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Technical Note of PWRI No.4094

Case Study on Risk Factor Analysis of 1991 Cyclone Disaster in Hatiya Island, Bangladesh

February 2008

International Centre for Water Hazard and Risk Management (ICHARM)

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Case Study on Risk Factor Analysis of 1991 Cyclone Disaster in Hatiya Island, Bangladesh

by

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Synopsis

Major objective of this research is the factor analysis of 1991 cyclone disaster in Hatiya Island, Bangladesh. First, four Disaster Charts were formed based on a bibliographic survey and hearings in Japan. Next, a hypothesis was set up regarding the mechanism of the disaster in Hatiya Island. Then, verification of the hypothesis was conducted using the Disaster Charts and the outcome of field surveys.

Key Words: Cyclone Disaster, Case Study, Field Survey, Disaster Chart

Table of Contents

1. Purpose of the report ····· 1

2. Selecting country and region for the case study ····· 2

2.1 Selecting the country ····· 2

2.2 Selecting the region ····· 2

3. Document survey ····· 3

4. Interview survey in Japan ····· 4

4.1 Japanese Red Cross Society ····· 4

4.2 Designated NPO Shapla Neer ····· 5

4.3 Public Forum “Winning Against Disasters” ····· 8

5. Preparing the Disaster Profile Sheets ····· 10

6. Setting the hypotheses ····· 27

7. Field survey in Bangladesh ····· 28

7.1 Survey procedure ····· 28

7.2 Interview survey at Dwip Unnoyan Songstha ····· 28

7.3 Interview survey of local victims of the disaster ····· 34

7.4 Damage scenarios of the cyclone disaster in 1991 on Hatiya Island ····· 47

8. Revising the Disaster Profile Sheets ····· 49

9. Verifying the hypotheses ····· 73

9.1 Results of verifying the hypotheses ····· 73

9.2 Verifying the hypotheses ····· 74

9.3 Disaster mitigation measures (a proposal) ····· 81

Attachments

Collected GIS maps prepared based on the field survey of Hatiya Island

Disaster Profile Sheets Reference Documents

1. Purpose of the report

This report describes an analysis of the causes of the cyclone in 1991 on Hatiya Island in Bangladesh. The purpose of the report is to present a concrete analysis and quantitative evaluation of factors ① and ②.

① Causes of the occurrence and expansion of damage caused by the flooding

② Effectiveness of efforts and countermeasures by disaster mitigation systems

In order to analyze and evaluate items ① and ② above, information and numerical data that can clarify the actual state of the disaster are absolutely essential. Therefore, the first step was a document survey performed to gather and classify related information and numerical data. This was followed by interviews with experts and other concerned people in Japan and the gathering of even more detailed documentary information. Through this document survey and the interview survey inside Japan, our knowledge of the above items ① and ② was deepened and we set hypotheses on preparing the Disaster Profile Sheets. The hypotheses set in this way were verified based on the results of the information in the Disaster Profile Sheets and the field survey (collection of information and interview surveys from concerned organizations and interview survey of disaster victims).

The following is a chart of the study procedure.

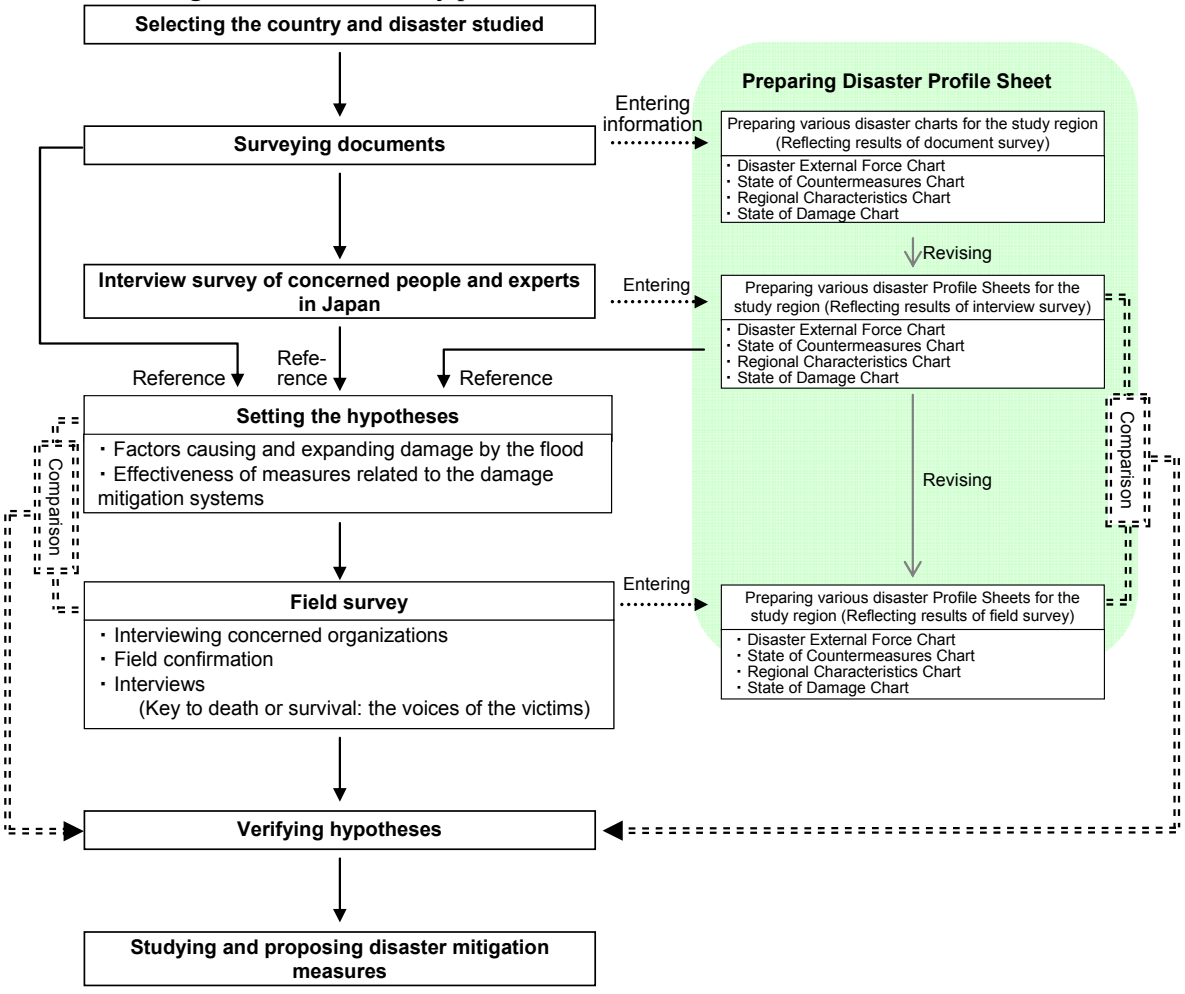


Figure 1. Study Flow Chart

2. Selecting country and region for the case study

2.1 Selecting the country

Cyclone disasters in Bangladesh claim far more lives than flood disasters in other countries (1970: approximately 300,000, 1991: approx. 140,000), so Bangladesh was selected as the country to be the object of this case study.

2.2 Selecting the region

Hatiya Island where cyclone disasters are considered to be particularly severe compared with other parts of Bangladesh, was selected as the region to be the object of the case study. This choice was made for the following reasons.

① Hatiya Island has been designated as a High Risk Area (HRA) for cyclones.

② Hatiya Island is assumed not to be adequately provided with materials, communications, and other factors creating a disaster prevention environment, because it is separated from the mainland.

③ For these reasons it was assumed that Hatiya Island is particularly susceptible to disasters as clarified by the document survey conducted as part of this case study.

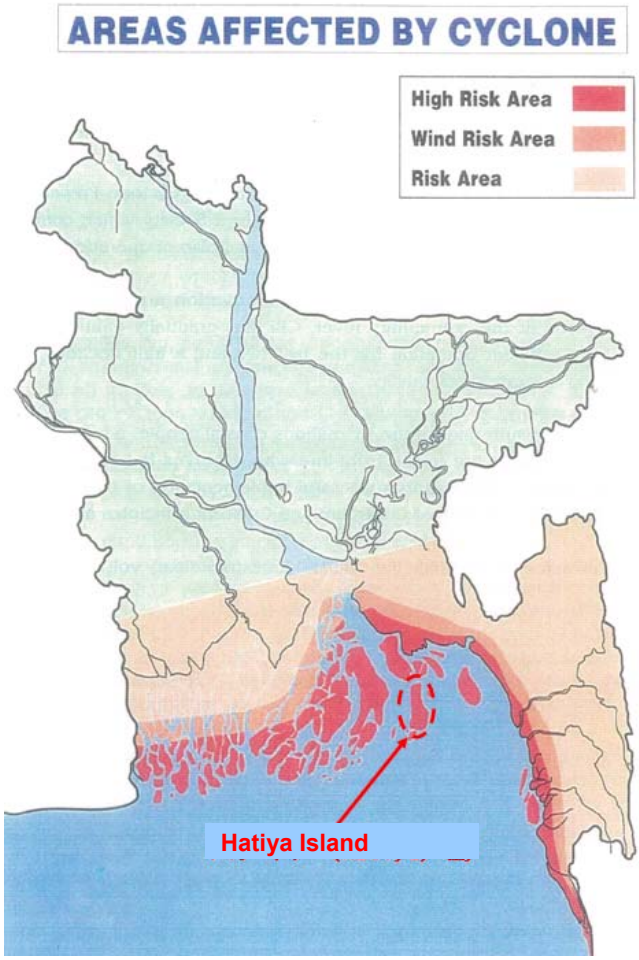


Figure 2. Location of Hatiya Island in Bangladesh

3. Document survey

From the perspectives of the “Disaster Profile Sheet (External Force)”, “Disaster Profile Sheet (Regional Characteristics)”, “Disaster Profile Sheet (Countermeasure) ”, and “Disaster Profile Sheet (Disaster Damage)” shown in Figure 1, documents that are widely available were obtained, and based on these, data for Hatiya Island was organized.

As a result, to prepare the Disaster Profile Sheet (External Force), maximum wind speed distributions, landfall time, and cyclone route maps were obtained. For the Disaster Profile Sheet (Regional Characteristics), the population, land use, employment, and other kinds of statistical information were obtained. But these data did not clarify the object year nor the object region etc. The change of the coastline of Hatiya Island could be learned using satellite images obtained by the Shuttle Radar Topography Mission (SRTM). To prepare the Disaster Profile Sheet (Countermeasure), it was learned that although physical structure measures were taken by constructing a dike surrounding Hatiya Island, its height was only 4.5m above sea level (estimated), that was not high enough to prevent tidal surges caused by the cyclone in 1991. We were informed that in 2005, there were 1,728 disaster protection volunteers, but the number of people acting as disaster protection volunteers and the volunteer system etc. in 1991 is not clear. To prepare the Disaster Profile Sheet (Disaster Damage), information was obtained indicating that approximately 140,000 people died throughout Bangladesh, but it was almost impossible to obtain information indicating the extent of the disaster in Hatiya Island (※see the Disaster Profile Sheets from page 11 to 26).

As stated above, of the items that could presumably be obtained through the document survey, it was impossible to obtain anything but extremely limited information. So to obtain more detailed documents and to clarify the damage in greater detail, we continued by conducting an interview survey of concerned organizations and persons inside Japan (see the following page, “4. Interview survey in Japan”)

4. Interview survey in Japan

An interview survey concerning Hatiya Island was conducted in Japan in order to obtain information for the various Sheets concerning the cyclone in 1991 and to collect and organize data needed for the field survey.

When we began the selection of organizations to interview, we discovered that the Japanese Red Cross Society had been generously building cyclone shelters and supporting community activities to provide disaster protection in Hatiya Island and the surrounding region, so we conducted an interview survey of members of the Japanese Red Cross Society. We also surveyed the Designated NPO Shapla Neer introduced by the Japanese Red Cross Society at the time of the interview survey. This organization has a record of poverty relief activities at the grass roots level in Bangladesh. And we also attended a lecture given by the Director of the Bangladesh Disaster Preparedness Centre (BDPC), Mr. Muhammad Saidur Rahman, introducing an outline of the damage caused by floods and cyclones and flood and cyclone countermeasures taken in Bangladesh at the United Nations University on October 19 (Thursday) in 2006 at the event, Public Forum “Winning Against Disasters”.

4.1 Key information obtained by the interviews with the Japanese Red Cross Society (Oct. 20, 2006)

The key information obtained by the interview with the Japanese Red Cross Society are summarized as below:

- □ Outline of the international activities of the Japanese Red Cross Society
  - ➢ Provides international aid, supports recovery efforts, and carries out development assistance activities in countries around the world.
- □ Past construction of cyclone shelters by Japanese Red Cross Society
  - ➢ Japanese Red Cross Society has focused on this field of activity since 1970, not only on Hatiya Island, but also in the surrounding region of Noakhali District, because of the disastrous cyclones that strike the region.
  - ➢ Japanese Red Cross Society has worked hard to create local organizations capable of continuous maintenance (Shelter Management Committees). Each Shelter Management Committee consists of 11 members. Of these, 9 are selected by 300 families around each shelter (beneficiaries). The beneficiaries pay a membership fee of 2 taka (about 6 yen) to the Management Committee each month.
  - ➢ It took more than five years to firmly establish the Shelter Management Committee in the region, because of budget and personnel challenges.
- □ Documents obtained from Japanese Red Cross Society
  - ➢ Documents about the activities of Japanese Red Cross Society on Hatiya Island (total of 14 documents)

4.2 Key information obtained from the interviews with the Designated NPO Shapla Neer (overseas assistance organization formed by private citizens) on November 17, 24, 2006

The key information obtained from the interview with the Designated NPO Shapla Neer are listed below:

(First (Nov. 17): Representative Ohashi)

☐ External force and casualties caused by the cyclone in 1991

- The distribution of tidal surge heights caused by the cyclone on the coast of Hatiya Island in 1991 was not uniform. It showed variations from place to place. The height of the approaching waves varied from place to place according to the course of the cyclone. Even on Hatiya Island, there were places with both light and heavy casualties.
- There was a report of a fatality caused by a galvanized metal sheet roof being blown off and cutting a person's neck. Many homes still have galvanized sheet roofs.

☐ Transportation methods

- It is possible to reach Hatiya Island by ferry from Dacca. But, this is not recommended because of the danger of piracy at night. It is safer to drive from Dacca to the shoreline opposite Hatiya Island during the daytime.
- If travelling starts at about 6:00 or 7:00 a.m. by a car from inside Dacca City, it is possible to reach the coast opposite the island by about 1:00 p.m.
- It is better to drive on Hatiya Island. Arrangements must be made in advance.

☐ Mr. Rafiq

- Mr. Rafiq fulfills a leading guidance role on Hatiya Island. He is the leader of an NGO organization on Hatiya Island (DUS: Dwip Unnoyan Songstha). Mr. Rafiq is also the leader of the Cyclone Preparedness Programme (CPP) on Hatiya Island
- Mr. Rafiq is the son of a leader of the independence movement. He is the No. 2 person in the Bangladesh Disaster Preparedness Centre (BDPC). He is connected with its Director, Mr. Muhammad Saidur Rahman. Mr. Rahman is well-informed on conditions throughout Bangladesh. As far as Hatiya Island alone is concerned, Mr. Rafiq is better informed.
- There is a DUS guest house where visitors to Hatiya Island can lodge.

☐ Mr. Kusakabe

- Mr. Kusakabe who is a student at Sophia University has summarized research on Hatiya Island to prepare his graduation thesis under the guidance of Professor Murai Yoshinori. He stayed in Bangladesh in 2006, and he probably obtained the most up-to-date information.

☐ Information about internal Bangladesh affairs

- An election was scheduled for January 25, 2007 and affairs inside Bangladesh are unstable. It would be better not to visit the country in January 2007.

☐ Conditions on Hatiya Island

- The ocean side of the Hatiya Island dike (new land created by sedimentation) is called khas land. There is a law that stipulates that this be provided with priority on landless citizens, but it is not an efficacious law.
- Landlords let their cattle range free (cared for by residents living along the dike) and in fact, hold exclusive rights to the land.
- Transplanted forests are off-limits to the people and managed by forest rangers.

□ Killa (embankments higher than the tidal surge level intended to protect farm animals)

- Killa are no longer used.
- The reason is that people have decided that it is difficult to evacuate to shelters with household property and animals.
- He assumes that disaster protection is provided more effectively by installing about 1 small cyclone shelter for each 2 or 3 dwellings.

□ Others

- Stilt houses are located on Sandwip Island to the east of Hatiya Island, but there were undamaged.
- If stilt houses could be also constructed on Hatiya Island, the casualties would be reduced.
- It would be better if the information about the distribution of casualties is obtainable; i.e. how, who and where were persons dead?
- Concerning population data etc., it is difficult to smoothly obtain the data, for example, even when a letter is sent in advance to the Noakhali District Office.

(Second (November 24), Mr. Kusakabe)

□ Information about the cyclone disaster in 1991

- Statistics for the cyclone disaster in 1991 that have been publicized by concerned organizations are not very reliable. When numerical data are compared they do not match.
- There were rumors that more than a half of the victims of the cyclone in 1991 on Hatiya Island were children younger than up to ten years old.
- Statistical information about Hatiya Island has been clarified by the DUS, but this does not include regional distributions.
- During the cyclone in 1991, some people fell into ponds while evacuating. Because embankments were guaranteed by excavating nearby ground, large ponds formed beside cyclone shelters.
- When the cyclone in 1991 struck, it was late in the night, so the surroundings were complete dark, and nobody had any idea where they should go to evacuate.
- Since the warning information indicated by flags above the roofs of the cyclone shelters had been displayed in error many times, nobody trusted them.

□ NGO on Hatiya Island

- The members of NGO are a so-called elite class. The monthly salary paid to NGO leaders is

high at about 100,000 yen in Japanese yen. It seems that it is impossible for them to grasp the needs of members of the poor class in Bangladesh.

- Staff employed by NGO include many members of the wealthy class, and their homes are also sturdy concrete structures.
- The NGO activities on Hatiya Island are Red Crescent, DUS, HASI, RIC, HEED, Care, OXFAM, BRAC, Grameen Bank and others. DUS is the largest, with staff of 68. HASI is acting in the field only on Hatiya Island. It is an organization formed under a government contract. Its main activity is providing credit.
- The budget for Hatiya Island is determined by the Evaluation Committee. This committee is formed by one member of the Bangladesh Parliament and members of DUS, which takes advantage of the influence of DUS (Mr. Rafiq). Even if Mr. Rafiq is not able to attend, the second person in command would be able to attend.

□ Obtaining data for Hatiya Island

- It is probably difficult to obtain information from the local administrative offices or related organizations in Hatiya Island.
- Information can be obtained at the Noakhali District Office, but it cannot be counted on very much.
- It is also generally difficult to obtain maps.
- Asking DUS is a good way to find out about shelters on the island.
- It is also difficult to interview women. This is particularly true along the dikes from the east to the south-east of the island where many people are poor and most hold conservative Islamic views.

□ The poor living along the dike (land side) on Hatiya Island

- Many poor people live along the dike (either on or very close to the ocean side of the dike), where they take care of cattle on the ocean side. The owners of the cattle are members of the wealthy class. There is a law stipulating that new land is distributed with priority on landless people, but this law has no substance and is unenforceable.
- Poor regions are governed by relatively Islamic ideas, which women rarely appear in public.

□ Precautions where performing a field survey

- From the end of October, public transport functions will be shut down nationwide because of the January 2007 election, so it would be impossible to go out from the hotels.
- Judging from the current situation, it will likely be possible to do the field survey in the beginning of February.
- Electric power can be used at the guest house operated by DUS, It is available from 6:00 p.m. to 10:00 p.m., but it is necessary to be careful because the generator may be stopped intermittently.

□ Documents obtained

- Basic data concerning Hatiya Island

- Documents from the OV Society of Bangladesh (person with experience as a JICA volunteer) for example.

4.3 Points made by the lecture by Mr. Muhammad Saidur Rahman at the Public Forum, Winning Against Disasters (October 19, 2006)

The points by the lecture by Mr. Muhammad Saidur Rahman at the Public Forum are summarized below:

☐ Severe casualties caused by natural disasters in Bangladesh

- The major disasters are cyclones, floods and river course erosion.
- The flood in 2004 had disastrous effects on 3.4 million people.
- The cyclone in 1970 killed more than 500,000 people in one evening.
- It is important to fully understand reasons for the differences between the damage caused by hurricanes in America and by cyclones in Bangladesh.

Figure 3 shows a comparison between the hurricane disasters in the United States of America and the cyclone disaster in Bangladesh.

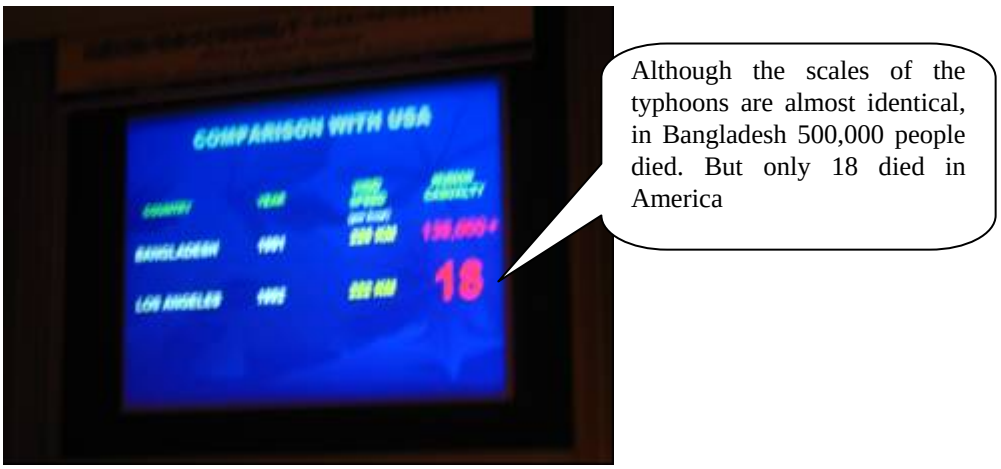


Figure 3. Comparison of Hurricane Disaster in America with Cyclone Disaster in Bangladesh

☐ Casualties caused by disasters are concentrated on the poor and there has been no improvement

- Poor people in areas of frequent flooding (for example, one woman also raising three unrelated children) support their families on 25 yen per day.
- For example, the day-labor fisherman shown in the slide does not own a boat. Every year, such people become the victims of disasters. They do not live in a real residential building.
- There is a ministry especially concerned with disaster protection (Ministry of Food and Disaster Management) unique to Bangladesh. But there has been no decline in victims of natural disasters, because of a vicious circle of poverty and disasters. Every year international aid is invested but the numbers of victims does not fall.

- Funds ought to be sufficient. The problem is how the funds are spent. After a flood, Bangladesh receives a flood of aid contributions, and a lot of this money is provided directly to consultants. The thick reports prepared using this money are not thoroughly understood by Bangladesh government officials.
- The funds are used solely in this way, and in fact probably only about 1% is used to benefit the poor in reality. It can be concluded as a “failure of development” which is the disaster. The top down aid funds do not resolve any problems anymore.
- We want to take greater actions in order to break the links between disasters and poverty.
- It seems that people’s capabilities must be developed. Not only aid after a disaster, but advance preparations are also important.

□ Lessons taught by the cyclone in 1970 and present efforts

- The cyclone in 1970 caused extremely severe casualties. Almost every home in the disaster region was destroyed. The Meteorological Agency understood that it was a dangerous cyclone, but they could not transmit this information to the general population.
- If the people lack confidence in the government, nobody will pay any attentions to danger (or warning) announcements. The people whom they can trust are the so-called religious leaders. Male and female midwives and folk singers are also respected, so their words are trusted. Such people have been playing active leadership roles.
- There are about 10 volunteers in each of the more than 2,700 villages of Bangladesh. Their tasks include giving advance evacuation warnings by announcing that “A cyclone is coming”. Japanese Red Cross Society has provided them with radios and megaphones to spread this information. These efforts are now sustainable, because they are handled by the communities.

5. Preparation of the Disaster Profile Sheets

To learn about the state of disasters occurring on Hatiya Island, the information obtained by the surveys described in the previous chapters, "3. Reorganizing the existing document survey" and "4. Interview Surveys in Japan" was collected and organized. The Disaster Profile Sheets Collection was prepared by collecting and organizing information in order to efficiently clarify the state of disasters. The Disaster Disaster Profile Sheets Collection includes four kinds of Sheets: "External Force", "Regional Characteristics", "Countermeasure " and "Disaster Damage". The following table presents outlines of the disaster Sheets that have been prepared.

See Disaster Profile Sheets Collection (p11 – p26) for details about each Sheets..

Table 1. Outline of the Disaster Profile Sheets

(Based on Document Survey and Interview Survey in Japan

External Force	The maximum average wind speed in the study region during the cyclone of April 1991 is estimated to be between 176 and 220 km/hr (48.9 – 61.1m/s). When the cyclone struck, it overlapped with high tide, so it is estimated that this resulted in a maximum tide level of 5 to 6m along the eastern coast. The design standard height of the dikes was 4.5m and they were constructed only to prevent flooding caused by high tides, so it could not be counted on the prevent overtopping by a tidal surge caused by a cyclone or tsunami.
Regional Characteristics	The population of Hatiya Island before the cyclone of 1991 was a little less than 300,000 people on land area of approximately 1,000km^2. The population density was about 300/km^2 (300,000/1,000km^2). This value is smaller than the population density of Bangladesh at that time (774/km^2). Hatiya Island is located at the mouth of the Ganges River on the Bay of Bengal, so it has suffered from severe erosion action on its north coastline that is struck directly by the flow of the Ganges River. But sedimentation has occurred on the south side of the island. The ocean side of the dike in the South District where sedimentation occurs has been occupied by poor people without land.
Countermeasures	To provide protection from high tides, a dike (4.5m high) has been constructed around the periphery of the island. Because it is a measure taken for normal high tides, it cannot be counted on to prevent overtopping by a high tide caused by a cyclone (tidal surge). On the south side, new land (ocean side of the dike) has been created by the deposition action. This land is in a zone at high risk of devastation by cyclones, but as it has been formed, it has been occupied by poor people. Cyclone shelters intended to reduce the number of cyclone fatalities have been constructed by various organizations, but their capacity was inadequate in 1991, when they could accommodate fewer than 10% of the island's population (less than 300,000). Other measures not requiring physical structures include a warning transmission system called the Cyclone Preparedness Programme (CPP) that operates in response to cyclone warning signals issued by the Meteorological Agency. But, because even when cyclone warnings are issued, they are often false alarms, people's confidence in the warning system has declined. And if people evacuate in response to a warning, their animals and households goods may be stolen while they are gone, so most people refuse to evacuate.
Disaster Damage	On Hatiya Island, approximately 3,000 people died, mostly poor people who did not leave their homes and were engulfed by the tidal surge. A high percentage of the fatalities were women, infant, and elderly people who lacked the strength to swim and hold on to a tree or floating debris. It is reported that 52.7% of people use cyclone shelters provided by the Red Crescent Society, but many of these evacuees were compelled to evacuate because their homes had been destroyed by the wind and rain and by high waves generated by the cyclone.

Collected Disaster Profile Sheets

(Based on the Document Survey, Interview Surveys in Japan)

Explanation of Codes/Symbols in Source Columns of Disaster Disaster Sheets

Codes/symbols in Source Column	Explanation of code/symbol
June 2007 document	PWRI Document: Analysis of Causes of Water Disasters in Bangladesh (June 2007)
BA_S_02	Vulnerability to Tropical Cyclones: Evidence from the April 1991 Cyclone to Coastal Bangladesh by Haque, C. E. and Blair, D.
BA_S_20	JICA Report for the Basic Design Study on the Project for the Construction of Multipurpose Cyclone Shelter (Phase V) in People's Republic of Bangladesh
CYCLONE'91	CYCLONE '91 -An environmental and perceptional study- by Bangladesh Centre for Advanced Studies
Bangladesh report	http://www.kyoiku-shuppan.co.jp/kousha/wadai2006.pdf/2006.04.pdf
BANGLAPEDIA	http://a-bangladesh.com/
National Water Management Plan 2000	http://www.warpo.gov.bd/home.htm
GTOPO30	http://edc.usgs.gov/products/elevation/gtopo30/gtopo30.html
SRTM30	http://www2.jpl.nasa.gov/srtm/
SRTM3	http://www2.jpl.nasa.gov/srtm/
Google Map	http://maps.google.com/
University of Maryland web site	http://glcfapp.umiacs.umd.edu:8080/esdi/index.jsp
R1	Document obtained from Japanese Red Cross Society Development Cooperation Report 2000 (in Japanese)
R3	Document obtained from Japanese Red Cross Society Evaluation Report for disaster reduction projects in Bangladesh by Japanese Red Cross Society (1998) (in Japanese)
R4	Document obtained from Japanese Red Cross Society Disaster and People's Participation: Issues of Cyclone Shelter Construction in Bangladesh by Prof. Ohashi and Mr. Kayano (1995) (in Japanese)
R9	Document obtained from Japanese Red Cross Society Community Based Disaster Preparedness in Hatiya, Monpura and Noakhali Region by Bangladesh Red Crescent Society (BDRCS) and Japanese Red Cross Society (JRCS)
R11	Document obtained from Japanese Red Cross Society Evaluation -Community Based Disaster Preparedness Programme in Hatiya, Nijhumdwip & Monpura Islands in Bangladesh- by Dilip Choudhury et al. (1997)
R12	Document obtained from Japanese Red Cross Society BDRCS/JRCS COMPREHENSIVE REVIEW on JRCS supported Disaster Preparedness Activities in Bangladesh by Dilip Choudhury et al. (1995)
R13	Document obtained from Japanese Red Cross Society Programme Description and Plan of Action 1998 to 2002 for CYCLONE PREPAREDNESS PROGRAMME by Bangladesh Red Crescent Society (1997)

1. Profile Sheet (External Force)

[Outline of Disaster External Forces in the Study Region]

The cyclone in 1991 made landfall late at night.
Because the cyclone struck during high tide, it is estimated that ultimately a maximum tidal surge between 5 and 6m struck the coast of the East District.

Cyclone studied: 1991 Cyclone (April 29, 1991)
District studied: Noakhali District, Hatiya Island

○: There are data for Hatiya Island in 1991.
□: Includes data for years other than 1991 and places other than Hatiya Island. Or it shows estimated values.
×: No corresponding data can be found.

Item			Value etc.	unit	Remarks	Data acquisition method					
						1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan		
						Data available ?	Source	Year	Data available ?	Source	Year
Wind speed	Max. gust speed			km/hr		×			×		
	Max. average wind speed		176-225 (48.9-61.1)	km/hr m/s	Max. wind speed distribution (see attached map) ※ Wind speed in study region unknown.	△	CYCLONE '91	1991	-		
	Strong wind duration		7.0-8.0	hr	Wind generally strongest from 20:00 to 27:30.	×			×		
			2.5	hr	Wind and rain strongest from 24:00 to 26:30	×			×		
	Wind force distribution			—		×			×		
Rainfall	Total rainfall		208	mm	Total rainfall in April 29 and 30	×			×		
	Total rainfall distribution			—		×			×		
	Hourly max. rainfall			mm/hr		×			×		
	Hourly max. rainfall distribution			mm/hr		×			×		
Tide level	Max. tide level		5.0-6.0	m	The tidal surge with height of 5-6 meter washed the island from southeast direction.	×			○	R12	1991
			4.5-5.4	m	[East] dike is 3.6m to 4.5m: Tidal surge from 4.5 to 5.4 m presumably overtopped it.	-			-		
			1.5-2.0	m	[Ocean side of dike in South] Tidal surge 1.5m to 2.0m struck land without dike.	-			-		
Inundation	Max. inundation depth			m		×			×		
	Inundated districts	Inundation map	Map of hypothetical tidal surge wave damage in 1991	—	Map of hypothetical tidal surge damage by the cyclone in 1991 (Based on SRTM3 grid elevation data, land below elevation of 6m shown in red)	△	SRTM3	2002	△	R11, R12	1991
			Map of tidal surge wave damage of 1991cyclone	-	Prepared based on results of interviews with DUS (local NGO) during field survey.	-			-		
		Inundation depth	0.6-1.5	m	The tidal surge level reversed the flow of rivers flooding the land side of the dike. Inundation caused by rain is thought to have inundated the entire island to an average depth of about 1m.	-			-		
		Area inundated		km^2	Almost the entire island was inundated, but it is not clear exactly what percent was inundated.	×			×		
Cyclone landfall time			Late at night (22:00、Chittagong landfall)	—	When the cyclone struck, it was high tide, resulting in an estimated max. tidal surge from 5m to 6m pm the coastlines of the region.	△	BA_S_02	1991	×		
Cyclone route			Route map	—	Route map (see attached drawings)	○	BA_S_02, CYCLONE '91	1991	○	R12	1991

2. Disaster Profile Sheet (Regional Characteristics)

【Outline of the regional characteristics of the study region】

The population of Hatiya Island before the cyclone in 1991 struck the region was about 300,000 living on approximately 1,000km^2 of land. The population density was about 300/km^2 (=300,000/1,000 km^2). This value is lower than the population density of Bangladesh at that time (about 800/km^2).
Because Hatiya Island is located at the mouth of the Ganges River on the Bay of Bengal, the current of the Ganges River have directly and vigorously striked and eroded the northern shore of Hatiya Island. At the same time, sedimentation occurred on the south side of the island. In recent years, landless poor people have moved to the land on the ocean side of the dike in the South District where sedimentation has advanced. A major road about 3m wide runs from south to north on the Island and a network of farm roads centered on this main road link the island's hamlets. But in 1991 it was almost entirely unpaved.

Cyclone studied: 1991 Cyclone (April 29, 1991)
District studied: Noakhali District, Hatiya Island

○: There are data for Hatiya Island in 1991.
△: Includes data for years other than 1991 and places other than Hatiya Island. Or it shows estimated values.
×: No corresponding data can be found.

Item		Value etc.	unit	Remarks	Data acquisition method					
					1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan		
					Data available ?	Source	Year	Data available ?	source	year
Regional characteristics	(Regional) population	346,853	persons	Hatiya Island population	△	Bangladesh Rept.	2001	-		
		4,896	persons	Nijhum Dwip Island population	△	Bangladesh Rept.	2005	-		
		295,501	persons	For Hatiya Upazila(county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
		384,448	persons	For Hatiya, Nijhum Dwip、Monpura Islands	-			△	R11	1991
		333,087	persons	For Hatiya and Nijhum Dwip Islands	-			△	R11	1991
		51,361	persons	For Monpura Island	-			△	R11	1991
	Regional land area	1,508.2	km^2	Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
		999.74	km^2	For Hatiya and Nijhum Dwip Islands	-			△	R11	1997
		373.19	km^2	For Monpura Island	-			△	R11	1997
		1,372.93	km^2	For Hatiya, Nijhum Dwip、Monpura Islands	-			△	R11	1997
	(regional) population density	333.2	persons /km^2	Calculated by 333,087/999.74km^2 ※For Hatiya and Nijhum Dwip Islands（Source：R11、Population：1991、Area：1997） ※National pop. density 834/km2（2001）	△			△	R11	1991 （1997）
		280.0	persons /km^2	Calculated by 384,448 /1372.93km^2 ※For Hatiya, Nijihum Dwip、Monpura Islands（Source：R11、population：1991、Area：1997）	△			△	R11	1991 （1997）
	Households		household		×			×		
	Number of unions (administrative towns)	10	Union	There are 10 unions (towns). One union vanished in the North District of the island because of river erosion. Sedimentation created one union offshore in the south of the island.	△	Bangladesh Rept.	Unknown	-		
		10	Union	For Hatiya Upazila(county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
		9	Union	For Hatiya and Nijhum Dwip Islands	-			△	R11	1997
		3	Union	For Monpura Island	-			△	R11	1997
	Number of Mouza (hamlets)	37	Hamlet	For Hatiya Upazila(county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
	No. of Villages	69	Village	For Hatiya Upazila(county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
		78	Village	For Hatiya and Nijhum Dwip Island	-			△	R11	1997
		33	Village	For Monpura Island	-			△	R11	1997

Item			Value etc.	unit	Remarks	Data acquisition method					
						1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan		
						Data available ?	Source	Year	Data available ?	source	year
Regional characteristics	Roads	Road network	See remarks	-	A major road about 3m wide runs from north to south and a network of farm roads centered on it links hamlets. And dikes that double as roads are built along the coast to prepare for tidal surges caused by cyclones.	△	Bangladesh Rept.	Unknown	-		
			See attached maps	-	Roads are marked on the MAP OF HATIYA AND LOCATION OF BDRCS SHELTERS See attached maps: there are unclear places.）	-			△	R11	1997
		pucca	380	km	For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		semi pucca	220	km	For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		mud road	800	km	For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
	Schools	College	4	School	For Hatiya Island	△	Bangladesh Rept.	Unknown	-		
			3	School	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997
			1	School	For Monpura Island	-			△	R11	1997
			3	School	For Hatiya Upazila(county)（Govt. system：1, Not Govt. system: 2	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		High School	21	School	For Hatiya Island	△	Bangladesh Rept.	Unknown	-		
			26	School	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997
			4	School	For Monpura Island	-			△	R11	1997
			25	School	Hatiya Upazila(county)（Govt. system：2、, Not Govt. system: 23）	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Junior High School	4	School	For Monpura Island	-			△	R11	1997
		Primary	151	School	For Hatiya Island	△	Bangladesh Rept.	Unknown	-		
			105	School	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997
			38	School	For Monpura Island	-			△	R11	1997
			222	School	Hatiya Upazila(county)（Govt. system：105, Not Govt. system: 117）	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Madrasha	36	School	For Hatiya Island	△	Bangladesh Rept.	Unknown	-		
			16	School	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997
			10	School	For Monpura Island	-			△	R11	1997
			16	School	For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
	Sex	Male	149,908	person	Calculated based on 50.73% and 295,501 people For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
			26,516	person	For Monpura Island	-			△	R11	1991
		Female	145,475	person	Calculated based on 49.23% and 295,501 people For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
			24,845	person	For Monpura Island	-			△	R11	1991
	Age	Under 15		person		×			×		
		15 to 64		person		×			×		
		Elderly (65 and older)		person		×			×		

Item			Value etc.	unit	Remarks	Data acquisition method					
						1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan		
						Data available ?	Source	Year	Data available ?	source	year
Regional Characteristics	Persons in need of care during a disaster	Disabled		person		×			×		
		Elderly (65 and older)		person		×			×		
		Infants		person		×			×		
		Ill or injured		person		×			×		
	Income	Average daily income		Dollar		×			×		
		Income distribution		-		×			×		
	Assets	Assets/household		Dollar		×			×		
	Land use	Arable land area	28396.20	ha	For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		1 crop 1st cropping area of arable land	10790.56	ha	Calculated based on 38.0% and 28396.2ha For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		2 crop 2nd cropping area of arable land	13062.25	ha	Calculated based on 46.0% and 28396.2ha For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		3 crop 3rd cropping area of arable land	4543.39	ha	Calculated based on 16.0% and 28396.2ha For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Irrigated area of arable land	21297.15	ha	Calculated based on 38.0% and 28396.2ha For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Area of fallow land	2815.46	ha	For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
	Employ-ment	Farmer	114,211	Persons	Calculated based on 38.65%and 295,501。 For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Farm laborer	71,600	Person	Calculated based on 24.23%and 295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Wageworker	11,140	Person	Calculated based on 3.77% andd295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Commerce	25,679	Person	Calculated based on 8.69% and295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Service industry	10,579	Person	Calculated based on 3.58% and 295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Fishing industry	15,868	Person	Calculated based on 5.37% and 295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unnkown	-		
	Employ-ment	Others	46,423	Person	Calculated based on 15.71%and 295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-		
		Agriculture (%)	60	%	For Hatiya Upazila (county)	△	Bangladesh Rept.	1995	-		
		Non-agriculture (%)	15	%	For Hatiya Upazila (county)	△	Bangladesh Rept.	1995	-		
		Business (%)	10	%	For Hatiya Upazila (county)	△	Bangladesh Rept.	1995	-		
		Public service (%)	10	%	For Hatiya Upazila (county)	△	Bangladesh Rept.	1995	-		
		Unemployed (%)	30	%	For Hatiya Upazila (county)	△	Bangladesh Rept.	1995	-		
		Others (%)	5	%	For Hatiya Upazila (county)	△	Bangladesh Rept.	1995	-		

Item			Value etc.	unit	Remarks	Data acquisition method					
						1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan		
						Data available ?	Source	Year	Data available ?	source	year
Regional Characteristics	Break-down of tenant farmers	No land	52.13	%	For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
		Small plot of land	18.00	%	For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
		Medium plot of land	22.00	%	For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
		Sufficient land	7.87	%	For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
		Per capita arable land	0.09	ha	For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
Regional Characters	Agriculture	Paddy rice area	75,618	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
		Peanuts area	14,350	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
		Legumes area	11,060	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
		Potato area	5,700	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
		Sweet potato area	2,480	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
		Wet rice yield	2.5	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
		Peanuts yield	1.6	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
		Legumes yield	0.5	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
		Potato yield	1.5	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
		Sweet potato yield	1.8	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-		
	Land price		6,000	tk/0.01 ha	market value of the land of the first grade For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
	Poverty rate ($1 or less/day)		50 or more	%	Poverty rate distribution map by District (See attached maps)	△	National Water Management Plan 2000	Unknown	-		
	Literacy rate	Men and women	21.0	%	For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
			21.0	%	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997
			21.0	%	For Monpura Island	-			△	R11	1997
		Men	27.2	%	For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
	Literacy rate	Men	27.3	%	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997
		Women	14.7	%	For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
			14.0	%	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997
	Religion	Islam	257,559	Person	Calculated based on 87.16% and 295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
			257,712	Person	Calculated based on 74.3% and 346,853 For Hatiya Island	△	Bangladesh Rept.	2001	-		
		Hinduism	36,376	Person	Calculated based on 12.31% and 295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
			89,766	Person	Calculated based on 10.6% and 346,853 For Hatiya Island	△	Bangladesh Rept.	2001	-		

Item			Value etc.	unit	Remarks	Data acquisition method					
						1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan		
						Data available ?	Source	Year	Data available ?	source	year
Regional Characters	Religion (cont'd)	Christian	473	Person	Calculated based on 0.16% and 295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
		Others	1,093	Person	Calculated based on 0.37% and 295,501 For Hatiya Upazila (county)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-		
	Budget			$		×			×		
Regional Characteristics	Elevation	Digital Elevation Model (DEM)	See attached maps	—	GTOPO30(See attached maps)	△	GTOPO30		×		
					SRTM30(See attached maps)	△	SRTM30	2000/2	×		
					SRTM3(See attached maps)	△	SRTM3	2000/2	×		
	Zero meter zone	Area		km^2		×			×		
		% of total region	100	%	Elevation Map(See attached maps)	△	June 2007 document	1990	-		
	Satellite images		See attached maps	-	Google Map(See attached maps)	△	Google Map	Unknown	-		
					LANDSAT(See attached maps)	△	MaryLand University Web Site	1977 1989 1999	-		
	Topo-graphical change	Change of coastline over time	See attached maps	-	Map of change over time of coastline by satellite images (See attached maps)	△	BA_S_20	73/74 1984 1996 2001	-		

※ Notes

1) The SRTM (Shuttle Radar Topography Mission) uses radar installed on the Space Shuttle to prepare detailed stereoscopic topographical data for the entire world.
2) SRTM30 obtains 30 second (900m) mesh data. SRTM3 obtains 3 second (90m) mesh data, and SRTM1 obtains 1 second (30m) mesh data.
3) GTOPO30 has poorer resolution than the SRTM30, and its data includes many mistakes and errors. With SRTM30, the elevation changes with each scene.
4) A fee is charged for SRTM1, but considering the price and precision, it is better to use SRTM.
5) Google Map was prepared by pasting screen cap pictures of satellite images taken of the study region from the Web Site Google Maps.

3. Disaster Profile Sheet (Countermeasure)

【Outline of State of Countermeasures in the Study Region】

To provide protection from tidal surges, a dike (height 4.5m) has been constructed on the periphery of the island. It was constructed to deal with normal high tides, so it cannot be counted on to prevent overtopping by a tidal surge caused by a cyclone. And in the South District, the action of sedimentation has created new land (ocean side of the dike). This land is a high risk zone that is susceptible to casualties caused by cyclones but poor people have steadily moved onto this land, so coastal forests have been planted. But by 1991, this development had just started, so trees were still scarce, and it provided almost no tidal surge protection functions.
Various aid organizations have constructed cyclone shelters to reduce the number of casualties caused by cyclones, but in 1991, their capacity was still insufficient. They could only accommodate about 10% of the total population of the island (300,000 people).
Non-structural measures include a warning transmission system called the Cyclone Preparedness Programme (CPP) that operates in response to cyclone warning signals issued by the Meteorological Agency. It was a network of volunteers who warn individual households. But, many residents who did not (or could not) evacuate immediately before the arrival of the cyclone in 1991 were killed by the disaster.

Cyclone studied: 1991 Cyclone (April 29, 1991)
District studied: Noakhali District, Hatiya Island

○: There are data for Hatiya Island in 1991.
△: Includes data for years other than 1991 and places other than Hatiya Island. Or it shows estimated values.
×: No corresponding data can be found.

Item			Values, etc.	Unit	Remarks	Data Acquisition Method					
						1. Document survey (public data)			2.Documents obtained from concerned domestic organizations		
						Data available ?	Source	Year	Data available ?	Source	Year
Physical Structure measures	Dikes	Height of the dike	4.5	m	The standard design height of the dike is 4.5m, and it was constructed only for protection from high tides, so it can not be counted on to prevent overtopping by a tidal surge caused by a cyclone or a tsunami.	△	June 2007 Document	Un-known	–		
						△	BANGLAPEDIA: Embankment	Un-known	–		
		Planned level of the dike (1 year probability)		1 year probability		×			×		
		Total dike length		km		×			×		
			Existing dike location map	-	Existing dike location map (see attached maps)	△	BANGLAPEDIA: Embankment	Un-known	–		
				-	Locations of dikes are shown on MAP OF HATIYA AND LOCATION OF BDRCS SHELTERS (see attached maps: There are unclear locations)	-			△	R11	1997
		Required dike length		km		×			×		
		Budget for existing dikes		$/m		×			×		
		Budget to construct a dike needed to for cyclone protection		$/m		×			×		
	Coastal forests	Length of coastal forests		km	On Nijhum Dwip Island where sedimentation has advanced, management of new land is conducted by the Bangladesh Ministry of Environment and Forestry, After trees were planted to form revetments, more were planted to improve it as residential land. ※ Reference documents and images attached to the Sheet of Regional Characteristics permit the calculation of the area to be planted with coastal forests.	△	Bangladesh Rept.	Un-known (approx. 2006?)	–		

Item			Values, etc.	Unit	Remarks	Data Acquisition Method					
						1. Document survey (public data)			2.Documents obtained from concerned domestic organizations		
						Data available ?	Source	Year	Data available ?	Source	Year
Physical structure measures	Cyclone shelters	Number of existing shelters	28	Shelter	As a result of DUS interviews, the PWD (Public Works Dept.) built 12 shelters. And the Red Cross report shows that BDRCS (Bangladesh Red Crescent Society) built 16 shelters.	×			△	R12	1991
			↓Achievements of the JRCS (Japanese Red Cross Society) and the BDRCS（Bangladesh Red Crescent Society）in the two islands: Hatiya Island and Nijhum Dwip Island.↓								
			16	Shelter	On Hatiya Island, at the time of the cyclone in 1991, the BDRCS had 16 shelters. (For Hatiya Island and Nijhum Dwip Island (as of April 1991))	×			△	R4, R9	1991（Before the cyclone）
			22	Shelter	From 1985 to 1991, Japan helped the BDRCS build 29 cyclone shelters （Hatiya Island 20, Nijhum Dwip 2 Monpura Island 7) ＜（Of the above, for Hatiya Island, and Nijhum Dwip Island（during 1991）＞	×			△	R3	Within 1991
			21	Shelter	From 1985 to 1991, Japan helped the BDRCS build 29 cyclone shelters (Hatiya Island 20, Nijhum Dwip Island 2, Monpura Island 7)). One shelter at the northerm end of Hatiya Island was made unusable by erosion in 1996. ＜(Of the above, for Hatiya Island and Nijhum Dwip Island)	×			△	R3	1996
			↓Achievements by the JRCS AND BDRCS on the three islands: Hatiya Island、Nijhum Dwip Island and Monpra Island								
			29	Shelter	By 1993, 29 shelters (max. capacity of 1,600 people/shelter) and 1 multi-purpose center had been constructed on Hatiya Island in Noakhali District and in Monpra Island in Bhola District, ensuring evacuation sites for residents ＜For Hatiya Island,Nijhum Dwip, Island, and Monpura Island＞	×			△	R1	1993
			29	shelter	By 1994, 6 more shelters had been constructed on Hatiya Island and 7 more on Monpura Island.（By 1991, there had been 16, so 16+6+7=29 shelters） ＜For Hatiya Island、Nijhum Dwip Island, and Monpura Island＞	×			△	R9	1994
			29	Shelter	※ Number of shelters estimated based on document (R12).	×			△	R12	1995
			28	Shelter	In 1996, the north end of Hatiya Island was eroded, making one shelter unusable.	×			△	R3	1996
			28	Shelter	※ Number of shelters estimated based on document (R11).	×			△	R11	1997
			↓Achievements in cyclone shelter building three islands: Hatiya Island. Nijhum Dwip Island and Monpra Island↓								
			107	Shelter	＜For Hatiya Island and Nijhum Dwip Island＞ Saudi Arabia (GOB) 24, BDRCS 22, World Bank (GOB) 12, CARITAS (NGO) 7, HEED (NGO) 2, JICA (GOB) 2, DUS (NGO) 1 ＜For Monpura Island＞ CARITAS (NGO) 11, BDRCS 7, World Bank (GOB) 6, Swedish Free Mission (NGO) 2, Swiss Disaster R	×			△	R12	1995

Item				Values, etc.	Unit	Remarks	Data Acquisition Method					
							1. Document survey (public data)			2.Documents obtained from concerned domestic organizations		
							Data available ?	Source	Year	Data available ?	Source	Year
Physical structure measures	Cyclone shelters (cont'd)	Number of existing shelters (cont'd)		137	Shelter	＜For Hatiya Island and Nijhum Dwip Island＞ BDRCS 21, HEED BANGLADESH 3, OXFAM 1, PROSHIKA 4, JICA 4, CARITAS 9 SAUDI GRANT 42, WORLD BANK 18 ＜For Monpura Island＞ BDRCS 7,WORLD BANK 6, CARITAS 10,SWEDISH 2,SWEDISH FREE MISSION 2,FACILITIES DEPT. 6	×			△	R11	1997
		Locations of existing shelters		See distribution map	—	Shown in MAP OF HATIIYA AND LOCATION OF BDRCS SHELTERS. (See attached documents) ＜For Hatiya Island, Nijhum Dwip Island, Monpura Island,＞	×			△	R11	1997
Physical structures	Cyclone shelters	Outline of existing shelters	Name	Table	—	For 28 shelters shown in the LIST OF CYCLONE SHELTERS IN HATIYA & MONPURA THANA. (see attached document) ＜For Hatiya Island, Nijhum Dwip Island, Monpura Island,＞	×			△	R11	1997
			With a school?									
			Lot area									
			Shelter building area	Table	—	For 28 shelters shown in the LIST OF CYCLONE SHELTERS IN HATIYA & MONPURA THANA. (see attached document) ＜For Hatiya Island, Nijhum Dwip Island, Monpura Island,＞	×			△	R11	1997
			Boundary setting									
			Fence?									
			Aquaculture?									
			Nursery school?									
			Land use on the site									
		Capacity of existing shelters		12,800	Person	On Hatiya Island, there were 16 BDRCS cyclone shelters at the time of the cyclone in 1991, and their official capacity was 12,800. ＜For Hatiya Island and Nijhum Dwip Island (2 islands)＞	×			△	R4, R12	1991
				24,800	Persons	Value of the capacity of the BDRCS cyclone shelters plus the PWD capacity (estimated).	×			△	R12	1991
		Toilets inside shelters? (sanitation)		See remarks	—	Toilets were constructed on the ground outside the shelters, but when a cyclone or tidal surge struck, they were useless if people could not go outside the shelters, and their sanitation condition was a serious problem.	×			△	R3	1998
		Normal use of shelters		See remarks	—	Of the BDRCS shelters at 28 locations in Hatiya Island and Monpura Island, at 8 locations, primary schools operated by the BDRCS were used and at 3 locations, schools operated by the government were used. The remaining 17 locations are not in use at normal times, although they can be used as schools and other public buildings.	×			△	R3	1998
				See remarks	—	At normal times, primary health care, primary education, job training, loan organizations and other community development activities (CDP) were conducted with their bases in cyclone shelters.	×			△	R3	1985～1991
				See remarks	—	Child literacy classes are conducted in 7 shelters. Others are not yet linked with any regular community service institution or programme.	×			△	R12	1995
		Maintenance of shelters		See remarks	—	Members pay 2 taka (about 4.2 yen) per household, and management committees manage the organization and use the funds for its operation and its activities, but this fee alone is not enough to maintain and take care of the shelters.	×			△	R3	1998

Item			Values, etc.	Unit	Remarks	Data Acquisition Method					
						1. Document survey (public data)			2.Documents obtained from concerned domestic organizations		
						Data available ?	Source	Year	Data available ?	Source	Year
Physical structures	Cyclone shelters (cont'd)	Number of shelters needed	291	No.	The capacity per shelter is calculated to be 1,000 people, to estimate the number of shelters needed.	×			×		
		Necessary locations of shelters		—		×			×		
		Sufficiency rate		%		×			×		
		Number of people needing evacuation		Person		×			×		
	Kila	Number of Kila	16	No.	Buildings constructed by the BDRCS and the Japanese Red Cross Society 〈For Monpura Island〉	×			△	R11	1997
			6	No.	Distribution map	×			△	R11	1997
				—		×			×		
		Livestock capacity		Head		×			×		
		Sufficiency rate		%		×			×		
		Number of livestock needing protection		Head		×			×		
Non-structural measures	Warning systems	System outline		—	Many cyclone warnings that are issued are false alarms, reducing people's confidence in the warning system. And some people fear that it they evacuate in response to warnings, their livestock and property might be stolen, so they do not evacuate.	×			△	R13	1997
		Problems with warning systems		—	As non-physical structure measures, a warning transmission system called the CPP (Cyclone Preparedness Programme) has been established. When the Meteorological Agency issues a cyclone warning signal, a network of volunteers spread the warnings to individual households.	×			△	R4	Until 1991
	Evacuation systems	Information transmission methods	See remarks	—	Ordinary members are people living in the district around each cyclone shelter (approx. 300 households). They elect 11 of their members to form a management committee (at least two of these are women).	×			△	R4	?
		Existence of leaders?	See remarks	—	Discussion meetings, essay contests, art contests are held on the theme of community level disaster protection measures. Though participants fell short of expectations, they were welcomed by the educated class and community leaders who declared that, "These events were a means of communicating effectively with others."	×			△	R1	1986～2000？
		State of community	See remarks	—	From 1995 to 1998, the CBDP: Community Based Disaster Preparedness Programme was implemented. Later, a community level shelter management committee (SMC: Shelter Management Committee) took over its roles.	×			△	R3	1998

Item				Values, etc.	Unit	Remarks	Data Acquisition Method					
							1. Document survey (public data)			2.Documents obtained from concerned domestic organizations		
							Data available ?	Source	Year	Data available ?	Source	Year
Non-structural measures	Evacuation systems (cont'd)	State of community (cont'd)		See remarks	–	Ordinary members are people living in the district around each cyclone shelter (approx. 300 households). They elect 11 of their members to form a management committee (at least two of these are women). Members pay 2 taka (about 4.2 yen) per household, and management committee manages the organization, using the funds for its operation and its activities. The management committee cooperates with key members and with volunteers (20 per shelter) of the cyclone countermeasures committee that is implemented by the BDRCS in cooperation with the government. During emergencies, they transmit disaster and evacuation warnings, guide evacuees, carry out rescue activities, and distribute rescue goods.	×			△	R9	1995～1998
	Evacuation systems	Shelter management committee		See remarks	–	The organization of Management Committees for 28 shelters based on a proposed project evaluation of 1995 is cited as a major success of this project (BDRCS-Japan Red Cross Society Joint Disaster Protection Measures Project). Each Shelter Management Committee consists of 11 members, 9 of whom are elected by the 300 families living around each shelter (beneficiary families) who pay 2 taka (about 6 yen) as membership fee to the Management Committee each month. The remaining 2 members are women members selected by the Management Committee.	×			△	R1	1986～2000？
				See remarks	–	※ Region covered by the disaster prevention volunteers is thought to be Hatiya Island, but this is unclear.	×			△	R3	1998
		Disaster protection volunteers	Total	1,728	Person	※ Region covered by the disaster prevention volunteers is thought to be Hatiya Island, but this is unclear.	△	Bangladesh Rept.	2005	×		
			Men	1,440	Person	※ Region covered by the disaster prevention volunteers is thought to be Hatiya Island, but this is unclear.	△	Bangladesh Rept.	2005	×		
			Women	288	Person	The use of radios has spread since the 1970 cyclone, reaching a radio penetration rate of 60% during the 1990's.	△	Bangladesh Rept.	2005	×		
		Area where evacuation information is broadcast by radio or TV			–		×			×		
		Problems with the evacuation systems		See remarks	–	It was reported by communities that were visited that evacuation training has been carried out with active community participation.	×			△	R4	Before 1991
	Disaster protection education	Disaster protection education		See remarks	Times/year		×			△	R3	1998
		School education			–		×			×		
		Training			–		×			×		

4. Disaster Profile Sheet (Disaster Damage)

【Outline of state of casualties in the study region】

The cyclone in 1991 caused nearly 3,000 fatalities on Hatiya Island. Many of those killed were old people, children, and women who are susceptible to disasters. Many residents did not evacuate. Related reasons for this were the religious and social characteristics (gender issues etc.) of the region.
And because severe damage remained after the cyclone had abated, some of the residents were forced to spend half a year living in evacuation camps.

Cyclone studied: 1991 Cyclone (April 29, 1991)
District studied: Noakhali District, Hatiya Island

○: There are data for Hatiya Island in 1991.
△: Includes data for years other than 1991 and places other than Hatiya Island. Or it shows estimated values.
×: No corresponding data can be found.

Item				Values etc.	Unit	Remarks	Data acquisition method					
							1. Document survey (public data)			2.Documents obtained from interview survey in Japan		
							Data available ?	Source	Year	Data available ?	Source	Year
Injuries/fatalities	Direct casualties	Fatalities		1,714	Person	People who died while evacuating within a range of 1km around one of 16 shelters on Hatiya Island (constructed by BDRCS or Japanese Red Cross Society) or when high waves engulfed them along with the roofs of their houses (see attached documents) ＜For Hatiya Island and Nijhum Dwip=Island＞	×			△	R4 R12	1991
				3,000	Person	Nearly 3,000 died only on Hatiya Island. ＜For Hatiya Island＞	×			△	R9	1991
		Injuries			Person		×			×		
		Effected people			Person		×			×		
		Fatality rate		5.0 - 6.0	%	Mortality rate in the unions in the southeast coast was 5-6%. ＜For Southeast coast district of Hatiya Island＞ ※Reverse calculation from submitted documents indicates that approximately 14,500 to 17,500 people lived in the study region on the Southeast coast (within 1km of 4 shelters) when the cyclone struck.	×			△	R12	1991
		Injury rate			%		×			×		
		Causes of deaths			%		×			×		
				See remarks	-	Poor people who did not move from their homes even after the cyclone struck were engulfed in the high waves and drowned. The percentage of fatalities was particularly high among women, children, and elderly people who lacked the strength to swim and hold onto a tree or drifting objects.	×			△	R4	1991
	Indirect casualties	Fatalities			Person		×			×		
		Injuries			Person		×			×		
		Death rate			%		×			×		
		Injury rate			%		×			×		
		Causes of death	Drowning		%		×			×		
			Others		%		×			×		
Material damage	Breached dike				km		×			×		
	Damaged dike				km		×			×		
	Totally destroyed homes				No.		×			×		
	Partly destroyed homes				No.		×			×		
	Total number of homes				No.		×			×		

Item			Values etc.	Unit	Remarks	Data acquisition method					
						1. Document survey (public data)			2.Documents obtained from interview survey in Japan		
						Data available ?	Source	Year	Data available ?	Source	Year
Material damage	Totally destroyed home rate			%		×			×		
	Partially destroyed home rate			%		×			×		
	Total number of Livestock died			Head		×			×		
	Total number of livestock (cattle)			Head		×			×		
	Livestock death rate (cattle)			%		×			×		
	Area of crop damage			ha		×			×		
	Total area of crops			ha		×			×		
	Crop damage rate			%		×			×		
	Shrimp culture area damage			ha		×			×		
	Total shrimp culture area			ha		×			×		
	Shrimp culture damage rate			%		×			×		
State of evacuation	Number of evacuees		Table	Person	Twenty-two shelters are indicated under the “Number of evacuees/deaths in cyclone shelter command area (1km radius)”. (See attached table) ＜For Hatiya Island and Nijhum Dwip Island＞	×			△	R12	1991, 1992, 1994
	Evacuation rate		See remarks	%	The usage rate of shelters during cyclones is gradually rising. This may be a result of a campaign to raise consciousness of cyclones at normal times.	×			△	R3	1998
			52.7	%	The percentages who evacuated before, during, and after the cyclone are not clear. And it is not clear if they evacuated to the veranda or to the roof of the cyclone shelters. It is difficult to clarify the actual number of evacuees to the shelter.	×			△	R12	1991
	Evacuation site	Cyclone shelter	6,750	Person	Cyclone shelter usage rate: 52.7% (Official capacity is 12,800 evacuees)	×			△	R4	1991
			6,750	Person	Number of evacuees within 1km of existing shelters (22 shelters) on Hatiya Island. Number of evacuees in each shelter are recorded (April 29, 1991)	×			△	R12	1991
	Camp after the disaster		See remarks	-	Many people were forced to live in camps for six months.	○	Bangladesh Rept.	1991	-		
	The state of Warning or evacuation information reception	Recipients		Person		×			×		
		Reception rate		%		×			×		
	Evacuation action rate			%		×			×		
	Evacuation information reception method	Warning system		Person		×			×		
		Television		Person		×			×		
		Radio		Person		×			×		
		Word of mouth		Person		×			×		
State of evacuation	Reason for not evacuating		See remarks	-	Among the people, some remained in their homes with their property instead of evacuating. When the storm surge finally arrived, it was too late for them to evacuate to the shelter and the condition of the roads also obstructed evacuation.	×			△	R12	1991
			See remarks	-	Assets such as livestock and household property were treated as being of equal importance to their own lives. If they evacuated, they would suffer from loss caused by both the evacuation and the disaster. Therefore, even if the wind strengthened and the waves rose, they chose to remain at home.	×			△	R12	1991

Item		Values etc.	Unit	Remarks	Data acquisition method					
					1. Document survey (public data)			2.Documents obtained from interview survey in Japan		
					Data available ?	Source	Year	Data available ?	Source	Year
State of evacuation	Reason for not evacuating (cont'd)	See remarks	-	Their attitude that leave themselves to their fate: "If it is the will of Allah, I will be saved."	×			△	R12	1991
		See remarks	-	Past warnings had included many false alarms, so even if they were warned, they decided that it was not a dangerous cyclone.	×			△	R12	1991
		See remarks	-	Women did not evacuate, because of gender problems they would encounter in the shelters.	×			△	R12	1991
	State of evacuation	See remarks	-	Many did not evacuate immediately even when they were given warnings advisories by the CPP volunteers. Those who did evacuate were forced to do so after their homes were destroyed. Others evacuated during the cyclone.	×			△	R12	1991
				Some residents did not evacuate even when they heard a warning. Although they heard many warnings, and the wind and rain had begun strengthening many hours earlier, residents would not leave their homes. If the water level rose, they climbed to the roofs of the bamboo and straw houses. Or they started to evacuate only when the high waves finally arrived. This is the actual normal pattern of action taken by the residents.	×			△	R4	?

6. Setting the hypotheses

The information obtained by 3. Document survey and 4. Interview survey in Japan above was summarized in the Disaster Profile Sheets Collection (p. 11 to p. 26). And based on the understanding they provided, hypotheses were established as explained below to answer four questions: “Why were they sacrificed?”, “Why did they not evacuate?”, “Why could they not evacuate?”, and “Were many specific types of people (the poor, women, children who are susceptible to disasters) sacrificed?”.

Table 2. Hypotheses Concerning the Disaster on Hatiya Island Caused by the cyclone in 1991

	No.	Hypotheses
Why were they sacrificed?	1	Drowned when engulfed by the tidal surge.
	2	Killed when struck by flying objects.
Why did they not evacuate?	3	Because many cyclone warnings had been false alarms.
	4	Because they feared that if they evacuated, their livestock and property might be stolen, so they remained to protect them.
	5	Did not evacuate because there were no cyclone shelters near their homes.
	6	The cyclone is the will of Allah.
	7	Women did not evacuate because of social and religious restrictions.
	8	If they evacuate, their family members might be separated.
Why could they not evacuate?	9	Could not walk easily because the roads were muddy.
	10	Because they would be asked to pay a fee to use the shelter.
Were many specific types of people (poor, women, children who are susceptible to disasters) sacrificed?	11	Most fatalities were concentrated among poor people on the ocean side of the dike in the South District (high risk zone).
	12	Ninety-percent of victims were women and children.
	13	From 30% to 40% of residents of a dike protected island died.

A field survey was carried out to clarify the state of the damage and evacuation and social background, and to verify the above hypotheses. Details of the field survey are presented in the next chapter: 7. Field Survey in Bangladesh.

7. Field survey in Bangladesh

7.1 Survey schedule

Table 3 shows the Bangladesh Survey Schedule.

Table 3. Bangladesh Survey Schedule

Dates	Activities
Feb. 3, 2007	・ Travel: Depart Narita → Arrive in Dacca
Feb. 4	・ Preparing to obtain data at WARPO (Water Resources Planning Organization) and BOS (Bureau of Statistics) etc. through local experts (Bangladesh citizens). ・ Consulting with Mr. Rufiq: representative of DUS (Description of cyclone casualities on Hatiya Island)
Feb. 5	・ Travel: Dacca → Hatiya Island
Feb. 6	・ At the Hatiya Island Office of the DUS, interview survey and obtaining data concerning the casualities caused by the cyclone in 1991.
Feb. 7	・ Interview survey with residents of Hatiya Island (south ocean side region and eastern region)
Feb. 8	・ Travel: Hatiya Island → Dacca
Feb 9	・ Obtaining and checking data collected by local experts ・ Travel: Departure from Dacca
Feb. 10	・ Travel: Arrival at Narita

Members of Survey

Name	Affiliation	Notes
Ryoji Hirakawa	Pacific Consultants Co.,LTD	Researcher
Kenichiro Kato	Pacific Consultants Co.,LTD	Researcher
Naonori Kusakabe	Sophia University	Interpreter

7.2 Interview survey at Dwip Unnoyan Songstha

Outline of the interview survey at the DUS Office in Dacca on February 4 (Sunday) 2007

- Consultations were held at the Dacca Office of DUS with Mr. Rafiq who represents the local NGO (DUS: Dwip Unnoyan Songstha). The following is an outline of the interviews.
  - The cyclone in 1991 killed many people in the eastern part and in the ocean side of the dike in the southern part.
  - In public announcements, it was stated that 3,000 people had died, but DUS estimates that 6,000 people died throughout Hatiya Island.

- Throughout Hatiya Island, conditions, including that on the main roads, were extremely poor.
- The ability of CPP volunteers to deliver warnings were severely impacted by the bad road conditions.
- It is difficult to maintain the shelters after they have been constructed.
- People failed to evacuate because of their fear that their possessions would be scattered or lost; very few because they feared theft.



Figure 4. Photo Taken at the DUS Dacca Office (The representative, Mr. Rafiq is seen in the center.)

Outline of the interview survey at the DUS Office on Hatiya Island on February 6 (Tuesday) 2007

- Consultations with Assistant Representative Mr.Tibriz of the local NGO, DUS (Dwip Unnoyan Songstha) at the DUS Hatiya Island Office. The following is an outline of the interview.
  - In the East, water overtopped the dike, submerging the land. There were 4,000 fatalities in the east, but they died on top of the dike or on the protected land side.
  - The ocean side of the south coast dike was struck by a 5 to 7 foot (1.5m to 2.0m) tidal surge. The top of the dike on the south coast was undamaged, but people living on the ocean side died. We think that between 1,000 and 1,500 people were killed by the tidal surge.
  - In the north, from 150 to 200 people died. Not all were swept away by the sea water. Those who were engulfed by the tidal surge were on the coast.
  - The tidal surge caused no damage except on the ocean side on the eastern and southern coastlines, and on the coastline area on the north side. But toppled houses and wind and rain buried people.
  - Broadly categorized, two kinds of people died. By social class, they were people a little lower in status than the middle class. People in this class kept livestock with asset value, and lived in somewhat sturdy homes made of galvanized metal plate, so they did not evacuate. People in the even poorer class reportedly, “did not evacuate because of insufficient

information" or "did not evacuate because they had no clear reason to and thought they were safe.

- Most of the poor know their homes are not well-made so they evacuated promptly. (People a little lower in status to the middle class people refers to residents of the land side in the east. And the even lower class people refers to the residents of the ocean side in the south.)
- The report on the approach of the cyclone was broadcast by radio at about 12 noon in 1991. At that time the sky was cloudless and there were no signs of the cyclone so nobody believed the report, but beginning about 1:00 p.m., the weather began to steadily deteriorate.
- Some have claimed that the weather report was late. It is still not clear if it was late because of negligence or because of a lack of experience. But they did all they could after they realized the danger.
- Question: Do people who had livestock and buildings not become part of the poor class?
- ➔ Answer: They can largely recover. For a few years after they suffer losses because of the cyclone, they are given assistance by donor organizations or the government, so after 2 or 3 years, they can recover their livelihoods.



Figure 5. Photo Taken in the DUS Hatiya Island Office (Mr. Tibriz on the extreme right)

We processed the information about the state of the casualies we obtained through the interviews with DUS members by organizing it as follows according to characteristics of society in each district.

State of Casualties in each District

The cyclone in 1991 devastated the entire Island of Hatiya. The tidal surge created by the rainfall and the full tide destroyed large parts of the dike submerging the entire island under as much as 1m or water. In addition to the rain, powerful winds scattered galvanized plates and tree branches.

The following table organizes the state of damage in each district, and the details are plotted on Figure 6.

Table 4. Outline of Damage by District※

North district	Because of erosion, there were many places without a dike. So submersion damage was conspicuous, and the tidal surge claimed 150 to 200 lives.
South district	The population at that time was between 7,000 and 8,000 people including residents on the ocean side and on top of the dikes. It is presumed that most of the fatalities were residents of the ocean side. It is hypothesized that from 1,000 to 1,500 people died on the south side.
East district	It is estimated that of this district's population of 10,000 at that time, about 4,000 people died. Near **Sunnerchar** in particular, the casualties were high and it is estimated that 4,000 people who are about 75% of the fatalities lived in the East district. In this district, the waves were high and the dike collapsed at many points, causing wide-spread submersion of the land. The water rose, overtopping major roads (these roads block small floods), submerging more than 150km^2 of land.
Other districts	In the poorest region, 500 people died. Many homes were toppled by strong wind and rain. And in regions without dikes, the inundation caused severe damage.

※: Residents near the dike: In Bangladesh, it is forbidden to live on the ocean side or on top of a dike, but in fact, many people do so. The exact number of people is unclear, but it is said that the population density on dikes is said to be about twice the average for Bangladesh.

Relationship of Social Class with Number of Fatalities

According to the interview survey with the DUS representatives, victims are broadly categorized as "residents that did not evacuate" and residents that "could not evacuate" even after hearing the cyclone warning.

Many of the residents that did not evacuate were residents who lived on the land side of the dike in the eastern part, and residents who thought, "We are safe this time, because our home withstood the cyclone of 1970".

And poor people were concentrated on the ocean side of the dike in the South District. So while there were residents who evacuated when they realized their house could not withstand a powerful cyclone, there were others who did not evacuate because of fear that they would be separated from their property and their family.

It is clear that consciousness of the disaster varied widely according to people's social class in this way. The relationship between social class and the number of fatalities is presented in Figure 7.

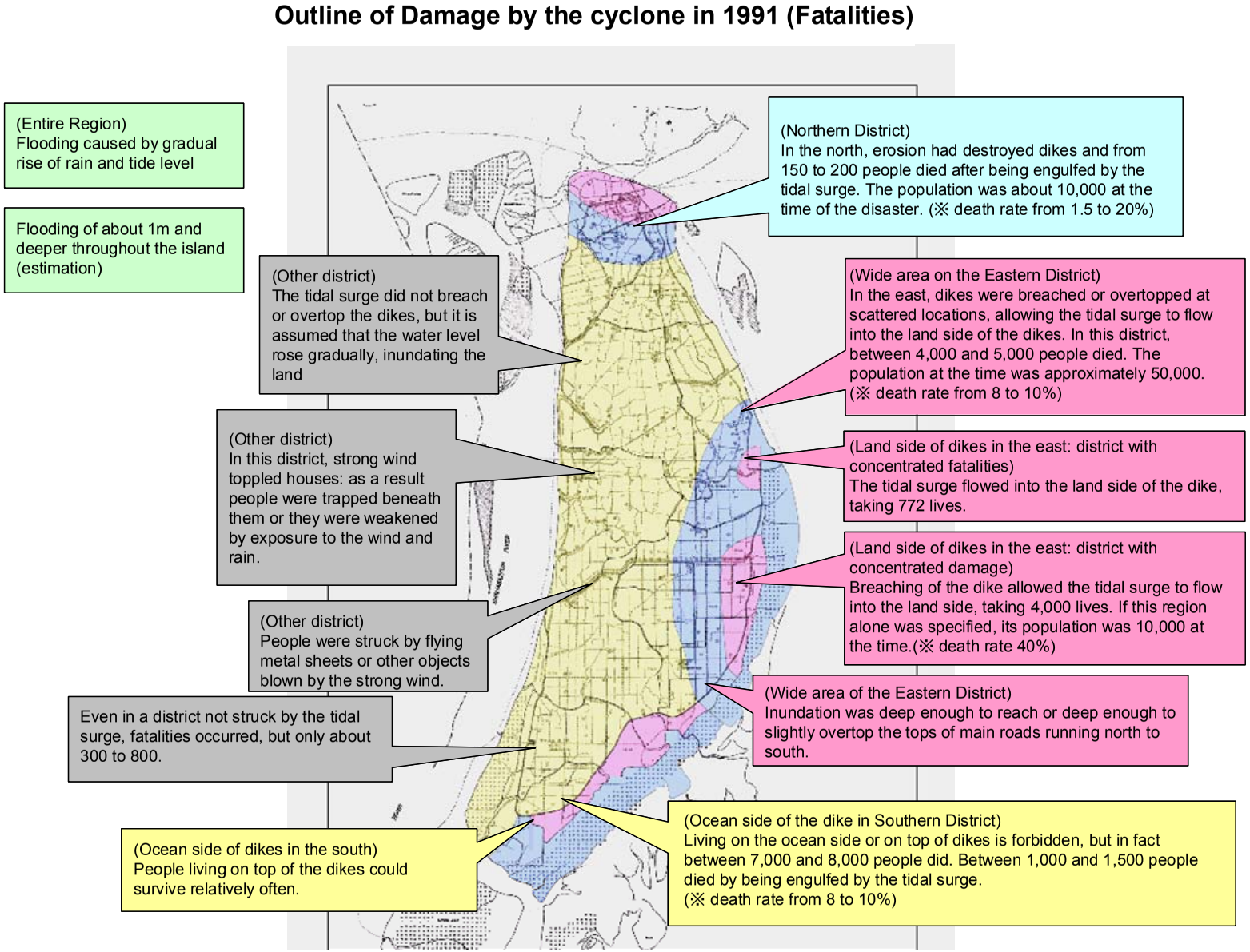


Figure 6. 1991 Cyclone Disaster Region (Prepared based on interviews at DUS)

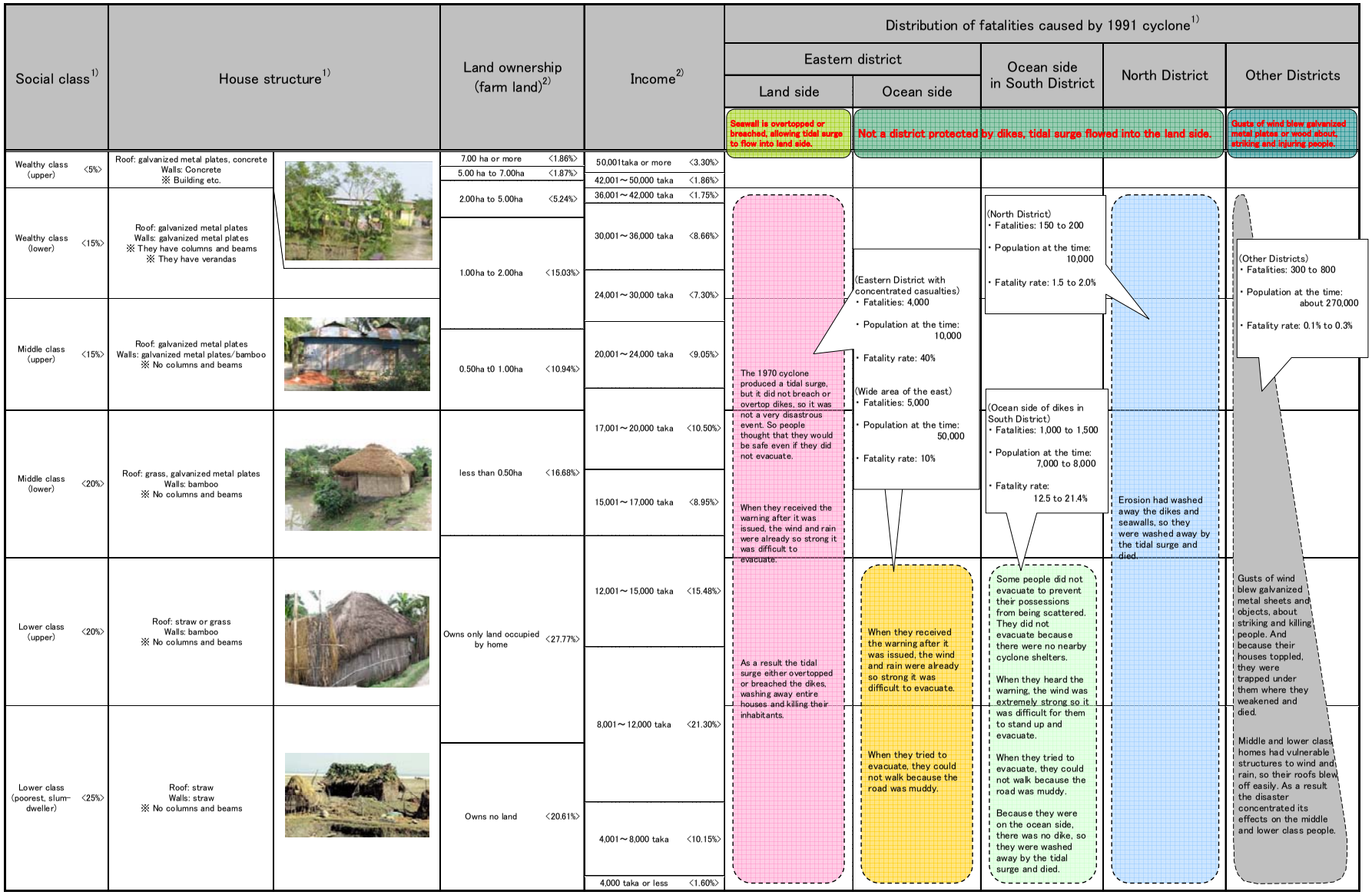


Figure 7. Relationship of Social Class and Fatality Rate

7.3 Interview Survey of Residents who were Victims of the Disaster

Outline of Residents Interview Survey Performed on February 7 (Wednesday) 2007

- Residents were interviewed in the ocean side of the dike in the South District, and in the Eastern District where many people were killed by the cyclone in 1991. The following five people where interviewed.
  - Victims on the ocean side of the dike in the South District of Hatiya Island
    - Amanunra, male, 55
    - RohimaKatun, female, 60
  - Victims in the Eastern District of Hatiya Island
    - Robindro Chocoroboti, male, 52
    - Ononto Zorodas, male, 60
    - Sheckholido, male 29
- On the ocean side of the dike in the South District, there were residents conscious of the high risk who were prepared to evacuate as soon as they heard a warning. On the other hand, there were people who either did not evacuate or delayed evacuation because they were afraid that their household property would be blown away or who hesitated to evacuate because when they heard the warning, the wind was already strong.
- On the land side in the East District, the typical disaster pattern was that although people felt confident that they were safe without evacuating because the dikes were not overtopped in the past, the dikes were breached, allowing the tidal surge to flow in, washing away their homes.

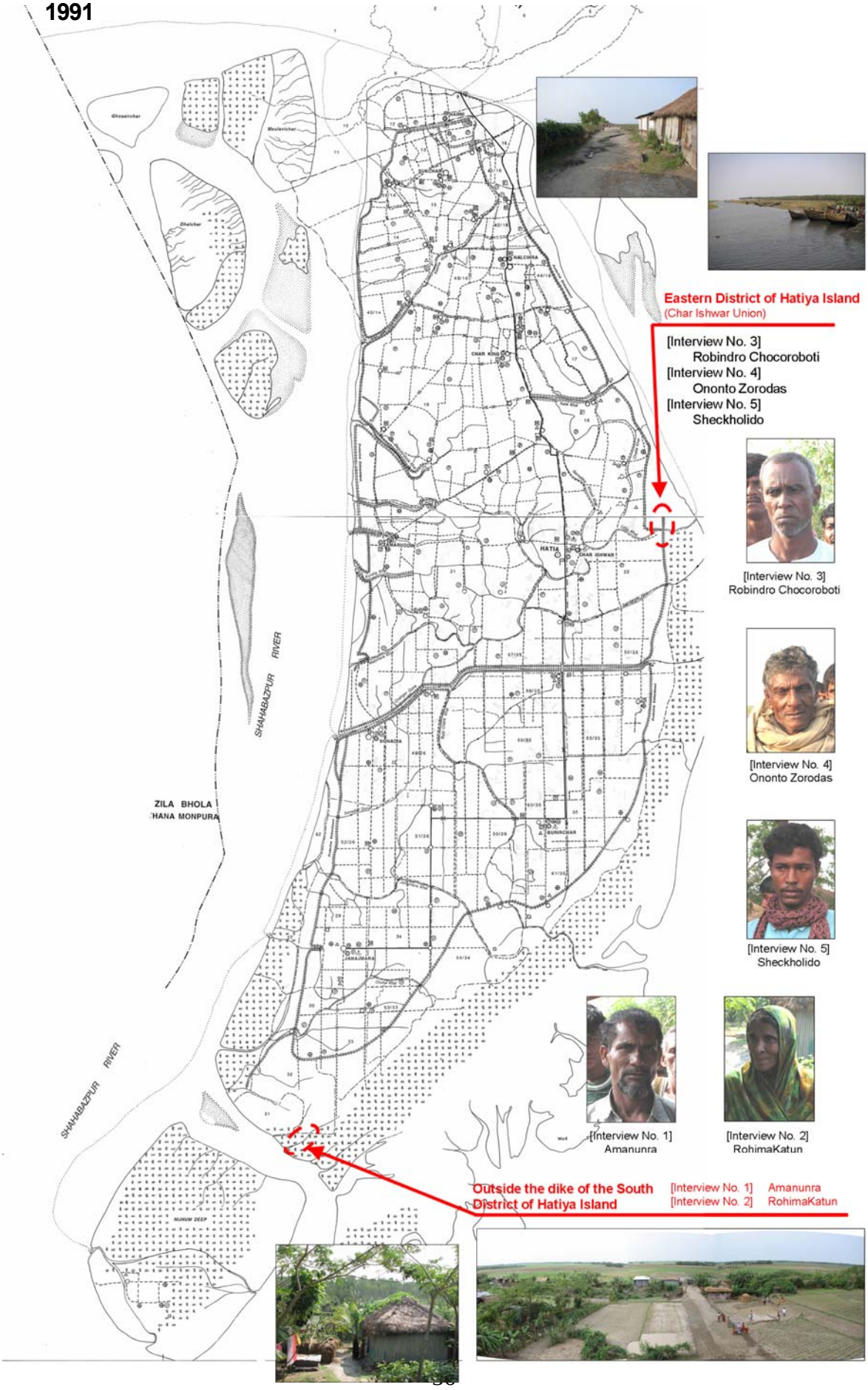


Figure 8. View of the Interview with Amanunra who lives in the Southern District of Hatiya Island

Collection of Field Interviews with Resident Victims of the Disaster

(Prepared based on the Field Survey of Hatiya Island in Bangladesh)

Locations of Interviews with Residents who were Victims of the cyclone disaster in 1991



[Interview No. 1]



“I evacuated to safety immediately after I heard the warning, but my older brother who remained behind because he was worried about his property was killed.”

Amanunra (55, 39 at the time of the disaster)

Resident of the ocean side of the dike in the Southern District of Hatiya Island

[Present (February 2007) living environment]

Family	Himself, wife, 6 sons, 3 daughters 2 daughters-in-law (total 13 people)
Employment	Tenant farmer (Rents dry fields. No cattle. Raises calves.) and fishing. ※ Was a fisherman in 1991.
Income	Monthly household income is 2,000 Taka (≒3,400 yen)
Residence	Has lived 37 years between new and old dikes.
Land	Only housing lot (1/4 acre(≒1,000m^2), no farm land)
Cyclone experience	Since 1970, large cyclones in 1970 and 1991; moderate cyclones three times.

Account of the cyclone disaster in 1991

Amanunra suffered from the disaster on the ocean side (coastline) in the South District of Hatiya Island. It was one of the regions most severely impacted by the disaster. He had formerly lived in the North District, but soil erosion washed away his land, so he moved to the south side where new land had been created by the action of sedimentation. He lived outside the dike that existed at that time, but before the cyclone struck, he escaped danger by evacuating to a sturdy house on the land side of the dike. He was prompted to evacuate by a warning of the danger of the cyclone that was issued by volunteers of the Red Crescent, changing the degree of danger from 5 to 10 at 4:00 p.m., Then he evacuated with his entire family for about 1.5 kilometers to a sturdy house on the land side of the dike. It was a stranger’s home, but they were welcomed in. After he had left his children there, he tried to go back to get his brother who had remained behind to protect their possessions from the cyclone, but the wind was so strong he could not walk, and it was blowing directly towards him so he could not return. Ultimately, his brother was caught and drowned by the tidal surge, and his body was never found.

“I learned the signal was 10 from the broadcast by the Red Crescent and began to evacuate, but the wind was already so strong that I could not stand. The rain was so strong I felt like I

was being stabbed. Fortunately it was a following wind, so we were able to move some way, but I could not return to bring my brother."

The tide level was highest at about 2:00 a.m. at night, and Amanunra realized that the tidal surge had arrived when he heard the roar of flowing water and the excited voices of the residents of the neighborhood. But it was already impossible to move at that time because of the strong wind, so all he could do was to stay at other people's house and pray. The tidal surge did not reach the place he evacuated to, but the following morning he witnessed bodies floating on the surface or hanging from trees, reminding him of how fierce the destructive power of a cyclone could be.

"While the cyclone was passing, strong winds struck my house in the blackness, truly terrifying me. I and all my family sat in the house shaking. Resigned to our deaths, we could only pray to Allah."

Amanunra has lived on land on the ocean side of the dike for more than 30 years, but because he was close to the dike, he assumed that he would be safe even if a cyclone struck. In fact, he had assumed he was safe during the 1970 cyclone. There were many residents who did not evacuate even when warned of the danger because of such imprudence and overconfidence. Amanunra believes that such people became victims of the cyclone.

"They all should have evacuated. But their failure to evacuate, and their death as a result of their failure were completely the will of Allah so there is nothing that can be done about it. My own survival was also the will of Allah."

Since that time, Amanunra has been sharply reminded that when he hears a report that a cyclone will strike, he must try to evacuate somewhere before it arrives, and he has earnestly advocated this to his children and his neighbors. The consciousness of cyclones has increased among his neighbors, and when a cyclone evacuation warning was issued in 1997, between 70% and 80% of the residents of his district evacuated. Among them there were people who evacuated with their cattle and other property, but most evacuated empty-handed.

But regardless of the warning, between 20% and 30% did not evacuate. Most did not evacuate because of overconfidence that they were still safe, and because of fear that their livestock that was their property would be washed away.

"After a cyclone comes, I tell everyone around me to evacuate to any sturdy and safe place, either a house or a shelter; it doesn't matter which. They must not remain in a dangerous place to protect their livestock from the cyclone. No matter how much property is saved, if a person loses their life, it is meaningless."

[Interview No. 2]



I spent the night enduring the cyclone, holding my child above my head in my submerged house.

RohimaKatun (60, but in 1991, 44)

Resident outside the dike in the South District of Hatiya Island

[Present (February 2007) living environment]

Family	Husband, herself, 2 sons, 2 daughters-in-law, 2 grandsons, 3 granddaughters (total 11)
Employment	Housewife (husband: day laborer, no steady employment) and fishing (they own nets) ※ She was also a housewife in 1991.
Income	Daily household income 150 taka (≒250 yen) ※ Total for 3 people: husband and 2 sons
Residence	The lived on the slope of the old dike, and have moved to the slope of the new dike (because it is wider.)
Land	No housing land (no farm land)

Account of the cyclone disaster in 1991

RohimaKatun was in her home on the southern coast of Hatiya Island when the cyclone struck. It appeared that she spent the night of the cyclone in her home, because when she heard the cyclone warning, it was already impossible to go outside because of the strong winds. At that time, she lived in a house made of straw and bamboo on the slope of the dike, but the straw roof was blown off, leaving only the relatively strong exterior wall made of interlaced bamboo. The water flowed into the house, rising until its surface was at her waist, but she and her family members somehow survived as she held her child above her head. Many of her neighbors obeyed the warning by escaping to shelters located a short distance away. But, because her house was located closer to the top of the dike, she assumed the water would not rise to the height of the house, so she did not try to evacuate.

"I was saved because I stayed in my home. Everyone who went outside died. When the warning was issued, the wind was already terribly strong, so I was too frightened to go outside."

She also stated that she remained in her home because she did not want to trouble anyone else. There were no cyclone shelters near her home, so she would have been forced to ask for help from another resident with a strong house if she had evacuated. In a place like Hatiya Island where human relationships

within communities are extremely close, there is a strong feeling that it would be embarrassing to bother other people, and this awareness prevented her from evacuating. But she stated that on the other hand, if there had been a shelter nearby, it would have been better to evacuate in response to the siren or warning. This suggests that the distance to the shelter was a major factor preventing her from evacuating.

"I didn't want to go on living by taking advantage of another person. If I had, what would people have said about me? And because I had already resigned myself to dying, I thought it would be better to die in my own house. But there is now a cyclone shelter near my home, so I think I will flee to the shelter when I hear the siren or a warning in the future."

RohimaKatun has moved to a location on the ocean side of a new dike that has been constructed on the ocean side of the dike on which she lived at that time. Land on a dike and that newly created by sedimentation on the ocean side of dikes is owned by the government and is registered as "khas land", but with ownership rights unclear, no matter who wishes to live on it, the government gives its tacit approval. People repeatedly move to live on such land, aware that it is somewhat dangerous.

"We wanted more land so we moved to the place we live now. Our life has improved since the disaster because our children have matured and now work. But this house would disappear without a trace if a cyclone as powerful as the cyclone in 1991 were to strike."



Present dwelling (on the ocean side of the new dike)

It is constructed at the bottom of the slope of the ocean side of the new dike and its roof is made of straw and its walls of galvanized metal sheets. At the time of the 1991 disaster, homes were similarly constructed at the bottom of the ocean side slope of the old dike. The walls were made of bamboo. Although called a house, it is a hut 5m wide and 5m deep.



Cooking utensil shelf in her home

There is a cooking utensil shelf opposite the entrance as shown in the photograph. Although it is not shown in the photograph, to the left of the shelf, there is a hearth where she does her cooking. There is no electricity in the hut and it is very dark inside even in the daytime.

[Interview No. 3]



Because of my experience of the cyclone of 1970, I had assumed I was safe and had not evacuated in 1991, but the water had reached my house.

Robindro Chocoroboti (52, at the time of the disaster he was 36)
Home in the East District (Char Ishwar) of Hatiya Island (500m on the land side of the dike)

[Present (February 2007) living environment]

Family	Himself, wife, 2 sons, 3 daughters (total 7)
Employment	Unemployed ※ In 1991, he was a tailor and a Hindu monk. He was also active as a CPP volunteer.
Income	None (household income is 4,000 taka/month from his sons)
Residence	Moved to the land side about 500m west of the dike
Land	Only housing land (1/5 acres (≒800m^2), no farm land)
Cyclone experience	He experienced he 1970 cyclone and the cyclone in 1991).

Account of the cyclone disaster in 1991

Robindro Chocoroboti, who was a volunteer with the Red Cross (now the Red Crescent Association) at the time of the cyclone in 1991, carried a siren and megaphone throughout the town actually spreading the warning. Beginning the day before the cyclone arrived, degrees of danger of 5 and 6 were announced, and on that day it was changed to 10 about 4:00 p.m., so from 9:00 p.m. to 11:00 p.m. he continuously announced this change. But the townspeople did not evacuate, saying that they were not worried. He believes that because the people remembered the cyclone of 1970 and lived in sturdier houses than they had in 1970, they thought they were safe from a cyclone of the same intensity. In fact, Robindro Chocoroboti who had spread the warning, did not evacuate to a cyclone shelter

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"We had spread the warnings continually since the previous day, but nobody evacuated, assuming they were safe. In the meantime, the wind strengthened, and by about 10:00 p.m. it was impossible to go outside, so I took refuge in my own home."

Later at about 11:00 p.m., water approached, overtopping the dike and submerging the land deeper than a person's height. The water submerged Robindro Chocoroboti's house waist deep, but fortunately, his

entire family was spared.

"We did not evacuate to a cyclone shelter, because we thought that even if we made it to a distant cyclone shelter, it would be full and we would not have been able to get into it, and did not know that the cyclone would be as powerful as it was."



Eastern District (Char Ishwar, Union) dike

At the time of the cyclone in 1991, the tidal surge overtopped and breached the dike at scattered locations. The tidal surge was 1 to 2m higher than the dike crest.



Homes constructed on the dike in the East District (Char Ishwar, Union)

Even now (February 2007) homes are still built on top of the dike. They face the ocean side of the dike, and if a cyclone as powerful as the cyclone in 1991 struck, they would disappear without a trace.

[Interview No. 4]

I lost two daughters and one son when my house was washed away by the tidal surge. I was able to survive by holding on to a tree.



Ononto Zorodas (60, but 44 at the time of the disaster,)

Resident of the East District (Char Ishwar) of Hatiya Island (150m on the land side of the dike)

[Present (February 2007) living environment]

Family	Himself, wife, 3 sons, 3 daughters, 3 daughters-in-law, (total of 11 people)
Employment	Fishing (his sons catch the fish and he sells them)
Income	Monthly household income of 2,000 taka (≒3,400 yen)
Residence	Lives about 1.5km inland from the dike.
Land	Only housing land (1/10 acre(≒100m^2), no farm land)
Cyclone experience	He experienced the 1970 and the cyclone in 1991.

Account of the cyclone disaster in 1991

Ononto Zorodas survived the disaster on the coast of the East District where the casualties were more severe than anywhere else on Hatiya Island. This region is the home of many poor fishermen. Ononto Zorodas also worked as a fisherman and lived in a home about 1.5km inside the dike. He heard the evacuation warning at about 4:00 p.m. on the day of the cyclone, but thinking it was not very serious, he remained in his house without evacuating. But by 10:00 p.m., the wind was so strong he could not sleep, and water began to cover the ground at about 10:30 p.m., so he took his children up to the roof of his house, but at 11:00 p.m. the water breached the dike, washing away his entire house.

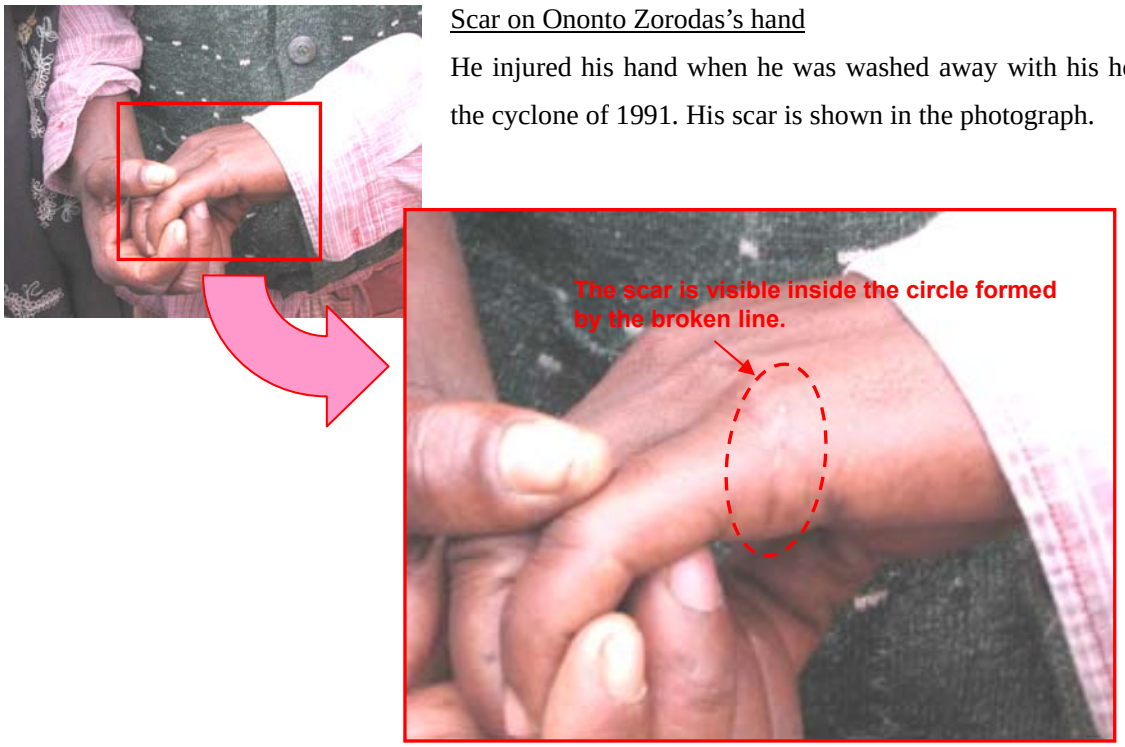
"When the 1970 cyclone struck, no water flowed over the dike, so we thought we would be safe again. And the wind was so strong that we were too frightened to go outside."

His entire family were engulfed by the tidal surge, and in the darkness, he did not know where he was, but Ononto Zorodas grabbed a tree that happened be nearby, and hung on to it as he waited for the storm to pass. About 3:00 a.m. winds blowing from the west pulled back the water, so he narrowly escaped death. But the next morning, two of his daughters and one son did not return. The other children returned safely, but because his home was completely washed away, he had no idea where his home was.

"When I clung to the tree alone, I had no idea if I would live or die. If that tree had not been close to me, I probably would have been carried away and drowned. Just like me, many other people including men, women and children were saved by hanging on to trees."

Immediately after the disaster, corpses of people and cattle and other livestock were scattered about so he was too frightened to even go back to his home. For about a month after the disaster, he survived with food aid (dropped from airplanes) from NGO, the government, and international organizations. He lived by borrowing space in other people's homes for a while, but the victims lived in tents provided as emergency aid materials for between 1 and 2 years. He restored his livelihood by living in this tent.

During the interviews, we heard residents of the neighborhood make comments such as, "People were injured by being struck by galvanized sheets and trees blown by the wind.", "I could see nothing because of the sea water and sand." These revealed that even the people who were rescued were harmed in various ways.



Scar on Ononto Zorodas's hand

He injured his hand when he was washed away with his house by the cyclone of 1991. His scar is shown in the photograph.

[Interview No. 5]



My house was about to collapse, so I escaped by running with my older brother along the slope of the dike to a sturdy building.

Sheckholido (29, but 14 at the time of the disaster)
Resident on the ocean side of a dike in the East District of Hatiya Island

[Present (February 2007) living environment]

Family	Himself, mother, wife, 3 sons (total of 6)
Employment	Fishing industry (fish wholesaler)
Income	Monthly household income 2,000 taka (≒3,400 yen)
Residence	Has lived on a slope of a dike (ocean side) since he was a child.
Land	Only housing land (no farm land)

Account of the cyclone disaster in 1991

Sheckholido who was 14 years old at the time of the disaster has lived on the ocean side of a dike in the East District of Hatiya Island continuously since the time of the disaster. He remembers that on the day the cyclone struck, the wind and rain had been strong since the afternoon, but when he heard it was a very dangerous storm, the outside was already submerged so he could not move. So he remained inside his home, but when the house began to creak and started to fall over, he and his older brother evacuated to a nearby forest management office on his mother's order. When he evacuated, he was able to safely reach his destination by traveling along the slope instead of on the road on top of the dike, in order to avoid the strong wind. Later his older brother went back to their home to bring his mother, but on the way, he was washed away by a tidal surge and returned to the forest management office barely escaping with his life. Fortunately his mother was helped by a neighbor woman to escape from the wind and rain under the slope and was finally able to make it to the forest management office.

"My mother told me to escape to a safe place with my older brother, but I hated leaving 18 goats and 3 head of cattle behind. Finally I and my brother escaped to the forest management office, but because the wind was so strong that we could not walk on top of the dike, we survived by walking on its slope. We were really saved because of the kindness of the people of the forest management office."

And at the forest management office, the door collapsed at about 2:00 a.m., allowing waist deep water to submerge the interior, but its walls were made of concrete and it was sturdy, so it was not washed away. When the sun came up at 4:00 a.m., the wind blew from the west, removing the water so that all the people in the office were saved.

"The cyclone shelter is now far away, 1.5 kilometers from my house. But if a cyclone came, I would promptly escape to it instead of staying in my house."



Sheckholido's home (ocean side)

He has lived at the bottom of the slope of a dike (ocean side of the dike) since he was a child. He rebuilt the house because it was damaged by the tidal surge caused by the 1991 cycle.

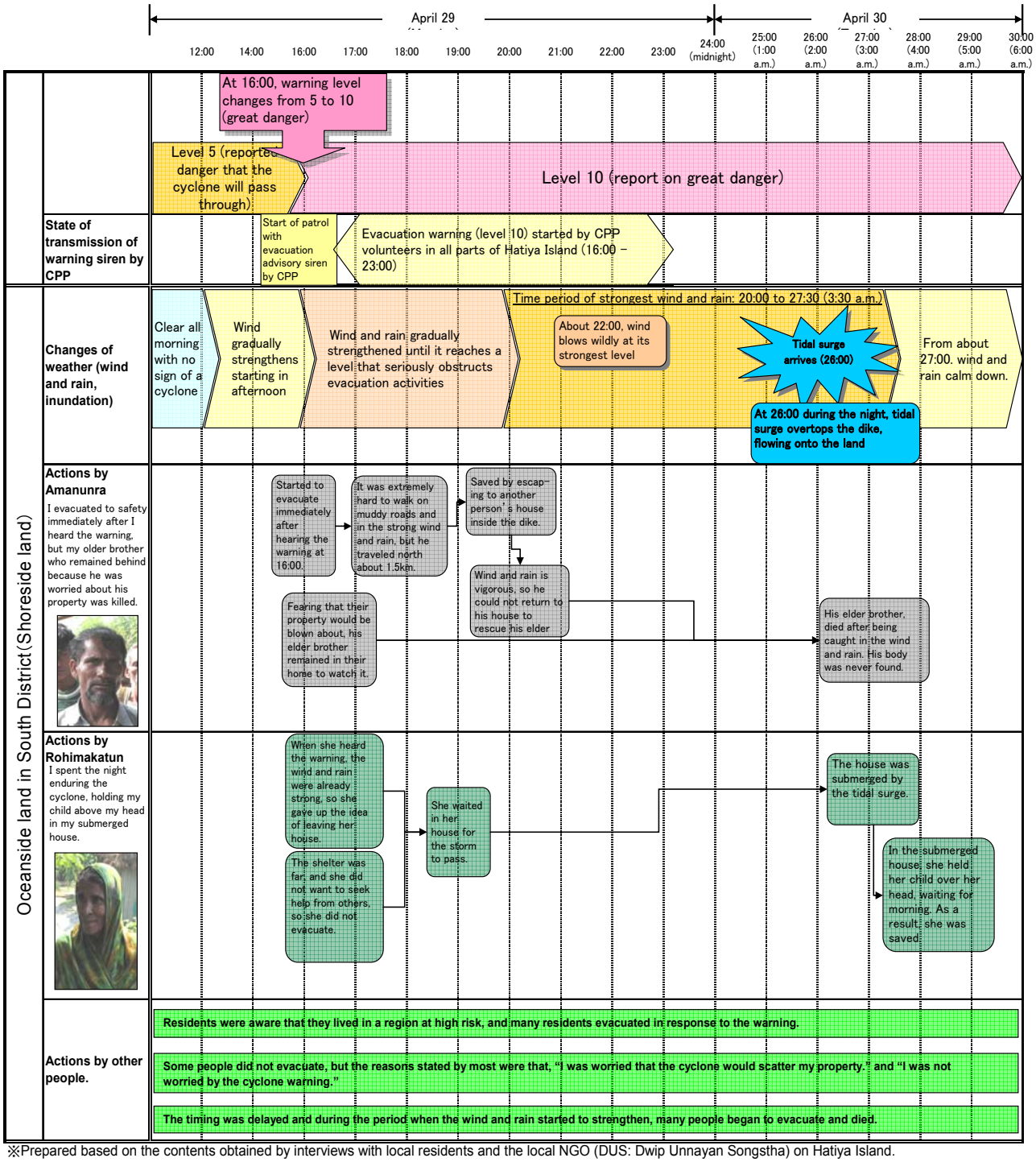


Slope on the land side of the dike

When he evacuated from the cyclone in 1991, the top of the dike was already so muddy because of the strong wind and rain that it was impossible to travel on it. Therefore, he escaped by traveling on the slope on the land side of the dike.

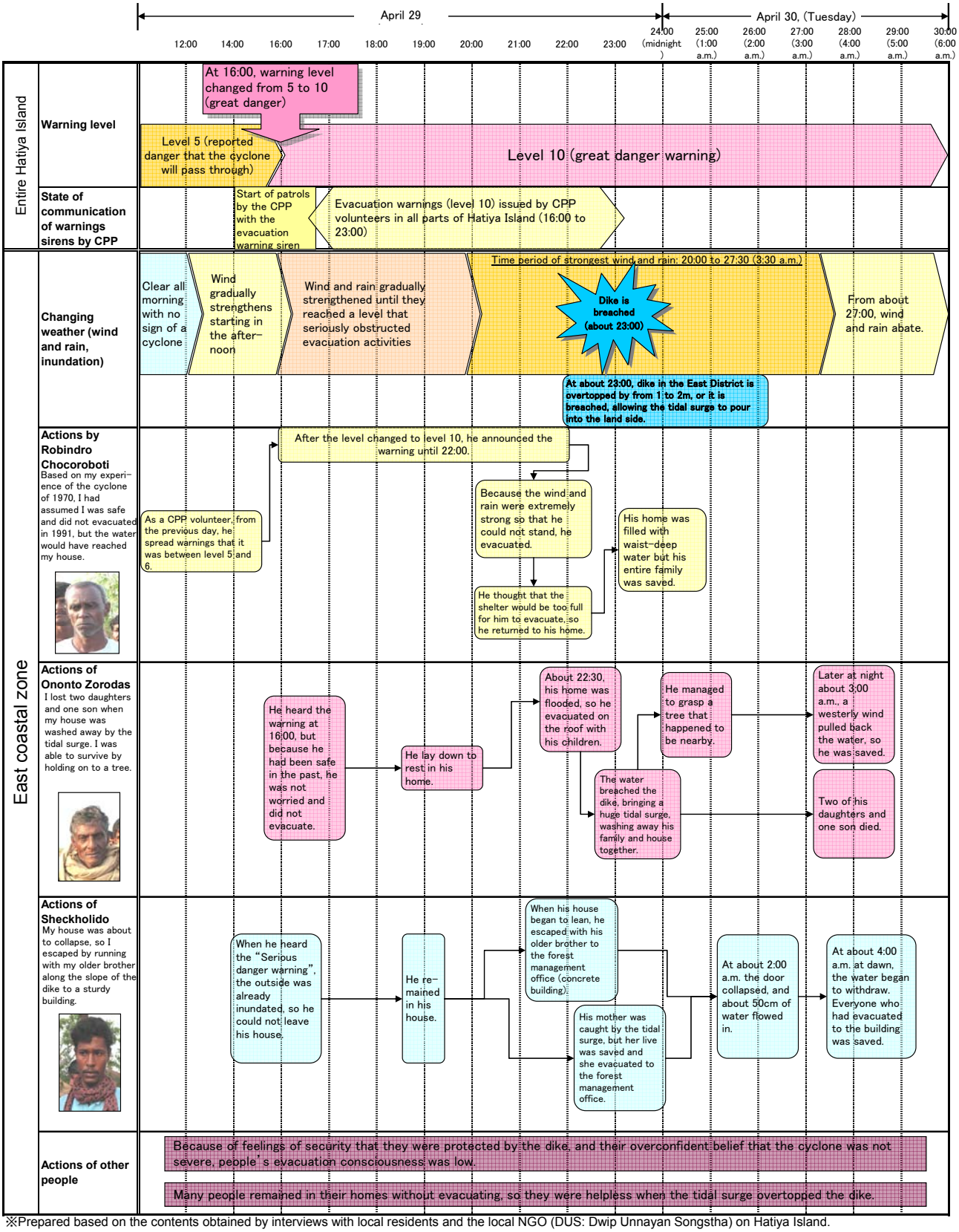
7.4 Damage scenarios of the cyclone disaster in 1991 on Hatiya Island

Based on the results of the interview surveys described in 7.2 Interview Survey in Dwip Unnoyan Songstha and in 7.3 Interview Survey of local victims of the disaster, we have organized the disaster process in a time series (See Fig. 9).



※Prepared based on the contents obtained by interviews with local residents and the local NGO (DUS: Dwip Unnayan Songstha) on Hatiya Island.

Figure 9 (1): Disaster Scenarios for Hatiya Island during the April 1991 Cyclone
(Oceanside of the dikes on the southern coast)



※Prepared based on the contents obtained by interviews with local residents and the local NGO (DUS: Dwip Unnayan Songstha) on Hatiya Island.

Figure 9 (2): Disaster Scenarios for Hatiya Island during the April 1991 Cyclone (Eastern coastal area)

8. Revising the Disaster Profile Sheets

In 5. Preparing the Disaster Profile Sheets, the preparation of the sheets based on 3. Reorganizing the document survey and 4. Interview survey in Japan is explained. Here, the results of 7. Field survey in Bangladesh are added to revise the Sheets. The following table outlines of each Sheets: Disaster Profile Sheet (External Force),Disaster Profile Sheet (Regional Characteristics),Disaster Profile Sheet (Countermeasure),Disaster Profile Sheet (Disaster Damage)

See the Disaster Profile Sheete Collection on the following pages (51 – 72) for details of the revision..

Table 5. Outline of the Revised Disaster Profile Sheets

(Based on Document Survey, Interview Survey in Japan, and Field Survey in Bangladesh)

External Force	The maximum average wind speed in the study region during the cyclone of April 1991 is estimated to be between 176 and 220 km/hr (48.9 – 61.1m/s). The total rainfall on April 20 and 30 was 208mm. So it is assumed that the entire island was submerged to an average depth of 1m. When the cyclone struck, it overlapped with high tide, so it is estimated that this resulted in a maximum tide level of 5 to 6m along the eastern coast. The design standard height of the dikes was 4.5m and they were constructed only to prevent flooding caused by high tides, so they could not be counted on the prevent overtopping by a tidal surge caused by a cyclone or tsunami. The seawall in the East District was overtopped or breached, allowing the tidal surge to submerge the land side. And the ocean side the dike in the South District was invaded by a 1.5 to 2.0m tidal surge.
Regional Characteristics	The population of Hatiya Island before the cyclone of 1991 was a little less than 300,000 people on land area of approximately 1,000km2. The population density was about 300/km^2 (300,000/1,000km^2). This value is smaller than the population density of Bangladesh at that time (774/km^2). Hatiya Island is located at the mouth of the Ganges River on the Bay of Bengal, so it has suffered from severe erosion action on its north coastline that is struck directly by the flow of the Ganges River. But sedimentation has occurred on the south side of the island. In recent years, the ocean side of the dike on the south side where sedimentation occurs has been occupied by poor people without land. A major road about 3m side runs from south to north, and centered on this road, a network of farm roads link hamlets. However, in 1991, these were almost entirely unpaved.
Countermeasures	To provide protection from high tides, a dike (4.5m high) has been constructed around the periphery of the island. Because it is a measure taken for normal high tides, it cannot be counted on to prevent overtopping by a high tide caused by cyclone (tidal surge). On the south side, new land (ocean side) has been created by sedimentation. This land, that is in a zone at high risk of devastation by cyclones, has been steadily occupied by poor people, so although shelter forest measures were taken, these had barely started in 1991, so the trees were scarce and they had almost no tidal surge protection functions. Cyclone shelters intended to reduce the number of cyclone fatalities have been constructed by various aid organizations, but their capacity was

	inadequate in 1991, when they could accommodate fewer than 10% of the island's population (less than 300,000). Measures not requiring physical structures include a warning transmission system called the Cyclone Preparedness Programme (CPP) that operates in response to cyclone warning signals issued by the Meteorological Agency. It is a network of volunteers who warn individual households. But, many residents who did not (or could not) evacuate immediately before the arrival of the cyclone in 1991 were killed by the disaster.
Disaster Damage	During interviews with the DUS officials, the estimate, "Approximately 6,000 people died just on Hatiya Island." was made. The damage was concentrated in the East District and South District. In the East District, the tidal surge overtopped or breached the dike, flowing into the land side killing between 4,000 and 5,000 people. On the ocean side of the dike in the South District, between 1,000 and 1,500 people died, mainly residents who did not evacuate because of fear that their property would be lost. The Red Crescent cyclone shelter usage rate is reported to be 52.7%, but many of the evacuees were forced to evacuate because their homes were destroyed by the powerful wind and rain and by the tidal surge that were triggered by the cyclone.

Collected Disaster Profile Sheets
(Revised)

(Based on the Document Survey, Interview Survey in Japan, and Field Survey)

Explanation of Codes/Symbols in Source Columns of Disaster Profile Sheets

Codes/symbols in Source Column	Explanation of code/symbol
June 2007 document	PWRI Document: Analysis of Causes of Water Disasters in Bangladesh (June 2007)
BA_S_02	Vulnerability to Tropical Cyclones: Evidence from the April 1991 Cyclone to Coastal Bangladesh by Haque, C. E. and Blair, D.
BA_S_20	JICA Report for the Basic Design Study on the Project for the Construction of Multipurpose Cyclone Shelter (Phase V) in People's Republic of Bangladesh
CYCLONE'91	CYCLONE '91 -An environmental and perceptional study- by Bangladesh Centre for Advanced Studies
Bangladesh report	http://www.kyoiku-shuppan.co.jp/kousha/wadai2006.pdf/2006.04.pdf
BANGLAPEDIA	http://a-bangladesh.com/
National Water Management Plan 2000	http://www.warpo.gov.bd/home.htm
GTOPO30	http://edc.usgs.gov/products/elevation/gtopo30/gtopo30.html
SRTM30	http://www2.jpl.nasa.gov/srtm/
SRTM3	http://www2.jpl.nasa.gov/srtm/
Google Map	http://maps.google.com/
University of Maryland web site	http://glcfapp.umiacs.umd.edu:8080/esdi/index.jsp
R1	Document obtained from Japanese Red Cross Society Development Cooperation Report 2000 (in Japanese)
R3	Document obtained from Japanese Red Cross Society Evaluation Report for disaster reduction projects in Bangladesh by Japanese Red Cross Society (1998) (in Japanese)
R4	Document obtained from Japanese Red Cross Society Disaster and People's Participation: Issues of Cyclone Shelter Construction in Bangladesh by Prof. Ohashi and Mr. Kayano (1995) (in Japanese)
R9	Document obtained from Japanese Red Cross Society Community Based Disaster Preparedness in Hatiya, Monpura and Noakhali Region by Bangladesh Red Crescent Society (BDRCS) and Japanese Red Cross Society (JRCS)
R11	Document obtained from Japanese Red Cross Society Evaluation -Community Based Disaster Preparedness Programme in Hatiya, Nijhumdwip & Monpura Islands in Bangladesh- by Dilip Choudhury et al. (1997)
R12	Document obtained from Japanese Red Cross Society BDRCS/JRCS COMPREHENSIVE REVIEW on JRCS supported Disaster Preparedness Activities in Bangladesh by Dilip Choudhury et al. (1995)
R13	Document obtained from Japanese Red Cross Society Programme Description and Plan of Action 1998 to 2002 for CYCLONE PREPAREDNESS PROGRAMME by Bangladesh Red Crescent Society (1997)
DUS Interviews	Dwip Unnoyam Songstha (Local NGO)
WARPO	Documents received from WARPO (Water Resources Planning Organization)
Population Census	Statistical documents

1. Disaster Profile Sheet (External Force)

【Outline of Disaster External Force in the Study Region】

The maximum average wind speed in the study region when the April 1991 cyclone struck is estimated to be between 176 to 220km/hr (48.9 to 61.1m/s). The total rainfall on April 29 and 30 was 208mm. It was thought that this resulted in average inundation of about 1m throughout the island.
When the cyclone arrived, the tide was high, resulting in a maximum tidal surge level from 5 to 6m striking the coast of the East District. The dike was constructed with a design standard height of 4.5m, and was constructed only to serve as a high tide flood protection measure, so it could not be counted on to function as a measure to prevent overtopping by a tidal surge caused by a cyclone or tsunami. The tidal surge overtopped and breached the dike in the East District, pouring into the land side of the dike. The ocean side of the dike in the South District was struck by a 1.5m to 2.0m tidal surge.

Cyclone studied: 1991 Cyclone (April 29, 1991)
District studied: Noakhali District, Hatiya Island

○: There are data for Hatiya Island in 1991.
△: Includes data for years other than 1991 and places other than Hatiya Island. Or it shows estimated values.
×: No corresponding data can be found.

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2. Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Wind speed	Max. gust speed			km/hr		×			×			×		
	Max. average wind speed		176-225 (48.9-61.1)	km/hr m/s	Max. wind speed distribution map (see attached maps) ※Wind speed in the study area unclear.	△	CYCLONE '91	1991	-			-		
	Strong wind duration		7.0-8.0	hr	Wind was strongest generally from 20:00 to 27:30	×			×			△	DUS Interviews	1991
			2.5	hr	Wind/rain were most intense from 24:00 to 26:30.	×			×			△	DUS Interviews	1991
	Wind force distribution			—		×			×			×		
Rainfall	Total rainfall		208	mm	Total rainfall on April 29 and 30	×			×			○	WARPO	1991
	Total rainfall distribution			—		×			×			×		
	Hourly max. rainfall			mm/hr		×			×			×		
	Hourly max. rainfall distribution			mm/hr		×			×			×		
Tide level	Max. tidal surge level		5.0-6.0	m	The tidal surge with height of 5-6m washed the island from southeast direction.	×			○	R12	1991	-		
			4.5-5.4	m	[East Side] Dikes hypothesized 3.6 to 4.5m, and it is assumed a tidal surge from 4.5m to 5.4m overtopped this dike.	-			-			○		1991
			1.5-2.0	m	【Ocean side of dike in South District】A tidal surge from 1.5m to 2.0m struck land without dikes	-			-			○		1991
Inun-dation	Max. water level of inundation			m		×			×			×		
	Inundated district	Map of inun-dation	Regional map of hypothesized tidal surge casualties by the cyclone of 1991	—	Regional map of hypothesized tidal surge casualties by the cyclone of 1991 (based on SRTM3 grid elevation data, land lower than 6m is shown in red)	△	SRTM3	2002	△	R11, R12	1991	-		
			Regional map of tidal surge casualties by the cyclone of 1991	-	Prepared based on the results of interviews with the DUS (local NGO) during the field survey.	-			-			○	DUS Interviews	1991

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2. Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Inun-dation (cont'd)	Inundated district (cont'd)	Inun-dation depth	0.6-1.5	m	Flow of the river was reversed by the tidal surge level, inundating the land side of the dike. Inundation by rain is assumed to have caused inundation with an average depth of 1m throughout the island.	-			-			○	DUS Interviews	1991
		Area inundated		km^2	Almost the entire island was inundated, but the percentage inundated is unclear.	×			×			△	DUS Interviews	1991
Cyclone landfall time			Late at night (22:00、Chittagong landfall)	—	When the cyclone struck, it was high tide, resulting in a tidal surge from 5m to 6m striking the coast of the study region.	△	BA_S_02	1991	×			×		
Cyclone route			Route map	—	Route map (see attached documents)	○	BA_S_02, CYCLONE '91	1991	○	R12	1991	-		

2. Disaster Profile Sheet (Regional Characteristics)

【Outline of Regional Characteristics of the Study Region】

The population of Hatiya Island before the 1991 cyclone struck was a little less than 300,000 people living on about 1000km^2. Population density was 300 people/km^2 (=300,000/1,000km^2). This value was lower than the population density of Bangladesh at that time (774/km^2). Because Hatiya Island is located on the Bay of Bengal at the mouth of the Ganges River, the flow of the Ganges River strikes it directly causing vigorous erosion action on the north coastline. On the other hand, sedimentation has occurred on the southern part of the island. In recent years, poor landless people have moved to the ocean side of the dike on the south coast where sedimentation has advanced. There is a main road about 3m in width running from south to north, and a network of farm roads centered on it links hamlets. But in 1991, it was almost entirely unpaved.

Cyclone studied: 1991 Cyclone (April 29, 1991)
District studied: Noakhali District, Hatiya Island

○: There are data for Hatiya Island in 1991.
△: Includes data for years other than 1991 and places other than Hatiya Island. Or it shows estimated values.
×: No corresponding data can be found.

Item		Values etc.	Unit	Remarks	Data acquisition method								
					1. Document survey (public data)			2. Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
					Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Regional characteristics	Population (of the region)	346,853	Person	Population of Hatiya Island	△	Bangladesh Rept.	2001	-			-		
		4,896	Person	Population of Nijum Dwip Island	△	Bangladesh Rept.	2005	-			-		
		295,501	Person	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		384,448	Person	For Hatiya Island、Nijhum Dwip Island、Monpura Island	-			△	R11	1991	-		
		333,087	Person	For Hatiya Island、Nijhum Dwip Island	-			△	R11	1991	-		
		51,361	Person	For Monpura Island	-			△	R11	1991	-		
		291,003	Person	Population of Hatiya Island	-			-			○	Population Census	1991
	(Regional) area	1,508.2	km^2	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		999.74	km^2	For Hatiya Island and、Nijhum Dwip Island	-			△	R11	1997	-		
		373.19	km^2	For Monpura Island	-			△	R11	1997	-		
		1,372.93	km^2	For Hatiya Island、Nijhum Dwip Island、and Monpura Island	-			△	R11	1997	-		
	Regional (popula-tion density)	333.2	Person /km^2	Calculated based on 333,087 persons/999.74km^2 ※For Hatiya Island and、Nijhum Dwip Island（Source：R11、Pop.：1991、Area：1997） ※Bangladesh Pop. Density 834 /km2（2001）	△			△	R11	1991 (1997)	-		
		280.0	Person /km^2	Calculated based on 384,448 persons/1372.93km^2 ※For Hatiya Island、Nijhum Dwip Island, and、Monpura Island（Source：R11、Pop.：1991、Area：1997）	△			△	R11	1991 (1997)	-		
	Number of house-holds	47,171	Household	Number of households on Hatiya Island	×			×			○	Population Census	1991
	Numeber of unions (administrative towns)	10	Union	There are 10 unions (towns); 1 union on the north end of the island has disappeared because of erosion action of the river. Sedimentation has created 1 union offshore from the southern coast.	△	Bangladesh Rept.	Unknown	-			-		
		10	Union	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		9	Union	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997	-		
		3	Union	For Monpura Island	-			△	R11	1997	-		
		9	Union	Number of unions (administrative towns) on Hatiya Island	-			-			○	Population Census	1991

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2. Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Regional characteristics	Number of Mouza（hamlets）		37	Hamlets	For Hatiya Upazila (County)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-			-		
	Number of villages		69	Village	For Hatiya Upazila (County)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-			-		
			78	Village	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997	-		
			33	Village	For Monpura Island	-			△	R11	1997	-		
	Roads	Road network	See remarks	-	A major road about 3m wide runs from south to north and farm roads centered on this road link hamlets. And a dike that doubles as a road is constructed on the coast to provide protection against tidal surges caused by cyclones.	△	Bangladesh Rept.	Unknown	-			-		
			See attached map	-	Roads are shown on MAP OF HATIYA AND LOCATION OF BDRCS SHELTERS（See attached maps：there are unclear locations）	-			△	R11	1997	-		
			See attached map	-	Roads are shown on _____（See attached maps）	-			-			△	DUS interviews	1994?
		pucca	380	km	For Hatiya Upazila (County)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-			-		
		Semi pucca	220	km	For Hatiya Upazila (County)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-			-		
	Road	mud road	800	km	For Hatiya Upazila (County)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-			-		
	School	College	4	School	For Hatiya Island	△	Bangladesh Rept.	Unknown	-			-		
			3	School	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997	-		
			1	School	For Monpura Island	-			△	R11	1997	-		
			3	School	For Hatiya Upazila (County) (Government affiliated: 1, non-governmental affiliated: 2)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-			-		
		High School	21	School	For Hatiya Island	△	Bangladesh Rept.	Unknown	-			-		
			26	School	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997	-		
			4	School	For Monpura Island	-			△	R11	1997	-		
			25	School	For Hatiya Upazila (County) (Government affiliated: 2, non-governmental affiliated: 23)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-			-		
		Junior High School	4	School	For Monpura Island	-			△	R11	1997	-		
		Primary	151	School	For Hatiya Island	△	Bangladesh Rept.	Unknown	-			-		
	School	Primary	105	School	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997	-		
			38	School	For Monpura Island	-			△	R11	1997	-		
			222	School	For Hatiya Upazila (County) (Government affiliated: 105, non-governmental affiliated: 117)	△	BANGLAPEDIA：Hatiya Upazila	Unknown	-			-		
		Madrasha	36	School	For Hatiya Island	△	Bangladesh Rept.	Unknown	-			-		
			16	School	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997	-		

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2. Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Regional characteristics	School (cont'd)	Madrasha (cont'd)	10	School	For Monpura Island	-			△	R11	1997	-		
			16	School	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
	Sex	Male	147,626	Person	Calculated based on 50.73% and 295,501persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
			26,516	Person	For Monpura Island	-			△	R11	1991	-		
			149,908	Person		-			-			○	Population Census	1991
		Female	143,261	Person	Calculated based on 49.23% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
			24,845	Person	For Monpura Island	-			△	R11	1991	-		
			145,593	Person		-			-			○	Population Census	1991
	Age	Under 15		Person		×			×			×		
		15～64		Person		×			×			×		
		Elderly (65 and older)		Person		×			×			×		
	People needing assistance during a disaster	Disabled		Person		×			×			×		
		Elderly (65 and older)		Person		×			×			×		
		Infants		Person		×			×			×		
		Sick and injured		Person		×			×			×		
	Income	Average daily income		$		×			×			-		
		Income distribution	See attached maps	-		×			×			○	DUS interviews	
	Assets	Assets per household		$		×			×			×		
	Land use	Arable land area	28396.20	ha	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		1 crop 1st cropping area of arable land	10790.56	ha	Calculated based on 38.0% and 28396.2ha For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		2 crop 2nd cropping area of arable land	13062.25	ha	Calculated based on 46.0% and 28396.2ha For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2. Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Regional Characteristics	Land use (cont'd)	3 crop 3rd cropping area of arable land	4543.39	ha	Calculated based on 16.0% and 28396.2ha For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Irrigated area of arable land	21297.15	ha	Calculated based on 38.0% and 28396.2ha For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Area of fallow land	2815.46	ha	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
	Employment	Agriculture	114,211	Person	Calculated based on 38.65% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
	Employment	Farm labor	71,600	Person	Calculated based on 24.23% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Paid employment	11,140	Person	Calculated based on 3.77% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Commerce	25,679	Person	Calculated based on 8.69% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Service industry	10,579	Person	Calculated based on 3.58% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Fishing industry	15,868	Person	Calculated based on 5.37% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Others	46,423	Person	Calculated based on 15.71% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Agriculture (%)	60	%	For Hatiya Upazila (County)	△	Bangladesh Rept.	1995	-			-		
		Non-agriculture (%)	15	%	For Hatiya Upazila (County)	△	Bangladesh Rept.	1995	-			-		
		Business (%)	10	%	For Hatiya Upazila (County)	△	Bangladesh Rept.	1995	-			-		
		Public service (%)	10	%	For Hatiya Upazila (County)	△	Bangladesh Rept.	1995	-			-		
		Unemployed (%)	30	%	For Hatiya Upazila (County)	△	Bangladesh Rept.	1995	-			-		
		Others (%)	5	%	For Hatiya Upazila (County)	△	Bangladesh Rept.	1995	-			-		

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2. Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Regional Characteristics	Breakdown of tenant farmers	No land	52.13	%	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Small plot of land	18.00	%	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Medium plot of land	22.00	%	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Sufficient and	7.87	%	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Per capita arable land	0.09	ha	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
	Agriculture	Paddy rice area	75,618	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
		Peanuts area	14,350	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
		Legumes arfea	11,060	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
		Potatoes area	5,700	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
		Sweet potato area	2,480	ha	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
		Paddy rice yield	2.5	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
		Peanuts yield	1.6	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
		Legumes yield	0.5	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
		Potato yield	1.5	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
		Sweet potato yield	1.8	t	For Hatiya Island Source: Hatiya Island DWIP Office	△	Bangladesh Rept.	2001	-			-		
	Land price		6,000	tk/0.01ha	Market value of the land of the first grade For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
	Poverty rate (income $1 or less/day)		50 or more	%	Poverty rate distribution map by District（See attached maps）	△	National Water Management Plan 2000	Unknown	-			-		

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2. Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Regional Characteristics	Literacy rate	Men and women	21.0	%	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
			21.0	%	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997	-		
			21.0	%	For Monpura Island	-			△	R11	1997	-		
		Men	27.2	%	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Men	27.3	%	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997	-		
		Women	14.7	%	For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
			14.0	%	For Hatiya Island and Nijhum Dwip Island	-			△	R11	1997	-		
	Religion	Islam	257,559	Person	Calculated based on 87.16% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
			257,712	Person	Calculated based on 74.3% and 346,853 persons For Hatiya Island	△	Bangladesh Rept.	2001	-			-		
		Hinduism	36,376	Person	Calculated based on 12.31% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
			89,766	Person	Calculated based on 10.6% and 346,853 persons For Hatiya Island	△	Bangladesh Rept.	2001	-			-		
		Christian	473	Person	Calculated based on 0.16% and 295,501 persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
		Others	1,093	Person	Calculated based on 0.37% and 295,501persons For Hatiya Upazila (County)	△	BANGLAPEDIA: Hatiya Upazila	Unknown	-			-		
	Budget			$		×			×			×		
Regional topography	Elevation	Digital Elevation Model(DEM)	See attached maps	—	GTOPO30 (See attached maps)	△	GTOPO30		×			×		
					SRTM30 (See attached maps)	△	SRTM30	2000/2	×			×		
					SRTM3 (See attached maps)	△	SRTM3	2000/2	×			×		
	Zero meter zone	Surface area		km^2		×			×			×		
		Percentage of entire region	100	%	Elevation Map (See attached maps)	△	June 2007 document	1990	-			-		
	Satellite images		See attached maps	-	Google Map (See attached maps)	△	Google Map	Unknown	-			-		
					LANDSAT (See attached maps)	△	MaryLand University Web Site	1977 1989 1999	-			-		

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2. Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Regional topography	Topographical change	Change over years of coastline	See attached maps	-	Map of change over time of coastline by satellite image (See attached maps) The three islands of Hatiya, Nijihum Dwip, and Monpura are located in the Bay of Bengal at the mouth of the River Ganges. Therefore, the flow of the River Ganges directly strikes them causing severe erosion of the north coast of Hatiya Island and sedimentation on the south side of the island. In recent years, poor landless people have moved to the ocean side of the dikes where sedimentation has advanced. To provide these poor people with some degree of protection from tidal surges, forests are being planted (information obtained by an interview with the Japanese Red Cross Society on October 20, 2006)	△	BA_S_20	1973/74 1984 1996 2001	-			-		

※ Notes

1) The SRTM（Shuttle Radar Topography Mission） uses radar installed on the Space Shuttle to prepare detailed stereoscopic topographical data for the entire world.
2) SRTM30 obtains 30 second (900m) mesh data. SRTM3 obtains 3 second (90m) mesh data, and SRTM1 obtains 1 second (30m) mesh data.
3) GTOPO30 has poorer resolution than the SRTM30, and its data includes many mistakes and errors. With SRTM30, the elevation changes with each scene.
4) A fee is charged for SRTM1, but considering the price and precision, it is better to use SRTM.
5) Google Map was prepared by pasting screen cap pictures of satellite images taken of the study region from the Web Site Google Maps.

3. Disaster Profile Sheet (Countermeasure)

【Outline of State of Countermeasures in the Study Region】

To provide protection from tidal surges, a dike (height 4.5m) has been constructed so it encompasses the periphery of the island. It was constructed to deal with normal high tides, so it cannot be counted on to prevent overtopping by a tidal surge caused by a cyclone. And in the South District, the action of sedimentation has created new land (ocean side of the dike). This land is a high risk zone that is susceptible to casualties caused by cyclones but poor people have steadily moved onto this land, so coastal forests have been planted. But by 1991, this development had just started, so trees were still scarce, and it provided almost no tidal surge protection functions.
Various aid organizations have constructed cyclone shelters to reduce the number of casualties caused by cyclones, but in 1991, their capacity was still insufficient. They could only accommodate about 10% of the total population of the island (300,000 people).
Non-structural measures include a warning transmission system called the Cyclone Preparedness Programme (CPP) that operates in response to cyclone warning signals issued by the Meteorological Agency. It is a network of volunteers who warn individual households. But, many residents who did not (or could not) evacuate immediately before the arrival of the 1991 cyclone were killed by the disaster.

Cyclone studied: 1991 Cyclone (April 29, 1991)
District studied: Noakhali District, Hatiya Island

○: There are data for Hatiya Island in 1991.
△: Includes data for years other than 1991 and places other than Hatiya Island. Or it shows estimated values.
×: No corresponding data can be found.

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data availabl e?	Source	Year
Physical structure measures	Dikes	Height of the dike	4.5	m	The standard design height of the dike is 4.5m, and it was constructed only for protection from high tides, so it can not be counted on to prevent overtopping by a tidal surge caused by a cyclone or a tsunami.	△	June 2007 document	Un-known	-			-		
						△	BANGLAPEDIA: Embankment	Un-known	-			-		
			3.6～4.5	m	According to the DUS interviews, the height of the dike when the 1991 cyclone struck (East District) ought to have been 12 to 15 feet (3.6m to 4.5m), so it is estimated that the water that overtopped it was from 15 to 18 feet (4.5m to 5.4m).	-			-			△	DUS interviews	1991
		Planned level of the dike (1 year probability)		1 year proba-bility		×			×			×		
		Total dike length		km		×			×			×		
			Existing dike length	-	Existing dike location map（See attached maps）	△	BANGLAPEDIA: Embankment	Un-known	-			-		
				-	Locations of dikes are shown in the MAP OF HATIYA AND LOCATION OF BDRCS SHELTERS（See attached maps：some locations are unclear)	-			△	R11	1997			
				-	Locations of dikes shown in the (See attached maps)	-			-			△	DUS interviews	1994?
		Required dike length		km		×			×			×		
		Budget for existing dikes		$/m		×			×			×		
		Budget to construct a dike needed for cyclone protection		$/m		×			×			×		

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data availabl e?	Source	Year
Physical structure measures	Coastal forests	Length of coastal forests		km	On Nijhum Dwip Island where sedimentation has advanced, management of new land is conducted by the Bangladesh Ministry of Environment and Forestry. After trees were planted to form revetments, it is improved as residential land and settled by people. ※ Reference maps and images attached to the Regional Characteristics Sheet permit the estimation of the area planted with coastal forests.	△	Bangladesh Rept.	Un-known (approx. 2006?)	-			-		
Physical structure measures	Cyclone shelters	Number of existing shelters	28	Shelters	As a result of DUS interviews, it is learnt that the PWD (Public Works Dept.) built 12 shelters. And Japanese Red Cross Society report shows that BDRCS (Bangladesh Red Crescent Society) built 16 shelters.	×			△	R12	1991	○	DUS Interviews	1991
			↓Achievements of the JRCS (Japanese Red Cross Society) and the BDRCS（Bangladesh Red Crescent Society）in the two islands: Hatiya Island and Nijhum Dwip Island.↓↓											
			16	Shelters	On Hatiya Island, at the time of the 1991 cyclone, the BDRCS had 16 shelters. (For Hatiya Island and Nijhum Dwip Island (as of April 1991))	×			△	R4, R9	1991 (Before cyclone struck）	-		
			22	Shelters	From 1985 to 1991, Japan helped the BDRCS build 29 cyclone shelters （Hatiya Island 20, Nijhum Dwip 2, Monpura Island 7) <(Of the above, for Hatiya Island and Nijhum Dwip Island（during 1991）>	×			△	R3	Within 1991	-		
			21	Shelters	From 1985 to 1991, Japan helped the BDRCS build 29 cyclone shelters (Hatiya Island 20, Nijhum Dwip Island 2, Monpura Island 7). One shelter at the northern end of Hatiya Island was made unusable by erosion in 1996. <(Of the above, for Hatiya Island and Nijhum Dwip Island)>	×			△	R3	1996	-		
			↓Achievements by the JRCS AND BDRCS on the three islands: Hatiya Island、Nijihum Dwip Island and Monpra Island↓											
			29	Shelters	By 1993, 29 shelters (max. capacity of 1,600 people/shelter) and 1 multi-purpose center had been constructed on Hatiya Island in Noakhali District and in Monpura Island in Bohla District, ensuring evacuation sites for residents (For Hatiya Island,Nijhum Dwip, Island, and Monpura Island)	×			△	R1	1993	-		
			29	Shelters	By 1994, 6 more shelters had been constructed on Hatiya Island and 7 more on Monpura Island.(By 1991, there had been 16, so 16+6+7=29 shelters) ＜For Hatiya Island、Nijhum Dwip Island, and Monpura Island ＞	×			△	R9	1994	-		
			29	Shelters	※ Number of shelters estimated based on document (R12).	×			△	R12	1995	-		
			28	Shelters	In 1996, the north end of Hatiya Island was eroded, making one shelter unusable.	×			△	R3	1996	-		
			28	Shelters	※ Number of shelters estimated based on document (R11).	×			△	R11	1997	-		
			↓Achievements in cyclone shelter building on three islands: Hatiya Island. Nijhum Dwip Island and Monpura Island↓											

Item				Values etc.	Unit	Remarks	Data acquisition method								
							1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
							Data available ?	Source	Year	Data available ?	Source	Year	Data availabl e?	Source	Year
Physical structure measures	Cyclone shelters (cont'd)	Number of existing shelters (cont'd)		107	Shelters	＜For Hatiya Island and Nijhum Dwip Island＞ Saudi Arabia (GOB) 24, BDRCS 22, World Bank (GOB) 12, CARITAS (NGO) 7, HEED (NGO) 2, JICA (GOB) 2, DUS (NGO) 1 ＜For Monpura Island＞ CARITAS (NGO) 11, BDRCS 7, World Bank (GOB) 6, Swedish Free Mission (NGO) 2, Swiss Disaster R	×			△	R12	1995	-		
				137	Shelters	＜For Hatiya Island and Nijhum Dwip Island＞ BDRCS 21, HEED BANGLADESH 3, OXFAM 1, PROSHIKA 4, JICA 4, CARITAS 9, SAUDI GRANT 42, WORLD BANK 18 ＜For Monpura Island＞ BDRCS 7, WORLD BANK 6, CARITAS 10, SWEDISH 2, SWEDISH FREE MISSION 2, FACILITIES DEPT. 6	×			△	R11	1997	-		
		Locations of existing shelters		See distribu-tion map	—	They are shown on MAP OF HATIYA AND LOCATION OF BDRCS SHELTERS (See attached maps) ＜For Hatiya Island, Nijhum Dwip Island, and Monpura Island＞	×			△	R11	1997	-		
					—	Entered directly on a map during the interview with Mr. Tibriz of the local NGO (DUS) (See attached maps)	×			-			○	DUS Interviews	1991
		Outline of existing shelters	Name	Table	—	For 28 shelters shown in the LIST OF CYCLONE SHELTERS IN HATIYA & MONPURA THANA. (see attached tables) ＜For Hatiya Island, Nijhum Dwip Island, and Monpura Island＞	×			△	R11	1997	×		
			With a school?												
			Lot area												
		Outline of existing shelters	Shelter building area	Table	—	For 28 shelters shown in the LIST OF CYCLONE SHELTERS IN HATIYA & MONPURA THANA. (see attached table) ＜For Hatiya Island, Nijhum Dwip Island, and Monpura Island,＞	×			△	R11	1997	×		
			Boun-dary setting												
			Fence?												
			Aqua-culture?												
			Nursery school?												
			Land use on the site												
		Capacity of existing shelter		12,800	Person	On Hatiya Island, there were 16 BDRCS cyclone shelters at the time of the 1991 cyclone, and their official capacity was 12,800. ＜For Hatiya Island and Nijhum Dwip Island (2 islands)＞	×			△	R4, R12	1991	×		
				24,800	Person	Value of the capacity of the BDRCS cyclone shelters plus the PWD capacity (estimated).	×			△	R12	1991	△	DUS Interviews	1991
		Toilets inside shelters? (sanitation)		See remarks	—	Toilets were constructed on the ground outside the shelters, but when a cyclone or tidal surge struck, they were useless if people could not go outside the shelters, and their sanitation condition is a serious problem.	×			△	R3	1998	×		
		Normal use of shelters		See remarks	—	Of the BDRCS shelters at 28 locations in Hatiya Island and Monpura Island, at 8 locations, were used as primary schools operated by the BDRCS and at 3 locations, were used as schools operated by the government. At the remaining 17 locations, they can be used as schools and other public buildings, but they were not used at normal times.	×			△	R3	1998	×		

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data availabl e?	Source	Year
Physical structure measures	Cyclone shelters (cont'd)	Normal use of shelters (cont'd)	See remarks	—	At normal times, primary health care, primary education, job training, loan organizations and other community development activities (CDP) were conducted with their bases in cyclone shelters.	×			△	R3	1985～1991	×		
		Maintenance of shelters	See remarks	—	Child literacy classes are conducted in 7 shelters. Others are not yet linked with any regular community service institution or programme.	×			△	R12	1995	×		
			See remarks	—	Members pay 2 taka (about 4.2 yen) per household, and management committees manage the organization and use the funds for its operation and its activities, but this fee alone is not enough to maintain and take care of the shelters.	×			△	R3	1998	×		
		Number of shelters needed	291	No.	The capacity per shelter is calculated to be 1,000 people, to estimate the number of shelters needed.	×			×			△	DUS Interviews	1991
		Locations of shelters needed		—	Distribution map	×			×			×		
		Sufficiency rate	9.6	%	Existing shelters/needed shelters	×			×			△	DUS Interviews	1991
		Number of evacuees needed		Person		×			×			×		
	Killa	Number of Killa	16	No.	Buildings constructed by the BDRCS and the Japanese Red Cross Society 〈For Hatiya Island and Nijhum Dwip Island〉	×			△	R11	1997	×		
			6	No.l	Buildings constructed by the BDRCS and the Japan Red Cross Society 〈For Monpura Island〉	×			△	R11	1997	×		
				—	Distribution map	×			×			×		
		Livestock capacity		Head		×			×			×		
		Sufficiency rate		%		×			×			×		
		Number of livestock needing accomoda-tion		Head		×			×			×		
Non-physical structure methods	Warning system	System outline		—	CPP with its 32,796 volunteers supported by 198 permanent staff is now operating in 2,733 Units spread over 258 Unions of 30 Thanas. Each Unit consists of a team of 12 trained volunteers including 2 female volunteers.	×			△	R13	1997	×		
		Area of land covered by warning systems	See remarks	km^2	Since the start of CPP in 1972 until 1991, sirens, microphones, flags, etc. were provided. When the 1991 cyclone struck, from 80% to 90% of the people knew that the cyclone was coming and that they had to evacuate.	×			×			△	DUS Interviews	1991
		Population of land covered by warning systems	See remarks	Person		×			×			△	DUS Interviews	1991
		Challenges facing warning systems	See remarks	—	Because many of the cyclone warnings were false alarms, people's trust in the warning system fell. Some people did not evacuate because if they had evacuated, their livestock and household property would have been stolen during their absence.	×			△	R4	Before 1991	-		

Item			Values etc.	Unit	Remarks	Data acquisition method								
						1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data availabl e?	Source	Year
Non-physical structure methods	Warning system (cont'd)	Challenges facing warning systems (cont'd)	See remarks	—	According to residents interviews, "When some people heard the evacuation warning, the rain and wind were already so strong that they could not go outside so they hesitated." This means that evacuation warnings should be made earlier.	-			-			△	Resident interviews	1991
	Evacuation system	Information transmission methods	See remarks	—	As a non-physical structure measure, the warning transmission system, the CPP (Cyclone Preparedness Programme) is a network of volunteers who give warnings to individual households in response to a cyclone warning signal issued by the Meteorological Agency.	×			△	R4	?	○	DUS Interviews	1991
			See remarks	—	Cyclone warning and evacuation orders are transmitted as follows: Meteorological Agency → (DMB: Disaster Manage- ment Bureau) →District level→ County level→ Ward→ Para (2 or 3 households)→ Household and individuals. Warnings are also transmitted by TV or by radio.	-			-			○	DUS Interviews	1991
		Existance of leaders	See remarks	—	Residents living around each cyclone shelter (approx. 300 households) are the regular members. They select people to form a management committee consisting of 11 people (at least two of them women).	×			△	R1	1986～2000？	×		
		State of community	See remarks	—	Discussion meetings, essay contests, and art contests were held with community level disaster protection measures as their theme. Community participants were fewer than expected, but educated people and community leaders approved of these events, stating for example, that, "These events are effective ways to communicate with the people concerned."	×			△	R3	1998	×		
			See remarks	—	From 1995 to 1998, the CBDP: Community Based Disaster Preparedness Program was implemented, then later, its activities were taken over at the community level by the SMC (Shelter Management Committee).	×			△	R9	1995～1998	×		
			See remarks	—	In each union, a 9 person evaluation committee + 1 representative is established to deal with disaster protection.	×			×			○	DUS Interviews	1991
		Shelter Management Committee	See remarks	—	Ordinary members are people living in the district around each cyclone shelter (approx. 300 households). They elect 11 of their members to form a manage- ment committee (at least two of these are women). Members pay 2 taka (about 4.2 yen) per household each month, and a management committee manages the organization, using the funds for its operation and its activities. The management committee cooperates with key members and with volunteers (20 per shelter) of the cyclone countermeasures committee that is implemented by the BDRCS in cooperation with the government. During emergencies, they transmit disaster and evacuation warnings, guide evacuees, carry out rescue activities, and distribute rescue goods.	×			△	R1	1986～2000？	×		

Item				Values etc.	Unit	Remarks	Data acquisition method								
							1. Document survey (public data)			2.Documents obtained from concerned organizations in Japan			3. Field survey in Bangladesh		
							Data available ?	Source	Year	Data available ?	Source	Year	Data availabl e?	Source	Year
Non-physical structure measures	Evacuation system (cont'd)	Shelter Management Committee		See remarks	—	The organization of Management Committees for 28 shelters based on a proposed project evaluation of 1995 is cited as a major success of this project (BDRCS-Japanese Red Cross Society Joint Disaster Protection Measures Project). Each Shelter Management Committee consists of 11 members, 9 of whom are elected by the 300 families living around each shelter (beneficiary families) who pay 2 taka (about 6 yen) as membership fee to the Management Committee each month. The remaining 2 members are women members selected by the Management Committee.	×			△	R3	1998	×		
		Shelter Management Committee		See remarks	—	Support for shelters and dikes is provided by foreign donors, but no support is given to build up the capacities of the residents, so if the donor that built the shelters stops its support, they do not function.	-			-			○	DUS Interviews	1991
		Disaster protection volunteers	Total	1,728	Person	※ Region covered by the disaster prevention volunteers is thought to be Hatiya Island, but this is unclear.	△	Bangladesh Rept.	2005	×			×		
			Male	1,440	Person	※ Region covered by the disaster prevention volunteers is thought to be Hatiya Island, but this is unclear.	△	Bangladesh Rept.	2005	×			×		
			Female	288	Person	※ Region covered by the disaster prevention volunteers is thought to be Hatiya Island, but this is unclear.	△	Bangladesh Rept.	2005	×			×		
		Area of land covered by evacuation transmission systems		See remarks	—	“Since the start of CPP in 1972 until 1991, sirens, microphones, flags, etc. were provided. When the 1991 cyclone struck, from 80% to 90% of the people knew that the cyclone was coming and that they had to evacuate.”	×			×			△	DUS Interviews	1991
		Population of land covered by evacuation transmission systems			—										
		Area where evacuation information is broadcast by radio or TV		See remarks	—	The use of radios has spread since the 1970 cyclone, reaching a radio penetration rate of 60% in the nineteen-nineties.	×			×			△	DUS Interviews	1991
		Problems with the evacuation system		See remarks	—	Residents did not evacuate even though they heard the warning. Residents did not leave their homes even thought they heard the warnings many times and the wind and rain had strengthened many hours earlier. After the water level rose, they climbed on the roofs of their straw and grass houses. And when large waves were finally arriving or when they had arrived, they began to evacuate. This is the actual normal action pattern of the residents.	×			△	R4	Before 1991	-		
	Disaster protection education	Disaster protection training		See remarks	Times/ year	It was reported by communities that were visited that evacuation training has been carried out with active community participation.	×			△	R3	1998	-		
		School education			—		×			×			-		
		OJB			—		×			×			-		

4. Disaster Profile Sheet (Disaster Damage)

【Outline of state of casualties in the study region】

Based on the DUS interview survey, it was estimated that, “Approximately 6,000 people died on Hatiya Island alone.” The casualties were concentrated in the East District and the South District. In the East District, tidal surges overtopped and breached the dikes flowing into the land side, killing 4,000 to 5,000 people. On the ocean side of the dike in the South District, 1,000 to 1,500 people died, mainly residents who did not evacuate because they feared the scattering of their household property. The usage rate of the cyclone shelters built by the BDRCS is reported to be 52.7%, but many evacuees were forced to evacuate because powerful wind and rain and high waves that were produced by the cyclone destroyed their homes.

Cyclone studied: 1991 Cyclone (April 29, 1991)
District studied: Noakhali District, Hatiya Island

○: There are data for Hatiya Island in 1991.
△: Includes data for years other than 1991 and places other than Hatiya Island. Or it shows estimated values.
×: No corresponding data can be found.

Item			Values etc.	Unit	Remarks	Data Acquisition Methods								
						1. Document survey (public data)			2. Interview Survey in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Injuries/fatalities	Direct casualties	Fatalities	1,714	Person	People who died while evacuating within a range of 1km around one of 16 shelters on Hatiya Island (constructed by BDRCS or Japanese Red Cross Society) or when high waves engulfed them along with the roofs of their houses (see attached documents) ＜For Hatiya Island and Nijhum Dwip. Island＞	×			△	R4 R12	1991	-		
			3,000	Person	Nearly 3,000 died on Hatiya Island alone. ＜For Hatiya Island＞	×			△	R9	1991	-		
			6,000	Person	According to a DUS Interview, “It has been publicly announced that about 3,000 people died, but it seems that 6,000 people died throughout Hatiya Island.”	×			-			○	DUS Interviews	1991
			See remarks	-	Number of fatalaties distribution map (see attached maps)	×			-			○	DUS Interviews	1991
		Injuries		Person		×			×			×		
		Effected people		Person		×			×			×		
		Fatalaties	5.0 - 6.0	%	Mortality rate in the unions in the southeast coast was 5-6%. ＜For Southeast coast district of Hatiya Island＞ ※Reverse calculation from submitted documents indicates that approximately 14,500 to 17,500 people lived in the study region on the Southeast coast (within 1km of 4 shelters) when the cyclone struck.	×			△	R12	1991	-		
			2.1	%	This was obtained by dividing the number of fatalities (6,000) by the population of Hatiya Island (291,003).	×			-			○	DUS Interviews	1991
			40	%	On the land side of dikes in the East District where casualties were concentrated, a region home to 10,000 people, 4,000 people died.	×			-			△	DUS Interviews	1991
			8 - 10	%	Over a wide area of the East District, 4,000 to 5,000 people died. The population at the time of the disaster was about 50,000.	×			-			△	DUS Interviews	1991
			8 - 10	%	Nobody was permitted to live on the ocean side of the dike in the South District, but in fact, it was home to between 7,000 and 8,000 people. Of these, between 1,000 and 1,500 people were killed by the tidal surge.	×			-			△	DUS Interviews	1991

Item				Values etc.	Unit	Remarks	Data Acquisition Methods								
							1. Document survey (public data)			2. Interview Survey in Japan			3. Field survey in Bangladesh		
							Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Injuries/fatalities	Direct casualties (cont'd)	Fatalaties (cont'd)		1.5 - 2.0	%	In the North District, there are no dikes because of erosion. From 150 to 200 people died when they were engulfed by the tidal surge. The population at that time was about 10,000.	×			-			△	DUS Interviews	1991
		Injury rate			%		×			×			×		
		Causes of death	Drown-ing		%		×			×			×		
			Others	See remarks	-	Poor people who did not move from their homes even after the cyclone struck were engulfed in the high waves and drowned. The percentage of fatalities was particularly high among women, children, and elderly people who lacked the strength to swim and hold onto a tree or drifting objects.	×			△	R4	1991	×		
				See remarks	-	On the ocean side of dikes in the South District, some people died because they remained in their homes, worried their property would be scattered by the cyclone.	×			-			○	Residents interviews	1991
				See remarks	-	On the land side of dikes in the East District, fatalities were concentrated because the tidal surge struck the residential area on the land side. People who, misled by their experience of the 1970 cyclone when severe casualties did not occur, did not evacuate, were washed away with their homes.	×			-			○	Residents interviews	1991
				See remarks	-	In the North District where the dikes and revetments were destroyed by erosion, people died by being engulfed by the tidal surge.	×			-			○	DUS interviews	1991
				See remarks	-	And others died when directly struck by flying galvanized metal sheet or other objects blown by gusts of wind. And because their houses were toppled, people were buried under them where they weakened and died.	×			-			○	DUS interviews	1991
	Indirect casualties	Fatalities			Person		×			×			×		
		Injuries			Person		×			×			×		
		Death rate			%		×			×			×		
		Injury rate			%		×			×			×		
		Causes of deaths	Drown-ing		%		×			×			×		
			Others		%		×			×			×		
Material damage	Breached dike				km		×			×			×		
	Damaged dike				km		×			×			×		
	Totally destroyed homes				No.		×			×			×		
	Partially destroyed homes				No		×			×			×		
	Total number of homes				No		×			×			×		
	Totally destroyed home rate				%		×			×			×		
	Partially destroyed home rate				%		×			×			×		
	Number of Live-stock died (cattle)				Head		×			×			×		
	Total number of livestock (cattle)				Head		×			×			×		

Item			Values etc.	Unit	Remarks	Data Acquisition Methods								
						1. Document survey (public data)			2. Interview Survey in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
Injuries/fatalities	Livestock death rate (cattle)			%		×			×			×		
	Area of crop damage			ha		×			×			×		
	Total area of crops			ha		×			×			×		
	Crop damage rate			%		×			×			×		
	Shrimp culture area damage			ha		×			×			×		
	Total shrimp culture area			ha		×			×			×		
	Total shrimp culture area damage rate			%		×			×			×		
State of evacuation	Evacuees		Table	Person	Twenty-two shelters are indicated under the “Number of evacuees/deaths in cyclone shelter command area (1km radius)”. (See attached table) ＜For Hatiya Island and Nijhum Dwip. Island＞	×			△	R12	1991, 1992,1994	×		
	Evacuation rate		See remarks	%	The usage rate of shelters during cyclones is gradually rising. This may be a result of a campaign to raise consciousness of cyclones at normal times.	×			△	R3	1998	×		
			52.7	%	The percentages who evacuated before, during, and after the cyclone are not clear. And it is not clear if they evacuated to the veranda or to the roof of the cyclone shelters. It is difficult to clarify the actual number of evacuees to the shelter.	×			△	R12	1991	×		
	Evacuation site	Cyclone shelter	6,750	Person	Cyclone shelter usage rate: 52.7% (Official capacity is 12,800 evacuees)	×			△	R4	1991	×		
			6,750	Person	Number of evacuees within 1km of existing shelters (22 shelters) on Hatiya Island. Number of evacuees in each shelter are recorded (April 29, 1991)	×			△	R12	1991	×		
		Other	See remarks	-	On the ocean side of dikes in the South District, some people evacuated to sturdy houses on the land side.	×			×			○	Residents interviews	1991
			See remarks	-	In the East District, some people were saved by evacuating to a nearby concrete building.	×			×			○	Residents interviews	1991
			See remarks	-	No only to shelters, but also to schools, mosques, concrete houses, and houses surrounding by windbreak forests.、	×			×			○	DUS interviews	1991
	Camp after evacuation		See remarks	-	Many people were forced to live in camps for six months.	○	Bangladesh Rept.	1991	-			-		
			See remarks	-	People whose livestock and homes were washed away were able to restore their former livelihoods. Because they were assisted by donor organizations and the government for a few years after the disaster, they recovered their lives in 2 or 3 years.	-			-			○	DUS interviews	1991
	Warning or evacuation information reception method	Recipients		Person		×			×			×		
		Reception rate	80 - 90	%	Since the start of CPP in 1972 until 1991, sirens, microphones, flags, etc. were provided. When the 1991 cyclone struck, from 80% to 90% of the people knew that the cyclone was coming and that they had to evacuate.	×			×			○	DUS interviews	1991
	Evacuation action rate			%		×			×			×		

Item			Values etc.	Unit	Remarks	Data Acquisition Methods								
						1. Document survey (public data)			2. Interview Survey in Japan			3. Field survey in Bangladesh		
						Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
State of evacuation	Evacuation information reception method	Warning system		Person		×			×			×		
		Television		Person		×			×			×		
		Radio		Person		×			×			×		
	Method of receiving evacuation information	Word of mouth		Person		×			×			×		
	Reasons for not evacuating		See remarks	-	Among the people, some remained in their homes with their property instead of evacuating. When the storm surge finally arrived, it was too late for them to evacuate to the shelter and the condition of the roads also obstructed evacuation.	×			△	R12	1991	-		
			See remarks	-	Assets that were livestock and household property were treated as being of equal importance to their own lives. If they evacuated, they would suffer from loss caused by both the evacuation and the disaster. Therefore, even if the wind strengthened and the waves rose, they chose to remain at home.	×			△	R12	1991	-		
			See remarks	-	Their attitude was to leave themselves to their fate: “If it is the will of Allah, I will be saved.”	×			△	R12	1991	-		
			See remarks	-	Past warnings had included many false alarms, so even if they were warned, they decided that it was not a dangerous cyclone.	×			△	R12	1991	-		
			See remarks	-	Women did not evacuate, because of gender problems they would encounter in the shelters.	×			△	R12	1991	-		
			See remarks	-	The 1970 cyclone did not overtop or breach the dikes so they assumed they would be safe even if they did not evacuate this time.	×			-			○	Residents interviews	1991
	Reason for not evacuating		See remarks	-	The cyclone shelter was far and they thought it would be full, so they did not evacuate.	×			-			○	Residents interviews	1991
			See remarks	-	Part of a family who remained to watch to make sure their household property was not scattered, did not evacuate. (They were not particularly worried about theft and did not treat their own lives lightly.)	×			-			○	Residents interviews	1991
			See remarks	-	They did not evacuate because there was no nearby cyclone shelter.	×			-			○	Residents interviews	1991
			See remarks	-	When they tried to evacuate, the roads were muddy so it was difficult to walk on them.	×			-			○	Residents interviews	1991
			See remarks	-	When the warnings were heard, the wind and rain were already extremely strong so it was difficult to start to evacuate.	×			-			○	Residents interviews	1991

Item		Values etc.	Unit	Remarks	Data Acquisition Methods								
					1. Document survey (public data)			2. Interview Survey in Japan			3. Field survey in Bangladesh		
					Data available ?	Source	Year	Data available ?	Source	Year	Data available ?	Source	Year
State of evacuation	Reason for not evacuating (cont' d)	See remarks	-	They did not begin to evacuate immediately after hearing the evacuation advisory by the CPP volunteers. Those who evacuated were forced to do so, because their homes were destroyed. Or they evacuated during the cyclone.	×			△	R12	1991	-		
				Residents did not evacuate even though they heard the warning. Residents did not leave their homes even though they heard the warnings many times and the wind and and rain had strengthened many hours earlier. After the water level rose, they climbed on the roofs of their straw and grass houses. And when large waves were finally arriving or when they had arrived, they began to evacuate. This is the actual normal action pattern of the residents.	×			△	R4	?	-		

9. Verifying the hypotheses

9.1 Results of verifying the hypotheses

In order to objectively verify the hypotheses, they should be backed up by numerical indices. It is assumed that these data can be obtained by a field survey, but as a result of the field survey, mainly statistical data and maps were obtained. And the survey was limited to interviews with local NGO representatives and with residents concerning the disaster. But the field survey clarified facts that had not been hypothesized. The following table shows the results of the verification of the hypotheses.

Table 6. Results of Verification of the Hypotheses (Summary)

	No.	Hypotheses	Verification Result	Remarks
Why were people sacrificed?	1	Drowned when engulfed by the tidal surge.	○	Verified by field survey.
	2	Killed when struck by flying objects.	○	Verified by field survey.
Why did they not evacuate?	3	Because many cyclone warnings had been false alarms.	○	Verified by field survey.
	4	Because they feared that if they evacuated, their livestock and property might be stolen, so they remained to protect them.	●	Field survey discovered a new fact (not fear of theft, but fear their assets will be scattered.)
	5	Did not evacuate because there were no cyclone shelters near their homes.	○	Quantitatively verified using numerical values.
	6	The cyclone is the will of Allah	—	Unverifiable.
	7	Women cannot evacuate because of social and religious restrictions.	—	Unverifiable.
	8	If they evacuate, their family members might be separated.	—	Unverifiable.
Why could they not evacuate?	9	Could not walk easily because the roads were muddy.	○	Verified by the field survey.
	10	Because they would be asked to pay a fee to use the shelter.	—	Unverifiable.
Were many specific types of people sacrificed?	11	Most fatalities were concentrated among poor people on the ocean side of the dike on the south side (high risk zone).	○	Quantitatively verified using numerical values.
	12	90% of victims were women and children.	△	Documents obtained from the Japanese Red Cross Society
	13	From 30% to 40% of residents of a dike protected island died.	—	Unverifiable.

○: Facts ≒ hypothesis
●: Facts and hypothesis differed. New facts were discovered.
△: Can be confirmed only by using documents
—: Hypotheses for which data and testimony necessary for confirmation could not be obtained by this survey.

9.2 Verifying the hypotheses

a. Hypothesis 1. Drowned when engulfed by the tidal surge, Hypothesis 2. Killed when struck by flying objects.

During the interview survey on Tuesday, February 6 (Hatiya Island office of the DUS), an interviewee stated, “The high waves triggered by the rainfall and the tidal surge breached the dikes over a wide area, submerging the land for depths of at least 1m. And in addition to the rain, a strong wind blew galvanized metal sheets and tree branches about.”

b. Hypothesis 3. Because many cyclone warnings had been false alarms

Many residents did not evacuate, even when they noticed the cyclone warnings. They did not because as a result of their experiences with cyclones since 1970, they believed that it would cause almost no casualties this time, and the underestimated the worth of the warnings.

c. Hypothesis 4. Because they feared that if they evacuated, their livestock and property might be stolen so they remained to protect them.

Many residents did not evacuate~~,~~ because they wanted to protect their livestock and property. But, not because they feared theft; many of the residents remained in order to prevent their property from being scattered.

d. Hypothesis 5. Did not evacuate because there were no cyclone shelters near their homes.

This hypothesis was verified using numerical indices. The figures below show an image of the way it was verified.

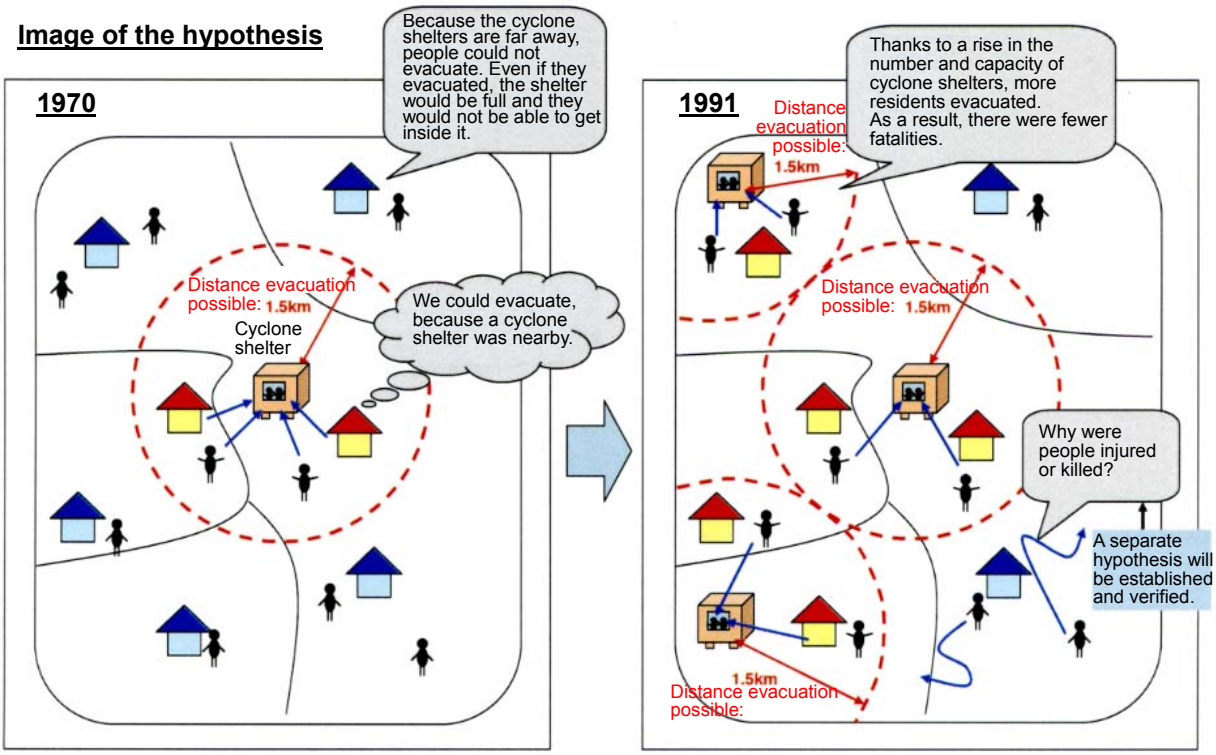


Figure 10. Image of the Verification of Hypothesis 5.

To verify the hypothesis, three questions were answered: ① Were there enough shelters for the district? ② Was the residents evacuation rate near the shelter high? ③ Did the death rate vary according to whether or not there was a nearby shelter?

① Were there enough shelters for the district?

☆ Shelters needed in the district ≒ Population of Hatiya Island/accommodation per single shelter
≒291,003（in 1991）/1,000（estimate）
≒291 shelters
☆ Number of shelters at that time = 28 shelters
⇨ Shortage of shelters

By the time of the 1991 cyclone, 28 cyclone structures had been constructed, but the number of shelters necessary had not been clarified. The number of shelters needed was estimated to be 291: a value obtained by dividing the population of Hatiya Island at that time that was 291,003 by the capacity of a single shelter (estimated to be 1,000 people). As a result only 9.6% of the number of cyclone shelters needed were available. And the capacity of the existing shelters is 24,800 (estimated value based on the field survey), but the sufficiency rate in terms of number of people is 8.5%, and in either case, before the 1991 cyclone, cyclone shelters could only accommodate less than 10% of the island's population.

② Was the resident evacuation rate high near shelters?

☆ Evacuation rate = number of evacuees/population within a radius of 1km around a shelter
= 6,750/12,800
= 58.7%

⇨ The evacuation rate was high, but many evacuees evacuated after the disaster.
※This is not the prior evacuation rate.

The results of a Red Crescent survey of the 1991 cyclone disaster reveals that 16 cyclone shelters had been constructed by the Red Crescent Society, and clarifies the number of people who can be accommodated and the number of evacuees within a radius of 1km of a shelter. As a result of the survey, within a radius of 1km from shelters, the number of people who could be accommodated was 12,800 and the number of evacuees was 6,750, therefore the evacuation rate was 52.7%, but according to a survey by Mr. Ohashi (representative of the special NGO Shapla Neer) many people evacuated after the cyclone had passed, and because there was nowhere they could go after the disaster, they were forced to evacuate. For this reason, regarding the state of evacuations to shelters, it is assumed that the prior evacuation rate is extremely low, but actual numbers are not clear.

③ Did the death rate vary according to whether or not there was a nearby shelter?

☆ Death rate in a district near the shelter

= Population within a radius of 1km from the shelter/number of fatalities within a radius of 1km from a shelter

≒1,714 / 15,000

≒11%

☆ Death rate throughout Hatiya Island = 2%

⇨ Death rate is high around a shelter

According to the results of a survey by the Red Crescent Society concerning the 1991 cyclone disaster, 16 cyclone shelters had been constructed by the Red Crescent Society, and fatalities (1,714) occurred within a 1km radius of the shelters are clarified. The population within a radius of 1km from shelters is unknown, but considering that the population density at the time of the disaster was 300 people/km^2, it is estimated to be approximately 15,000 people. For this reason, the death rate within a radius of 1km of cyclone shelters is roughly calculated as approximately 11%. And comparing this with the death rate of 2.06% (6,000 /291,0003) throughout Hatiya Island, reveals it is an extremely high percentage, and that the death rate within a 1m circle around shelters is high. Possible reasons for this are that people who lived close to a cyclone shelter did not or could not evacuate to the shelter and died as a result, or they did but while they were evacuating, they were struck and killed by galvanized metal sheets or other objects blown by the wind, but it was impossible to obtain objective data concerning the reasons for their deaths.

e. Hypothesis 9. Could not walk easily because the roads were muddy.

During the field survey, people interviewed testified that the wind was already strong and the waves high when they heard the warnings, and even the embanked major road surfaces were submerged. It is assumed that this made walking difficult, so some residents could not evacuate.

f. Hypothesis 11. Most fatalities were concentrated among poor people on the ocean side of the dike on the south side.

This hypothesis was verified using numerical indices. The following diagram is an image of how this verification was done.

Image of the hypothesis

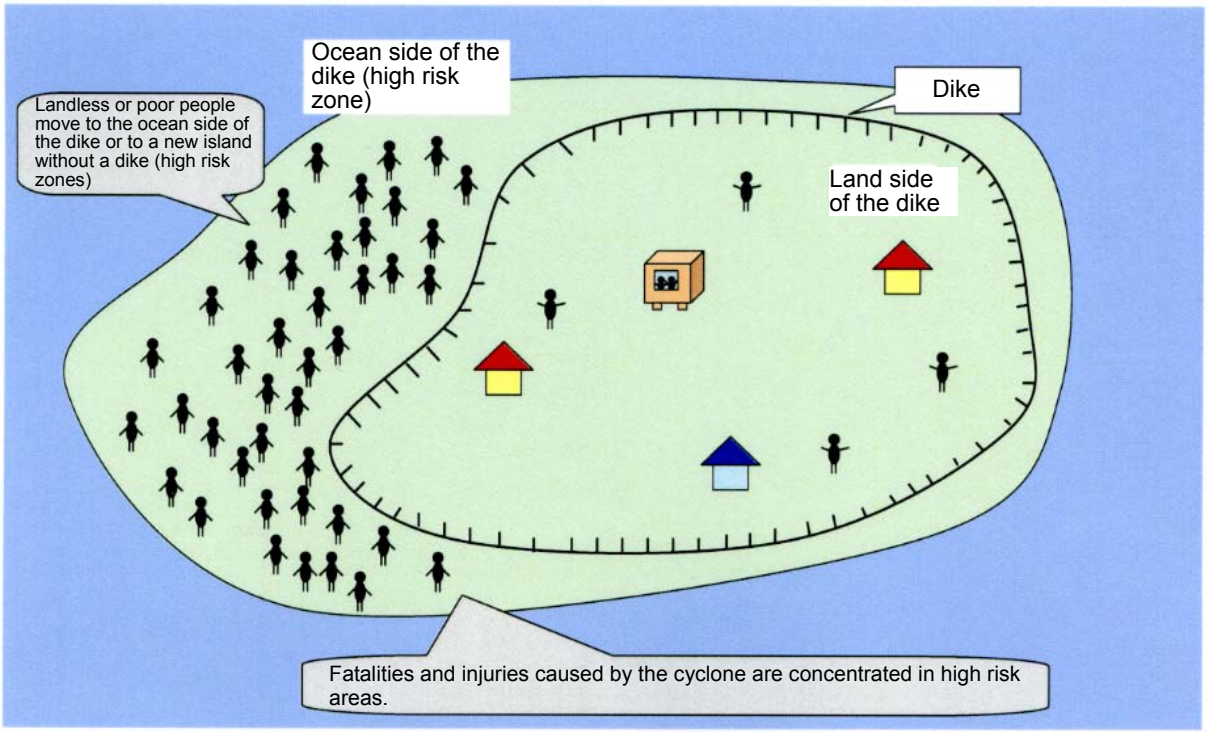


Figure 11. Image of Hypothesis 11.

The hypothesis was verified by answering two questions: ① Is the poverty rate high in high risk zones? ② Is the death rate high in high risk zones?

① Is the poverty rate high in high risk zones?

☆ It is assumed that the poverty rate in high risk zones ≒ 80% to 90%.

It was impossible to obtain any detailed information other than the fact that the poverty rate on Hatiya Island is higher than 50% through the survey in Japan and the field survey in Bangladesh. But, according to testimony by representatives of local NGO and by local residents that, “Poor people who have lost their land because of erosion on the north coast migrate to high risk zones.” the poverty rate in high risk zones (ocean side of dikes) is at least 80% to 90%, and the field survey conformed this belief.

② Is the death rate high in high risk zones?

☆ It is estimated that the death rate in high risk zones ≒ 12%.

Estimations made based on statistical information obtained by the field survey and of the interview survey of local NGO show that the number of death in high risk zones and the population of high risk zones were 2,642 and 21,325 respectively, and that the death rate in high risk zones (ocean

sides of dikes) was estimated at approximately 12.4%. When this value was compared with the death rate of 2.06% (=6,000/291,003) for all of Hatiya Island, it reminded us that this is a large percentage, and the number of fatalities and injuries caused by the cyclone are concentrated in high risk zones. But in the East District, the tidal surge breached the dike and flowed into the land side, resulting in a death rate of 40% (estimated), showing that the fatalities were not concentrated solely among poor people on the ocean side.

g. Hypothesis 12. 90% of victims were women and children

According to the document, Disaster and People's Participation: Issues of Cyclone Shelter Construction in Bangladesh, poor people who could not evacuate their homes even after the cyclone struck were engulfed in the high waves and drowned. And many who died were women, children, and elderly people who lacked the strength to hold on to a standing tree or to a floating object,

The hypotheses and results of the surveys in each district (East, South, North, and other districts) based on the field survey are shown in Figures 12 and 13 on the following pages.

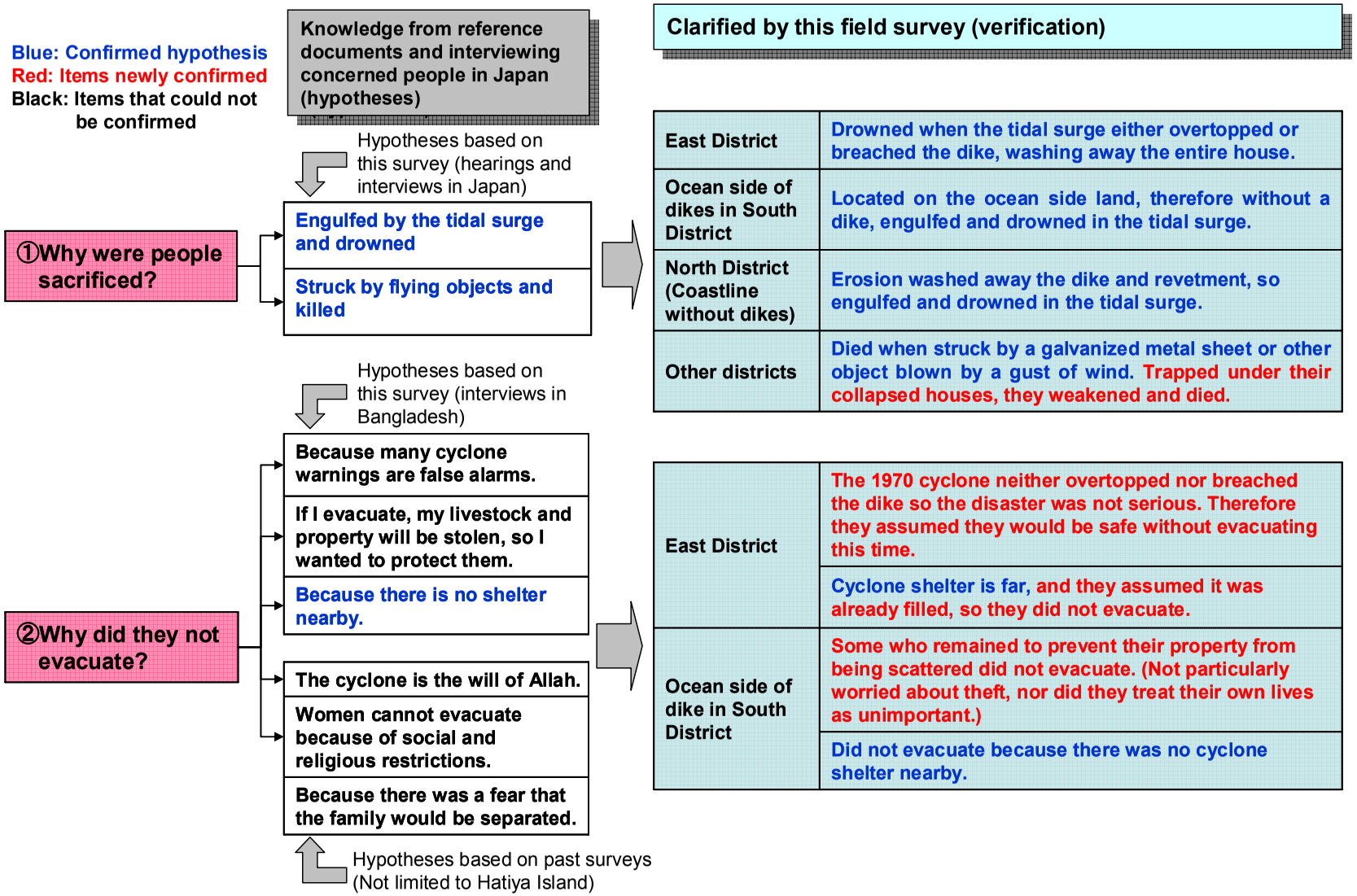


Figure 12. Hypotheses and Survey Results in Each District Based on the Field Survey (1/2)

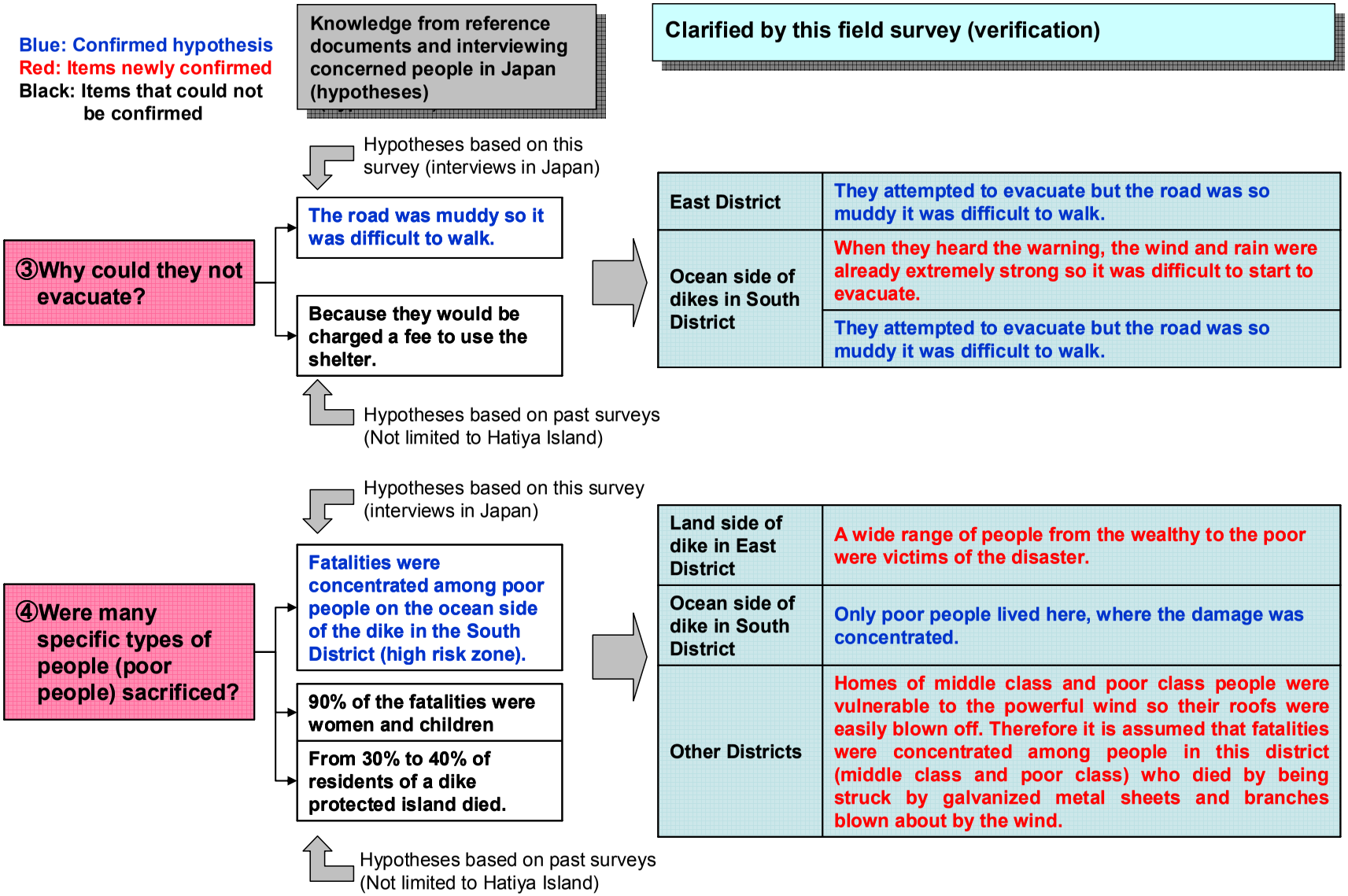


Figure 13. Hypotheses and Survey Results in Each District Based on the Field Survey (2/2)

9.3 Disaster mitigation measures (a proposal)

The actual state of the disaster caused by the 1991 cyclone was clarified to a certain degree by the field survey as shown in "9.2 Verifying the hypotheses". Table 7 presents the state of the disaster shown in Figure 12 and Figure 13.

Table 7. State of the Disaster Caused by the 1991 Cyclone

	State of the Disaster Caused by the 1991 Cyclone	
Why were people sacrificed?	East District	Tidal surge overtopping or breaching dikes, washing away entire homes and killing their inhabitants.
	Ocean side of dike: South District	Outside the dike where there are no dikes, they were engulfed and drowned by the tidal surge.
	North (Coast without dikes)	Erosion washed away dikes and revetments, so they were engulfed and drowned by the tidal surge.
	Other Districts	Gusts of wind blew galvanized metal sheets and other objects, directly striking and killing people. Houses collapsed, trapping people under the debris, where they weakened and died.
Why did they not escape?	East District	The 1970 cyclone neither overtopped nor breached dikes, so they assumed they were safe without evacuating.
		Cyclone shelters were far, and people thought they would be full, so they did not evacuate.
	Ocean side of dike: South District	Some people remained to make sure their property was not scattered, so they did not evacuate.
		Because there were no nearby cyclone shelters, they did not evacuate.
Why could they not escape?	East District	Thinking they were safe, after they heard the warning, the wind and rain were already terrible so it was difficult to escape.
		They tried to evacuate, but the roads were muddy so they could not walk.
	Ocean side of dike: South District	When they heard the warning, the wind and rain were extremely strong, so it was difficult to start to evacuate.
		They tried to evacuate, but the road was muddy so they could not walk.
Were many specific types of people sacrificed?	Ocean side of dike: East District	A wide range of people from the wealthy class to poor class suffered from the disaster.
	Ocean side of dike: South District	Only poor people lived here so the disaster was severe in this district.
	Other Districts	Homes of middle class and poor class people were vulnerable to the powerful wind so their roofs were easily blown off. Therefore it is assumed that fatalities and injuries were concentrated among people in this district (middle class and poor class) who died by being struck by galvanized metal sheets and branches blown about by the wind.

Proposed measures to mitigate the disaster are broadly categorized as ①Strengthening evacuation warning systems, ②expanding disaster protection education, ③ supporting strengthening of structures of homes, ④ Encouraging building of evacuation facilities, ⑤ Ensuring and improving evacuation routes, and ⑥ constructing and reinforcing dikes and revetments. Table 8 summarizes disaster mitigation measures proposed according to the state of disaster in each district of Hatiya Island.

Table 8. Disaster Mitigation Measures (Proposal)

① Strengthening evacuation warning systems
② Expanding disaster protection education
③ Supporting strengthening of structures of homes
④ Encouraging building of evacuation facilities
⑤ Ensuring and strengthening evacuation routes
⑥ Constructing and reinforcing dikes and revetments.

	State of Damge by 1991 Cyclone		Measures to mitigate damage					
			①Strengthening evacuation warning systems	②Expanding disaster protection education	③Supporting strengthening of structures of homes	④Encouraging building of evacuation facilities	⑤Ensuring and strengthening evacuation routes	⑥Constructing and reinforcing dikes and revetments
Why were people sacrificed?	East Districts	Tidal surge overtopping or breaching dikes, washing away entire homes killing their inhabitants.			○			○
	Ocean side of dike: South District	Outside the dike where there are no dikes, they were engulfed and drowned by the tidal surge.						○
	North (Coast without dikes)	Erosion washed away dikes and revetments, so they were engulfed and drowned by the tidal surge.						○
	Other districts	Gusts of wind blew galvanized metal sheets and other objects, directly striking and killing people. Houses collapsed, trapping people under the debris, where they weakened and died.		○	○			
Why did they not evacuate?	East District	The 1970 cyclone neither overtopped nor breached dikes, so they assumed they were safe without evacuating.	○	○				
		Cyclone shelters were far, and they thought they would be full, so they did not evacuate.				○		
	Ocean side of dike: South District	Some people remained to make sure their property was not scattered, so they did not evacuate.		○	○			
		Because there were no nearby cyclone shelters, they did not evacuate.				○		
Why could they not evacuate?	East District	They thought they were safe, and after they heard the warning, the wind and rain were already terrible so it was difficult to evacuate.	○	○				
		The tried to evacuate, but the roads were muddy so they could not walk.					○	
	Ocean side of dike: South District	When they heard the warning, the wind and rain were extremely strong, so it was difficult to start to evacuate.	○					
		They tried to evacuate, but the road was muddy so they could not walk.					○	
Were many specific types of people sacrificed?	Ocean side of dike: East District	A wide range of people from the wealthy class to poor class suffered from the disaster.	○	○				○
	Ocean side of dike: South District	Only poor people lived here so the disaster was severe in this district.	○	○				○
	Other districts	Homes of middle class and poor class people were vulnerable to the powerful wind so their roofs were easily blown off. Therefore it is assumed that fatalities and injuries were concentrated among people in this district (middle class and poor class) who died by being struck by galvanized metal sheets and branches blown about by the wind.			○			

Below the state of casualties caused by the 1991 cyclone as clarified by the analysis performed to obtain answers to four questions: “Why were they sacrificed?”, “Why did they not evacuate?”, “Why could they not evacuate?”, and “Were many specific types of people sacrificed?” plus measures proposed to mitigate the severity of these disasters are organized.

[Why were they sacrificed?]

A major cause of fatalities was people being engulfed in the tidal surge because their dike was breached or because they lived on the ocean side of the dike, so measures to strengthen existing dikes so they can withstand the force of the tidal surge generated by a cyclone were considered. Measures implemented by providing structures to provide protection from tidal surges around the periphery of the island—constructing tidal surge gates at river mouths or planting coastal forests for example—are needed. Moreover, dikes and revetments must be strengthened to prevent erosion from destroying revetments in the North District. In addition people die by being struck by galvanized metal sheets that are blown about by gusts of wind or being trapped under their toppled houses, or by being engulfed and carried away along with their homes by tidal surges that have breached the dikes. It is, therefore, necessary to strengthen weak houses that are now easily destroyed by tidal surges or cyclones, and to provide means of reinforcing the structures of houses (supplying instruction manuals etc.).

[Why did they not evacuate?]

One of the major reasons why residents did not evacuate in the East District is that misled by the fact that the dike was not breached during the 1970 cyclone, they assumed that they were safe in 1991. As measures related to the warning system, it is necessary to devise a way of providing warnings—for example, even on the land side, including warnings that there is a strong possibility that the dike will be overtopped or breached, and at the same time improving disaster protection education by stressing that it is important to evacuate when warned to do so, even though siren warnings include false alarms. It has also been clearly shown that on the ocean side in the South District, there were people who did not evacuate because they feared scattering and loss of their property, but it is also necessary to strengthen houses (use of concrete or piloti design for example) so their parts will not be blown about. Another reason people gave for not evacuating was that there were no nearby cyclone shelters in 1991, but since the 1991 disaster, new cyclone shelters have been constructed. And at the same time as the needed cyclone shelters are constructed, other measures must be taken, including encouraging the use of pubic facilities other than shelters and constructing small shelters.

[Why could they not escape?]

Residents evacuated too late in the East District because even when they heard the advance warning, misled by the fact that the dike was not breached during the 1970 cyclone, they assumed that they were safe this time, and when they became aware of the danger, the wind and rain were already so strong that it was difficult to evacuate, and when they tried to, the roads were muddy, making it very difficult for them to

walk. Changes must be made so that residents can evacuate allowing plenty of time to reach safety, by improving predictions provided by the warning system. And similar measures must be taken in the South District. And even where shelters have been constructed, the evacuation routes to their locations are still insufficient. Clay roads are bottlenecks, because even a little rain will transform their surfaces to mud that is difficult for people to walk on. So the road network must be expanded and improved so people can walk to the evacuation locations without being obstructed. Roads must be improved by paving their surfaces, raising their heights, or planting trees beside them.

["Were many specific types of people sacrificed?"]

The fact that the victims were mostly poor people can be seen in the survey on the ocean side in South District, but in the East District, the tidal surge breached the dikes then flowed into the land side, claiming victims from a wider range of social classes. To protect people on the ocean side of dikes in the South District from disasters, seawalls and coastal forests are being provided, but measures must be taken to ensure they have adequate strength to withstand a tidal surge triggered by a cyclone. Measures involving the construction of structures must be taken not only in the East District and the South District, but in all parts of the island to protect residents from tidal surges on all sides of Hatiya Island. These construction measures must be accompanied by a way of providing warnings—for example, even on the land side, including warnings that there is a strong possibility that the dike will be overtopped or breached, and at the same time improving disaster protection education by stressing that it is important to evacuate when warned to do so, even though siren warnings include false alarms. And houses of the middle class and poor class are susceptible to wind and rain and their roofs are easily blown off. So it is assumed that fatalities were concentrated among people in the district (middle class or poor class) who are struck by branches or galvanized metal plates blown by the wind, so they must provide support to strengthen the structures of these houses.

The above measures are presented on Table 9 classified by categories: ①Strengthening evacuation warning systems, ②expanding disaster protection education, ③ supporting strengthening of structures of homes, ④ Encouraging building of evacuation facilities, ⑤ Ensuring and strengthening evacuation routes, and ⑥ constructing and reinforcing dikes and revetments. In the future, both measures involving construction of structures and measures involving warning systems and education must be implemented from this perspective.

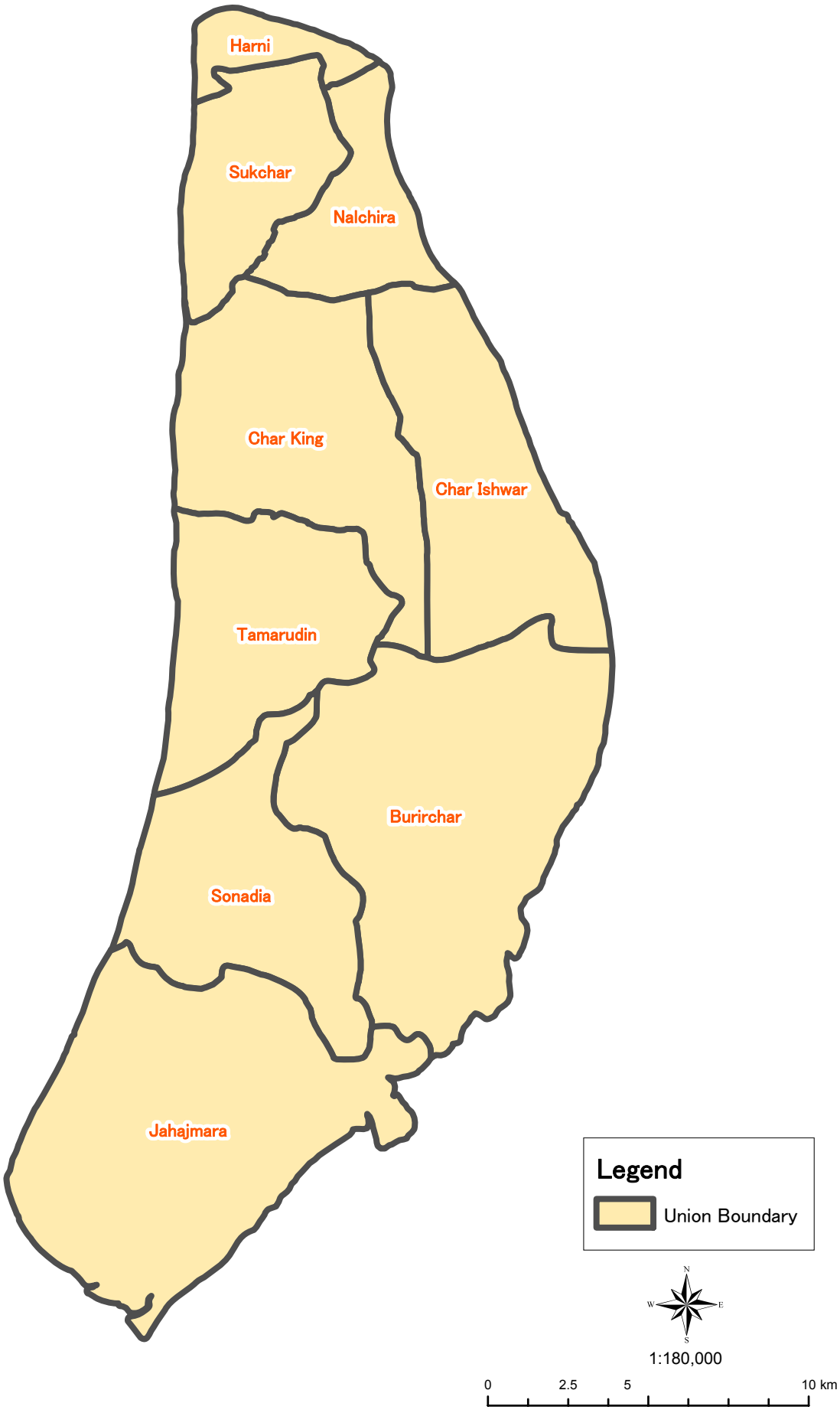
Table 9: Specific proposals for disaster mitigation measures

① Strengthening evacuation warning systems	・ Improve the existing siren warning system of the Cyclone Preparedness Programme (CPP) so that residents can take evacuation action with plenty of time to reach safety. ・ Devise ways of giving warnings: including warnings that there is a strong possibility that the dike will be overtopped or breached, even on the land side. ・ Boost the penetration rate of radio and TV to supplement CPP volunteers, in order to provide comprehensible cyclone warning information
② Expanding disaster protection education	・ Expand disaster education to include advice that it important to evacuate when warned to do so, even though siren warnings include false alarms. ・ Inform all residents that if, for example, an entire family is engulfed by a tidal surge, every family member would die.
③ Supporting strengthening of structures of homes	・ Construct houses so that their roofs (galvanized metal sheets) are not easily blown off by wind and rain ・ Construct houses that minimize damage even if a tidal surge strikes (for example, concrete construction, pilot design). ・ Provide support for efforts to strengthen the construction of houses (providing instruction manuals, etc.)
④ Encouraging building of evacuation facilities	・ Encourage the construction of cyclone shelters that still do not provide sufficient capacity. ・ Promote the construction of small cyclone shelters. ・ Use public facilities other than cyclone shelters in emergencies.
⑤ Ensuring and strengthening evacuation routes	・ Expand and improve the road network to ensure smooth evacuation to evacuation sites. ・ Pave, raise the height of, and strengthen (roadside trees, etc.) the roads.
⑥ Constructing and reinforcing dikes and revetments	・ Strengthen existing sea walls in order that they can withstand tidal surges caused by cyclones. ・ Strengthen dikes and revetments to prevent erosion from washing away North District revetments. ・ Build tidal surge gates ・ Plant and maintain coastal forests.

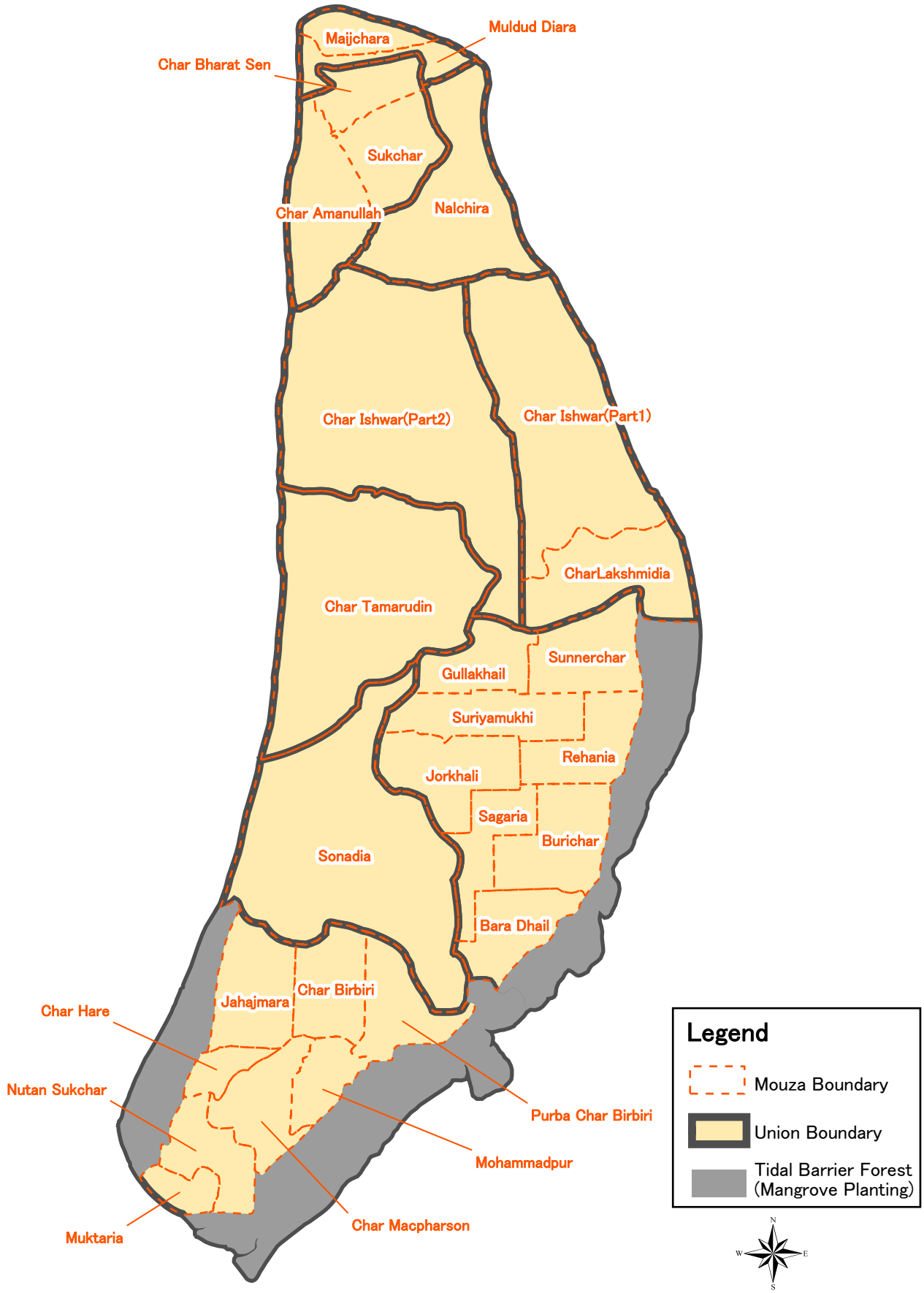
GIS Maps

(Based on the Results of field Investigation in Hatiya Island)

Union Map (1991)

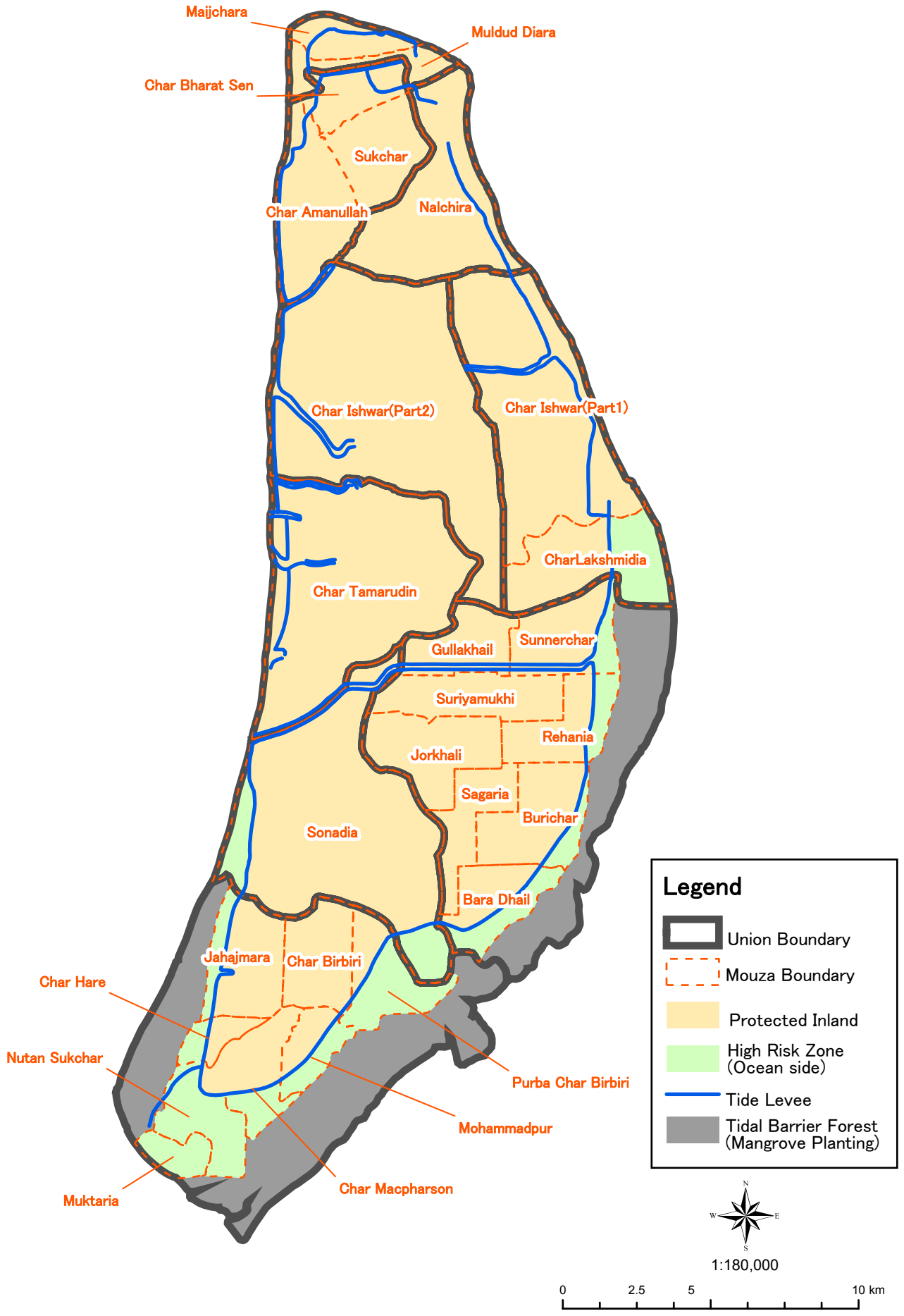


Mouza Map (1991)



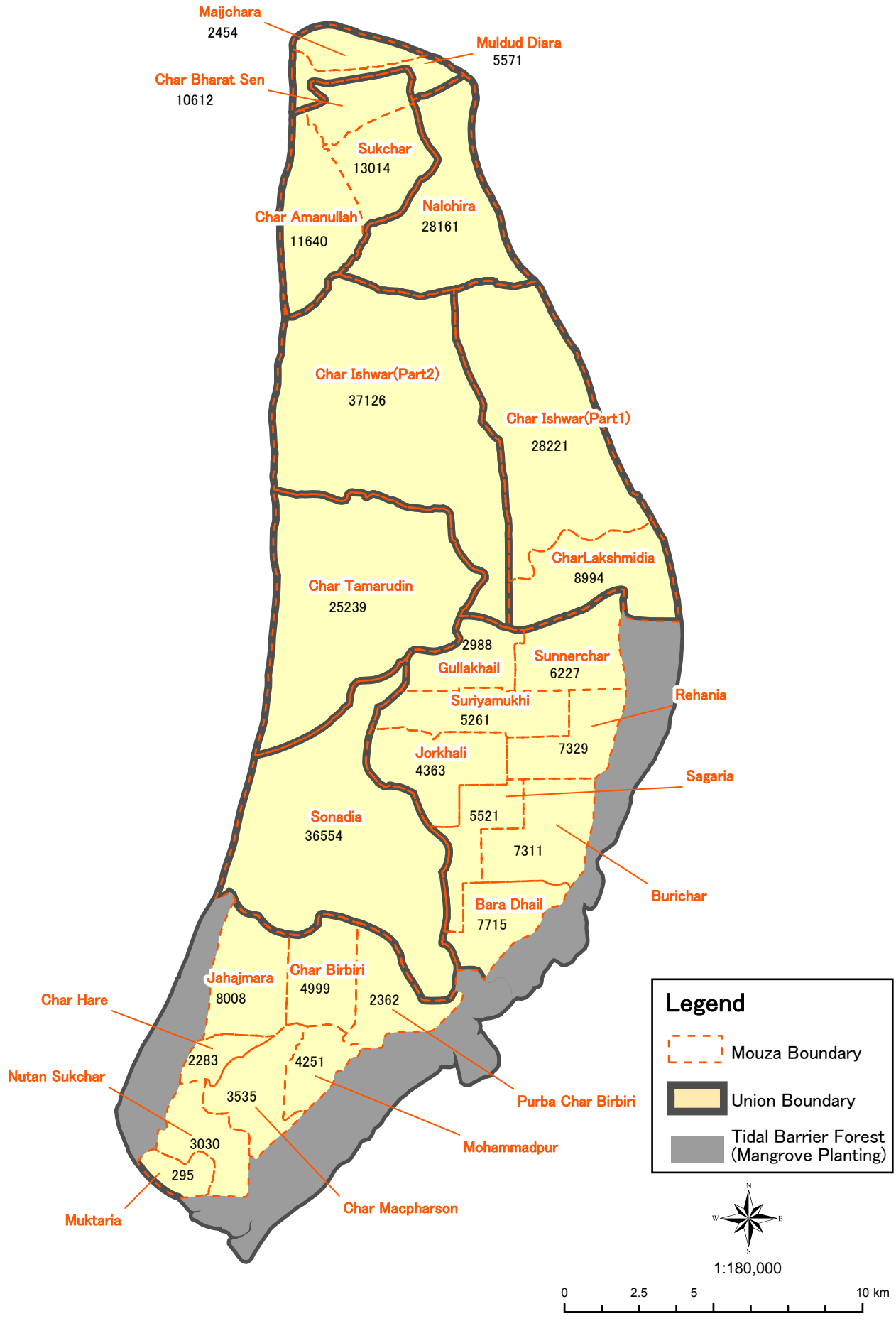
※Some Mouza boundary lines were unknown during the field investigation in Hatiya Island.

Tide Embankment in Hatiya (1991)

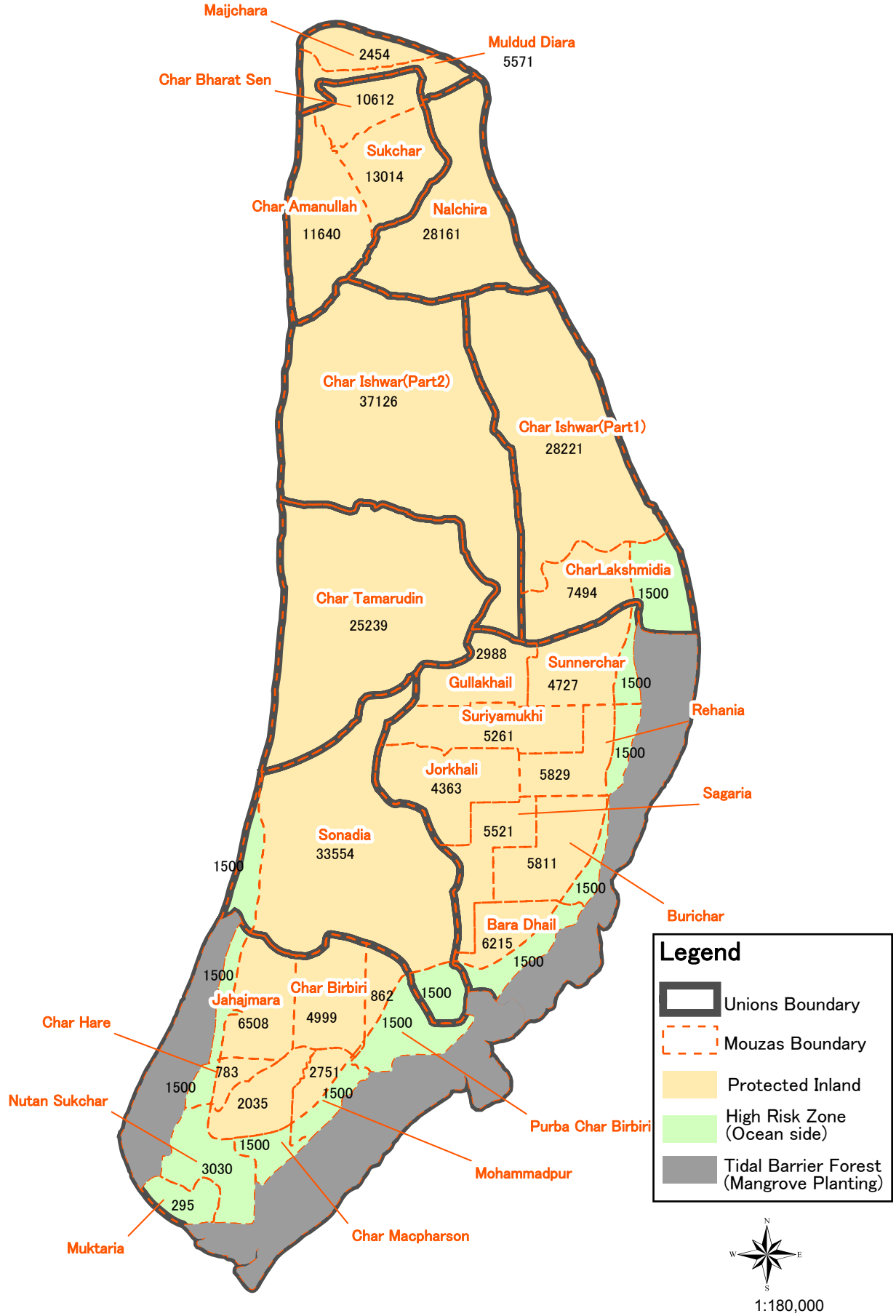


※Because the damages were concentarated in the Southern and Eastern regions , We did not make any distinction in the northern region.

Distribution of Population (1991)

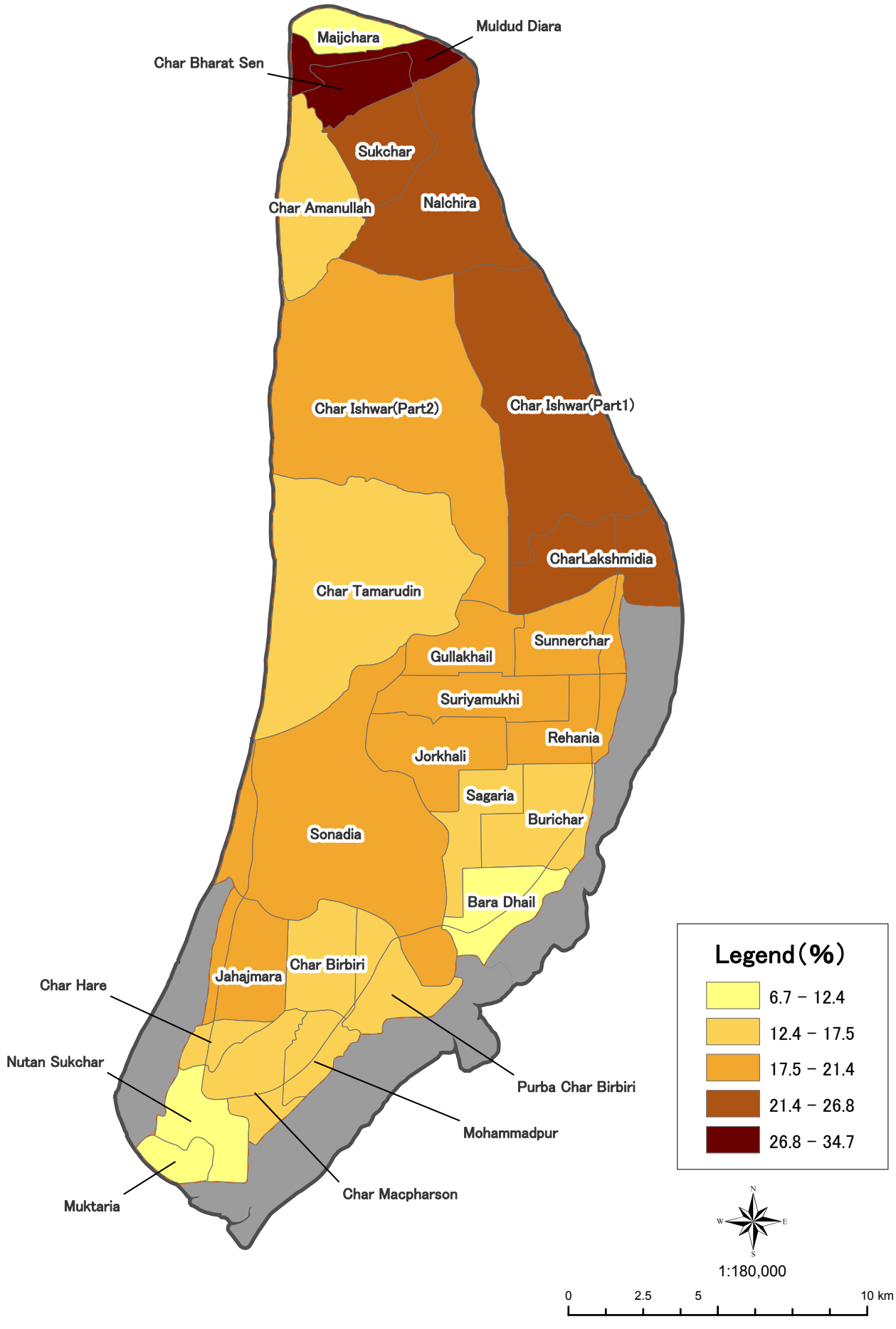


Population Distribution (1991)
(for Protected Inland and High Risk Zone)

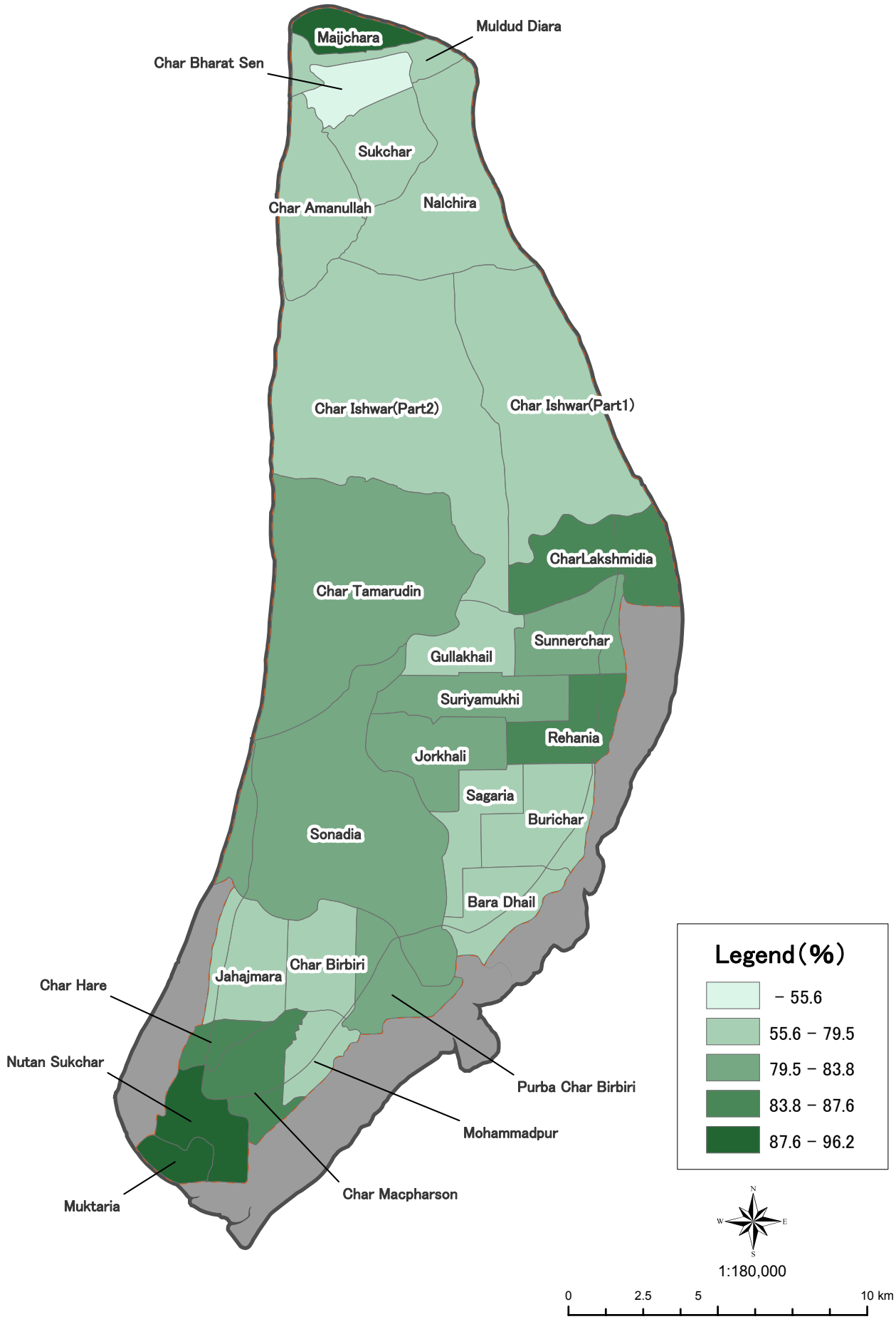


※The population distribution in High Risk Zone was assumed based on the interview survey to DUS.
(The population of Nutan Sukchar and Muktaria were taken from the Population Census.)

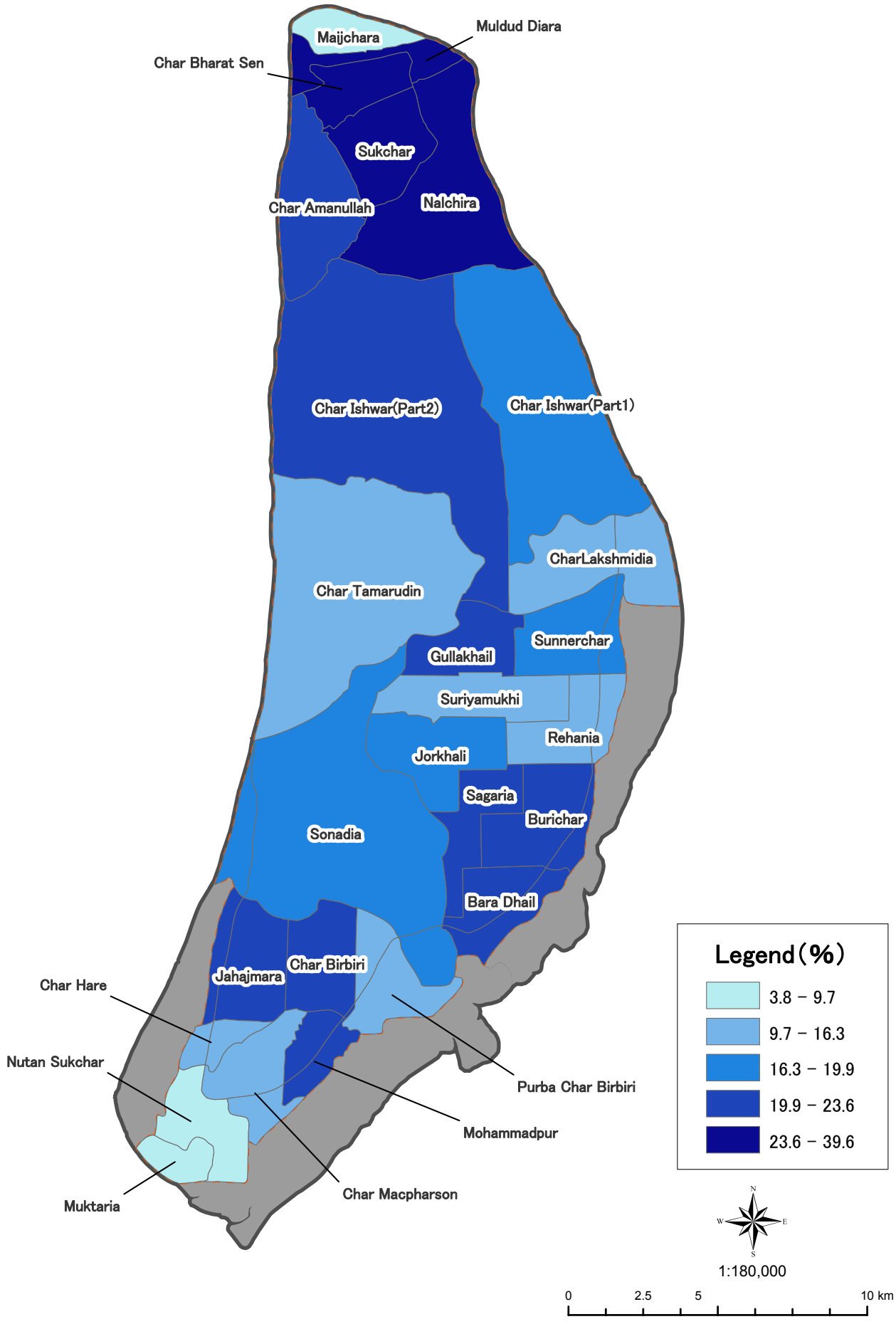
Literacy Rate (1991)



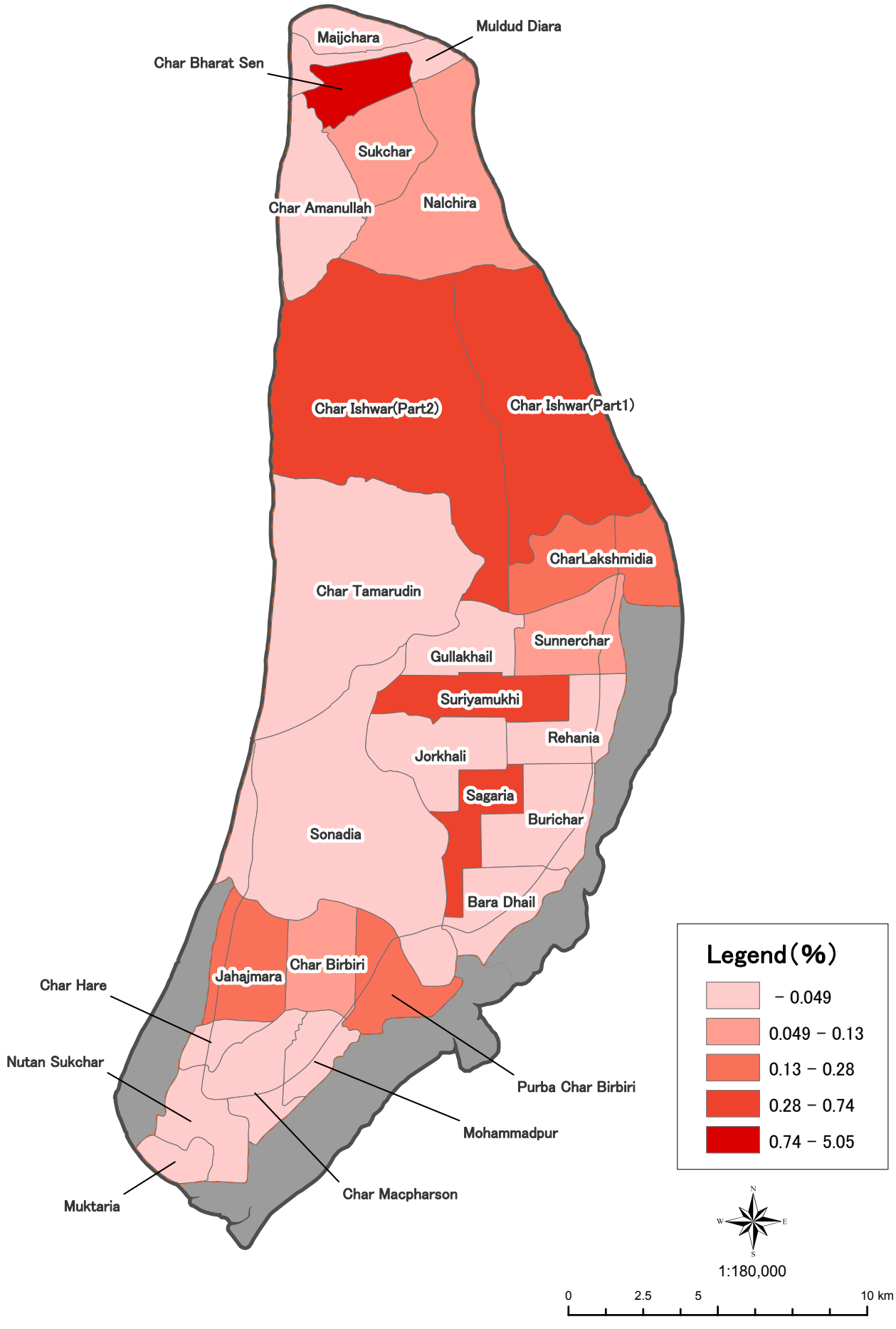
Percentage of thatch-roofed houses (1991)



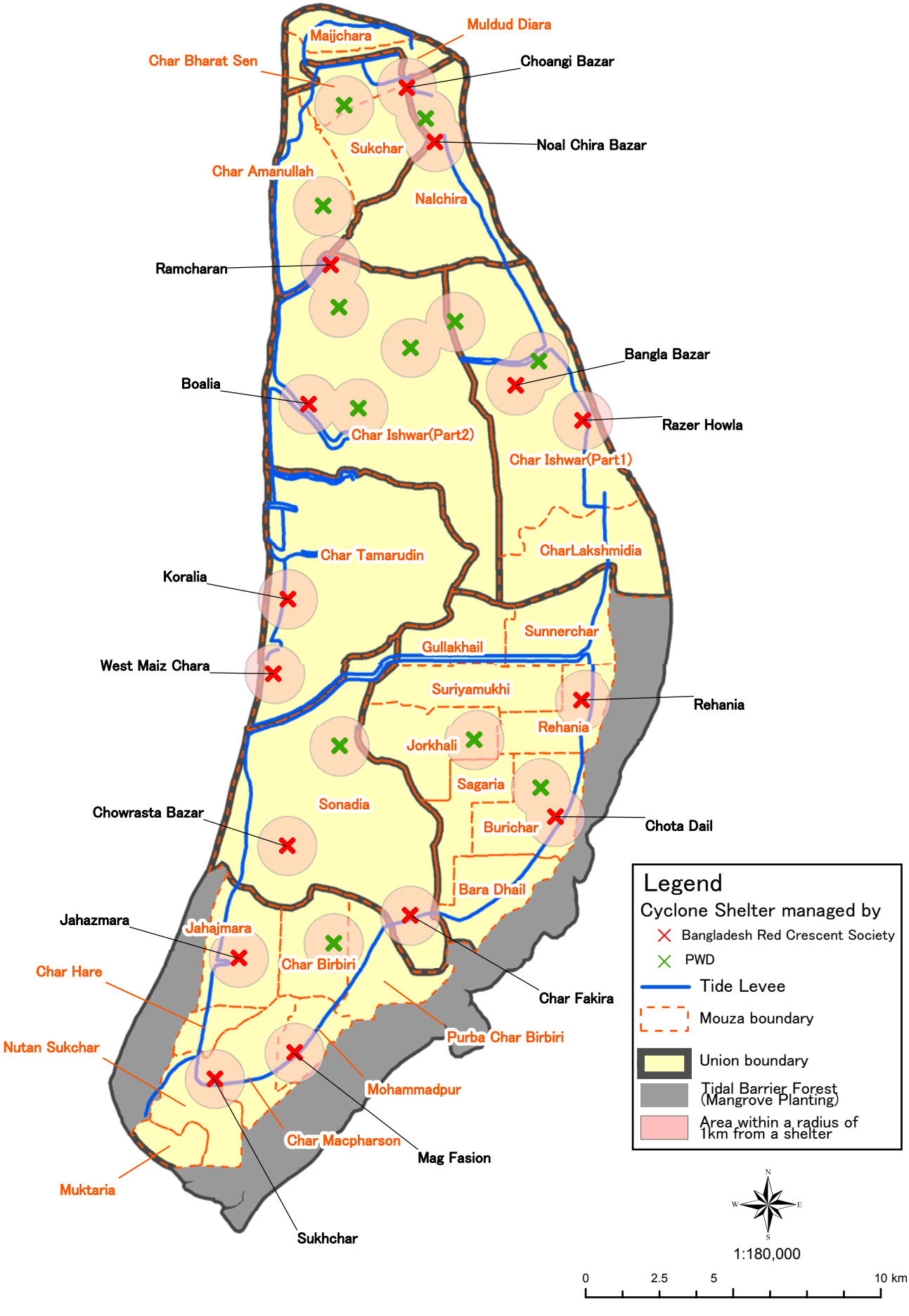
Percentage of tin-roofed houses (1991)



Percentage of houses of concrete (1991)

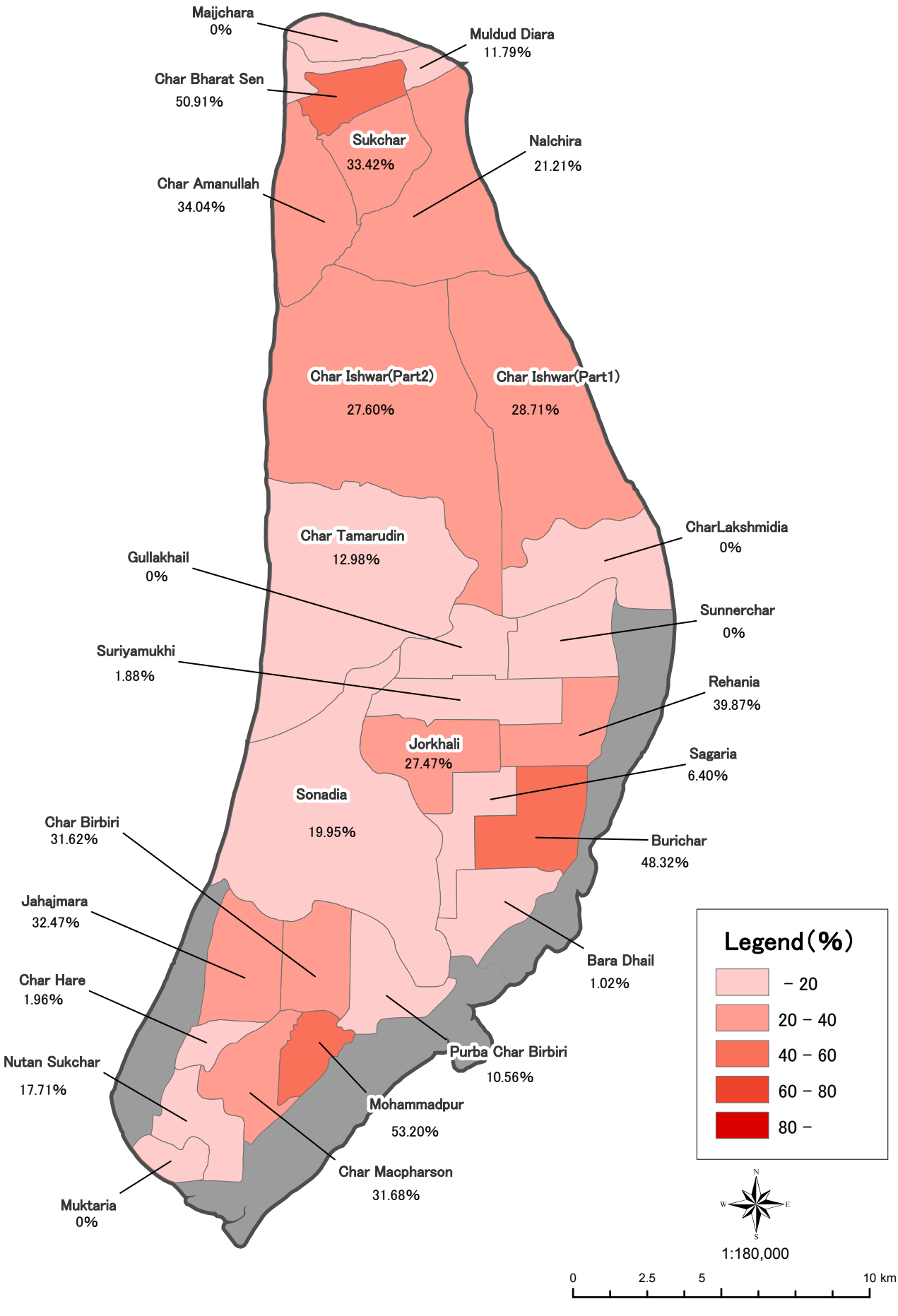


Location of Cyclone Shelters(1991)



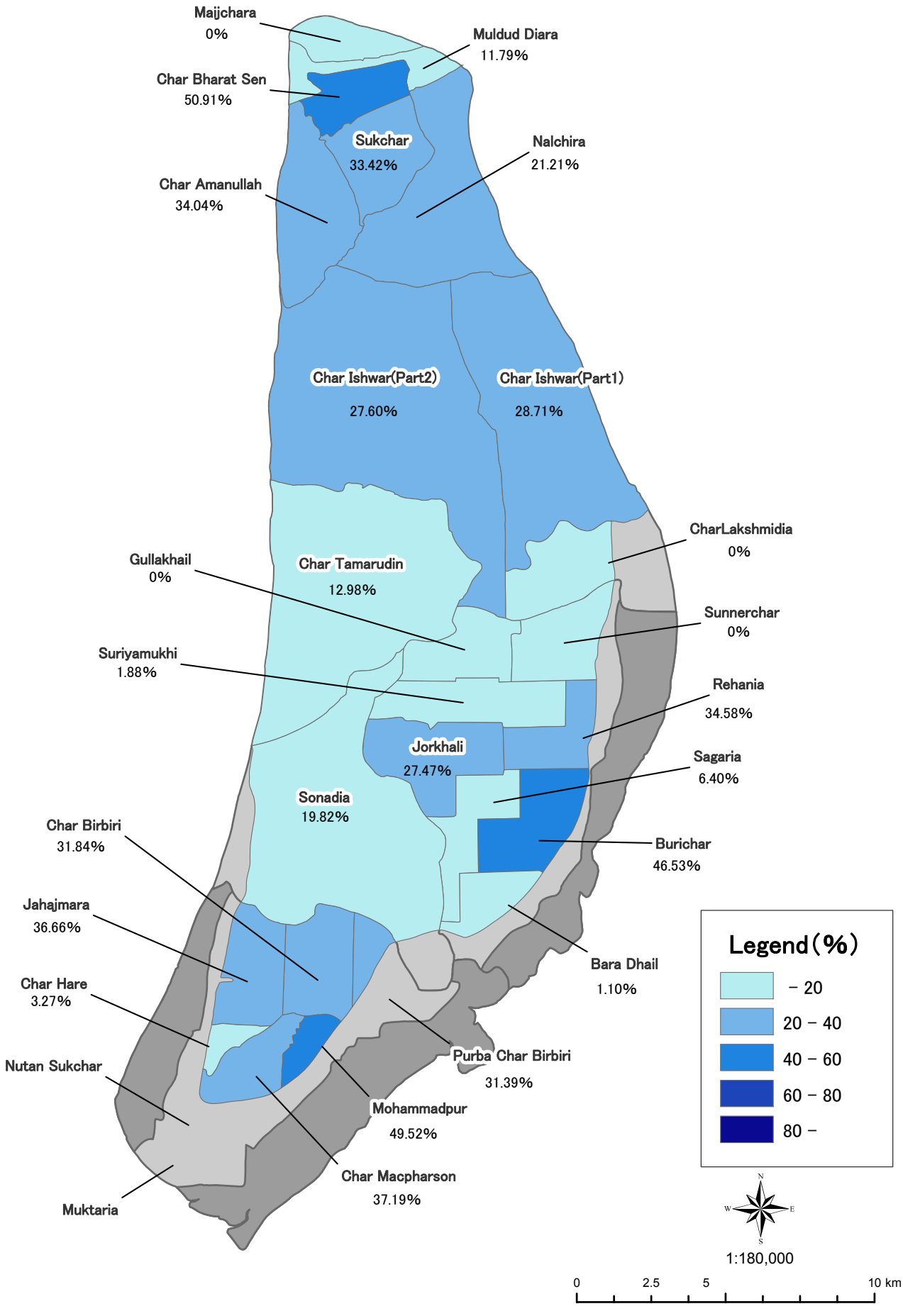
Area Coverage Rate(1991)

=(Area within a radius of 1km from a shelter/Mouza Total Area)×100%



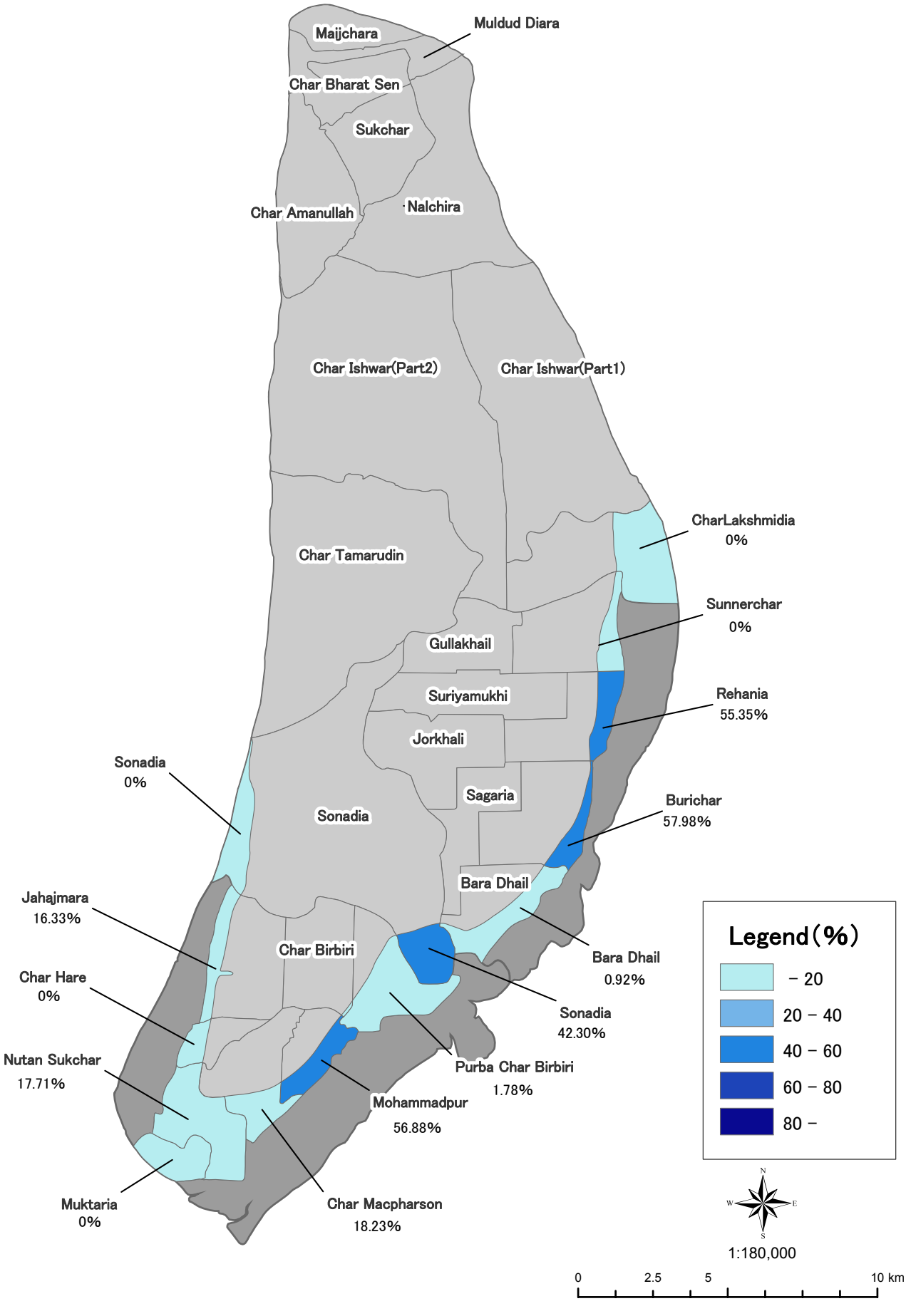
Area Coverage Rate(1991)

=(Area within a radius of 1km from a shelter in Protected Inland/Protected inland Total Area)×100%



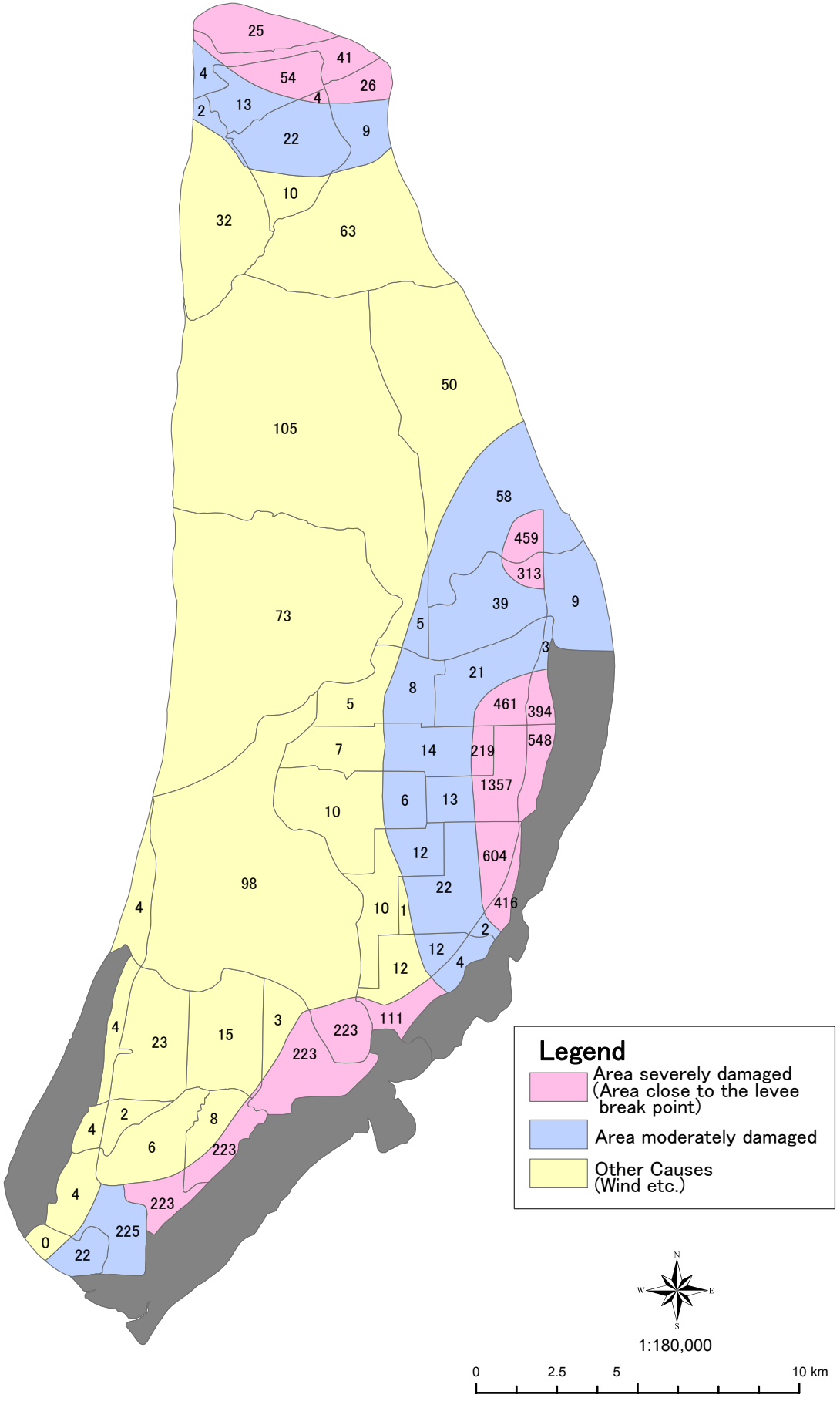
Area Coverage Rate(1991)

=(Area within a radius of 1km from a shelter in High Risk Zone/High Risk Zone Total Area)×100%

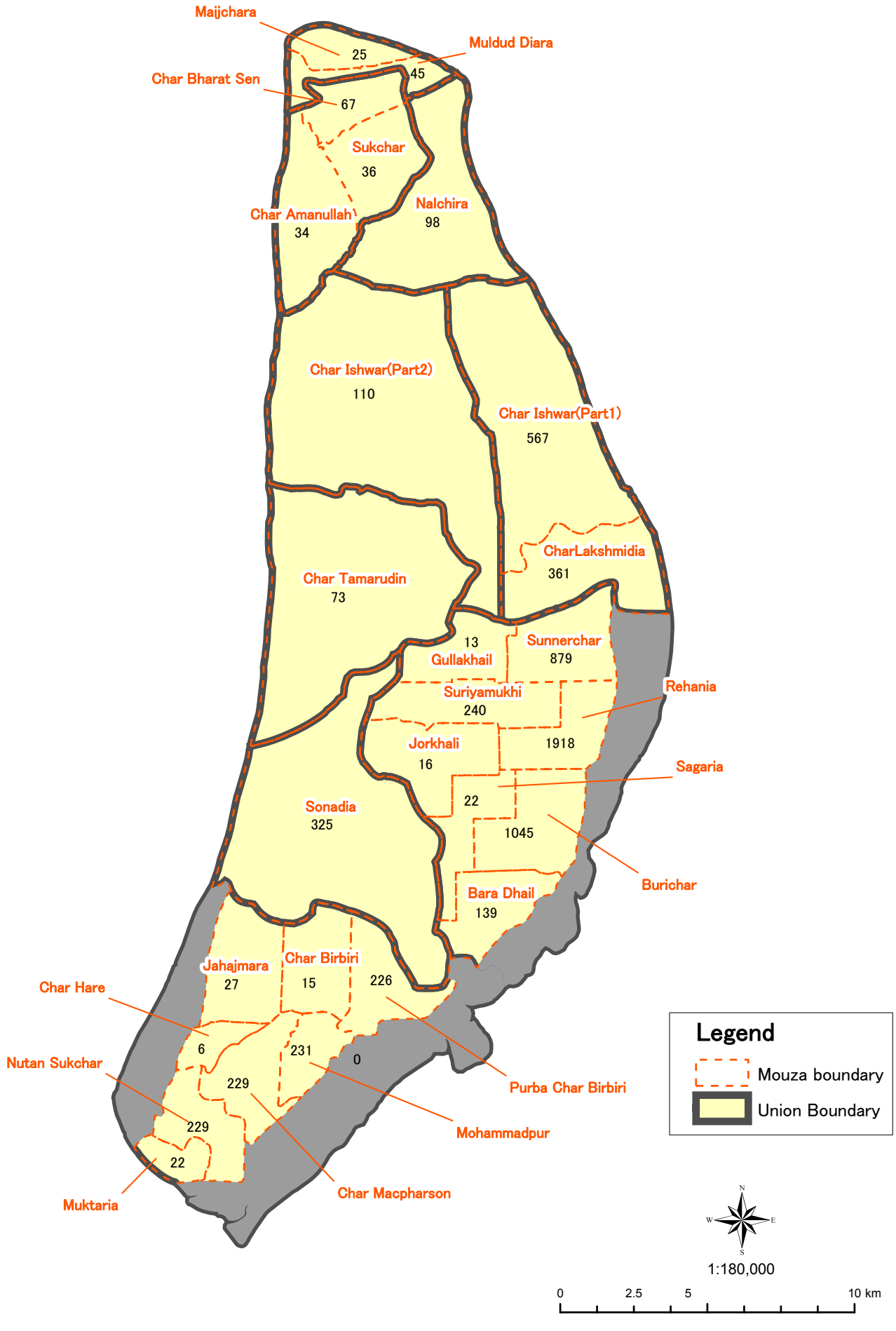


Distribution of deaths

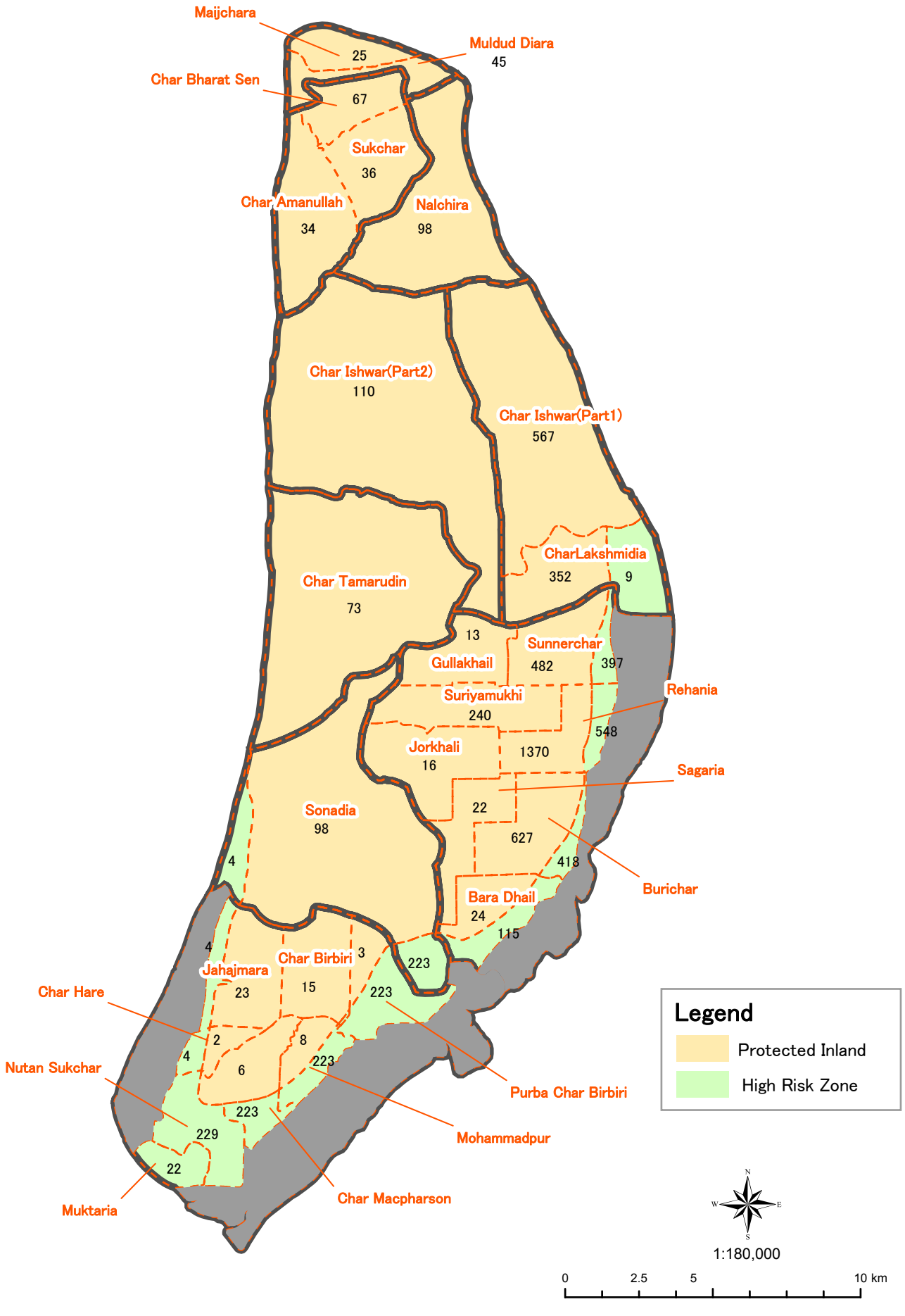
(Estimated based on the interview survey to DUS)



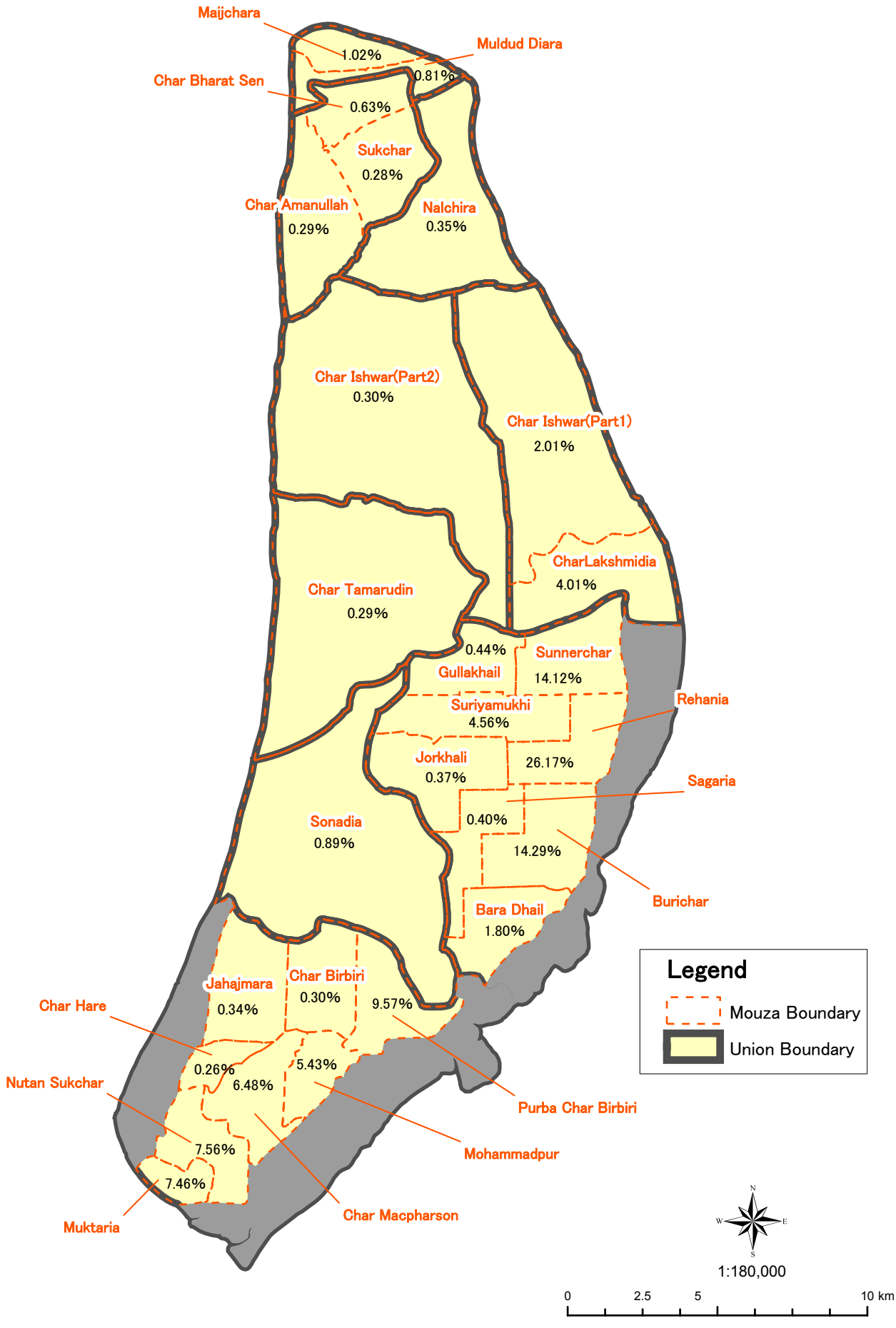
Distribution of Deaths
(Estimated based on the interview survey to DUS)



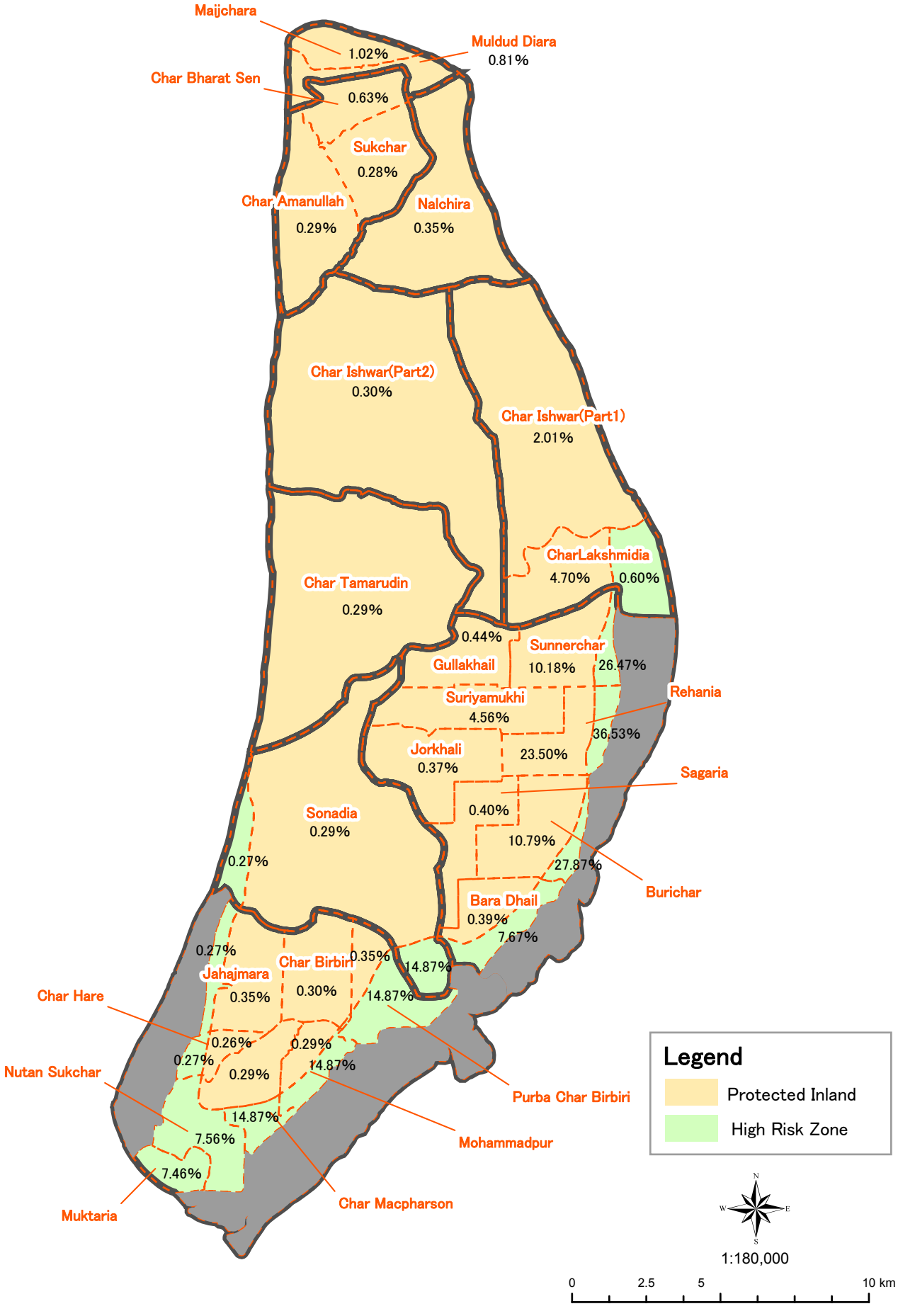
Distribution of deaths
(Estimated based on the interview survey to DUS)



Death Rate
(Estimate based on the interview survey to DUS)

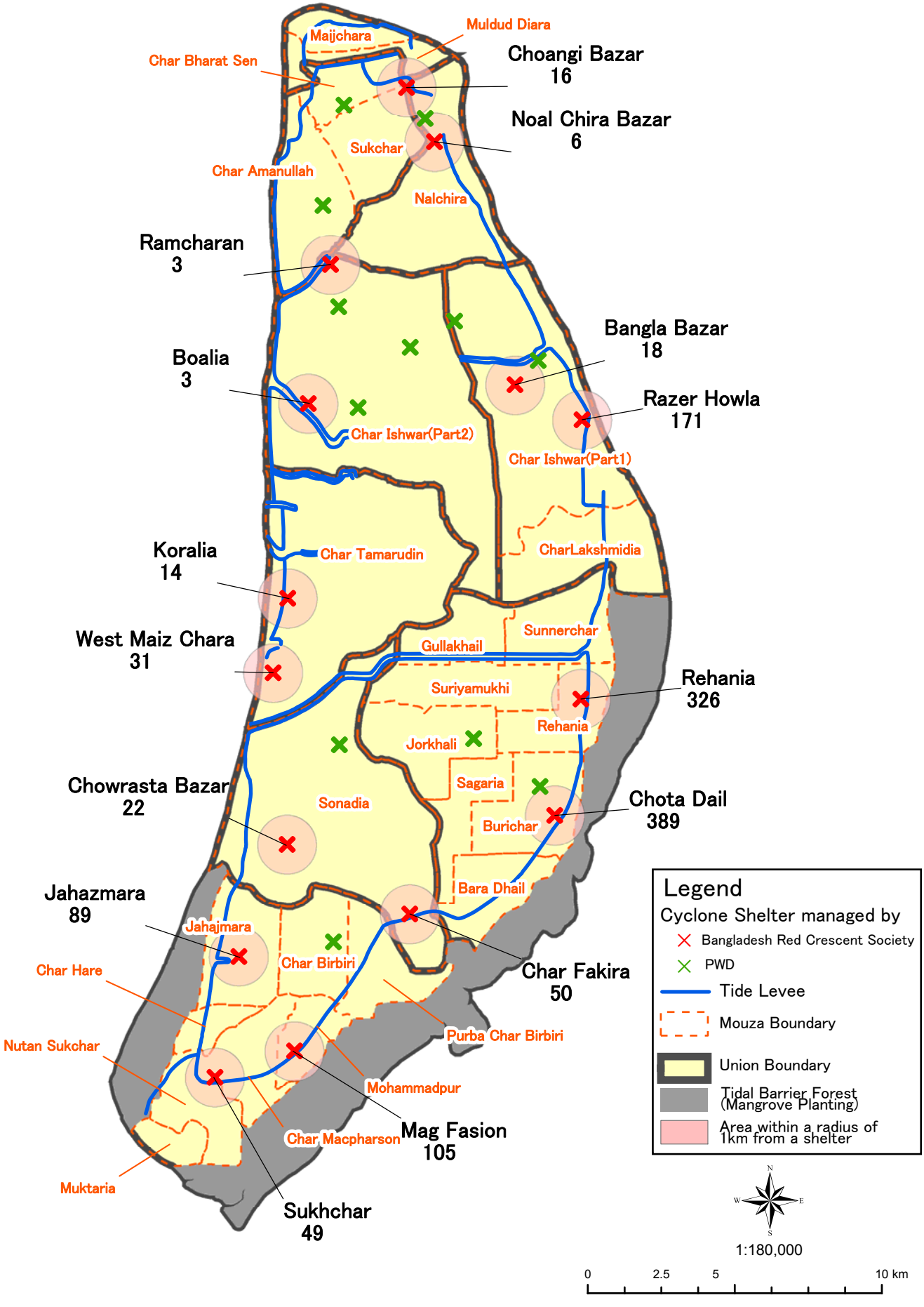


Death Rate
(Estimated based on the interview survey to DUS)



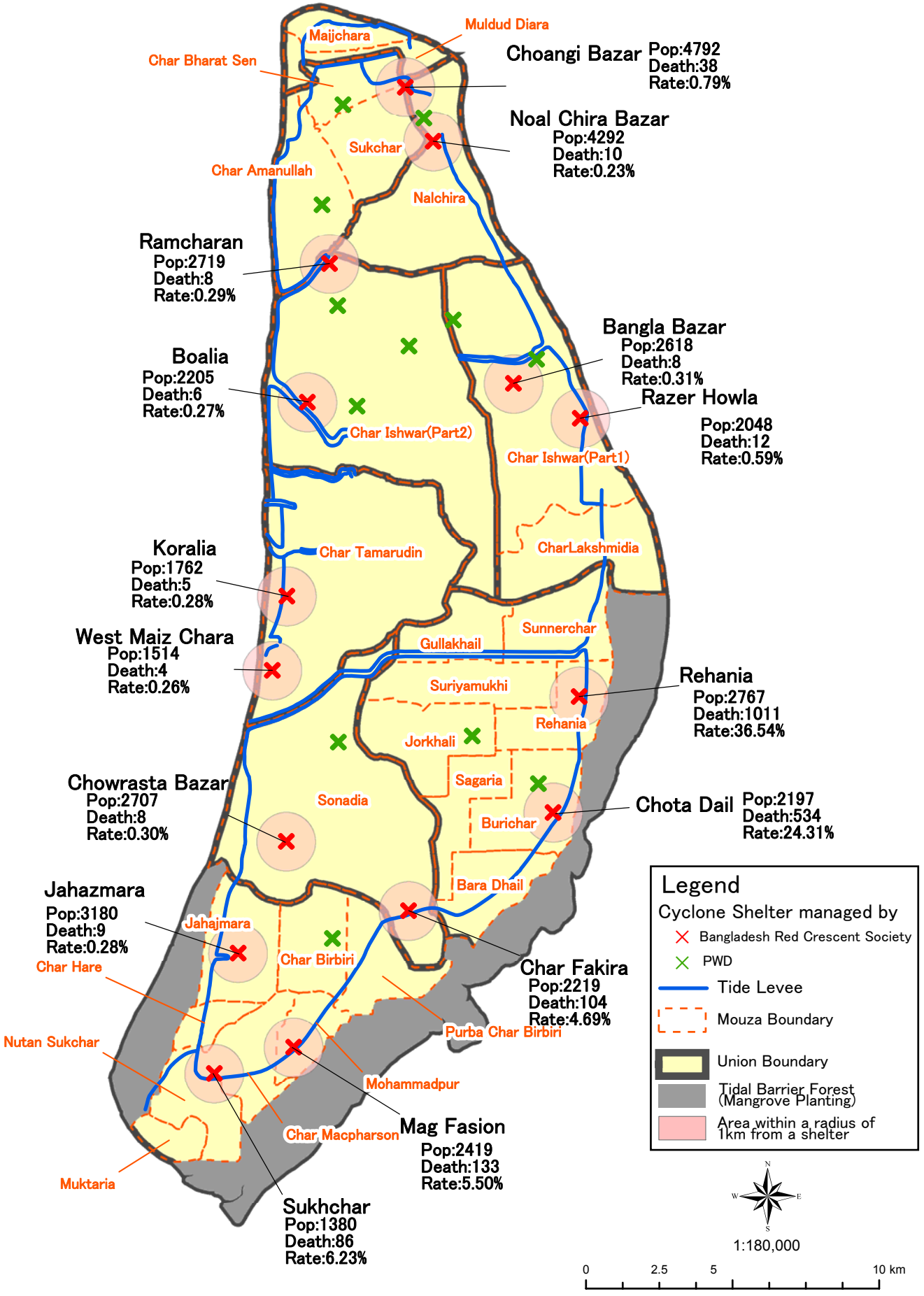
Death toll in areas within a radius of 1km from shelters

(Estimation based on the following report
"Disaster and People's Participation : Issues of Cyclone Shelter Construction in Bangladesh",Japanese Red Cross Society,1995)

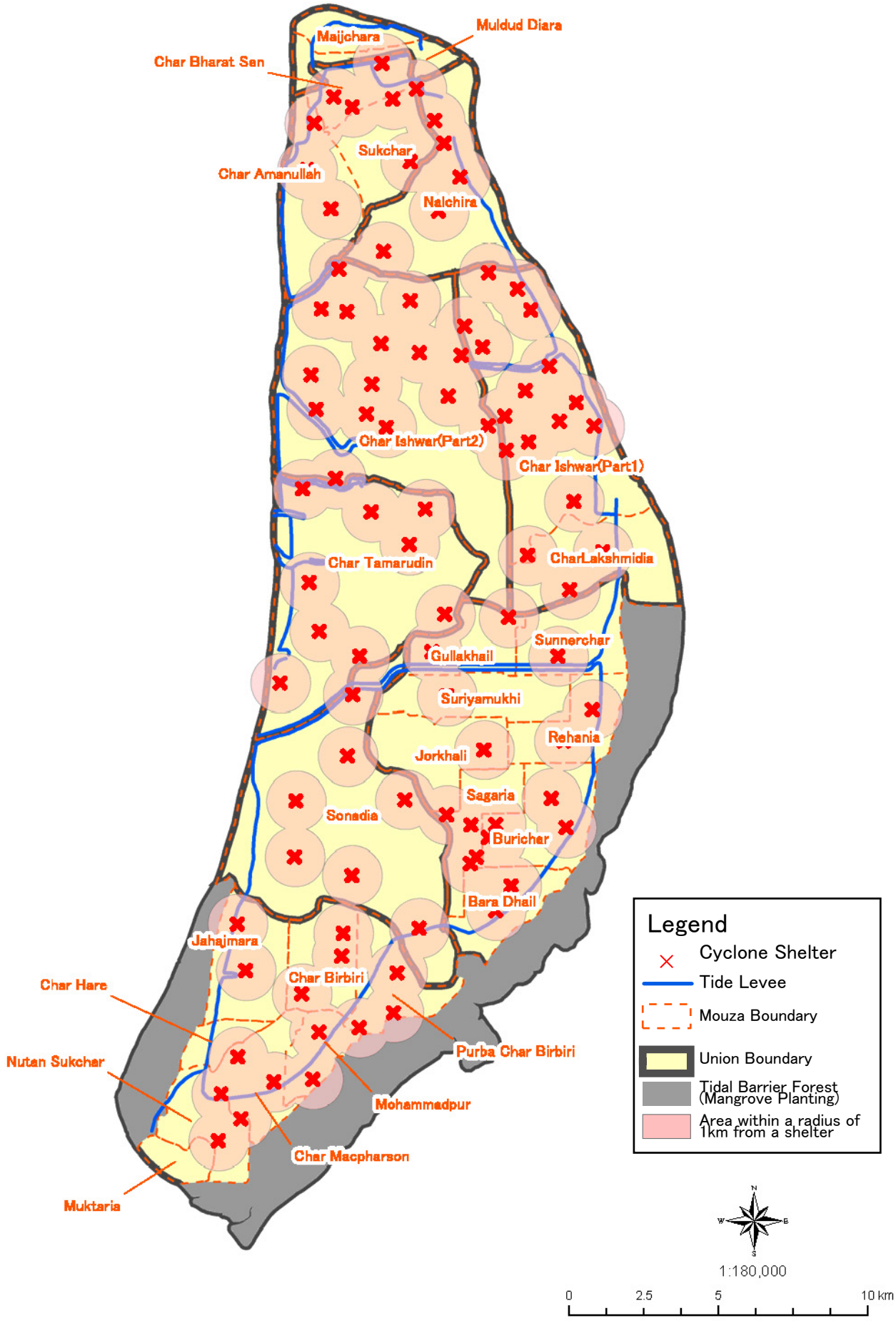


Population ,Death toll and death rate in areas within a radius of 1km from shelters

(Estimated based on the interview survey to DUS)

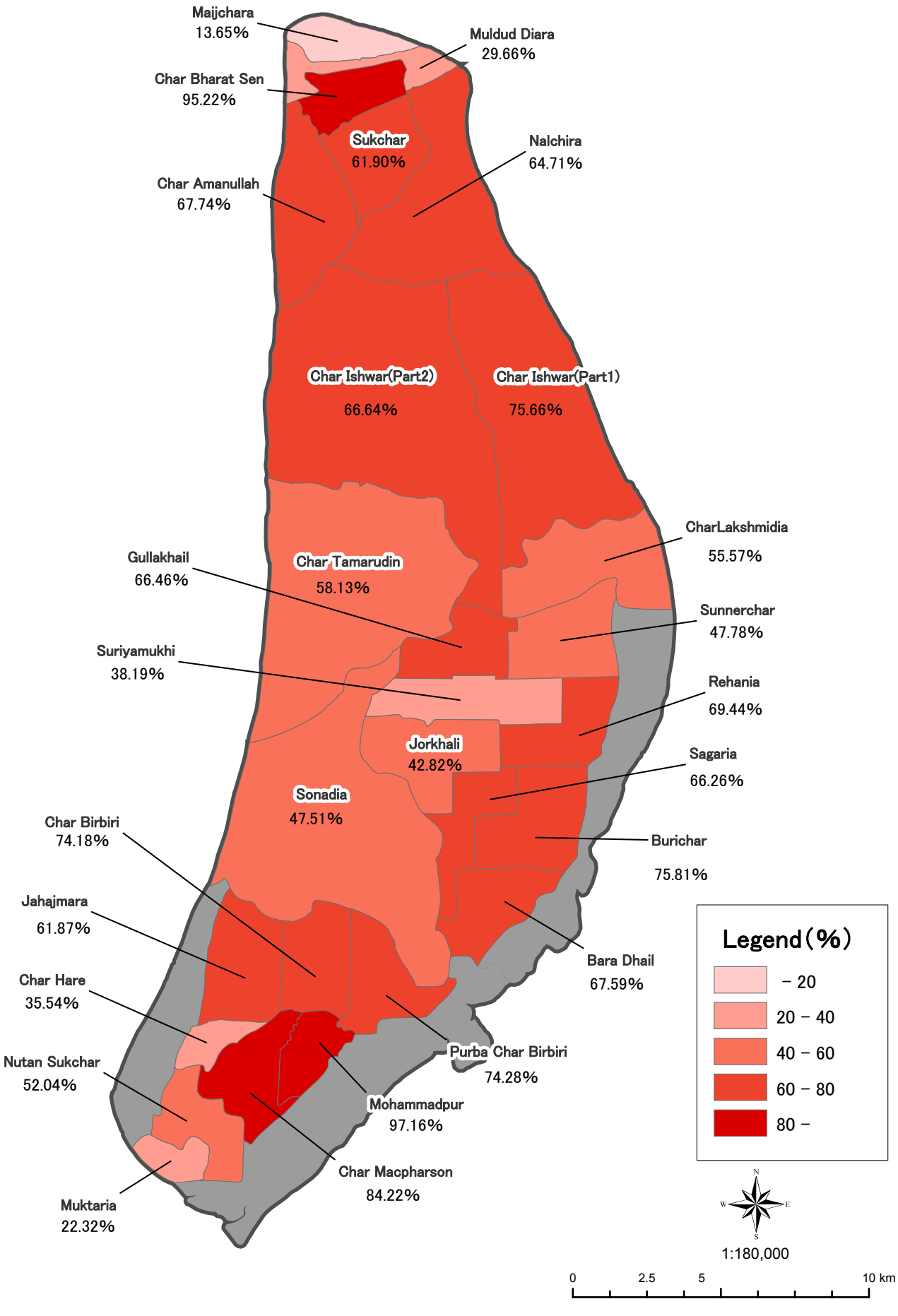


Location of Cyclone Shelters(2007)



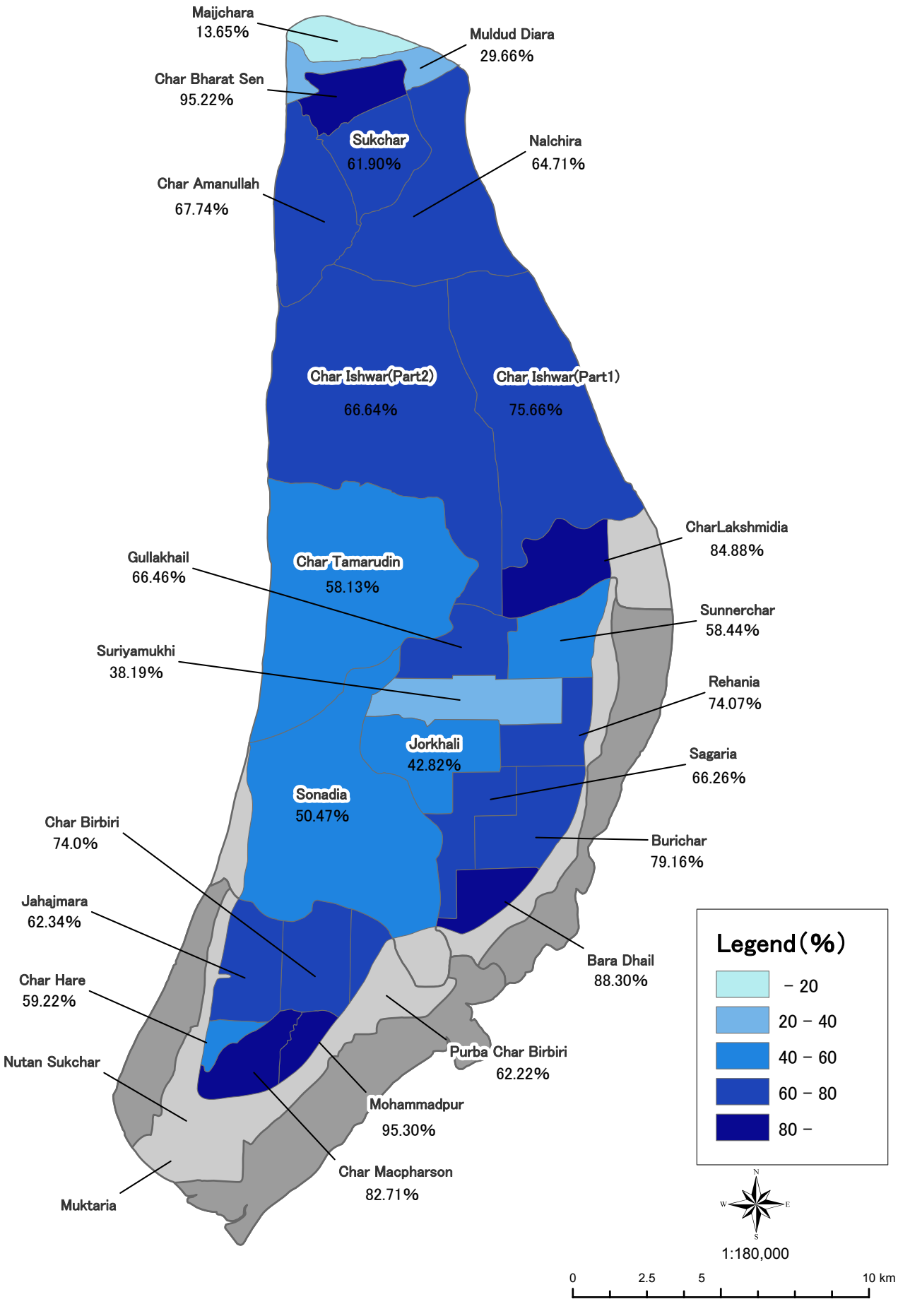
Area Coverage Rate(2007)

=(Area within a radius of 1km from a shelter/Mouza Total Area)×100%



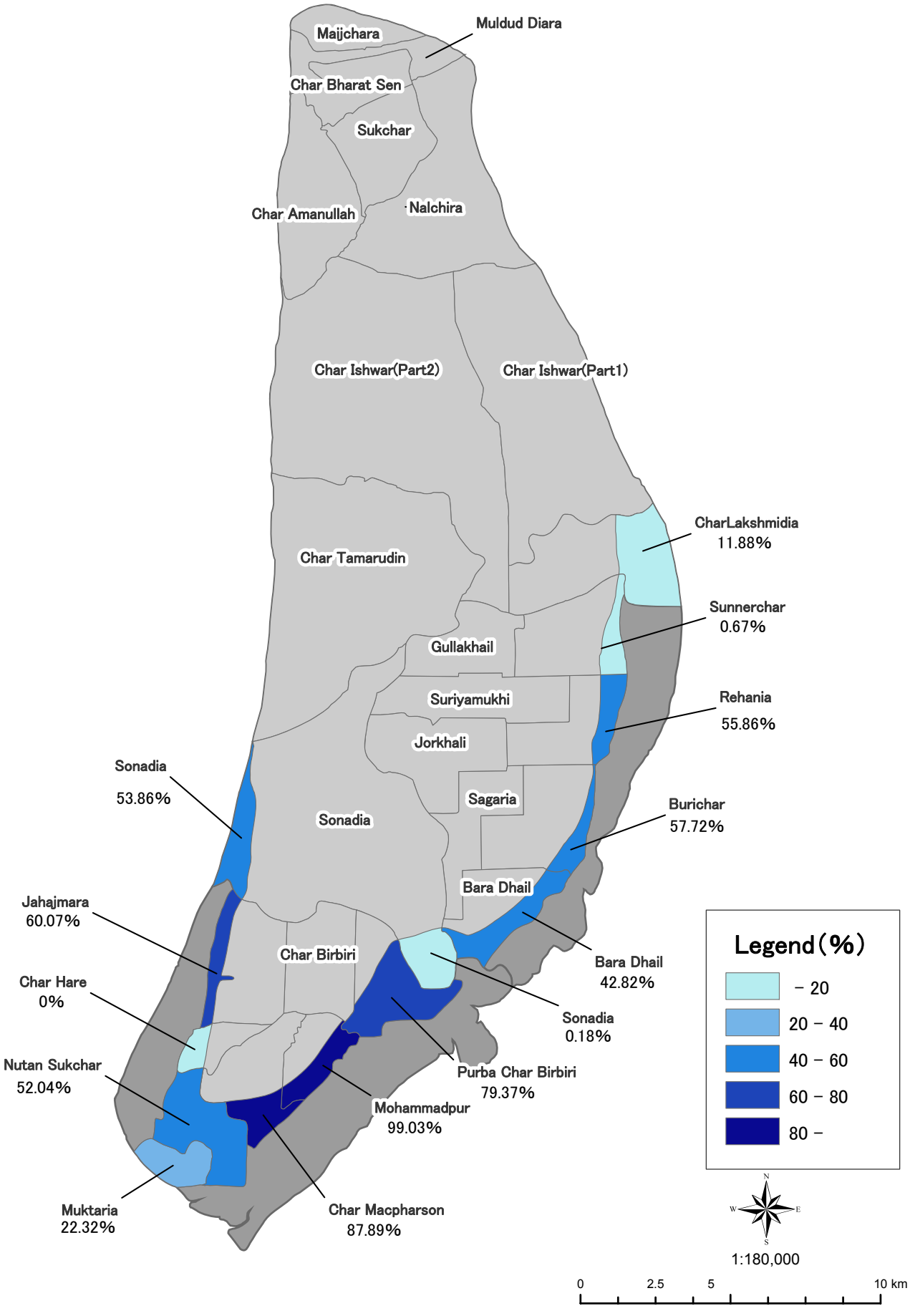
Area Coverage Rate(2007)

=(Area within a radius of 1km from a shelter in Protected Inland/Protected inland Total Area)×100%

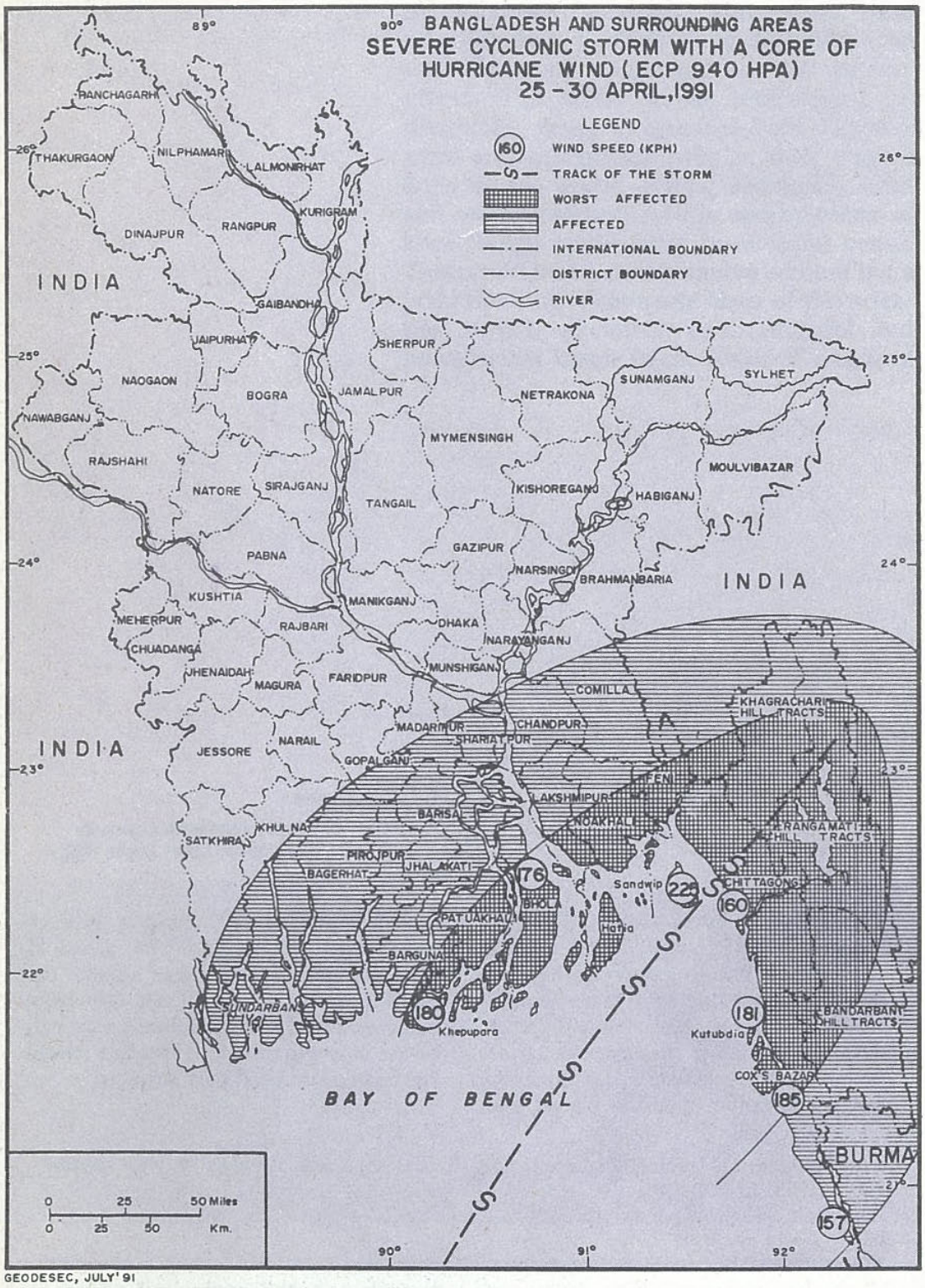


Area Coverage Rate(2007)

=(Area within a radius of 1km from a shelter in High Risk Zone/High Risk Zone Total Area)×100%



Disaster Profile Sheets
Reference Documents



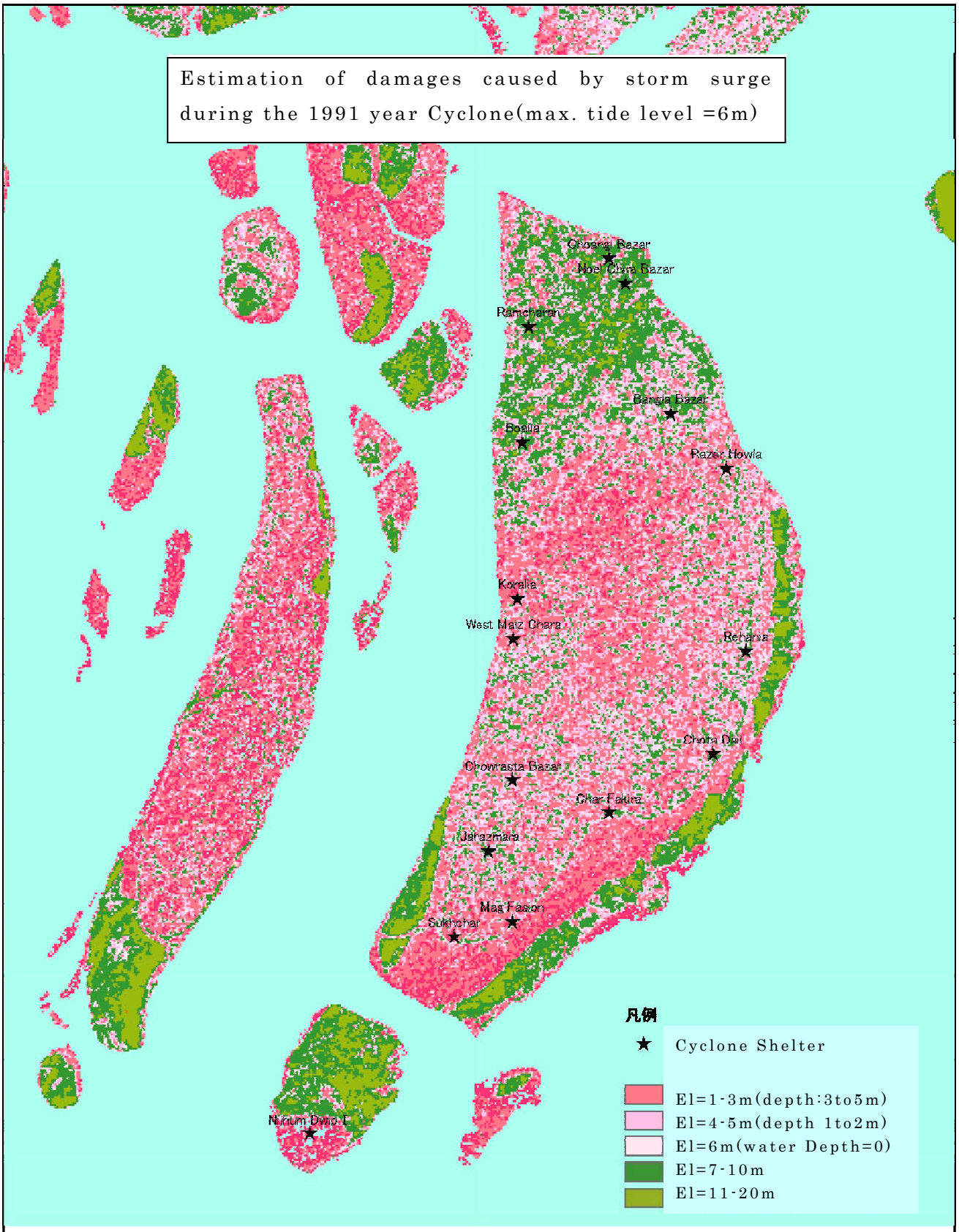
"In a disaster-prone country like this, disaster preparedness should be a 365-days-job"

"Natural disasters, floods, cyclones, earthquakes are not the only disasters. Poverty is also a disaster."

Mohammad Yunus, Grameen Bank

Source :

- Dr. A.M. Choudhury, Cyclones in Bangladesh, Dhaka, 1991.



Source:
・Choudhury D,et al , 1997,EVALUATION-Community Based Disaster Preparedness Programme in Hatiya,Nijundwig & Monpura Islands in Bangladesh
・Choudhury.D, et al , 1995 ,BDRCS/JRCS Comprehensive review on JRCS Supported Disaster Preparedness Activities in Bangladesh
・（Digital Elevation Model） http://www2.jpl.nasa.gov/srtm/version2/SRTM3/Eurasia

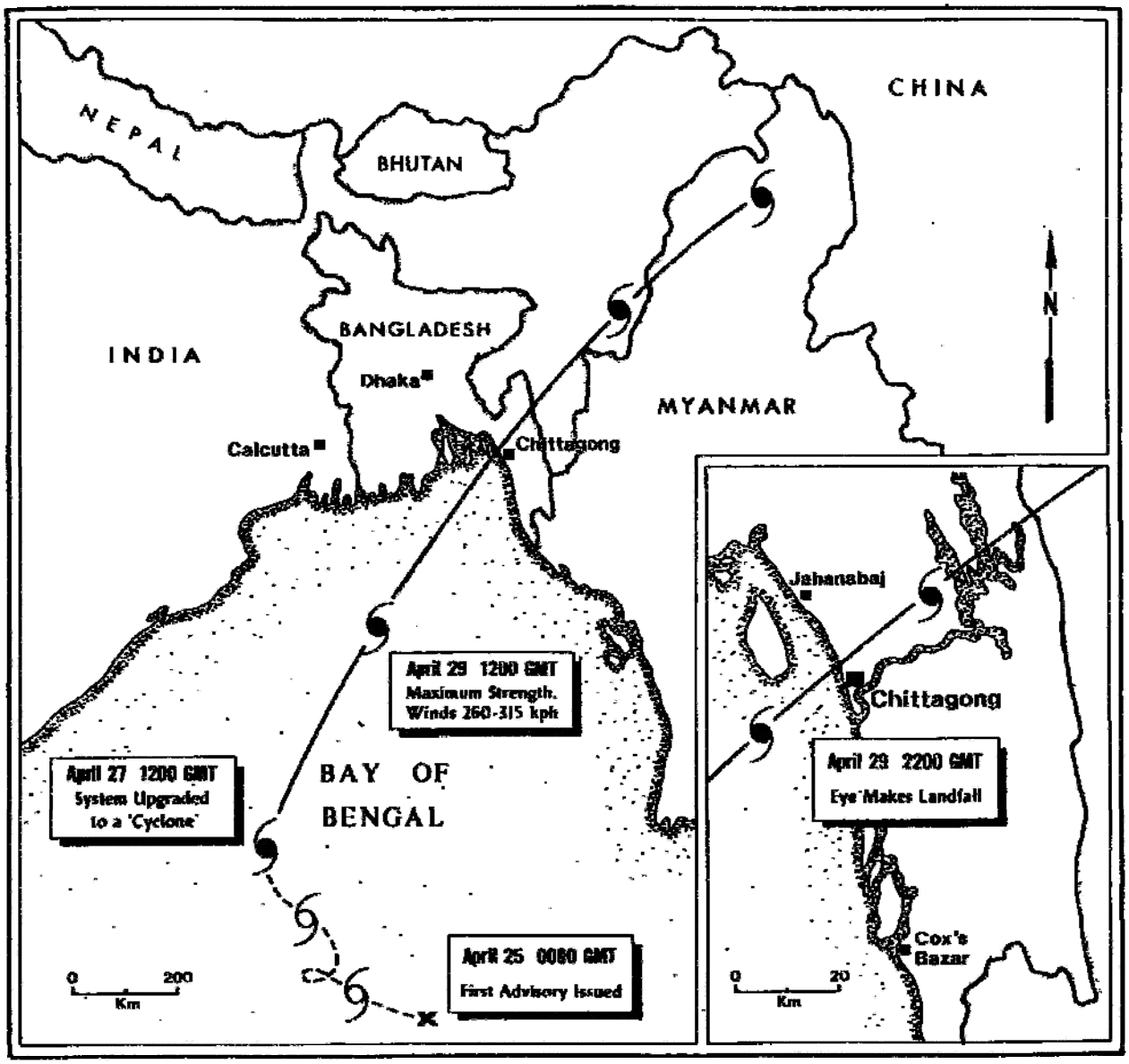
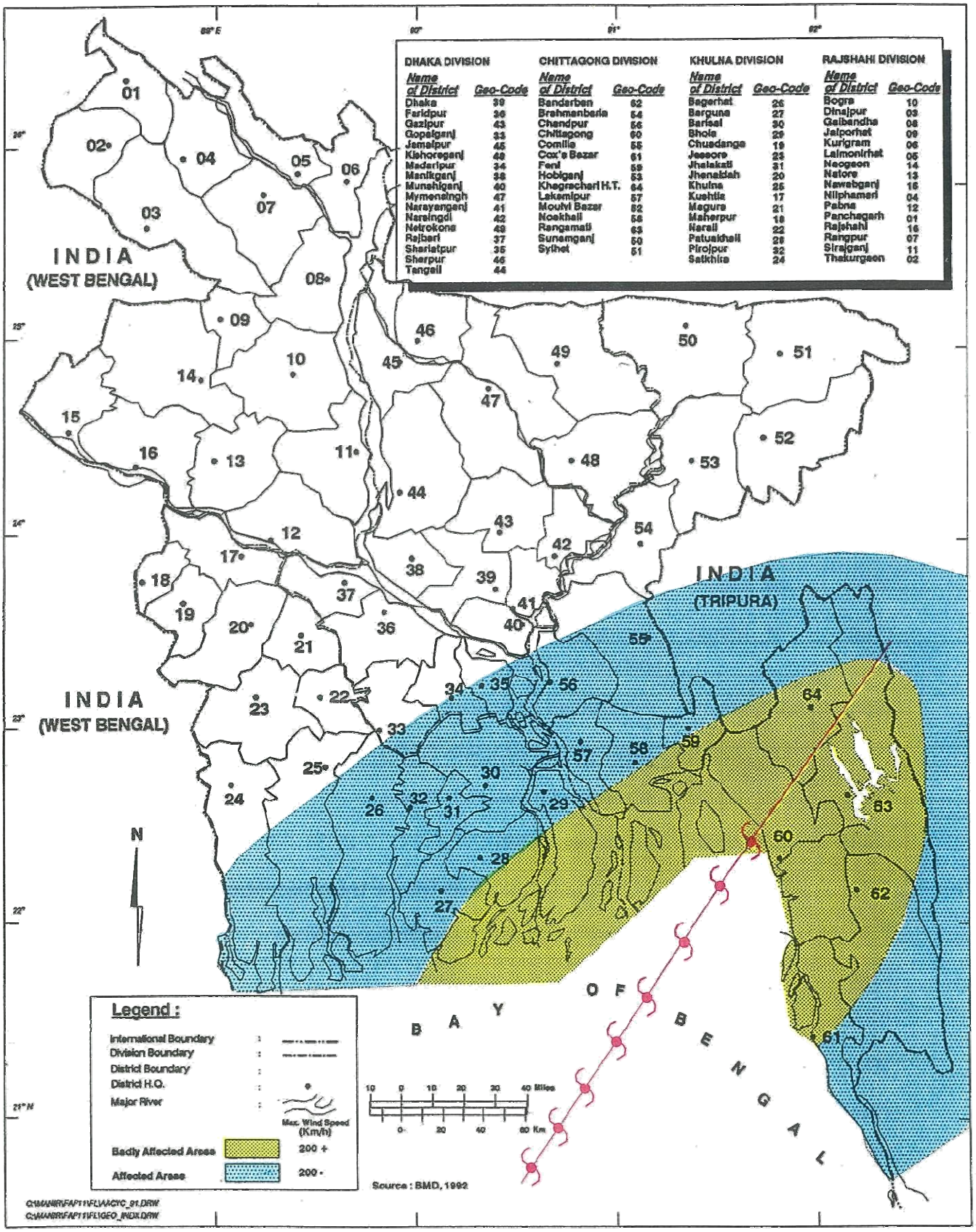


FIGURE 1 *Path of Tropical Cyclone 2B across coastal Bangladesh*

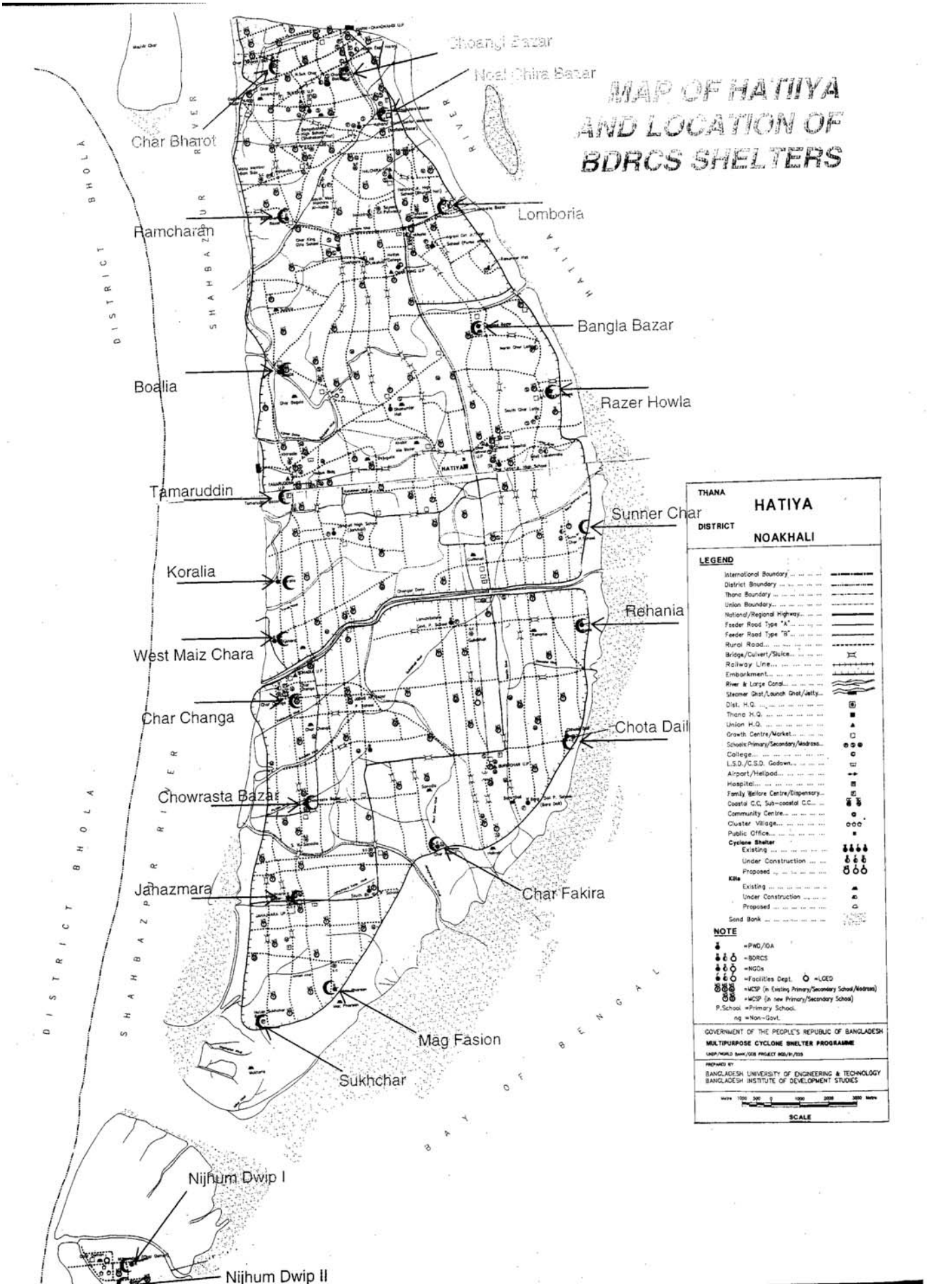
measurements taken from ships at anchor outside the port of Chittagong (Sevenhuysen, 1991). This depression of pressure, in conjunction with the full moon of 28 and 29 April, was sufficient to raise the pre-surge tides to the highest level of the normal range. Consequently, as reported by the national newspapers of Bangladesh, the surge that struck after midnight on 29 April and during the early morning of 30 April exceeded a height of six metres in the offshore islands. Marks on buildings and trees, measured by Haque indicated that the depth of water at the Chittagong airport exceeded two metres.

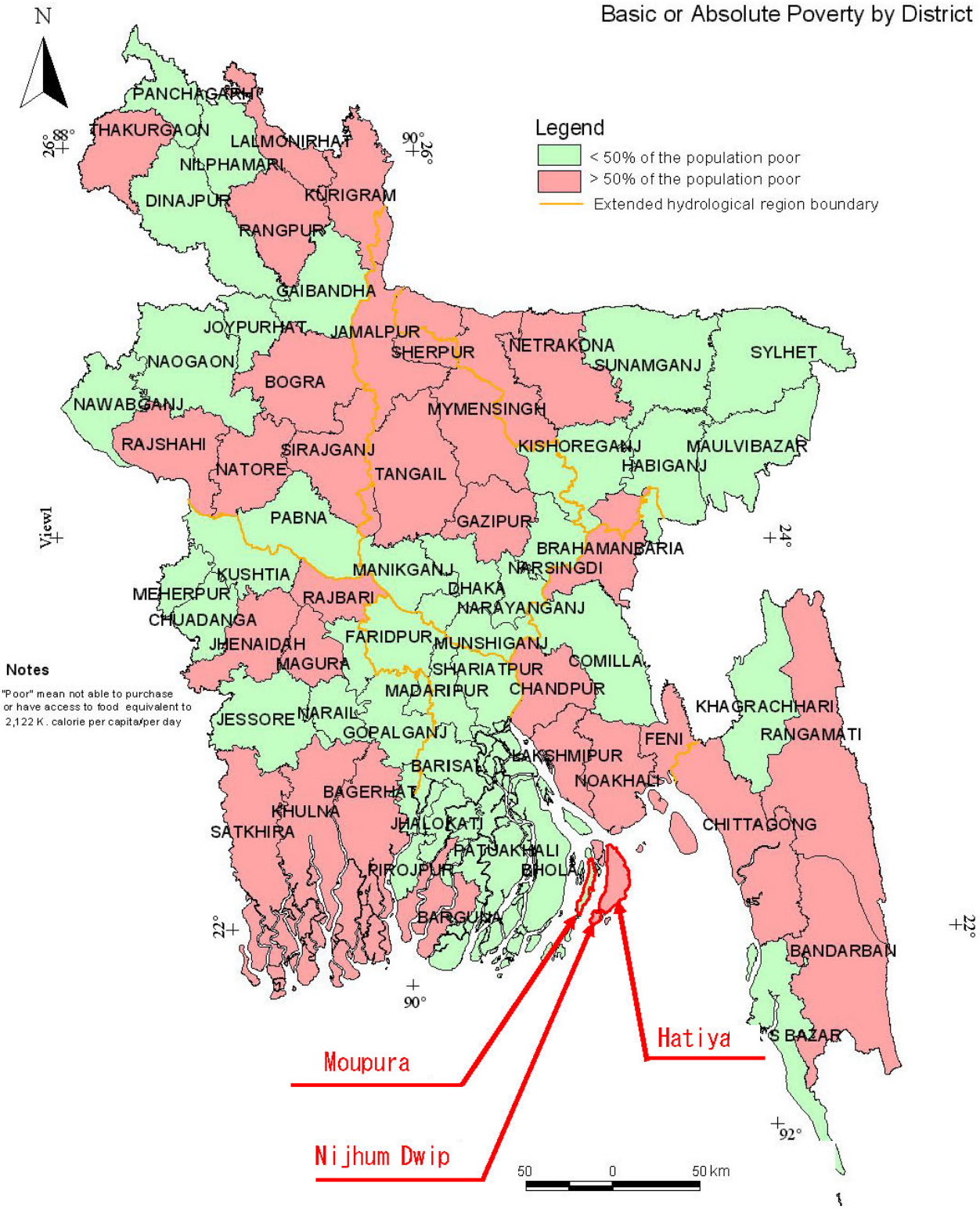
The surge and its associated waves submerged more than 160 km of the Bangladesh coastline, including areas of Cox's Bazar, Bashkhali, Chakoria, and the densely inhabited islands of Sonadia, Matarbari, Ujantia, Moheshkhali, Kutubdia, Koriardia, and Sandwip. The hurricane-force winds battered the region for about eight hours during its passage inland. After moving into northern Myanmar (formerly Burma) the storm became extratropical and

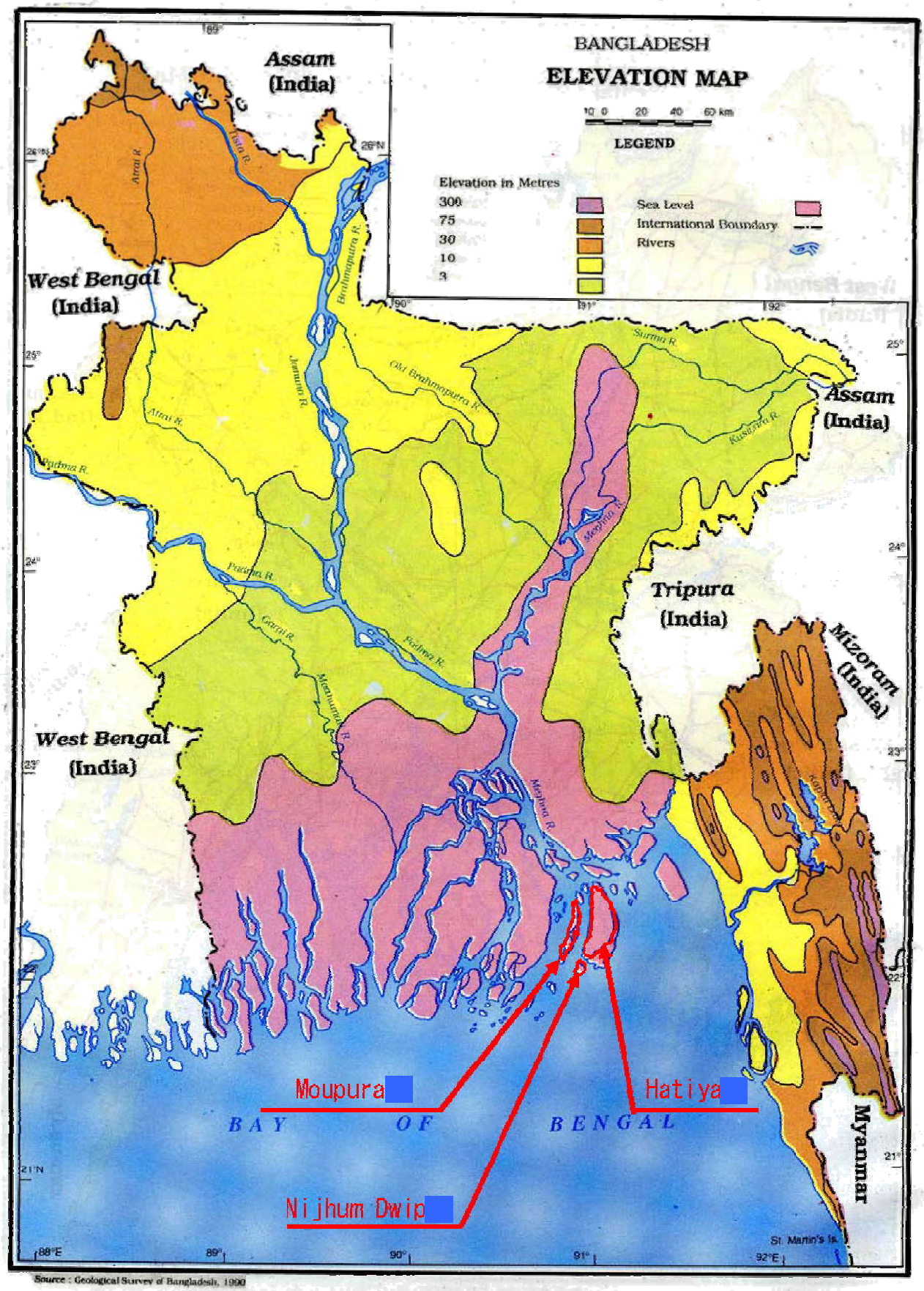
ANNEX-4
Areas Affected by Cyclone 1991

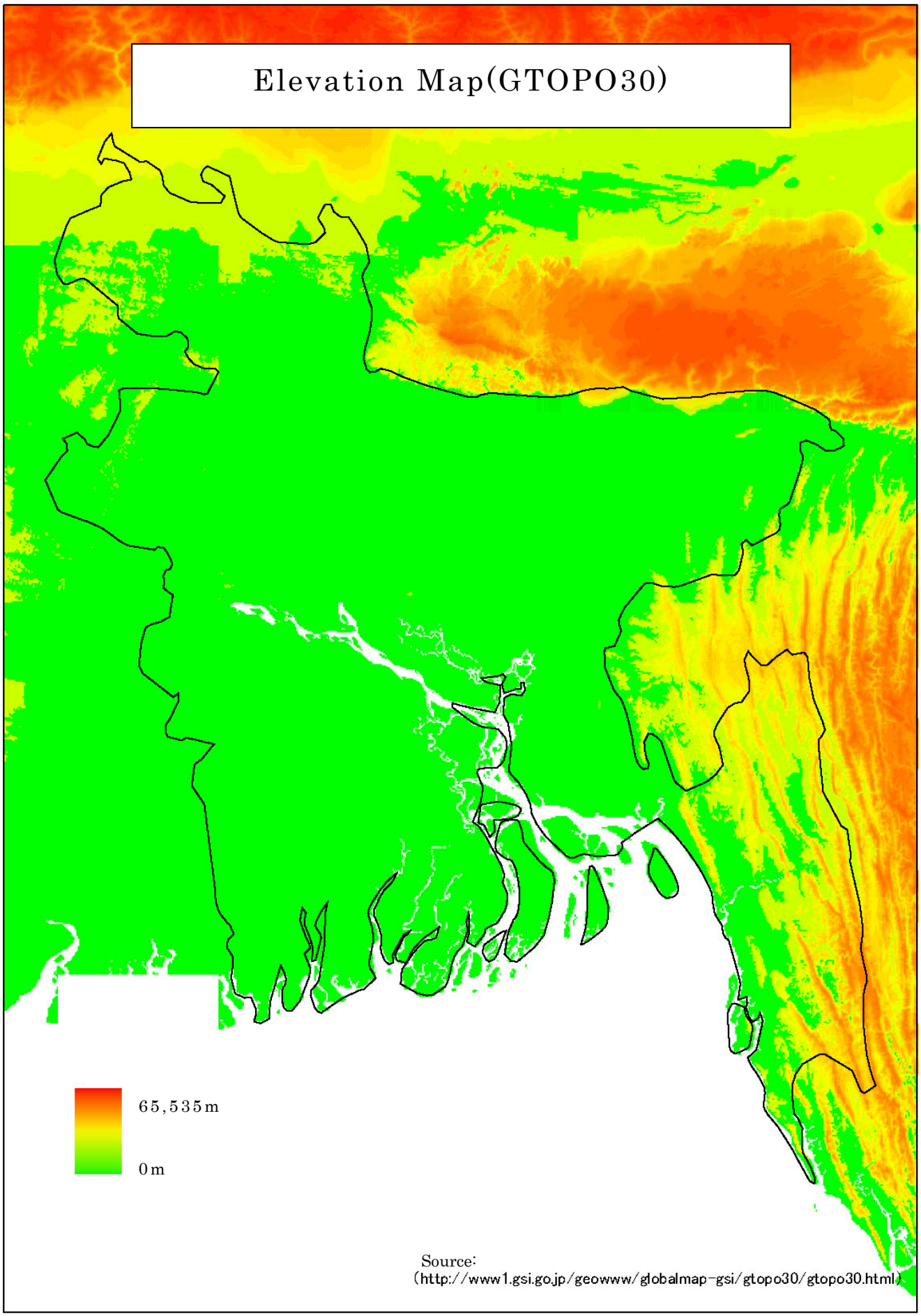


UNDP/GOB Project BGD/ 91 /021
Inception Report, June 1992

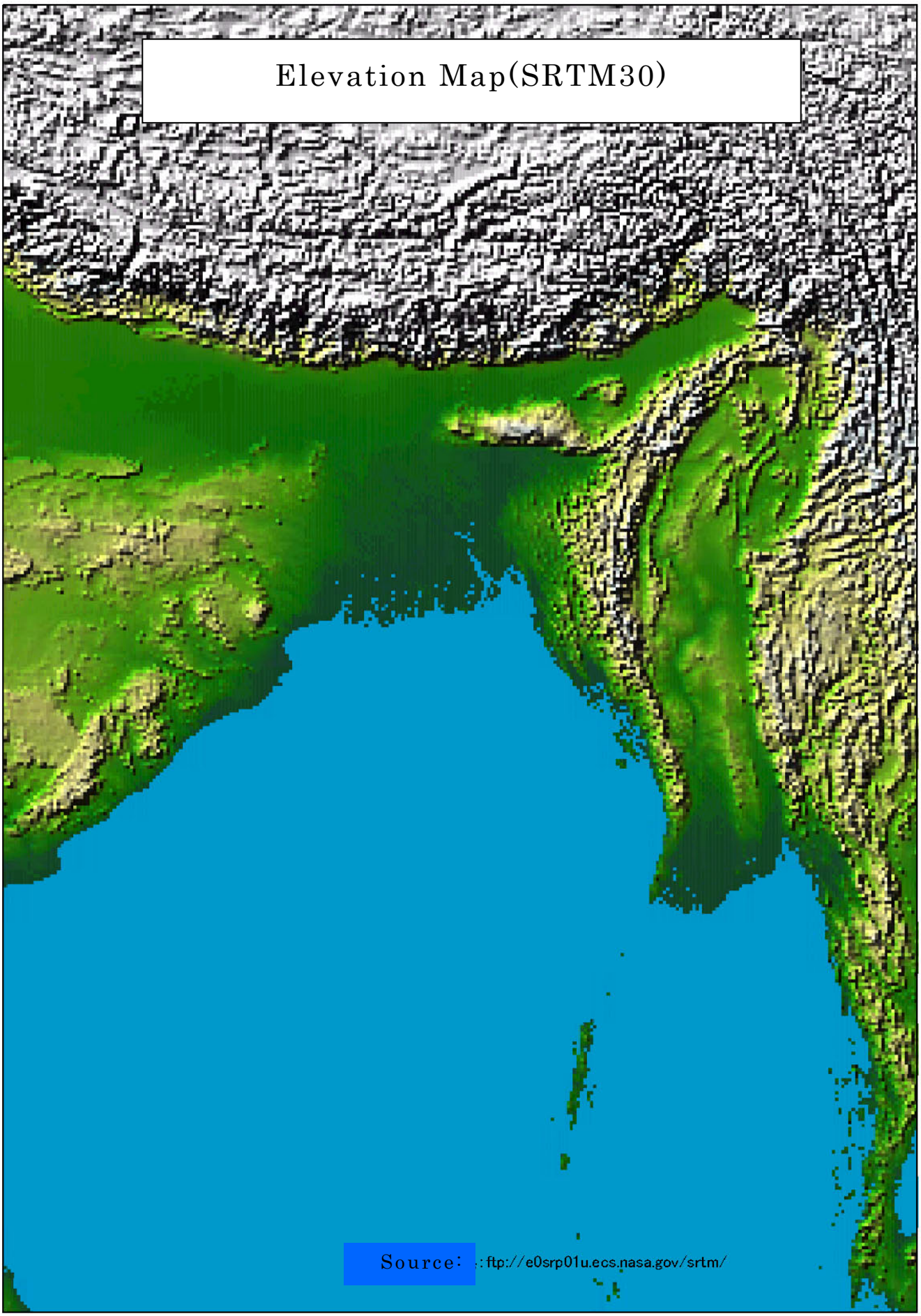

MAP OF HATIIYA
AND LOCATION OF
BDRCS SHELTERS
Choangi Bazar
Noal Chira Bazar
Char Bharot
Ramcharan
Lomboria
Bangla Bazar
Boalia
Razer Howla
Tamaruddin
Sunner Char
Koralia
Rehania
West Maiz Chara
Char Changa
Chota Dail
Chowrasta Bazar
Jahazmara
Char Fakira
Mag Fasion
Sukhchar
Nijhum Dwip I
Nijhum Dwip II
DISTRICT BHOLA
SHAHBAZPUR RIVER
HATIYA
BAY OF BENGAL
THANA
HATIYA
DISTRICT
NOAKHALI
LEGEND
NOTE
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MULTIPURPOSE CYCLONE SHELTER PROGRAMME
BANGLADESH UNIVERSITY OF ENGINEERING & TECHNOLOGY
BANGLADESH INSTITUTE OF DEVELOPMENT STUDIES
SCALE

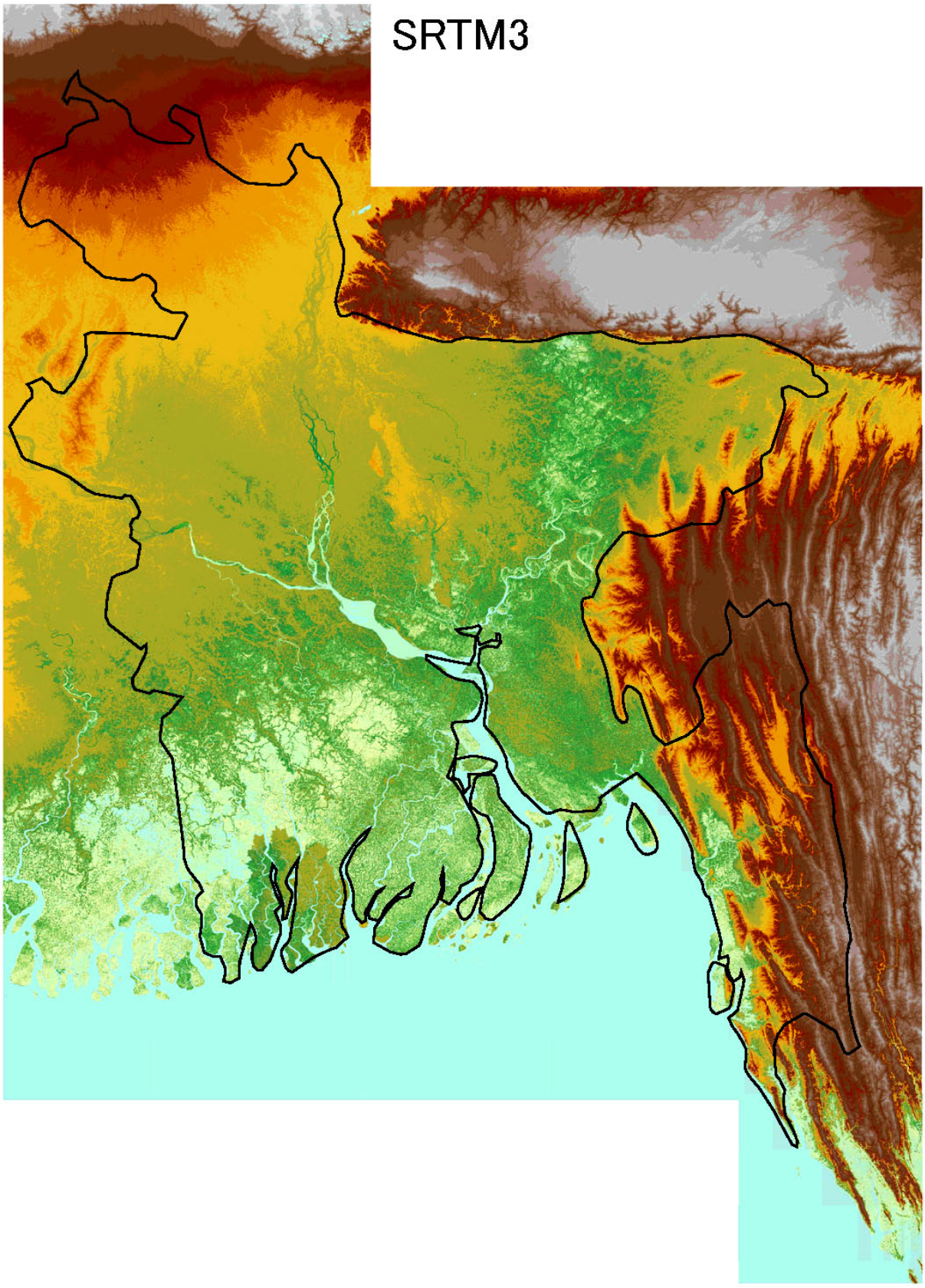

Basic or Absolute Poverty by District
N
Legend
< 50% of the population poor
> 50% of the population poor
Extended hydrological region boundary
Notes
"Poor" mean not able to purchase or have access to food equivalent to 2,122 K. calorie per capita/per day
PANCHAGARH
THAKURGAON
LALMONIRHAT
NILPHAMARI
DINAJPUR
KURIGRAM
RANGPUR
GAIBANDHA
JOYPURHAT
JAMALPUR
SHERPUR
NETRAKONA
SUNAMGANJ
SYLHET
NAOGAON
BOGRA
NAWABGANJ
MYMENSINGH
RAJSHAHI
SIRAJGANJ
KISHOREGANJ
MAULVIBAZAR
NATORE
TANGAIL
HABIGANJ
PABNA
GAZIPUR
BRAHAMANBARIA
KUSHTIA
MANIKGANJ
NARSINGDI
MEHERPUR
RAJBARI
DHAKA
NARAYANGANJ
CHUADANGA
FARIDPUR
MUNSHIGANJ
JHENAIDAH
MAGURA
SHARIATPUR
COMILLA
MADARIPUR
CHANDPUR
KHAGRACHHARI
JESSORE
NARAIL
GOPALGANJ
FENI
RANGAMATI
LAKSHMIPUR
BARISAL
NOAKHALI
BAGERHAT
KHULNA
JHALOKATI
CHITTAGONG
SATKHIRA
PATUAKHALI
PIROJPUR
BHOLA
BARGUNA
BANDARBAN
S BAZAR
Moupura
Hatiya
Nijhum Dwip
50 0 50 km
26°
88°
90°
24°
22°
92°
View1


BANGLADESH
ELEVATION MAP
LEGEND
Elevation in Metres
300
75
30
10
3
Sea Level
International Boundary
Rivers
Assam (India)
West Bengal (India)
Tripura (India)
Mizoram (India)
Myanmar
Moupura
Hatiya
Nijhum Dwip
BAY OF BENGAL
Source : Geological Survey of Bangladesh, 1990


Elevation Map(GTOPO30)
65,535m
0m
Source:
(http://www1.gsi.go.jp/geowww/globalmap-gsi/gtopo30/gtopo30.html)

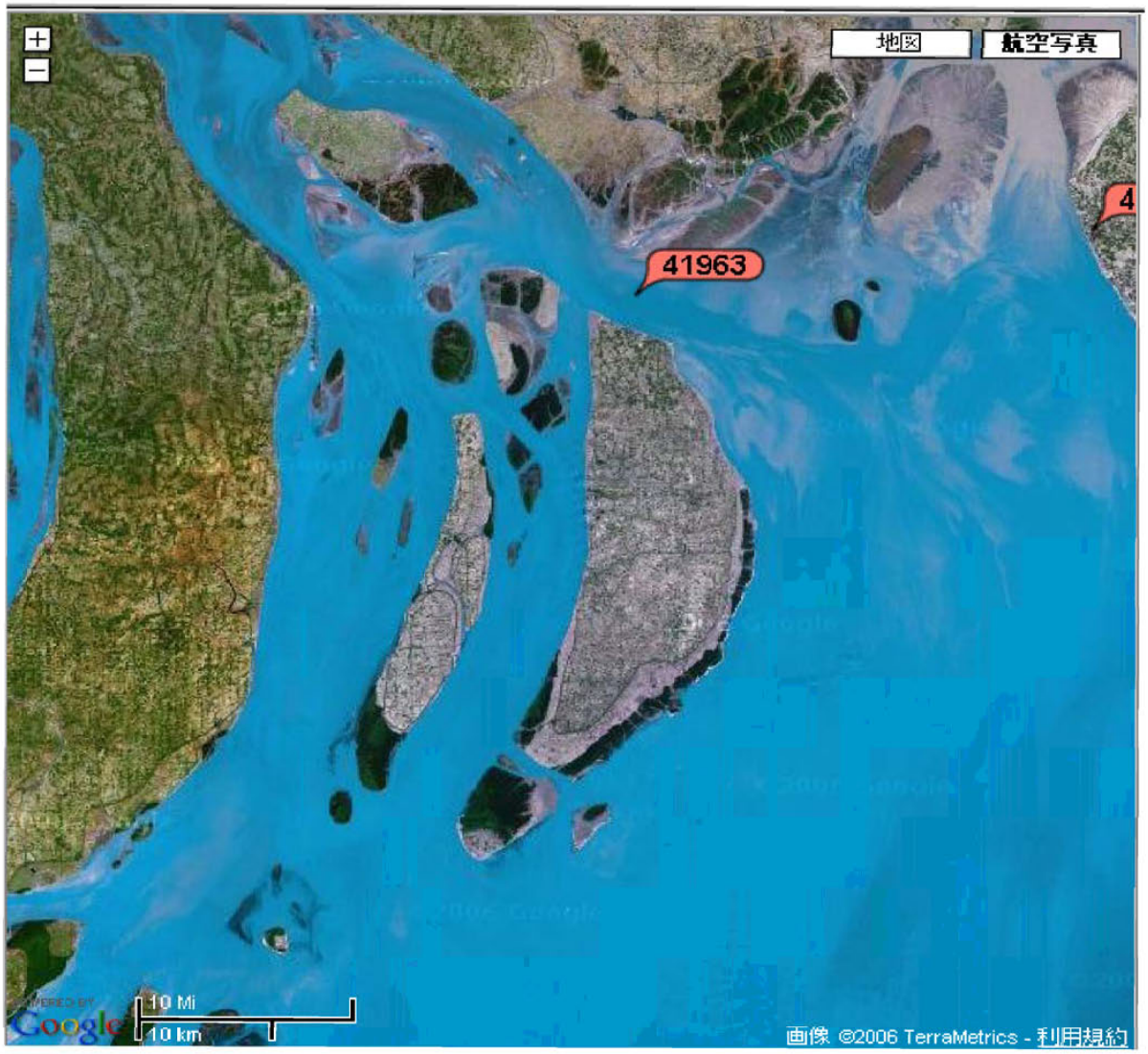
Elevation Map(SRTM30)





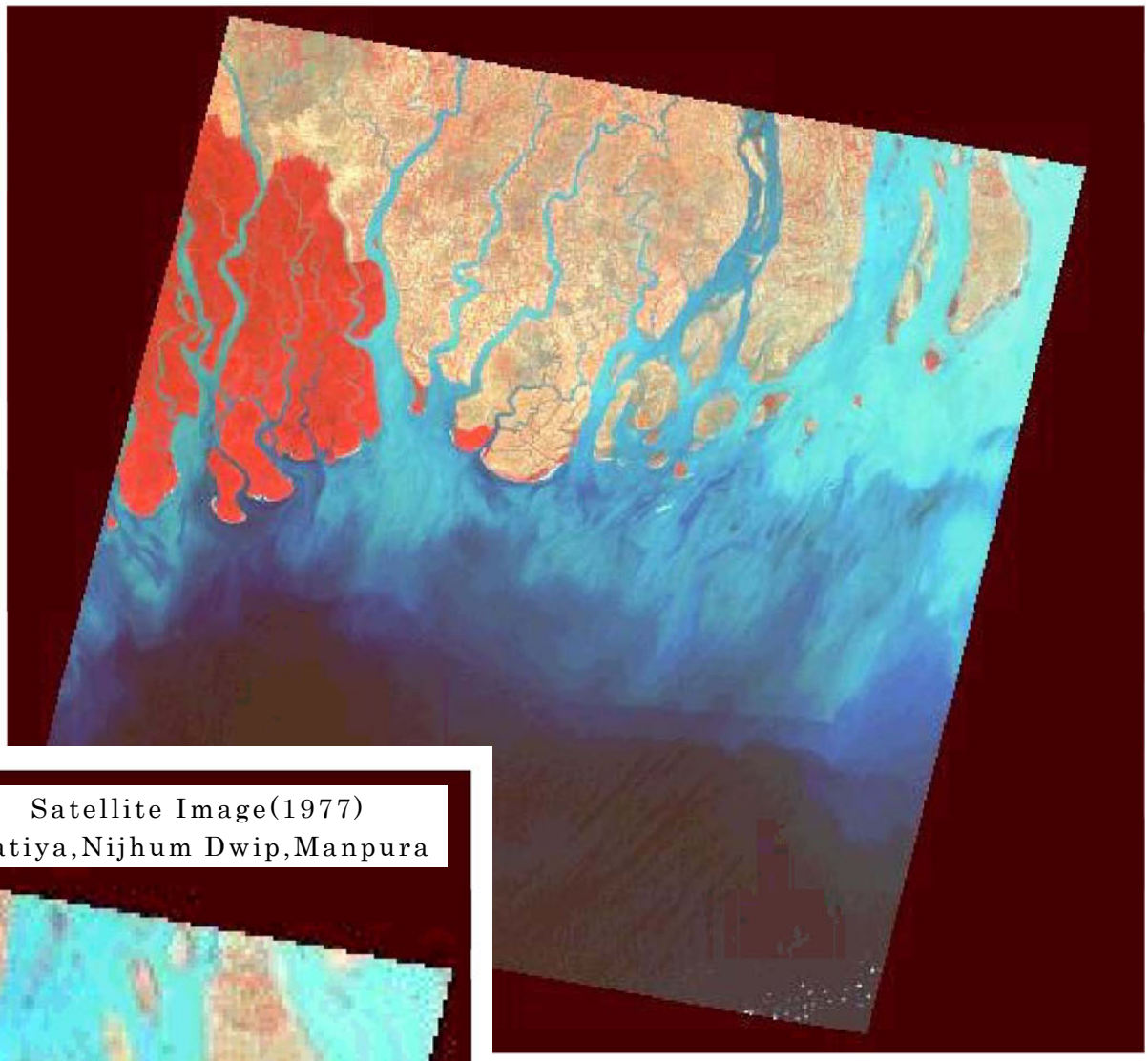
Source: :SRTM3
(ftp://e0srp01u.ecs.nasa.gov/srtm/version2/SRTM3/Eurasia/

Satellite Image(Google Map)

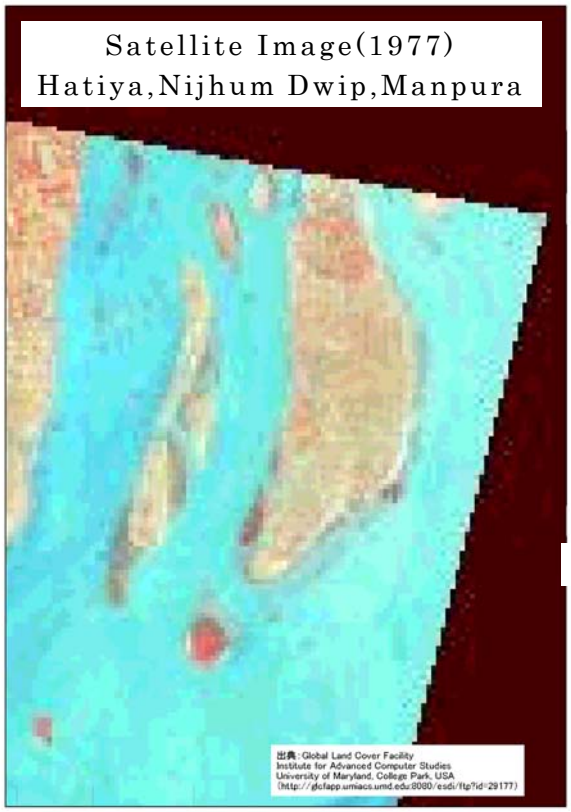


Google Map
(http://maps.google.co.jp/maps)

Satellite Image(1977)

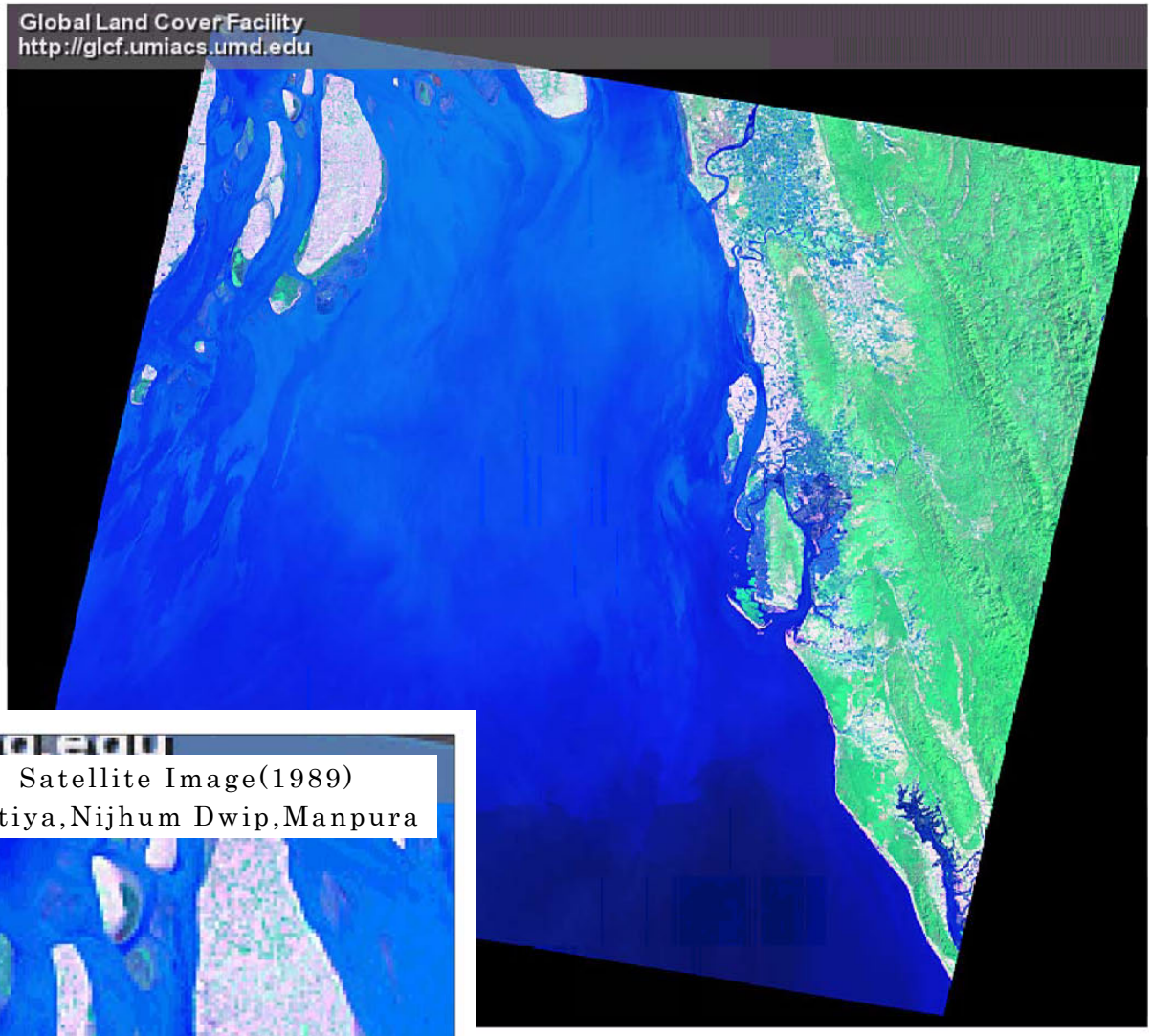


Satellite Image(1977)
Hatiya,Nijhum Dwip,Manpura



：Global Land Cover Facility
Institute for Advanced Computer Studies
University of Maryland, College Park, USA
(http://glcfapp.umiacs.umd.edu:8080/esdi/ftp?id=29177)

Satellite Image(1977)



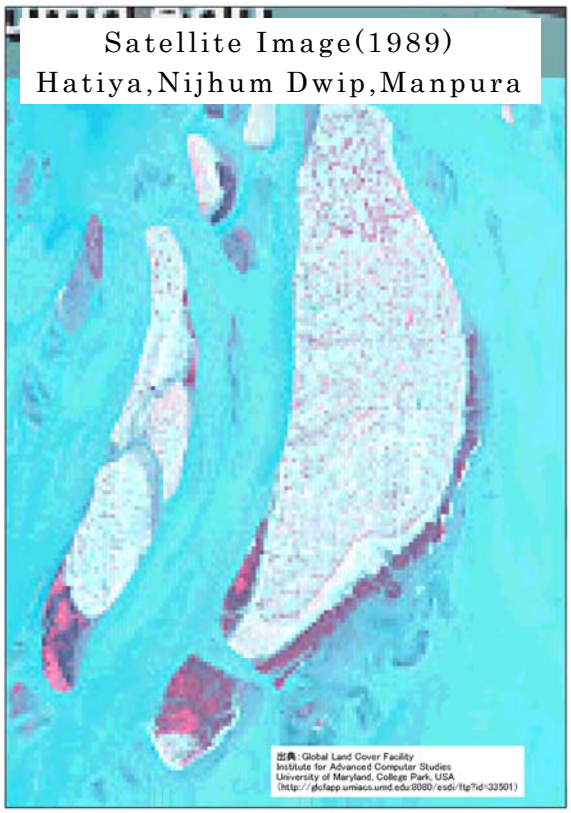


Satellite Image(1989)
Hatiya,Nijhum Dwip,Manpura

出典：Global Land Cover Facility
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University of Maryland, College Park, USA
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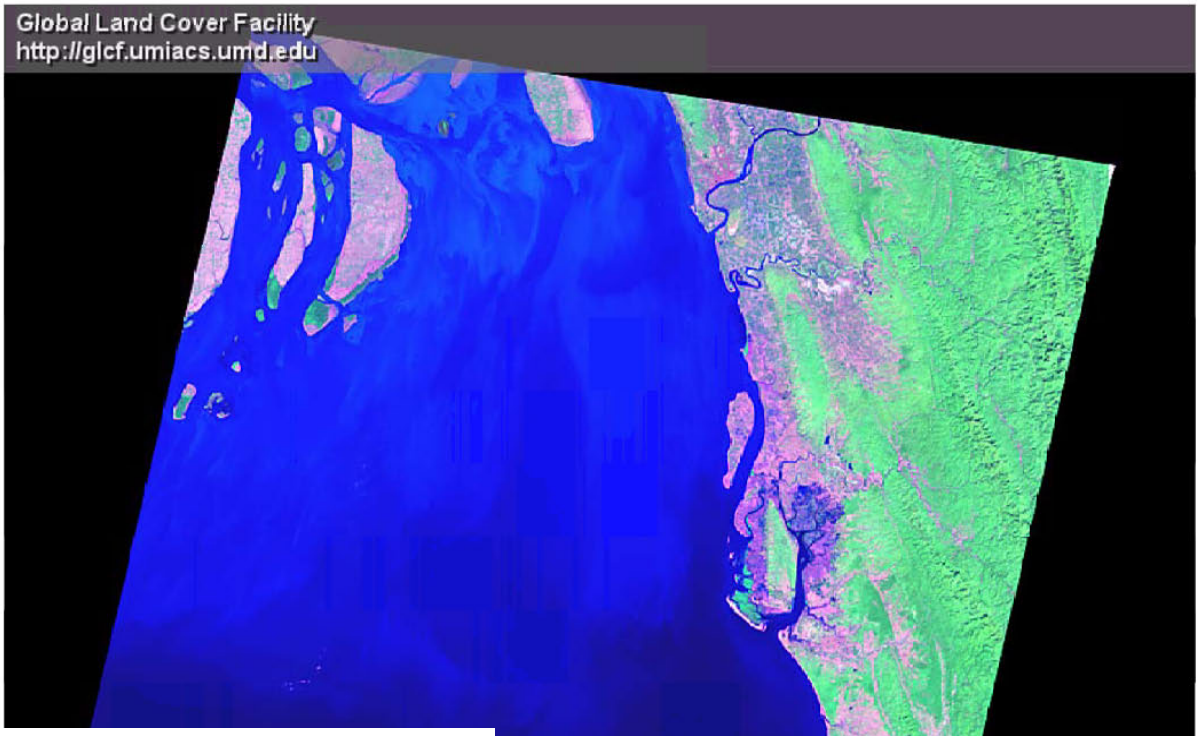
Satellite Image(1989)





出典：Global Land Cover Facility
Institute for Advanced Computer Studies
University of Maryland, College Park, USA
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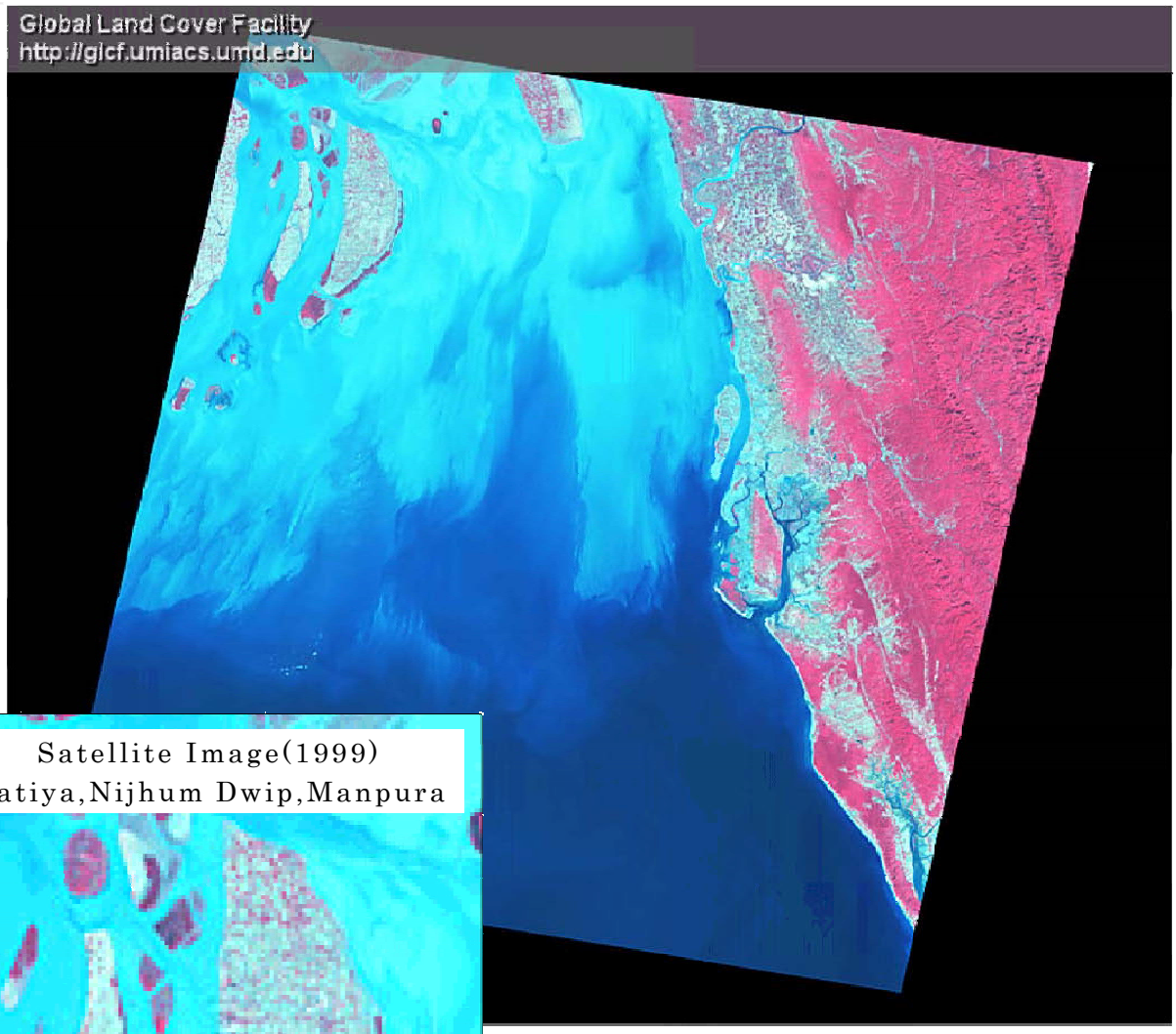
Satellite Image(1999)

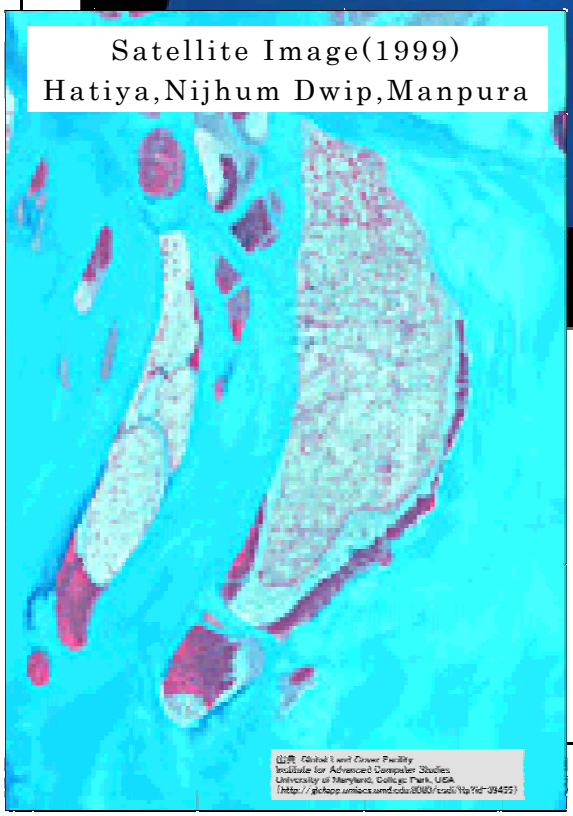




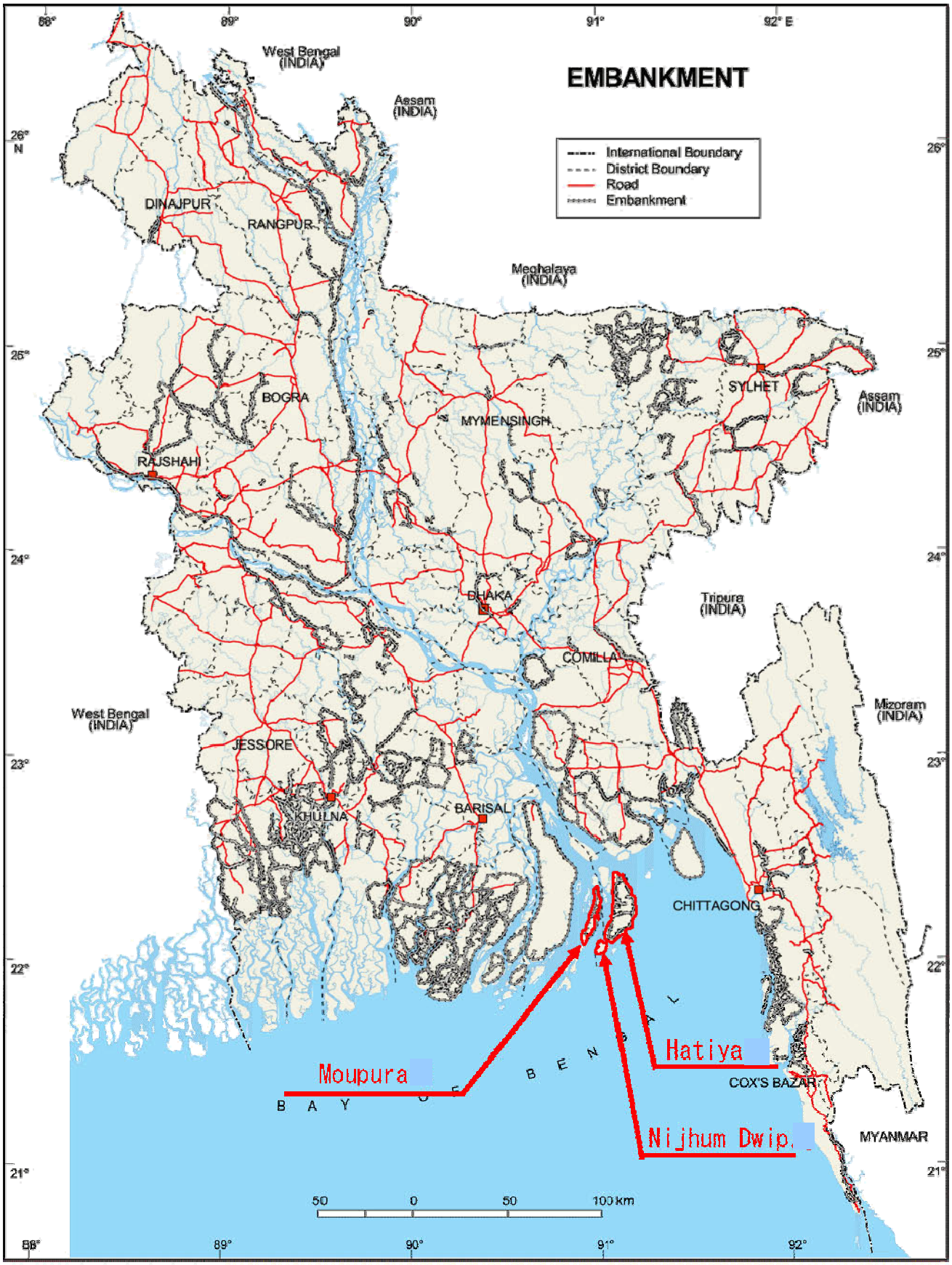
出典：Global Land Cover Facility
Institute for Advanced Computer Studies
University of Maryland, College Park, USA
(http://glcfapp.umiacs.umd.edu:8080/esdi/ftp?id=39455)

Satellite Image(1999)





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(http://glcfapp.umiacs.umd.edu:8080/esdi/ftp?id=39455)


EMBANKMENT
International Boundary
District Boundary
Road
Embankment
West Bengal (INDIA)
Assam (INDIA)
Meghalaya (INDIA)
Tripura (INDIA)
Mizoram (INDIA)
DINAJPUR
RANGPUR
BOGRA
RAJSHAHI
MYMENSINGH
SYLHET
DHAKA
COMILLA
JESSORE
KHULNA
BARISAL
CHITTAGONG
COX'S BAZAR
MYANMAR
Moupura
Hatiya
Nijhum Dwip
B A Y O F B E N G A L
50 0 50 100 km
88° 89° 90° 91° 92° E
26° N
25°
24°
23°
22°
21°

List of cyclone shelters and number of evacuee (constructed by Bangladesh Red Crescent Society ,Japanese Red Cross Society)

Document obtained from Japanese Red Cross Society (R11)														(R12)			
Name of theShelter	Primary School Prg.	Govt	Registered	Unregistered	Plottage (dec.)	building area (dec.)	Demarcation	Fencing	Fishiculture	Nursery	Use of open land	Leased for Agriculture	SHELTER NAME	1991 EVACUEE	1991 DEAH	1992 EVACUEE	1994 EVACUEE
SIRAZGONJ		—	—	—	80	10	Yes		Yes	Yes	Paddy &seadonal crops	Yes					
DIDAR BARI	Yes	—	○	—	70	10	Yes		Yes	Yes	Paddy &seadonal crops	Yes					
PEARY MOHON		—	—	—	97	10	Yes			Yes	Seasonal crops	Yes					
MASTER HAT		—	—	—	80	10	Yes				On process of site development						
SONAR CHAR	Yes	○			88	10	Yes			Yes	Play ground						
CROSS DAME		—	—	—	74	10	Yes			Yes	Paddy cultivation	Yes					
CHAR FAIZUDDIN		—	—	—	95	10	Yes				On process of site development						
MAIZCHARA	Yes	○	—	—	80	10	Yes			Yes	Play ground		West Maijchara	600	31	150	85
NALCHIRA		—	—	—	15	10	Yes			Yes	Seasonal crops	Yes	Noalchira	100	6	57	150
REHANIA		—	—	—	50	10	Yes			Yes	Seasonal crops by donor		Rehania	523	326	—	300
RAZAE HOWLA		—	—	—	50	10	Yes		Yes	Yes	Seasonal crops	Yes	Razar Howla	150	171	50	150
TOMORUDDI		—	—	—	40	10	Yes		Yes	Yes	Tree plantation	Yes	Tamaruddi	—	—	—	325
CHAR BHARAT SEN	Yes	—	○	—	40	10	Yes			Yes	Paddy &seadonal crops	Yes	Char Bharot	—	—	—	220
RAM CHARAN		—	—	—	35	10	Yes			Yes	Paddy &seadonal crops	Yes	Ramchoron	56	3	50	120
BANGLA BAZAR	Yes	—	—	○	20	10	Yes			Yes	Seasonal crops	Yes	Bangla bazar	200	18	80	85
BOALIA		—	—	—	45	10	Yes			Yes	Paddy &seadonal crops	Yes	Boalia	120	3	200	170
KORALIA	Yes	—	○	—	60	10	Yes			Yes	Paddy &seadonal crops	Yes	Koralia	525	14	85	400
SUNNER CHARAN	Yes	○	—	—	50	10	Yes	Yes	Yes	Yes	Play ground&plantation	Yes	Sunner char	—	—	—	365
CHOTA DAIL	Yes	—	—	○	60	10	Yes		Yes		Paddy cultivation	Yes	Chotodail	700	389	170	365
CHAR CHENGA		—	—	—	40	10	Yes			Yes	Play ground		Char changa	—	—	—	150
CHOWRASTA BAZAR		—	—	—	30	10	Yes			Yes	Play ground		Chowrasta bazar	450	22	200	150
LOMBORIA	Yes	—	○	—	70	10	Yes	Yes	Yes	Yes	Tree plantation	Yes	Lambolia	—	—	—	250
JAHAZ MARA		—	—	—	60	10	Yes			Yes	Paddy cultivation	Yes	Jahazmara	220	89	300	350
SHUKH CHAR		—	—	—	50	10	Yes				Mosque		Sukchar	700	49	300	200
MAC FARSON	Yes	—	○	—	50	10	Yes	Yes	Yes	Yes	Paddy cultivation	Yes	Magfasion	450	105	220	130
CHAR FAKIRA		—	—	—	50	10	Yes	Yes	Yes	Yes	Seasonal crops &Tree plane.	Yes	Charfakira	556	50	123	350
NIJHUMDWIP(1)	Yes			○	192	10	Yes			Yes	Paddy cultivation	Yes	Nijumdip Ⅰ	1200	422	1300	350
NIJHUMDWIP(2)		—	—	—	192	10	Yes			Yes	Paddy cultivation	Yes	Nijumdip Ⅱ	—	—	—	375
													Chowrangi	200	16	120	150

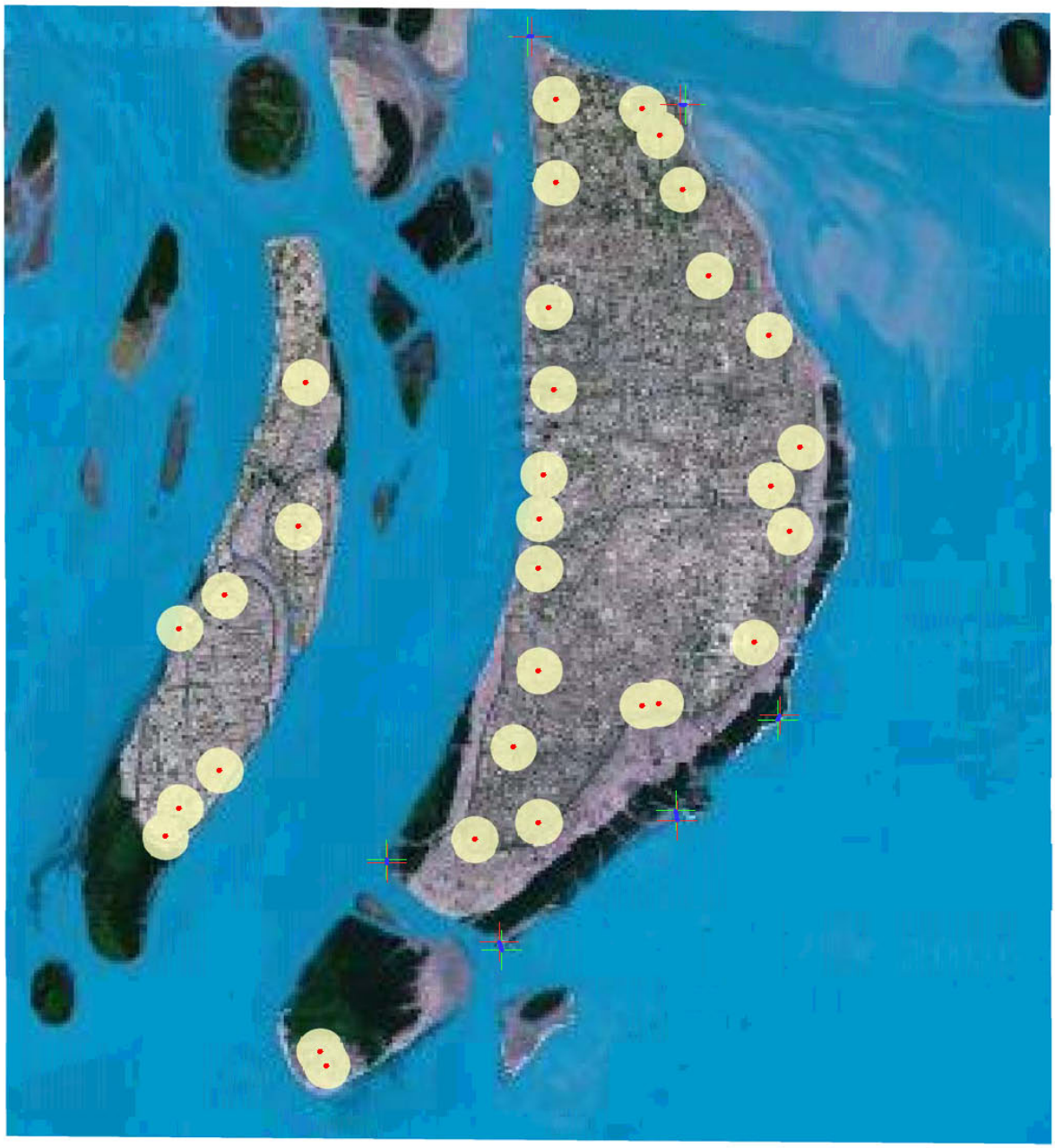
LIST OF CYCLONE SHELTERS IN HATIYA & MONPURA THANA

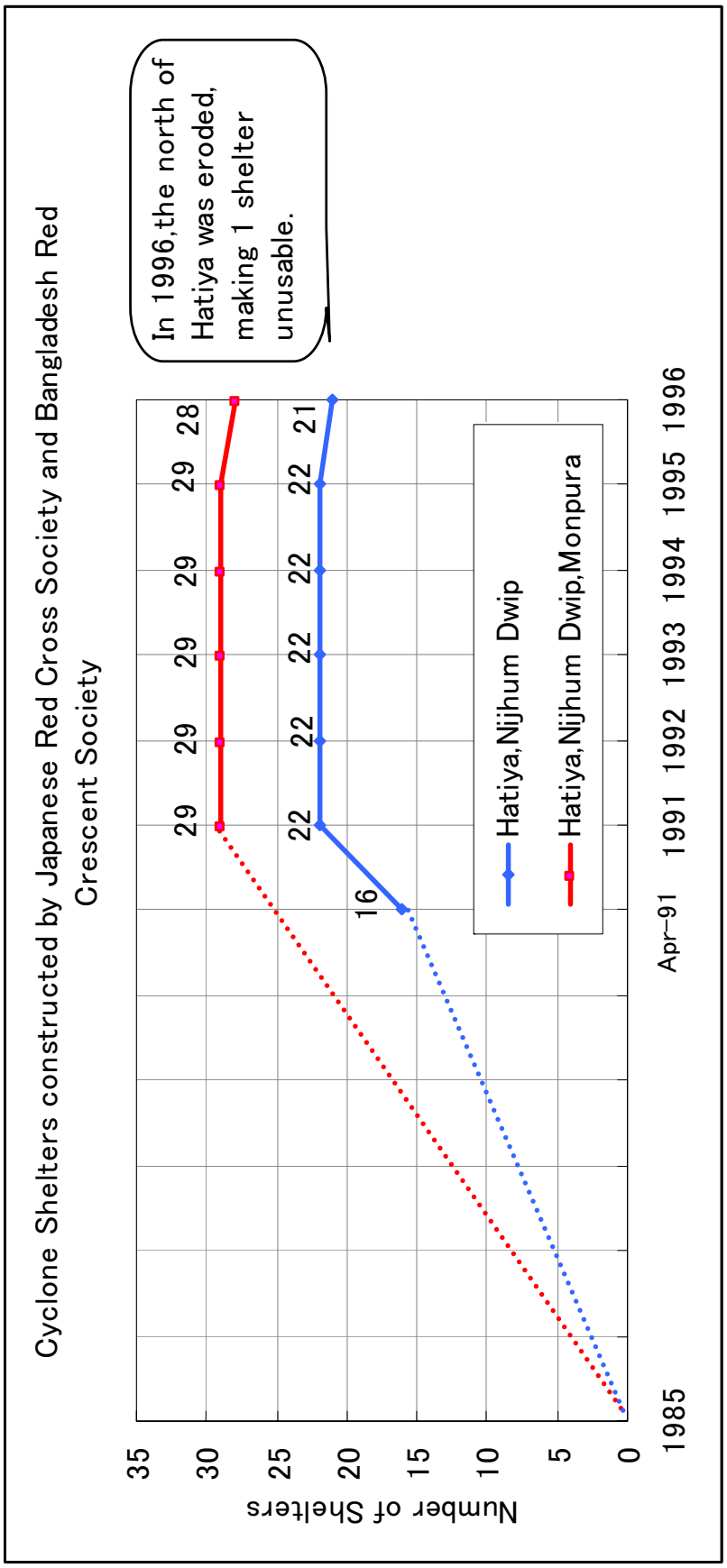
CONSTRUCTED BY BANGLADESH RED CRESCENT SOCIETY
WITH SUPPORT OF JAPANESE RED CROSS SOCIETY

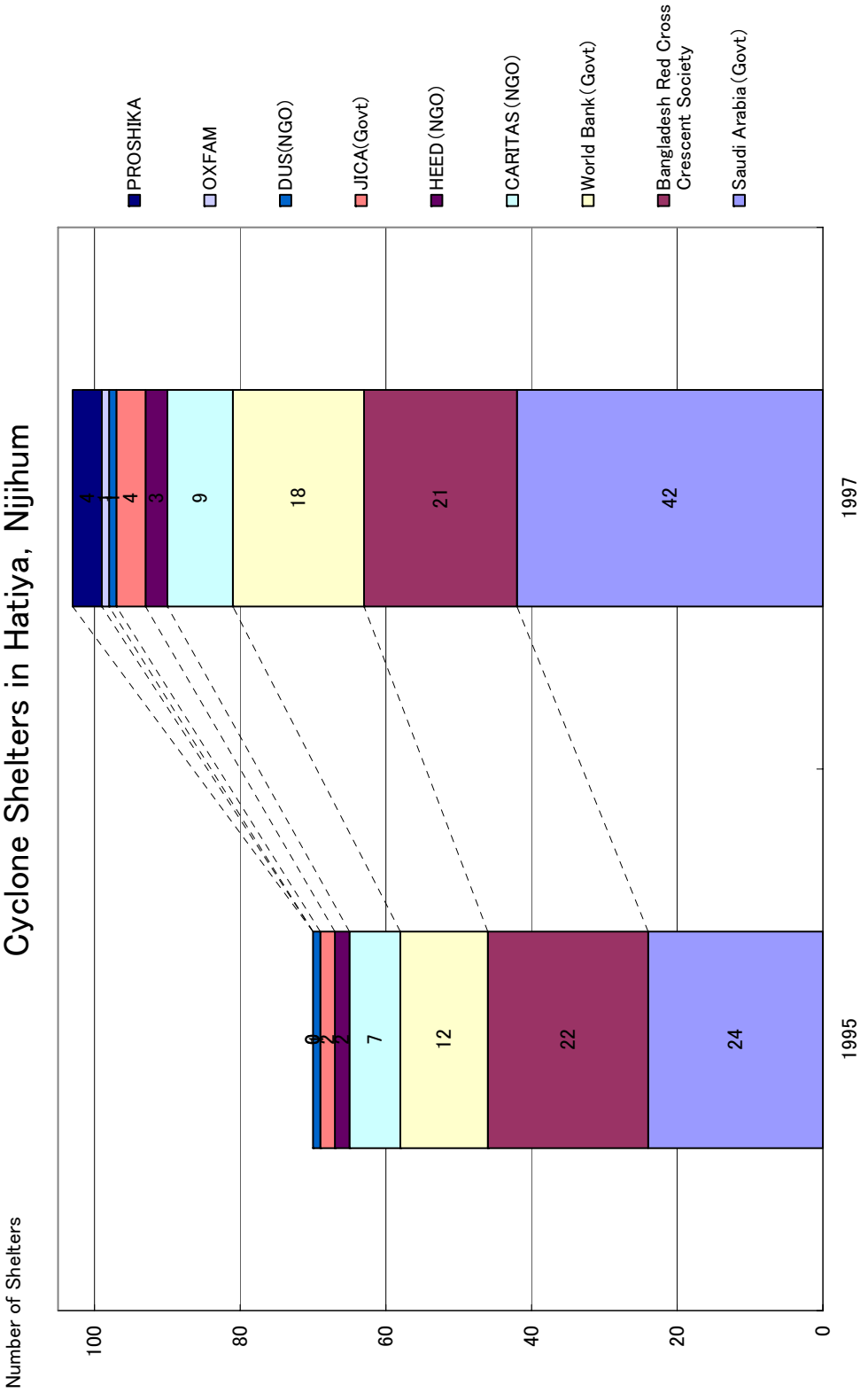
Name of the shelter	Primary school prg.	Total land	Occupied by shelter	Demarcation	Fencing	Fishiculture	Nursery	Use of open land
SIRAZGONJ		80 dec.	10 dec.	Yes	No	Yes	Yes	Paddy & seasonal crops ▲
DIDAR BARI	Yes ■	70 dec.	10 dec.	Yes	No	Yes	Yes	Paddy & seasonal crops ▲
PEARY MOHON		97 dec.	10 dec.	Yes	No	No	Yes	Seasonal crops ▲
MASTER HAT		80 dec.	10 dec.	Yes	No	No	No	On process of site development
SONAR CHAR	Yes ❖	88 dec.	10 dec.	Yes	No	No	Yes	Play ground
CROSS DAME		74 dec.	10 dec.	Yes	No	No	Yes	Paddy cultivation ▲
CHAR FAIZUDDIN		95 dec.	10 dec.	Yes	No	No	No	On process of site development
MAIZCHARA	Yes ❖	80 dec.	10 dec.	No	No	No	Yes	Play ground
NALCHIRA		15 dec.	10 dec.	Yes	No	No	Yes	Seasonal crops ▲
REHANIA		50 dec.	10 dec.	Yes	No	No	Yes	Seasonal crops by donor
RAZAR HOWLA		50 dec.	10 dec.	Yes	No	Yes	Yes	Seasonal crops ▲
TOMORUDDI		40 dec.	10 dec.	Yes	No	Yes	Yes	Tree plantation ▲
CHAR BHARAT SEN	Yes ■	40 dec.	10 dec.	Yes	No	No	Yes	Paddy & seasonal crops ▲
RAM CHARAN		35 dec.	10 dec.	Yes	No	No	Yes	Paddy & seasonal crops ▲
BANGLA BAZAR	Yes ●	20 dec.	10 dec.	Yes	No	No	Yes	Seasonal crops ▲
BOALIA		45 dec.	10 dec.	Yes	No	No	Yes	Paddy & seasonal crops ▲
KORALIA	Yes ■	60 dec.	10 dec.	Yes	No	No	Yes	Paddy & seasonal crops ▲
SUNNER CHAR	Yes ❖	50 dec.	10 dec.	Yes	Yes	Yes	Yes	Play ground & Plantation ▲
CHOTA DAIL	Yes ●	60 dec.	10 dec.	Yes	No	Yes	No	Paddy cultivation ▲
CHAR CHENGA		40 dec.	10 dec.	Yes	No	No	Yes	Play ground
CHOWRASTA BAZAR		30 dec.	10 dec.	Yes	No	No	Yes	Play ground
LOMBORIA	Yes ■	70 dec.	10 dec.	Yes	Yes	Yes	Yes	Tree plantation ▲
JAHAZ MARA		60 dec.	10 dec.	Yes	No	No	Yes	Paddy cultivation ▲
SHUKH CHAR		50 dec.	10 dec.	Yes	No	No	No	Mosque
MAC FARSON	Yes ■	50 dec.	10 dec.	Yes	Yes	Yes	Yes	Paddy cultivation ▲
CHAR FAKIRA		50 dec.	10 dec.	Yes	Yes	Yes	Yes	Seasonal crops & Tree plant. ▲
NIJHUMDWIP (1)	Yes ●	192 dec.	10 dec.	Yes	No	No	Yes	Paddy cultivation ▲
NIJHUMDWIP (2)		192 dec.	10 dec.	Yes	No	No	Yes	Paddy cultivation ▲

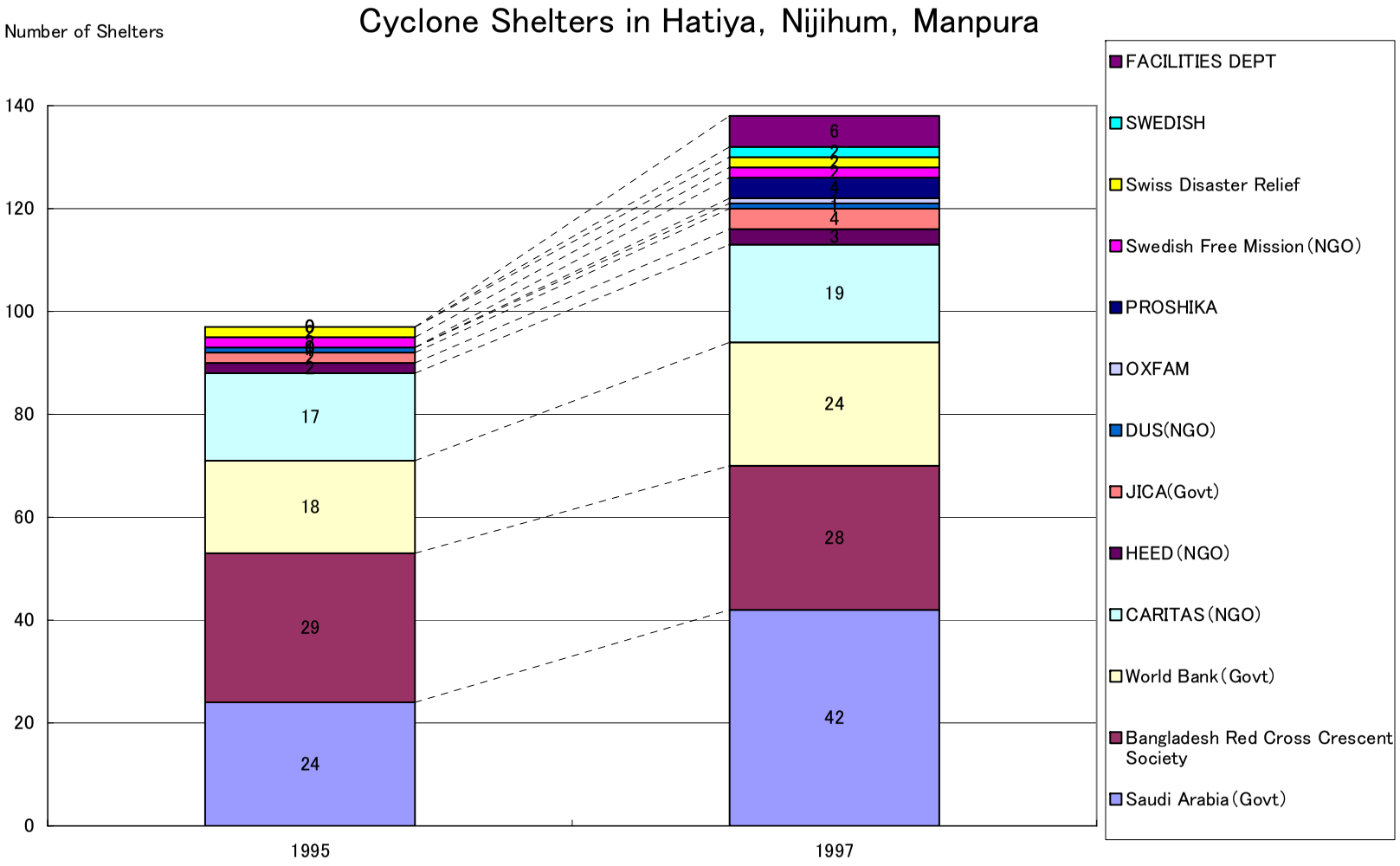
❖ = Govt. Primary School
■ = Registered School (Government enlistment)
● = Unregistered School (Not yet enlisted by the Govt.)
▲ = Leased for cultivation

Cyclone Shelters




Cyclone Shelters constructed by Japanese Red Cross Society and Bangladesh Red Crescent Society
In 1996,the north of Hatiya was eroded, making 1 shelter unusable.
Number of Shelters
0
5
10
15
20
25
30
35
1985
1991
1992
1993
1994
1995
1996
Apr-91
Hatiya,Nijhum Dwip
Hatiya,Nijhum Dwip,Monpura
16
22
22
22
22
22
21
29
29
29
29
29
28


Cyclone Shelters in Hatiya, Nijihum
Number of Shelters
PROSHIKA
OXFAM
DUS(NGO)
JICA(Govt)
HEED(NGO)
CARITAS(NGO)
World Bank(Govt)
Bangladesh Red Cross Crescent Society
Saudi Arabia(Govt)
0
20
40
60
80
100
1995
1997
4
1
1
4
3
9
18
21
42
0
2
2
7
12
22
24


Cyclone Shelters in Hatiya, Nijihum, Manpura
Number of Shelters
140
120
100
80
60
40
20
0
1995
1997
24
29
18
17
2
1
1
1
9
42
28
24
19
3
4
1
4
2
2
6
FACILITIES DEPT
SWEDISH
Swiss Disaster Relief
Swedish Free Mission (NGO)
PROSHIKA
OXFAM
DUS(NGO)
JICA(Govt)
HEED (NGO)
CARITAS (NGO)
World Bank (Govt)
Bangladesh Red Cross Crescent Society
Saudi Arabia (Govt)

BOX 2 NUMBER OF EVACUEE/DEATH IN CYCLONE SHELTER COMMAND AREA (1 KM RADIUS)

	1991		1992	1994
SHELTER NAME	EVACUEE	DEATH	EVACUEE	EVACUEE
NORTH-EAST				
Chowrangi	**200**	**16**	120	150
Noalchira	**100**	**6**	57	150
Lambolia	-	-	-	250
Bangla bazar	**200**	**18**	80	85
Razar Howla	**150**	**171**	50	150
Sunner char	-	-	-	365
SOUTH-EAST				
Rehania	**523**	**326**	-	300
Chotodail	**700**	**389**	170	365
Charfakira	**556**	**50**	123	350
Magfasion	**450**	**105**	220	130
NIJUMDIP				
Nijumdip I	**1,200**	**422**	1,300	350
Nijumdip II	-	-	-	375
SOUTH-WEST				
Sukchar	**700**	**49**	300	200
Jahazmara	**220**	**89**	300	350
Chowrasta bazar	**450**	**22**	200	150
Char changa	-	-	-	150
NORTH-WEST				
West Maijchara	**600**	**31**	150	85
Koralia	**525**	**14**	85	400
Tamaruddin	-	-	-	325
Boalia	**120**	**3**	200	170
Ramchoron	**56**	**3**	50	120
Char Bharot	-	-	-	220

* 1991 EVACUEE : number of people who evacuated in cyclone shelter on 29 April 1991

DEATH : number of people killed in the catchment area of cyclone shelter on 29 April 1991

* 1992 EVACUEE : number of people who evacuated in cyclone shelter responding to the peak warning on 21 November 1992

* 1994 Evacuee : number of people who evacuated in cyclone shelter responding to the peak warning on 2 May 1994.