevation of T-year surface water level in m.

ys = elevation of ground level at the location of shelter.

hr = allowance for local waves for which 1 m is suggested.

Therefore,

by using equation (2),

$$h_1 = 2.7 - (2 - 1)1/2 + [2.7 + (2 - 1)1/2]/4$$
  
= 2.7 - .5 + .55 = 2.75 m.

by using equation (4),

$$h_2 = 3.78 - 1.8 + 1 = 2.98 m$$
.

As  $h_1 < h_2$ , so value of  $h_2$  has been taken as the height of ground floor for proposed cyclone shelter.

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