Introduction

1. This 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, a multi-disciplinary team of national experts, drawn mainly from the Bangladesh University of Engineering and Technology (BUET) and the Bangladesh Institute of Development Studies (BIDS), (Annex A), carried out the six-month study commencing February, 1992, with funding provided by UNDP, the World Bank acting as the Executing Agency and sponsored by the Planning Commission, Govt. of Bangladesh. The major objective of the study is to formulate a Master Plan to serve as a framework for the establishment of a Cyclone Shelter Network in the coastal areas which will define the basic concept, strategy and locational pattern to be followed in all future construction.

   The Consultants submitted their Draft Final Report (DFR) in August, 1992. The DFR was discussed in meetings of the Task Force. A National Seminar was organized by the Planning Commission to receive comments on the DFR from among a wider cross-section of professionals, public representatives and development partners. The Task Force and the National Seminar provided the Study Team with valuable comments and suggestions, based on which the Final Report has been prepared. This Summary presents the methodology and the major findings of the Study. An outline of the structure of the Final Report is presented in Annex B.

Risk Zone

2. The study area covers the coastal zone prone to the risk of storm surge inundation due to tropical cyclones. About one-tenth of the global total of tropical cyclones occur in the Bay of Bengal. About one-sixth of tropical cyclones born in the Bay of Bengal had landfall on the Bangladesh coast. Fig. 1 shows the number of cyclonic storms landed on Bangladesh coast in different decades. Cyclones usually occur during April to June (called pre-monsoon cyclonic storm) and September to December (called post-monsoon cyclonic storm). Fig. 2 shows monthly distribution of cyclonic storm landed on Bangladesh coast between 1877 and 1990. The tracks of some of the severe tropical cyclones which struck this coastal zone in this century are shown in Fig. 3

3 The Risk Zone (RZ) has been delineated on consideration of the extent upto which the storm surge might travel inland. The area within the RZ 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). The demarcation of RZ and HRA has been based on records of past storm surges, results from mathematical model studies and information from field survey. The boundaries of RZ and HRA are shown in Fig. 4. The RZ comprises 12,046 sq. km. in 49 Thanas (313 Unions), whereas the HRA has 9,182 sq. km. in 46 Thanas (237 Unions); these represent 8.4% and 6.4% of the total area of Bangladesh.

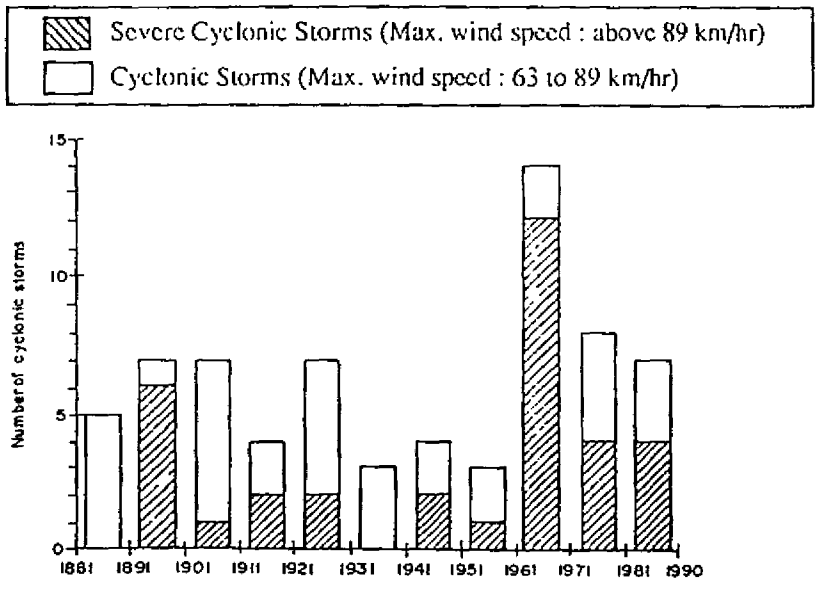


Fig. 1 Number of Cyclonic Storms Landed on Bangladesh Coast in Different Decades.

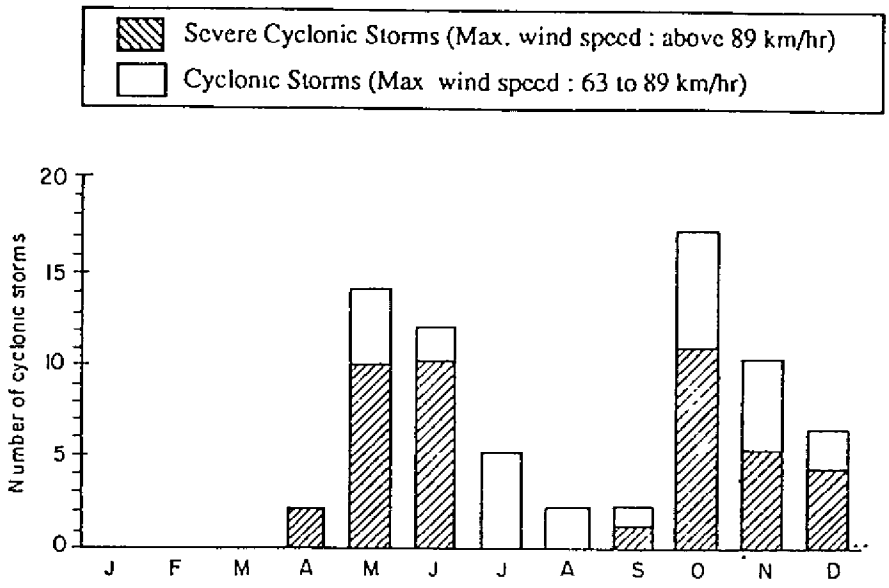


Fig. 2 Monthly Distribution of Cyclonic Storms Landed on Bangladesh Coast Between 1877 and 1990

Surge Height

4. Storm surge heights have been estimated using a mathematical model. Estimated surge heights at the sea coast for 20 years, 50 years and 100 years return periods with 90% confidence limits are given in Table 1. It is estimated that the surge height decreases over the land at the rate of 1/2 m per km for the Chittagong Coastal Plain and 1/3 m per km for the rest of the coastal area.

Table 1 Surge Height at the Sea Coast

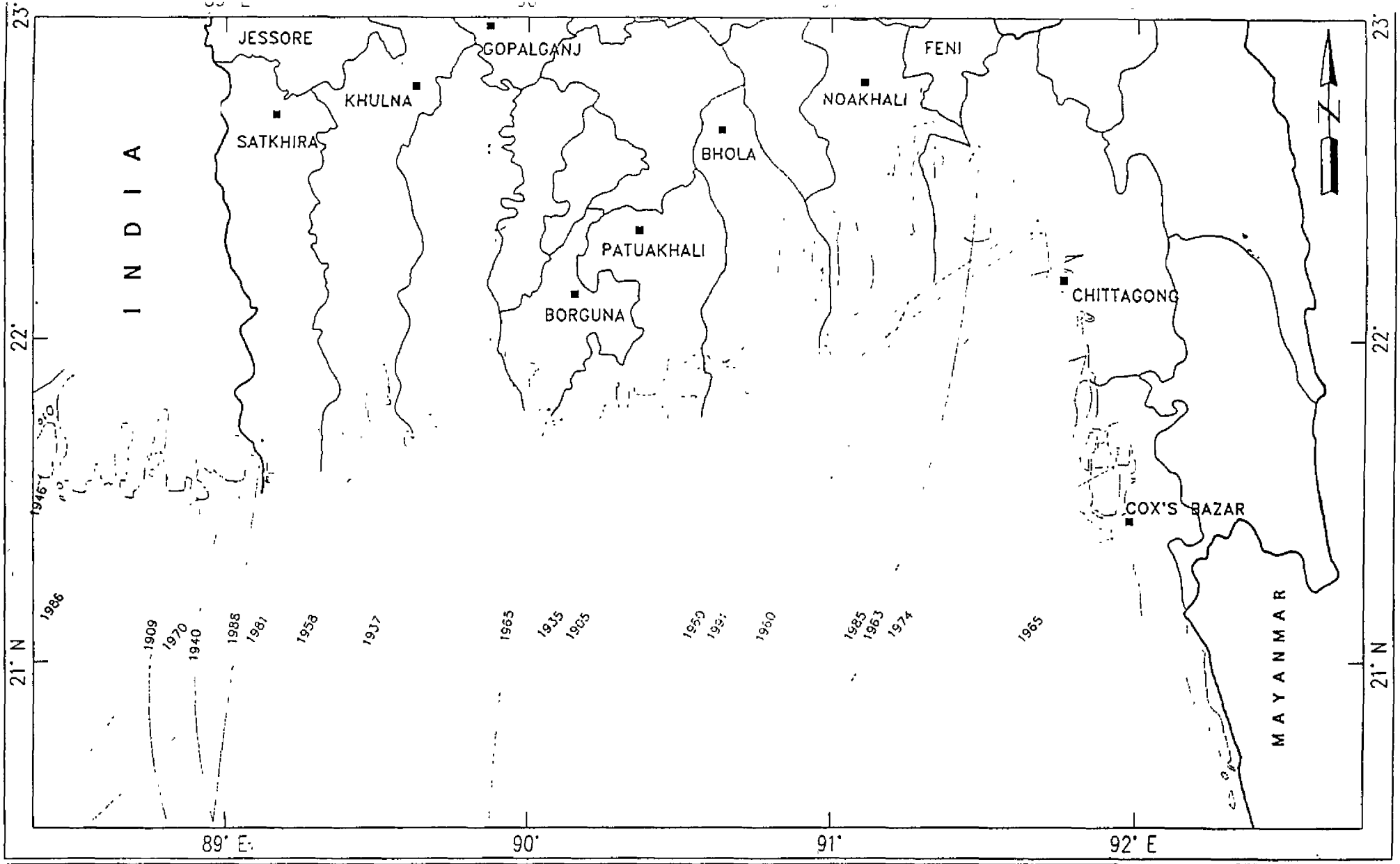
Region	Surge height at the sea coast along with 90% confidence limits (m)		
	20 - year return period	50-year return period	100-year return period
Teknaf to Cox's Bazar	2.7 ± 0.7	3.7 ± 0.8	4.5 ± 1.3
Chakaria to Anwara, and Maheshkhali-Kutubdia Islands	4.3 ± 0.9	5.8 ± 1.3	7.0 ± 1.6
Chittagong to Noakhali	4.8 ± 1.0	6.5 ± 1.4	7.8 ± 1.8
Sandwip, Hatiya and all Islands in this Region	4.8 ± 1.0	6.5 ± 1.4	7.8 ± 1.8
Bhola to Barguna	3.8 ± 0.8	5.1 ± 1.1	6.2 ± 1.5
Sarankhola to Shyamnagar	3.1 ± 0.7	4.3 ± 1.0	5.2 ± 1.2

Base Maps of the Study Area

5. Base maps of the study area have been prepared on 1:50,000 scale separately for each Thana using satellite imagery and available information and maps, showing the administrative boundaries, roads and communication network, river system, location of other important infrastructure and educational buildings, existing and under construction shelters.

Erosion and Accretion

6. The coastline of the study area is in a process of continuous change due to active erosion and accretion. A study on the erosion and accretion pattern between 1972 and 1991 showed that major erosion/accretion is taking place at the mouth of Meghna Delta. Results of the study are summarised in Table 2



LEGEND

International Boundary ... ...

River ... ...

Storm Tracks ... ...

20 0 20 40 60 80 100 km

SCALE

MULTIPURPOSE CYCLONE SHELTER PROGRAMME

UNDP/WORLD BANK/GOB PROJECT BGD/91/025

Fig. 3 Tracks of Severe Cyclonic Storms, 1905–1991

Bangladesh University of Engineering & Technology

Bangladesh Institute of Development Studies

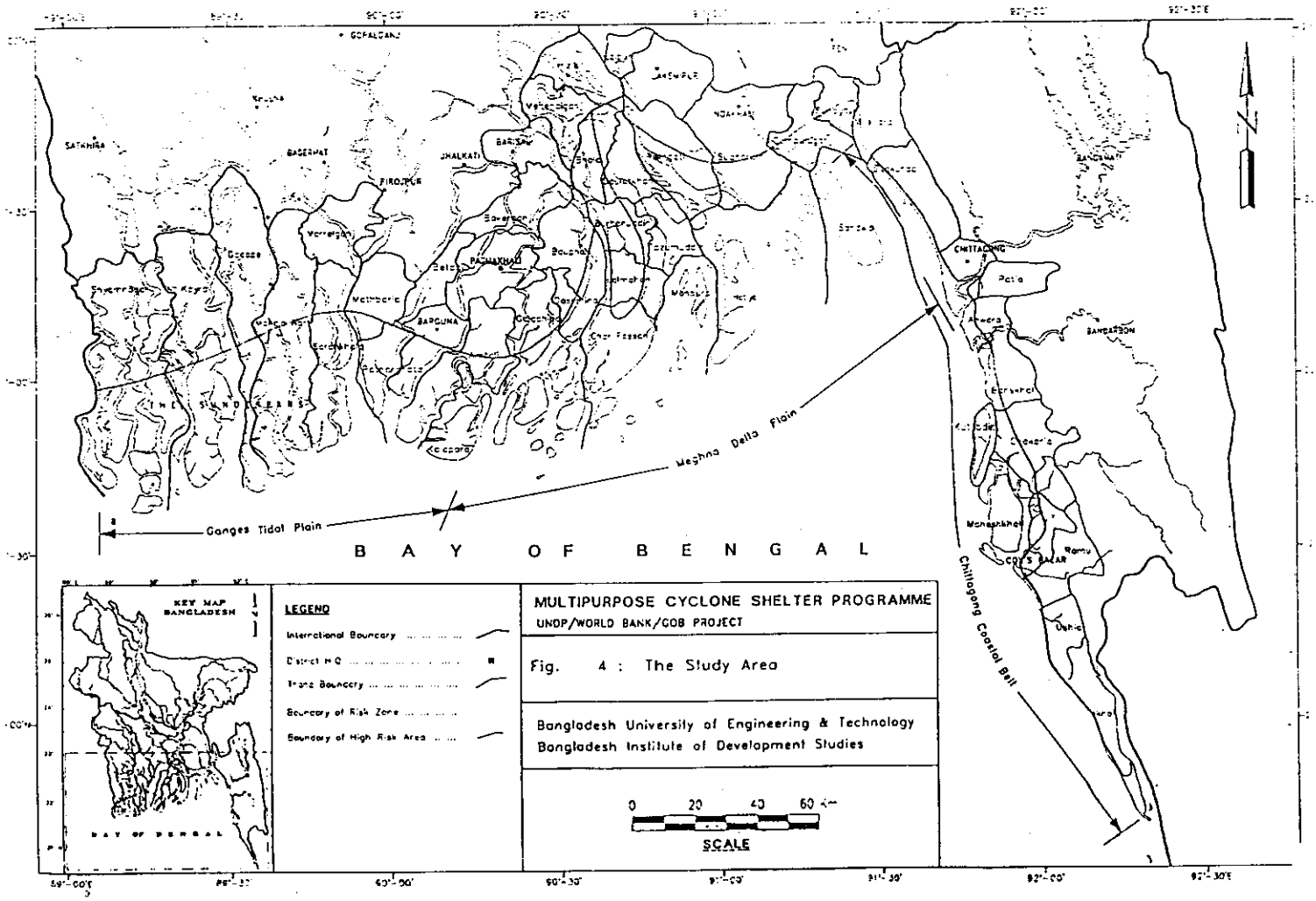

Ganges Tidal Plain
Meghna Delta Plain
B A Y O F B E N G A L
Chittagong Coastal Belt
KEY MAP BANGLADESH
BAY OF BENGAL
LEGEND
International Boundary
District HQ
Thana Boundary
Boundary of Risk Zone
Boundary of High Risk Area
MULTIPURPOSE CYCLONE SHELTER PROGRAMME
UNDP/WORLD BANK/GOB PROJECT
Fig. 4 : The Study Area
Bangladesh University of Engineering & Technology
Bangladesh Institute of Development Studies
0 20 40 60 Km
SCALE

Table 2 - Erosion and Accretion in the Study Area Between 1972-91

Area	Erosion (in sq. km.)	Accretion (in sq. km.)
Sundarbans	74.73	14.45
Bhola area	69.63	329.49
Noakhali-Chittagong area	494.39	587.04
Cox's Bazar area	33.43	8.88

Human Population

7. In 1991, there were 5.114 million people in the High Risk Area (HRA) representing 4.6% of the national population. A review of the population growth since 1951 indicates that the growth of the population in the HRA has been somewhat lower than that in Bangladesh as a whole. The growth rate of the population during the intercensal period of 1981-91 was 2.05% in the HRA as compared to 2.17% in all Bangladesh.

8. Intercensal net migration estimates, as have been calculated by Unions and Thanas indicate that, the HRA, as a whole, is losing population to other parts of Bangladesh; however the Chittagong coastal belt has net in migration. Out migration rate is the highest from the West Zone followed by Central Zone. Average yearly net migration rates are -0.283%, -0.081%, +0.040% and -0.080% for the West Zone, Central Zone, East Zone and all HRA, respectively.

9. The total number of fishermen, including fish traders, who move to the Sundarban areas, as well as in Patuakhali and Noakhali districts of Meghna estuary, for coastal and off-shore fishing, is estimated to be around 40 thousand at any time during the fishing season. Besides fishing, there are considerable number of Bawalies and Kathurias who move into the Sundarban areas for cutting and collecting wood/leaves of various kind as well as for collecting honey. There are also some seasonal migrants for shrimp culture/catches and for salt making in Sundarban and Cox's Bazar areas. The total number of seasonal migrants for such economic activities (other than fishing) is estimated to run as high as 30-40 thousand, spread over wide areas during various times of the year.

10. Elaborate population projections have been made by age groups and sex for each Union under the HRA for the next 25 years, at five year intervals, with assumed fertility, mortality and migration schedules under three sets of high, medium and low variants of assumptions, using July 1, 1992 as the base year reference date. From a base year population of 5.249 million in 1992, the projected population in the HRA in 2017 increases to 8.748 million, 8.326 million and 7.844 million, under high, medium and low variant assumptions, respectively. The growth rate of the population declines from 2.06% in 1992 to 1.74%, 1.39% and 1.15% in the terminal period of 2012-17 under high, medium and low variant assumptions, respectively.

11. Due to prolonged decline in fertility, the proportion of population at younger ages declines and that at higher ages increases. Thus, for example, the proportion of population under age 15 in the HRA would decline from 47.6% in 1992 to 31.9%, 29.1% and 25.8% in the terminal year of 2017 under high, medium and low variants of fertility assumptions, respectively. Fig. 5 shows Population Pyramid by Age Group and Sex in the HRA under medium variant fertility assumptions in 1992, 2002 and 2017. Because of declining fertility assumptions, the proportion of primary school age population (6-10 years) to total population declines to its two-thirds level from 15.9% in 1992 to 10.2% in 2017, with the number of primary school age population somewhat fluctuating between the years but maintaining an average of 830,501, which is somewhat smaller than the corresponding initial base year size of 834,925. The proportion of the secondary school age population (11-15 years) also declines in the HRA from 12.1% in 1992 to 10.2% in 2017 (Table 4).

Table 3 Selected Parameters of the Projected Population in the High Risk Area under Medium Variant Assumption, 1992 - 2017

	1992	1997	2002	2007	2012	2017
Mid-Year Population (Number) by Zone						
West	841,049	918,800	1,007,828	1,108,852	1,204,424	1,281,881
Central	2,896,875	3,176,813	3,532,319	3,912,174	4,278,624	4,584,517
East	1,511,773	1,679,680	1,871,290	2,082,135	2,287,604	2,460,289
Total HRA	5,249,697	5,775,293	6,411,437	7,103,161	7,770,652	8,326,687
Broad Age Groups of the Mid-Year Population						
Total	5,249,697	5,775,293	6,411,437	7,103,161	7,770,652	8,326,687
0-14	2,497,619	2,504,219	2,445,724	2,401,260	2,501,175	2,424,665
15-49	2,220,491	2,668,511	3,267,461	3,875,009	4,279,730	4,718,417
50-59	263,271	306.997	362 950	433,414	514,986	600,607
60 +	268,316	295,566	335,302	393,478	474,761	582,998
Percentage Distribution of Broad Age Group Population						
Total	100.0	100 0	100.0	100 0	100 0	100.0
0-14	47.6	43.4	38.1	33 8	32 2	29.1
15-49	42 3	46.2	51.0	54.6	55.1	56 7
50-59	5.0	5.3	5.7	6.1	6.6.	7 2
60 +	5.1	5.1	5.2	5 5	6.1	7.0
	1992-97	1997-02	2002-07	2007-12	2012-17	1992-17
Average Annual Population Growth Rate (Per Cent)						
West	1.78	1.87	1 93	1.67	1.25	1 70
Central	1.86	2.14	2.06	1 81	1.39	1 85
East	2.13	2.18	2.16	1 90	1.47	1.97
Total HRA	1.93	2 11	2.07	1.81	1.39	1.86
Crude Birth Rate (Per 1000 Population)						
Total HRA	32.34	30.84	28.92	24 94	19.59	-
Crude Death Rate (Per 1000 Population)						
Total HRA	12.20	10.29	8 48	7 02	5.92	
Average Annual Natural Growth Rate (Per Cent)						
Total HRA	2.01	2.06	2.04	1.79	1.37	-

Table 4 Number and Proportion of the Primary School Age (6-10 years) and Secondary School Age (11-15 years) Population in the HRA by Zone, Projected at Five Year Intervals, 1992-2017, Medium Variant Assumptions

Zone	Total Population	No. of Persons		% of the Total Population	
		6-10 years	11-15 years	6-10 years	11-15 years
July 1, 1992					
West Zone	841,049	133,986	102,852	15.93	12 23
Central Zone	2,896,875	465,111	346,839	16.06	12.97
East Zone	1,511,773	235,828	186,516	15.60	12.34
Total HRA	5,249,697	834,925	636,207	15.90	12.12
July 1, 1997					
West Zone	918,800	142,239	132,410	15.48	14.41
Central Zone	3,176,813	511,403	461,069	16.10	14 51
East Zone	1,679,680	255,602	234,110	15.22	13.94
Total HRA	5,775,293	909,244	827,589	15.74	14.33
July 1, 2002					
West Zone	1,007,828	119,492	141,455	11.86	14.04
Central Zone	3,532,319	419,492	511,367	11.88	14.48
East Zone	1,871,290	220,639	255,746	11.79	13.67
Total HRA	6,411,437	759,623	908,568	11.85	14.17
July 1, 2007					
West Zone	1,108,852	121,804	117,080	10.98	10 56
Central Zone	3,912,174	425,052	412,512	10.86	10 54
East Zone	2,082,135	229,610	218,328	11.03	10.49
Total HRA	7,103,161	776,466	747,920	10.93	10.53
July 1, 2012					
West Zone	1,204,424	132,725	121,147	11.02	10 06
Central Zone	4,278,624	468,404	425,628	10.95	9 95
East Zone	2,287,604	250,994	229,984	10.97	10.05
Total HRA	7,770,652	852,123	776,759	10.97	10.00
July 1, 2017					
West Zone	1,281,881	131,458	132,075	10.26	10 30
Central Zone	4,584,517	469,270	467,660	10.24	10 20
East Zone	2,460,289	249,894	251,199	10.16	10.21
Total HRA	8,326,687	850,622	850,934	10.22	10.22

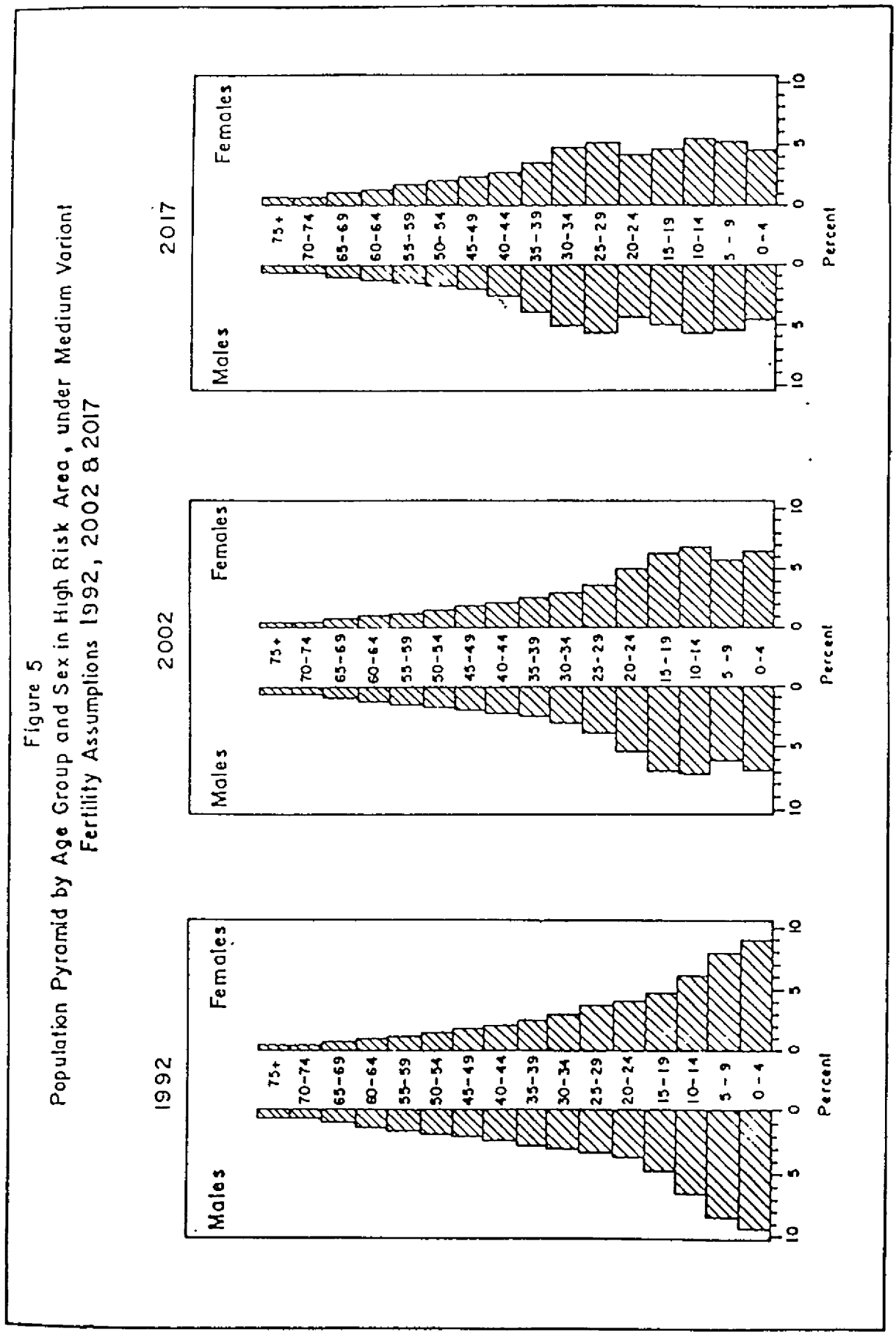


Figure 5
Population Pyramid by Age Group and Sex in High Risk Area, under Medium Variant Fertility Assumptions 1992, 2002 & 2017

Livestock Population

12. Bovine (cattle and buffaloes) and ovine (goat and sheep) population for each Union under the HRA has been estimated for 1992 and projected in five year intervals till 2017 under high, medium and low variant of assumptions. The bovine population increases from 1.272 million in 1992 to 1.672 million in 2017 under medium variant assumption (Table 5). As the projected growth rates of the bovine population under medium variant are lower than growth rate assumed under the medium variant of population projection, the proportion of the bovine population to the human population (medium variant) declines from 0.242 in 1992 to 0.201 in 2017 under medium variant of projection of bovine population.

Table 5 Number and Per Capita Availability of Bovine Population Projected at Five Year Intervals, 1992-2017, by Zone under Medium Variant Assumption

Zone	1992	1997	2002	2007	2012	2017
West Zone	296,879 (0.353)	310,725 (0.338)	325,236 (0.323)	341,054 (0.308)	357,030 (0.296)	373,778 (0.292)
Central Zone	658,456 (0.227)	692,995 (0 218)	729,520 (0.207)	769,021 (0.197)	809,891 (0 189)	853,097 (0.186)
East Zone	316,286 (0.209)	338,721 (0.202)	362,746 (0.194)	388,489 (0.187)	416,044 (0.182)	445,555 (0.181)
Total HRA	1,271,621 (0.242)	1,342,440 (0.232)	1,417,503 (0.221)	1,498,563 (0.211)	1,582,965 (0.204)	1,672,430 (0.201)

Note : Figures in parentheses indicate per capita availability

13. Ovine (goat/sheep) population increases from estimated 0.851 million in 1992 to 1.489 million in 2017 under medium variant assumption (Table 6). Unlike bovine population the projected growth rate of the ovine population under medium variant assumption is higher than that of the human population (medium variant), and hence, the ratio of ovine population to human population (medium variant) increases from 0.162 in 1992 to 0.179 in 2017 under medium variant assumption.

Table 6 Number and Per Capita Availability of Goat/sheep Population Projected at Five Year Intervals, 1992-2017, by Zone under Medium Variant Assumption

Zone	1992	1997	2002	2007	2012	2017
West Zone	170,238 (0.202)	199,638 (0.217)	227,838 (0.226)	254,559 (0.230)	278,731 (0.231)	300,466 (0.234)
Central Zone	467,122 (0.161)	542,409 (0.171)	614,627 (0.174)	682,190 (0.174)	744,130 (0.174)	799,910 (0.174)
East Zone	214,305 (0.142)	253,386 (0.151)	291,087 (0.156)	326,488 (0.157)	359,005 (0.157)	388,334 (0.158)
Total HRA	851,665 (0.162)	995,432 (0.172)	1,133,552 (0.177)	1,263,237 (0.178)	1,381,866 (0.178)	1,488,710 (0.179)

Note : Figures in parentheses indicate per capita availability

Settlement Patterns

14. Settlement pattern of human population, obtained from satellite imagery, has been sketched on the Mouza maps (1129 Mouzas) in each Union (237 Unions) and Thana maps (45 Thanas) with the ultimate object of ascertaining the location of the new shelters to be proposed and to help delineate the catchment area of each cyclone shelter, existing and proposed under MCSP.

15. A broad overview of the settlement pattern indicates that predominant settlement pattern in the HRA is of linear type. Other patterns of human settlement in the HRA are the nucleated, scattered and mixed types. Nucleated human settlements have been formed on the plains and foothills in East Zone. In the Central Zone where the density of population is high, human

settlement is mostly of scattered type. Mixed settlement pattern (linear and scattered) is also observed generally in the Central and East Zones. In the newly formed char lands the human settlement is thin and of scattered type.

Inventory of Shelters

16. A detailed inventory of existing and under construction cyclone shelters has been prepared (Table 7). There are 132 two-storied Coastal Community Centres constructed in the sixties; 238 three-storied PWD type shelters constructed in the seventies out of which 12 shelters have been washed away; 62 cyclone shelters constructed by BDRCS in the eighties; 12 shelters built by Caritas, an NGO; 12 shelters by other NGOs and 37 school-cum-shelters (of which 13 are outside RZ) constructed by Ministry of Education. Presently 40* shelters are under construction by BDRCS and another 58 under the initiative of various NGOs. During the last few months* various organisations have proposed construction of additional shelters (Table 7). BDRCS has selected 115 sites; Facilities Department has selected 360 locations (under Saudi Fund and IDB assistance); EEC plans to fund construction of 200 shelters; LGED has proposed 10 shelters (under IFAD funding) and 40 shelters (under Japanese assistance) and NGOs 190 shelters. Locations of some of the proposed shelters are yet to be finalized.

Inventory of Killas

17. A total of 156 killas (earthen mounds) were constructed as livestock shelters by BDRCS in the seventies and 5 others after the cyclone of 1985, out of which 146 could be located through field survey. Another 40 killas, construction of which was initiated by LGED after the 1991 cyclone, are in various stages of completion. The inventory of killas is shown in Table 8.

Existing Public and Private Buildings

18. A detailed inventory of all pucca buildings in the HRA which can be used as shelters (i.e. having two or more stories) has been prepared. There are 626 Public/ Community buildings providing a total shelter capacity of around 0.5 million. In addition, around 500 private buildings, (including 260 nuclear houses at Urir Char) provide a shelter capacity of 0.1 million. There are 1514 one-storied pucca buildings in RZ. It is estimated that around 430 of the existing one-storied public buildings are capable of supporting a second storey, construction of which will require around Tk. 626 million, adding a shelter capacity of around 0.23 million.

Repair and Rehabilitation of Existing Shelters and Killas

19. The PWD Type shelters are three-storied reinforced concrete framed buildings constructed during 1972-79 under IDA credit. Construction was hampered due to poor communication and scarcity of materials in the period immediately following the War of Liberation. The condition of most of the PWD shelters has deteriorated over the years. The possible factors and causes resulting in distress are poor construction practices, use of improper materials in concreting, drying shrinkage, thermal stress, weathering, chemical reactions, corrosion of reinforcements and effect of saline environment. The distresses are observed in the form of cracks, corrosion of reinforcing bars, spalling and scaling of concrete in all the structural elements, viz. slabs, beams, columns, and stairs, affecting not only the appearance but also the strength and durability of the shelters.

The rehabilitation work will mainly consist of repairing concrete damaged by corrosion of reinforcements as well as repairing cracks and spalling of concrete in slabs, beams and columns. This work is required to accomplish the following objectives : to restore load carrying capacity; to restore stiffness of the members; to improve functional performance; to improve appearance of concrete surfaces; to improve durability: to prevent ingress of corrosive materials to the reinforcements and inhibit corrosion.

A review has been made of the available materials and methods of repair. Causes of distress have been analysed and technique of repair using ferrocement technology has been found to be the most suitable.

There are no water supply or toilet facilities inside the existing shelter buildings. The facilities outside the shelters, but within reasonable distance, are also very limited. Recommendations have been made to include toilets inside the buildings and upgrade water supply.

* *On the basis of information collected in June, 1992*

Table 7 Inventory of Shelters

HIGH RISK AREA (HRA)

Sl NO.	Thana	Existing Cyclone Shelters						Cyclone Shelters Under Construction					Cyclone shelters Proposed by Various Agencies				
		PWD/ IDA	BDRCS	CARITAS	C C C	Others (c)	Total	BDRCS	CARITAS	Facilities'	Others (d)	Total	BDRCS (a)	CARITAS	Facilities (b)	Others (c)	Total
1	Shyamnagar	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1
2.	Dacope	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
3.	Koyra	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
4	Sarankhola	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3
5	Mongla port	0	0	0	0	0	0	0	2	0	0	2	0	2	0	0	2
6	Patharghata	1	1	0	7	0	9	2	0	0	1	3	3	0	0	0	3
7	Barguna	1	1	0	3	0	5	1	0	0	0	1	2	0	0	0	2
8.	Amtali	1	2	0	3	0	6	1	0	0	0	1	3	4	0	0	7
9	Betagi	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
10	Bauphal	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
11.	Galachipa	23	4	0	8	0	35	3	0	0	0	3	7	0	0	0	7
12	Dashmina	6	1	0	1	0	8	0	0	0	0	0	3	0	0	0	3
13.	Kalapara	21	1	2	6	0	30	1	2	0	0	3	4	11	0	0	15
14	Mathbaria	1	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0
15	Bhola Sadar	5	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
16	Burhanuddin	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
17.	Lalmohan	13	0	0	1	0	14	0	0	0	0	0	1	0	12	0	13
18	Char Fasson	24	3	0	6	0	33	5	0	0	1	6	2	0	12	0	14
19.	Manpura	6	0	4	1	2	13	7	6	0	0	13	1	0	3	0	4
20	Tazumuddin	9	3	0	0	0	12	0	0	0	0	0	1	0	11	0	12
21	Daulatkhan	8	0	0	0	0	8	0	0	0	0	0	1	0	11	0	12
22.	Bakerganj	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
23.	Barisal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Ramgati	8	0	0	4	0	12	0	0	0	0	0	5	0	0	0	5
25.	Raipur	1	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0
26	Lakshmipur Sadar	1	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0
27	Hatiya	13	16	0	7	0	36	6	0	12	0	18	0	3	13	0	16
28.	Noakhali Sadar	10	6	0	3	9	28	0	0	0	0	0	8	0	0	0	8
29	Companiganj	3	6	0	2	0	11	0	0	0	0	0	6	0	0	0	6
30	Sonagazi	3	0	0	5	0	8	0	0	0	0	0	5	0	0	0	5
31.	Sandwip	7	6	6	9	1	29	0	0	0	0	0	6	6	34	0	46
32	Mirsarai	3	0	0	3	0	6	0	0	7	0	7	0	0	2	0	2
33	Sitakunda	1	0	0	7	0	8	0	0	13	0	13	0	0	0	0	0
34	Patiya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	Anwara	2	0	0	5	0	7	0	1	13	0	14	10	0	5	0	15
36	Banshkhali	4	0	0	8	0	12	9	0	12	4	25	9	0	13	0	22
37.	Kutubdia	3	4	0	3	0	10	0	0	0	9	9	10	0	24	17	51
38.	Chakaria	3	2	0	8	0	13	0	8	18	0	26	13	0	17	0	30
39.	Maheshkhali	3	3	0	5	0	11	2	0	0	20	22	3	0	6	0	9
40.	Cox's Bazar Sadar	1	0	0	4	0	5	1	1	15	0	17	4	0	3	0	7
41.	Ramu	0	0	0	0	0	0	0	0	4	0	4	0	0	3	0	3
42.	Ukhia	1	0	0	0	0	1	0	0	2	0	2	0	0	5	0	5
43.	Teknaf	1	3	0	4	0	8	2	0	5	0	7	2	0	4	0	6
44	Bandar	2	0	0	0	0	2	0	0	0	0	0	0	0	2	0	2
45.	Chandanaish	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
	TOTAL :	195	62	12	118	12	399	40	23	101	35	199	109	30	183	17	339

WITHIN RISK ZONE (BUT OUTSIDE HRA)

TOTAL :	19	0	0	9	0	28	0	0	1	0	1	1	2	13	0	16

OUTSIDE RISK ZONE

TOTAL :	12	0	0	5	0	17	0	0	0	0	0	0	5	107	0	112

(a) Location of 5 Nos. are unknown

(b) Location of 19 Nos. are unknown and not included; 64 Nos of CEC financed primary schools are included

(c) Includes LGEB (10 nos.), BRAC (7 nos.)

(d) Includes Grameen Bank (1 no.), Church of Bangladesh (5 nos.), BRAC (9 nos), CCDB (15 nos), SAMPREETI (4 nos.), DRF (1 no), identified during field survey

(e) Includes DANIDA (1 no.), Netherlands (6 nos.), Indian Govt (1 no) and SDR (4 nos.)

Table 8 Inventory of Killas

Sl. No	Thana	Existing Killas (In HRA)	Killas Under Construction (In HRA)	Sl. No.	Thana	Existing Killas (In HRA)	Killas Under Construction (In HRA)
1.	Shyamnagar	0	0	26	Bakerganj	0	0
2.	Dacope	0	0	27.	Barisal	0	0
3.	Koyra	0	0	28.	Ramgati	23	2
4.	Morrelganj	0	0	29.	Raipur	0	0
5.	Sarankhola	0	0	30.	Lakshmipur Sadar	0	0
6.	Monglaport	0	0	31.	Hatiya	18	2
7.	Patharghata	0	1	32.	Noakhali Sadar	20	2
8.	Barguna	0	0	33.	Companiganj	0	2
9.	Amtali	0	1	34.	Sonagazi	0	1
10.	Betagi	0	0	35.	Sandwip	3	2
11.	Bamna	0	0	36.	Mirsarai (**)	0	1
12.	Bauphal	0	0	37.	Sitakunda	0	0
13.	Galachipa	19	1	38.	Patiya	0	0
14	Dashmina	5	0	39.	Anwara	0	0
15.	Kalapara	23	1	40.	Banshkhali	0	3
16.	Mathbaria	0	0	41.	Kutubdia	5	0
17.	Bhola Sadar	0	0	42.	Chakaria	0	9
18.	Burhanuddin	0	0	43.	Maheshkhali	1	6
19.	Lalmohan	0	1	44.	Cox's Bazar Sadar	0	0
20.	Char Fasson	18	1	45.	Ramu	0	0
21.	Manpura	6	2	46.	Ukhia	0	0
22.	Tazumuddin	5	1	47.	Teknaf	0	0
23.	Daulatkhan	0	1	48.	Bandar	0	0
24.	Mehendiganj	0	0	49.	Chandanaish	0	0
25.	Hizla	0	0		TOTAL :	146	40

(*) No. of Killas as per information obtained from Field Survey

(**) 1 Killa in Mirsarai Thana is outside HRA but inside RZ

Detailed cost estimates of all the PWD type shelters, Thana-wise, have been prepared for repair and rehabilitation works including provision of water supply and sanitation facilities. Summary of costs are presented in Table 9.

20. Most of the 146 existing killas are in poor condition and unlikely to be used during cyclones. The repair and rehabilitation needs have been identified, methods for repair proposed and cost estimates prepared (Table 10)

Review of Design of Existing and Proposed Shelters

21. Architectural and Civil Engineering review of designs of existing and proposed cyclone shelters have been carried out. Six designs viz. those of PWD, BDRCS (also adopted by Caritas), Facilities Department, LGED, Grameen Bank and BRAC have been critically evaluated. Deficiencies of some of these designs have been identified.

Table 9 Summary of Repair & Rehabilitation Costs for Existing Cyclone Shelters (PWD Type), Thana-wise

Sl. No.	Name of Thana	Name of District	No. of Shelters	Repair & Rehabilitation Cost (in Taka)
1	Char Fasson	Bhola	27	9,526,933
2	Lalmohan	Bhola	14	6,128,074
3	Tazumuddin	Bhola	9	3,242,282
4	Daulatkhan	Bhola	8	2,733,846
5	Burhanuddin	Bhola	1	387,203
6	Bhola Sadar	Bhola	6	1,976,907
7	Manpura	Bhola	6	3,116,658
8	Galachipa	Patuakhali	36	13,817,152
9	Kalapara	Patuakhali	21	10,225,398
10	Bauphal	Patuakhali	4	1,791,406
11	Mirzaganj	Patuakhali	1	473,238
12	Patuakhali Sadar	Patuakhali	4	1,121,455
13	Dashmina	Patuakhali	7	3,316,395
14	Barguna	Barguna	1	267,616
15	Betagi	Barguna	2	448,562
16	Patharghata	Barguna	1	391,016
17	Amtali	Barguna	2	658,630
18	Mathbaria	Pirojpur	1	362,223
19	Sudharam	Noakhali	13	3,810,469
20	Hatiya	Noakhali	13	6,011,495
21	Companiganj	Noakhali	3	800,562
22	Sandwip	Chittagong	7	2,083,750
23	Sonagazi	Feni	3	1,284,786
24	Ramgati	Lakshmipur	9	3,791,269
25	Raipur	Lakshmipur	1	468,112
26	Lakshmipur	Lakshmipur	1	281,400
27	Maheshkhali	Cox's Bazar	3	1,561,190
28	Kutubdia	Cox's Bazar	3	779,451
29	Ukhia	Cox's Bazar	1	256,603
30	Cox's Bazar	Cox's Bazar	1	576,136
31	Chakaria	Cox's Bazar	3	935,188
32	Teknaf	Cox's Bazar	1	591,358
33	Banshkhali	Chittagong	4	1,434,223
34	Anwara	Chittagong	2	770,910
35	Bandar Thana	Chittagong	2	393,290
36	Sitakunda	Chittagong	1	225,586
37	Mirsarai	Chittagong	4	1,105,578
	Total (for 226 shelters in 37 Thanas)		**Tk:**	87,146,350
	10% for supervision charges		**Tk:**	8,714,635
	Grand Total :		**Tk:**	95,860,985

Table 10 Summary of Repair and Rehabilitation Costs for the Killas

Thana	Number of Killas	Repair and Rehabilitation Costs in Taka
Kalapara	23	2,940,000
Galachipa	19	610,000
Dashmina	5	210,000
Char Fasson	18	860,000
Tazumuddin	5	240,000
Manpura	6	400,000
Ramgati	23	560,000
Sudharam	20	540,000
Hatiya	18	1,000,000
Sandwip	3	150,000
Kutubdia	5	320,000
Maheshkhali	1	60,000
Total	146	7,890,000

Planning for New Shelters

22. From the very inception of the study, the 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 of the area would play major role in shelter management at pre-disaster , during disaster and post-disaster periods and therefore, their views were considered of importance in the planing process. It was envisaged that community development 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.

The 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. Table 11 lists these activities.

Table 11 List of Meetings, Workshop and Conferences held for Public Participation

Sl No.	Description	Date	Location
1	Meeting with Representative of NGOs	8 Feb. 1992	Dhaka
2.	Conference on MCSP organised in collaboration with LGED	15 Feb. 1992	Cox's Bazar
3.	Meeting on MCSP with Officials, Journalists and Educationalists	11 March 1992	Patuakhali
4.	Meeting on MCSP with officials and staff of LGED	11 March 1992	Patuakhali
5.	Workshop on MCSP with local people	12 March 1992	Kalapara, Patuakhali
6.	Workshop on MCSP with local people	7 May 1992	Char Fasson, Bhola

Professionals working in the Study Team made extensive visits to the study area to develop proper understanding of the various relevant issues and hold consultation with the local people

Field officers visited all the Thanas of the study area and obtained suggestions of the local people on tentative shelter locations. Almost all the Unions were visited by them to secure views from the locality. At Dhaka, several meetings of the Interministerial Task Force on the Construction of Multipurpose Cyclone Shelters were held where views of various government and semi-government agencies, NGOs as well as members of the Task force were discussed and recorded. These meetings provided useful guidance to the Study Team in incorporating the views of concerned agencies and organizations in preparation of the Master Plan.

23. Methodology and various steps for the determination of numbers, locations and normal time use of new shelters in a Union have been presented in the schematic flow diagrams (Fig. 6). New shelters have been provided only in the High Risk Area. Detailed analysis of capacities of cyclone shelters

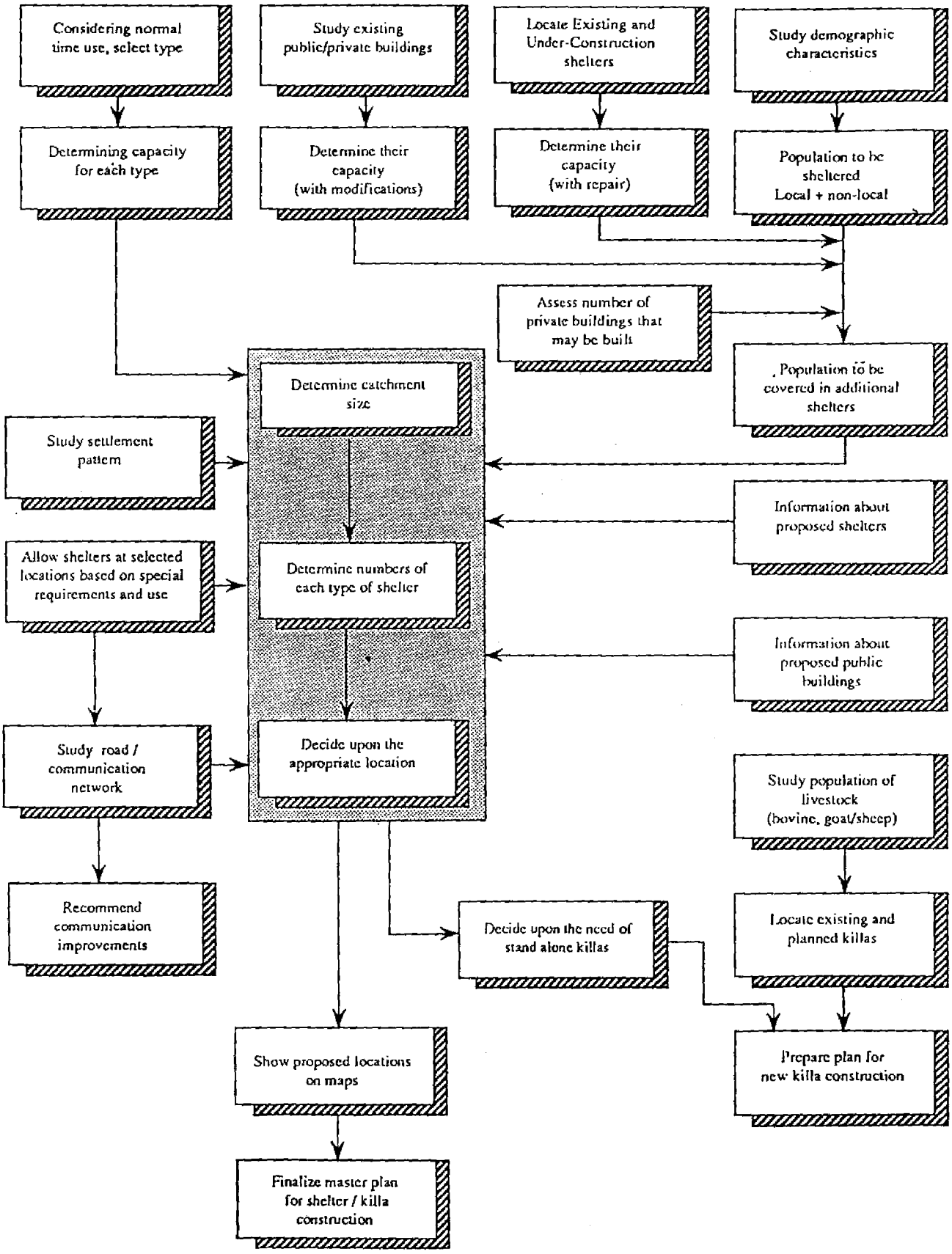


Fig. 6 Schematic Presentation of the Methodology for Determination of Numbers and Location of Shelters

existing, under construction and already proposed for construction by various agencies), other public/community buildings and private buildings have shown that these can provide shelter to around one-third of the total population. Construction of new shelters, with a total capacity of around 4.3 million persons, would therefore be necessary under MCSP to meet the projected needs in 2002. Buildings which would be used as educational institutions (primary schools, secondary schools and madrasas), health and family welfare centres, offices, passenger terminals during normal time have been considered as candidate shelter. It has been found that in general, expecting educational institutions the lowest level at which the facilities may be located are Union headquarter. In and around most of the Union headquarter adequate shelter capacity in the form of public or private pucca buildings already exists. Therefore, the most appropriate use of shelters can be ensured by providing schools in those shelters. This shelter capacity, which is provided by normal time use as primary school, also ensures that while having a threshold population of school going children within the catchment area of shelter, the farthest point in the catchment area would, in most locations, be within 1.5 km, the maximum distance people are willing to travel during cyclone 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. Thana-wise distribution and normal time use of shelters proposed by MCSP have been presented in Table 12.

24. A major element in the educational policy of the Government is to ensure Universal Primary Education by the year 2000 and the Government has enacted legislation to make attendance in primary schools compulsory. To achieve this target, a total of more than 3000 primary schools would be necessary in HRA. Similarly, using the criterion of one secondary school for every 5 primary schools, a total of 600 secondary schools would be necessary. These requirements of educational facilities match well with the number of additional shelters planned.

25. A spreadsheet computer model has been developed for determining the number of shelters in 2002 and the projected additional capacity needed in 2017. In determining the number of shelters, the Unions have been used as basic planning units. Out of the 2500 shelters proposed, around 60% are proposed to be located in existing primary school sites, 23% in new primary schools, 10% and 6% in existing madrasas and secondary schools respectively. Only in some special locations (e.g. Dublar Char) the shelters would have other normal time uses (e.g. community centre/adult education centre).

Private Housing

26. The number of existing private buildings in HRA capable of being used as Cyclone Shelters is very small and can meet less than 5% of the shelter needs. Introduction of a credit scheme with easy terms may encourage construction of houses capable of being used as shelter and would reduce the demand on public/community shelter. Designs of nucleus houses, suitable for newly accreted land, (as has been used in Urir Char) has been proposed and further studies have been suggested.

Distribution of Population in Various Types of Shelters

27. The probable distribution of movement of total population of HRA to different types of shelters has been worked out. It may be summarized that existing, under-construction and already proposed shelters would provide 18% of the capacity, other public and private buildings around 15% and the remaining 67% would be required to be provided by the new shelters proposed under this study (Fig. 7).

Table 12 Thana-wise Distribution of Shelters Proposed by MCSP

Sl. No.	Name of Thana	No. of MCSP Shelters		Location of Proposed MCSP Shelters					Total No. of Shelters in the year 2002
				Primary School		Madrasa	Seccondary School		
		Priority 1	Priority 2	Existing	New	Existing	Existing	New	
1.	Shyamnagar		27	12	10	4		1	27
2.	Dacope		25	12	9	2	2		25
3.	Köyra		16	8	6	2			16
4.	Sarankhola		16	14	2				16
5.	Monglaport		11	9	1	1			11
6.	Patharghata	59	15	70	1	3			74
7.	Barguna	39	43	77	1	3	1		82
8.	Amtali	25	18	39	1	3			43
9.	Betagi		23	16	4	1	1	1	23
10.	Bamna		8	7		1			8
11.	Bauphal		64	53	3	6	2		64
12.	Galachipa	50	43	80	6	5	2		93
13.	Dashmina	24	12	35		1			36
14.	Kalapara	36	49	65	9	7	4		85
15.	Mathbaria	19	25	33	2	4	4	1	44
16.	Bhola Sadar	31	81	70	20	14	5	3	112
17.	Burhanuddin	25	42	43	10	11	2	1	67
18.	Lalmohan	34	61	54	26	12	3		95
19.	Char Fasson	104	56	67	60	21	8	4	160
20.	Manpura	11		8	1	1	1		11
21.	Tazumuddin	31	17	42	3	1	2		48
22.	Daulatkhan	25	36	50	6	2	2	1	61
23.	Bakerganj		9	7		2			9
24.	Barisal Sadar		7	6		1			7
25.	Ramgati	75	120	107	54	24	9	1	195
26.	Raipur		47	18	25	3	1		47
27.	Lakshmipur		48	18	25		2	3	48
28.	Hatiya	131	8	77	26	34	2		139
29.	Noakhali Sadar	58	8	30	23	3	4	6	66
30.	Companiganj	16		11	4	1			16
31.	Sonagazi	30	33	38	20	2	3		63
32.	Sandwip	95		57	32	6			95
33.	Mirsarai	24	4	19	3	6			28
34.	Sitakunda	39	33	45	15	7	5		72
35.	Patiya	14	34	23	18	3	3	1	48
36.	Anwara	15	25	13	16	9	2		40
37.	Banshkhali	54	45	57	32	5	5		99
38.	Kutubdia	3		2		1			3
39.	Chakaria	67	54	37	66	13	4	1	121
40.	Maheshkhali	25	26	19	22	8	2		51
41.	Cox's Bazar	36	3	17	10	10	1	1	39
42.	Ramu		7	7					7
43.	Ukhia		11	7	3	1			11
44.	Teknaf	13	13	12	10	3	1		26
45.	Chandanaish		17	9	4	2	2		17
*	Dublar Char	5							5
**	Other Locations	37	10						47
	Total	1250	1250	1500	589	249	85	25	2500

* Special Locations : Dublar Char in Sarankhola Thana,

** For other special locations, a total of 47 shelters (approx. 2% of total no. of shelters proposed by MCSP) have been added.