THE CYCLONE DISASTER OF 29-30 APRIL, 1991 IN BANGLADESH

Iware MATSUDA*

Abstract I carried out field studies on the catastrophe of the April, 1991 cyclone hazard in Bangladesh. Vulnerability to cyclone hazard was discussed from the point of view of both social and physical conditions. Although losses of property and social facilities were larger in 1991 than in 1970, human casualty figures showed the reverse tendency. This fact indicates to the effectiveness of the shelters constructed after the 1970 disaster. Fact-finding on refuge taking behavior and living conditions soon after the disaster are necessary to plan countermeasures in the vulnerable coastal lowlands. Control of population growth and land reformation are indispensable to counter natural hazards in Bangladesh.

Key words: Bangladesh, cyclone disaster, comprehensive countermeasure, vulnerability

1. Introduction

The tropical depression was detected in the southern part of the Bay of Bengal on the 23rd of April. It grew up to be a cyclone on the 26th and moved to the north. It turned a direction easterly from the 28th and hit Chittagong, the second largest city of Bangladesh around midnight of the 29th. The coastal areas and off-shore islands were devastated by high storm surges and strong wind. The highest storm surge and the maximum wind speed as recorded were 20-25 feet and 235 km/h, respectively.

The Bangladesh Meteorological Observatory issued warning repeatedly. According to the Bangladesh Government, 3 millions of people took refuge. However, the catastrophic damage was induced. Since the southern part of Bangladesh had not suffered from cyclone disaster for these three decades, the poor preparedness to a cyclone made damage more serious.

The official report said that the number of deaths was over 140,000 and widespread losses in agriculture, industry, physical and socioeconomic infrastructure and others reached about 4.3 billion US dollars in total. The total loss was equivalent to one third of GDP.

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The United Nations Centre for Regional Development constituted an action team consisting of seven experts from Bangladesh, France, Japan and UNCRD. I carried out field studies on the catastrophe with other six members between the 9th and 19th of August, 1991.

I would like to mention that this article is the revised version of the report presented to UNCRD as a member of the action team (Matsuda, 1991).

2. Vulnerability to Storm Surge Disaster

Vulnerability due to social conditions

Bangladesh has the eighth largest population in the world on a total of 143,000 km^2 national land. That is, population density is 800/km^2. The large number and high density of population are the essential social vulnerability to storm surge disaster. In addition, population has been increasing rapidly at the rate of 2.5-3.0 % per year.

The present population estimated on the basis of the 1981 census data has become nearly twice as many as that of 1970 when Bangladesh experienced the severe cyclone hazard.

The gross national product of Bangladesh is 180 US dollars per person, being equivalent to 1 % of that of Japan. Bangladesh is said to be one of the poorest countries in the world. Also, large disparity in wealth exists among people, and the people of the lower classes are the overwhelming majority. These are the second social vulnerability to storm surge disaster.

Although more than 80 % of the total population depend on agriculture for their living, nearly 30 % of the farmers have less than 0.5 acres of land. Including these functionary landless farmers, about 60 % of the farmers are defined as landless.

As land partition is repeated through succession, the number of marginal farmers increases. Marginal farmers are apt to be degraded to landless people due to the loss of a strip of land induced by riverbank erosion or coastal erosion.

Most of fishermen and their families are petty. They are employees of a handful of enterprises. They are working on fishing boats, in shrimp farms and net making factories. Most of enterprisers and shipowners live apart from vulnerable areas.

Marginal people are forced to suffer most badly from natural hazards. They are likely to lose their means of living, even though they do not lose their lives. There is no reason for these people to move into accreted land in spite of dangerous conditions, otherwise they have to depend on a large landowner. Haque (1988) mentioned the process of increase of landless people. On the other hand, I did not hear that a rich person or a high government official lost his life at the cyclone disaster.

One more social vulnerability concerned with population is concentration of migrant workers in the southern parts of the country. Many landless people go south to find a job for sowing, harvesting and fishing. Especially, April, May, October and November are favorable months for getting a job at aman paddy fields, but these seasons coincide with two cyclone seasons. Also, these migrant workers are usually housed in huts which were temporarily built in the fields far from the village. It is said that concentration of migrant

workers increased the number of deaths to 500,000 in 1970. Islam (1974) pointed out that migrant workers during the sowing and harvesting seasons contribute not only to increase hazard potential but also make it difficult to estimate the number of casualties.

Economic development makes disaster potential increase. For example, the ratios for exported commodities changed very much. Jute goods and raw jute occupied 89.9 % in fiscal 1972, but they decreased to 29.6 % in fiscal 1988. On the other hand, the ratio for ready-made garments increased conspicuously. Although it was only 0.5 % in fiscal 1980, it reached 12.4 % in fiscal 1984 and 36.8 % in fiscal 1988. Also, the ratio for frozen foods increased gradually, and it became 11.0 % in fiscal 1988. Cultured shrimps, most of which were exported to Japan, represented about 90 % of frozen foods.

Industrial areas in the Chittagong District and the shrimp culture facilities in the Cox's Bazar District were most heavily affected. We can point out that disaster prevention works did not keep pace with the advance of industrialization. Also, mangrove forests along the coast were deforested for the creation of shrimp ponds and salt farms. Even low embankments were cut in order to lead sea water into these facilities. These land uses without taking account of storm surges made the losses more serious.

Vulnerability due to physical conditions

Bangladesh has the most serious storm surge problems in the world. Frank and Husain (1971) mentioned "the unique combination of a large astronomical tide, a funneling coastal configuration, low flat terrain and frequent severe tropical storms occasionally produced storm surges that killed thousands of people."

The range of astronomical tide is so large that the storm induced sea level is apt to become very high. The normal tidal range is about 3 m near the Indian border and becomes higher to the east to about 5 m near Sandwip Island. The tidal range is largest near the eastern head of the Bay of Bengal, where is located on the eastern part of the cyclone's course.

A funneling coast line reduces the width of storm induced waves to multiply them in height. Adding this fact, two strait coasts at right angles in the northern corner of the Bay of Bengal respond more effectively to multiply the storm induced waves than a strait coast line (Flierl and Robinson, 1972).

The coastal areas of the Bengal Plain and off-shore islands are low lying and very flat. The ground height of the area within some 200 km from the coast is lower than 3 m. Also, many tree stumps found in the Recent sediments 6 to 100 ft deep show existence of land subsidence in the deltaic region (Umitsu, 1985).

Geomorphic processes are very active in the Meghna Deltaic Plain located from Tentulia Estuary in the west to the Sandwip Channel in the east. Following the erosion and accretion of land, channels and shoals are always changing their position. For example, the Bamni Channel was buried for these two decades, and the North Hatiya Island of Noakhali District was connected to the main land (Umitsu, 1985). The northern coasts of such off-shore islands as Sandwip, South Hatiya and Manpura Islands have been eroded and newly emerged lands have been accreted on the coast south of them. Some villages located in the northwestern part of Sandwip Island in 1926 disappeared by

1970 due to erosion. A cyclone shelter once built near the southern coast is located several kilometers inland now (Umitsu, 1991).

Mooley and Mohile (1983) analysed the frequency of cyclonic storm incidents over the Bay of Bengal. They clarified that 392 tropical storms were born between 1877 and 1980, and 63 of them had landfall on the Bangladesh coast. That means Bangladesh suffered from more than one tropical storm every other year.

Figure 1 shows the monthly distribution of tropical storms hitting the Bangladesh coast between 1877 and 1990. A cyclonic storm means that it has the maximum sustained wind of 35 to 54 kt, and a severe cyclonic storm has more than 55 kt. Data before 1980 was depended on Mooley and Mohile (1983) and those after 1981 were compiled from the Mausam, Indian Journal of Meteorology. The figure shows two peaks of May to June and October to November. Especially, it is evident that the peak of severe cyclonic storms appears in May and October.

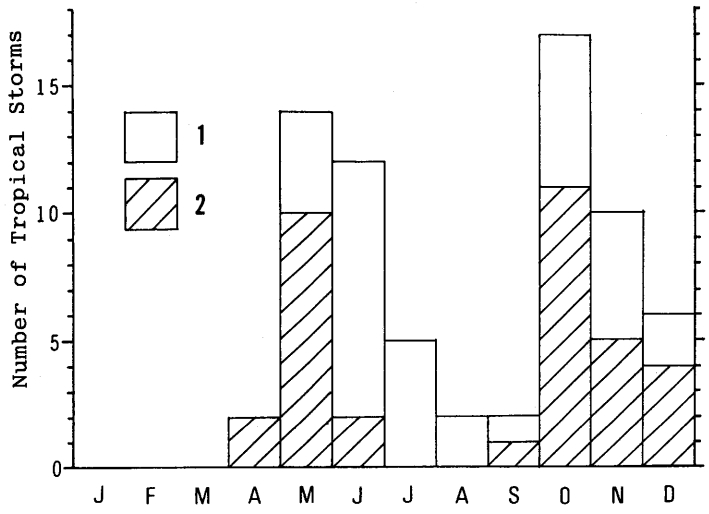

Fig. 1 Monthly distribution of tropical storms landed on the Bangladesh coast between 1877 and 1990
1 : Cyclonic storms, 2 : Severe cyclonic storms

Table 1 shows the cyclones which claimed much deaths for Bangladesh since 1960. Although 7 cyclones were listed in the 1960s, no cyclone claimed much deaths between 1971 and 1984. But I wonder that the records of deaths in the 1970s are not accurate because of confusion after independence. I suppose that more deaths occurred in this period because Mooley and Mohile (1983) mentioned that nine tropical storms hit the Bangladesh coast in the 1970s and 4 of them were a severe cyclonic storm.

Tracks of a cyclone hitting Bangladesh in recent years are shown in Fig 2. Many tropical disturbances are born in the southern part of the Bay of Bengal. After developing into a tropical cyclone, some of them move to the north. They continue to develop and turn a direction easterly to land on the Bangladesh coast. This is usual for a cyclone which affects the Meghna Deltaic Plain severely.

Table 1 Death toll from major cyclones since 1960 in Bangladesh

Data	Maximum wind velocity (kt)	Highest level of storm surge (ft)	Death toll
9 Oct 1960	100	10	3,000
30 Oct 1960	130	15−20	5,149
9 May 1961	90	8−10	11,466
28 May 1963	125	14−17	11,520
11 May 1965	100	12	19,279
14 Dec 1965	130	15−20	873
1 Oct 1966	90	15−30	850
12 Nov 1970	140	20−30	500,000
25 May 1985	95	10−15	11,069
29 Nov 1988	100	5−10	2,000
29 Apr 1991	127	20−25	140,161

Data except for 1991 are after Choudhury (1989).

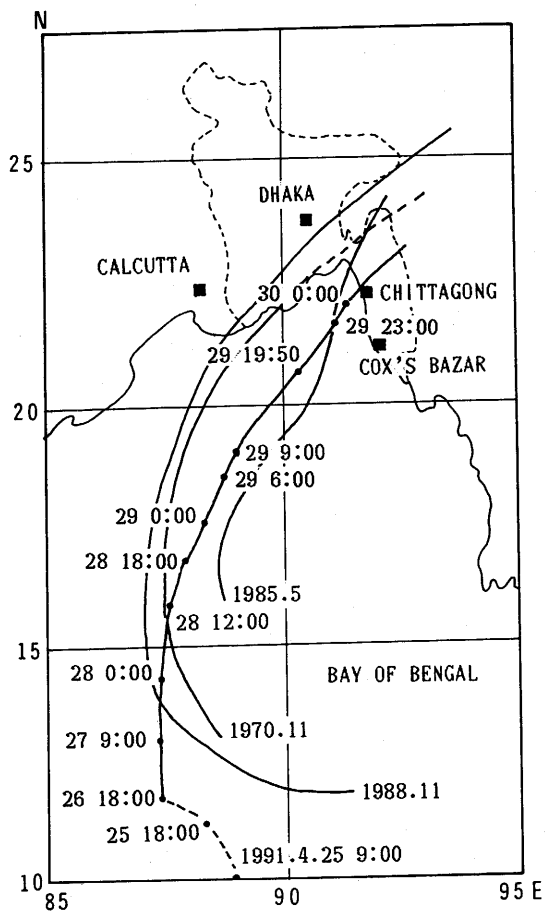

Fig. 2 Tracks of the 1970, 1985, 1988 and 1991 cyclones

3. Damage

Direct damage

The extent of damage due to cyclones of 1970 and 1991 is compared in Table 2. Estimated numbers after Frank and Husain (1971) were used for the damage of 1970. Flierl and Robinson (1972) calculated the maximum sea level of a storm surge of 30 ft. Damage of 1991 is as of 26 May, which was prepared by the Relief Control Room, Ministry of Relief.

Table 2 Comparison of damage due to cyclones of 1970 and 1991

	1991 A	1970 B	A/B
Total affected population	10,721,707	4,700,000	2.3
Total human deaths and missing	140,161	300,000	0.47
Total houses damaged	1,630,543	400,000	4.1
Total educational insutitutions damaged	9,367	3,500	2.7
Maximum wind speed	235 km/h	196 km/h	
Central pressure	950 mb	950-960 mb	
Highest level of storm surge	20-25 ft (MSL)	20-30 ft (MSL)	

Damage of 1991 is as of 26 May, which was prepared by the Relief Control Room, Ministry of Relief, and that of 1970 is after Frank and Husain (1971). Meteorological data of 1991 and 1970 are after UNDP (1991) and after Flierl and Robinson (1972), respectively.

Judging from the maximum wind speed, the 1991 cyclone was stronger. The landfall time of a cyclone and storm surges has much influences on the extent of damage, but both cyclones hit coastal areas around midnight.

Destruction of sea embankments was responsible for a large amount of damage in 1991. About 112 miles of the flood protection embankment were totally destroyed and 585 miles were partly destroyed.

Though the extent of damage cannot directly be compared because such social conditions as population, population density, land use, number of livestock etc. have greatly changed for these two decades, it is clear that direct damage was more serious in 1991 than in 1970. The total affected population of 1991 is 2.3 times as much as that of 1970. The total numbers of damaged houses and educational institutions of 1991 were 4.1 times and 2.7 times as many as those of 1970, respectively. But the total number of human deaths and missing of 1991 is 47 % of that of 1970. It may be said that such countermeasures for human lives as construction of shelters and issue of refuge warning were effective to decrease the number of casualties.

For example, a 230 m^2 shelter saved 3,000-4,000 people (13-17 persons/m^2) .in Kutubdia Island. They took refuge for 8 to 9 hours under the incredible density. Circumstances were similar for other shelters. Lots of people squeezed themselves into a narrow shelter. If shelters were not constructed, several times of human lives would

have been lost.

Islam (1974) reported that about 49 % of residents had lost their lives in Galachipa during the 1970 cyclone. Roughly 38 % saved their lives by climbing trees, about 5 % by taking refuge in the community center and nearly 8 % by remaining on top of an embankment. According to the Zonal Relief Coordinator (ZRC) (1991), Kutubdia recorded the highest death ratio of 18.9 % in the last disaster and Banskhali was the second at 12.9 %. Compared with 49 % mentioned above, these figures are fairly low.

ZRC (1991) classified the affected areas into 3 categories; worst, badly and partially. The worst affected area means that which was totally swept away by the cyclone and strong surges. Accordingly, residents of the worst affected area (worst affected population) were exposed themselves to loss of lives. The worst affected population ratio was 100 % in Kutubdia, and 35.6 % in Banskhali. As mentioned above, the death ratios of these two upazilas were 18.9 % and 12.9 %. On the other hand, the worst affected population ratios of Cox's Bazar Sadar and Hatiya were 47.1 % and 38.6 %, respec-

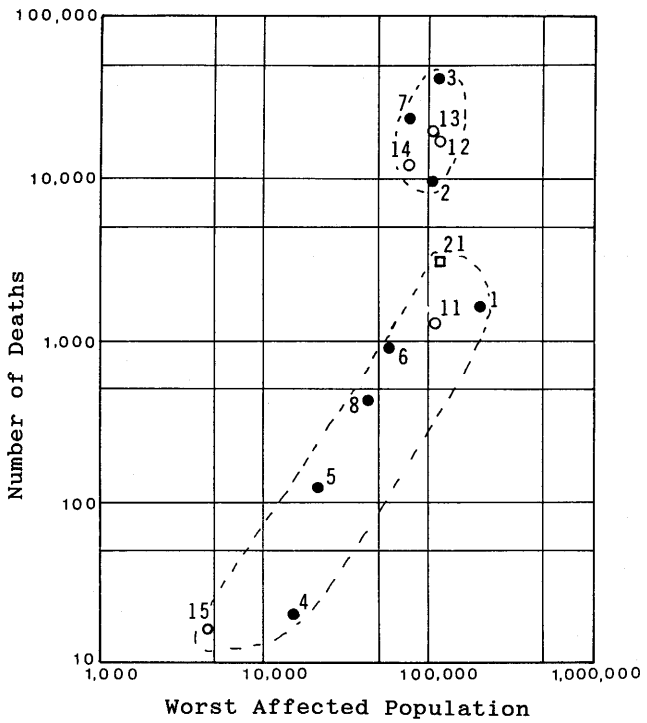

Fig. 3 Relationship between the number of deaths and the worst affected population
Black circles and white ones show upazilas in Chittagong and Cox's Bazar District, respectively. A white square means Hatiya Upazila in Noakhali District.
Chittagong District: 1: Chittagong City Corporation, 2: Anwara, 3: Banskhali, 4: Chandanaish, 5: Mirsarai, 6: Patiya, 7: Sandwip, 8: Sitakunda
Cox's Bazar District: 11: Cox's Bazar Sadar, 12: Chakaria, 13: Kutubdia, 14: Maheshkhali, 15: Teknaf
Noakhali District: 21: Hatiya
Upazilas which had less than 10 deaths or no worst affected population were omitted.

tively. But their death ratios were 0.5 % and 1.0 %. It is not necessarily true that a high worst affected population ratio claims a high death ratio.

Figure 3 shows the relationship between the worst affected population and the number of deaths. ZRC's data for each upazila were used. Upazilas are able to be classified into two groups on the basis of whether the ratio of the number of deaths to the worst affected population is higher or lower. I defined this ratio shown in percentage as the D-W ratio. Anwara, Sandwip and Banskhali in Chittagong District, and Chakaria, Kutubdia and Maheshkhali in Cox's Bazar District are classified into the former. In other upazilas, the D-W ratio takes a figure down more than one place.

Also, some difference in the D-W ratio can be detected among the upazilas having the higher D-W ratio. Banskhali shows the highest D-W ratio of 36.1 % and Sandwip with 29.5 % is the second. The D-W ratios of the neighbouring three upazilas, Kutubdia, Maheshkhali and Chakaria are about a half of those of the highest two. Anwara shows the lowest ratio of 9.6 % among the higher group. In addition, it can be detected from Fig. 4 that the upazilas located nearer to the cyclone track do not necessarily have a higher D-W ratio.

These facts reflect that there are many differences among upazilas in the regional characteristics of social and natural circumstances. The factors which might affect the D-W ratio are height and speed of storm surge, ground height, topography, height of embankment, existence of mangrove forest, attributes of residents, number and location of shelters, transmission of the warning, refuge seeking behavior, etc. But the deficient data and the inaccurate number of deaths which will be mentioned later discourage me from a precise analysis.

Indirect damage

Damage is apt to be enlarged by the environmental change induced by storm surges. For example, an epidemic usually spread after a heavy flood disaster. Diarrhea prevailed due to the deficiency of clean water and medicine. It was reported that 120,442 people had got diarrhea by the 12th of May, and 1,219 of them lost their lives. UNICEF estimates that as much as 10 % of the surviving population will be affected by diarrheal diseases. Especially, casualties were conspicuous for infants.

As for agricultural damage, it is a matter of concern that the number of deaths of livestock will be increased by deficiency of feed or a disease. Jabbar (1990) examined the effects of monsoon floods of 1984 on livestock. He detected that a much larger number of livestock died due to disease and hunger after the floods than due to drowning during floods. Loss of livestock affects farmers through being in deficient plowing power. As a result, farmers cannot plant adequate winter crops on time. Also, smaller farmers were more likely to lose livestock than larger ones, because the former could not cope with the high prices of feeds. Supply of food and others for human beings is usually expected after catastrophic disasters, but care of livestock is apt to be delayed. A newspaper reported in August that the deficiency of plowing animals was serious and it badly affected rice planting.

Heavy damage to the Export Processing Zone in Chittagong will have serious effects on industrial and commercial activities. Invasion of saline waters into paddy fields will

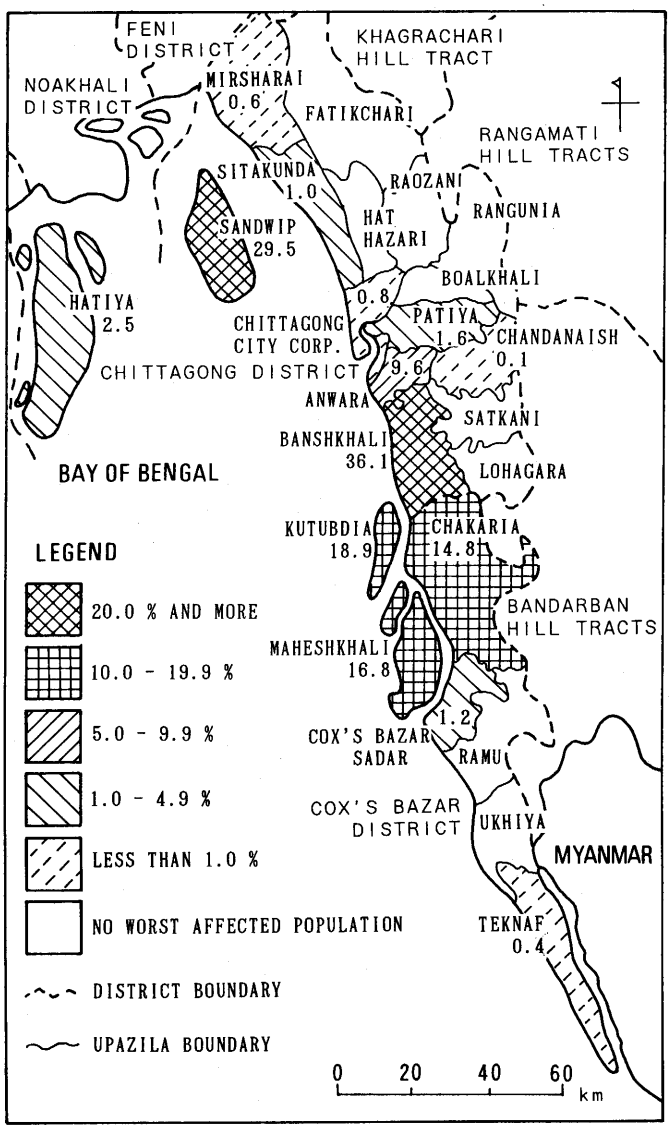

Fig. 4 Map showing the upazila-wise ratio of the number of deaths to the worst affected population (D-W ratio)
Numerals mean the D-W ratio shown in percentage.

decrease the rice product for several years. Many other influences to economy of Bangladesh will last over a long period of time.

Many kinds of indirect damage to human beings can also be listed up: collapse of family and occurrence of many orphans, increase of homeless or landless people, increase of marginal farmers and fishermen and so on. When we visited Cox's Bazar in the middle of August, many people were living in tents which were temporarily set up on the coast.

The real state of such indirect damage or after effects have not been clarified.

Fact-finding researches on the indirect damage must be carried out.

4. Some Recommendations for Development of Vulnerable Coastal Regions

Context of damage and countermeasures

Natural disasters are regarded as the serious disruption of normal everyday life caused by an extreme geophysical event. Although the mechanism and the extent of damage are mainly decided by the magnitude of an extreme geophysical event, they are often influenced by the regional characteristics concerning physical and social vulnerability to natural disasters. Physical vulnerability is mainly derived from geomorphological characteristics and the social one is closely related to population density and land use in the region concerned.

Once a natural disaster occurs, its damage works upon other vulnerabilities and new damage is apt to be induced; that is, the disaster develops into its second stage. In this stage, damage caused during the first stage is enlarged or triggers other kinds of damage. Aftereffects which result from the losses in the first and second stages persist in the third stage.

As for the storm surge disaster, very high waves break embankments and saline waters invade into land. Human beings are swept away as well as livestock. Such direct damage due to storm surges occur in the first stage. Since sea waters invading into land make environmental conditions worse, epidemics are apt to be prevalent. As a result, loss of human beings and livestock is added.

Many influences remain after the first and second stages. Agricultural production decreases due to intrusion of saline waters into farmland. Destruction of infrastructures affects industries as well as residents' everyday life. The third stage is characterized by aftereffects until everyday life and social activities are restored. Also, it must be mentioned that there are many kinds of losses which will never be recovered. If the head of household is killed, his family will be forced to suffer from the difficulties in living. Coastal erosion forces residents to move or gives rise to landless people. These irrecoverable consequences are also induced in the third stage.

In this manner, the chain reactions continue in succession. As a disaster develops, its aspect transforms and its influence changes mainly on the basis of social vulnerability. Accordingly, comprehensive countermeasures are necessary along the context of damage. Taking account of the physical and socioeconomic conditions of Bangladesh and the extent of damage as mentioned in the Chapters 2 and 3, I would like to recommend the countermeasure system as shown in Fig. 5 in order to mitigate losses due to storm surges.

What is possible for Bangladesh to put in practice a comprehensive countermeasure

Research on accurate number of residents including migrant workers

Because the number of residents as well as migrant workers is not on hand, the accurate number of affected people is not clear. Even the number of deaths is inaccurate.

According to ZRC (1991), the number of deaths in Hatiya is 2,956. On the other

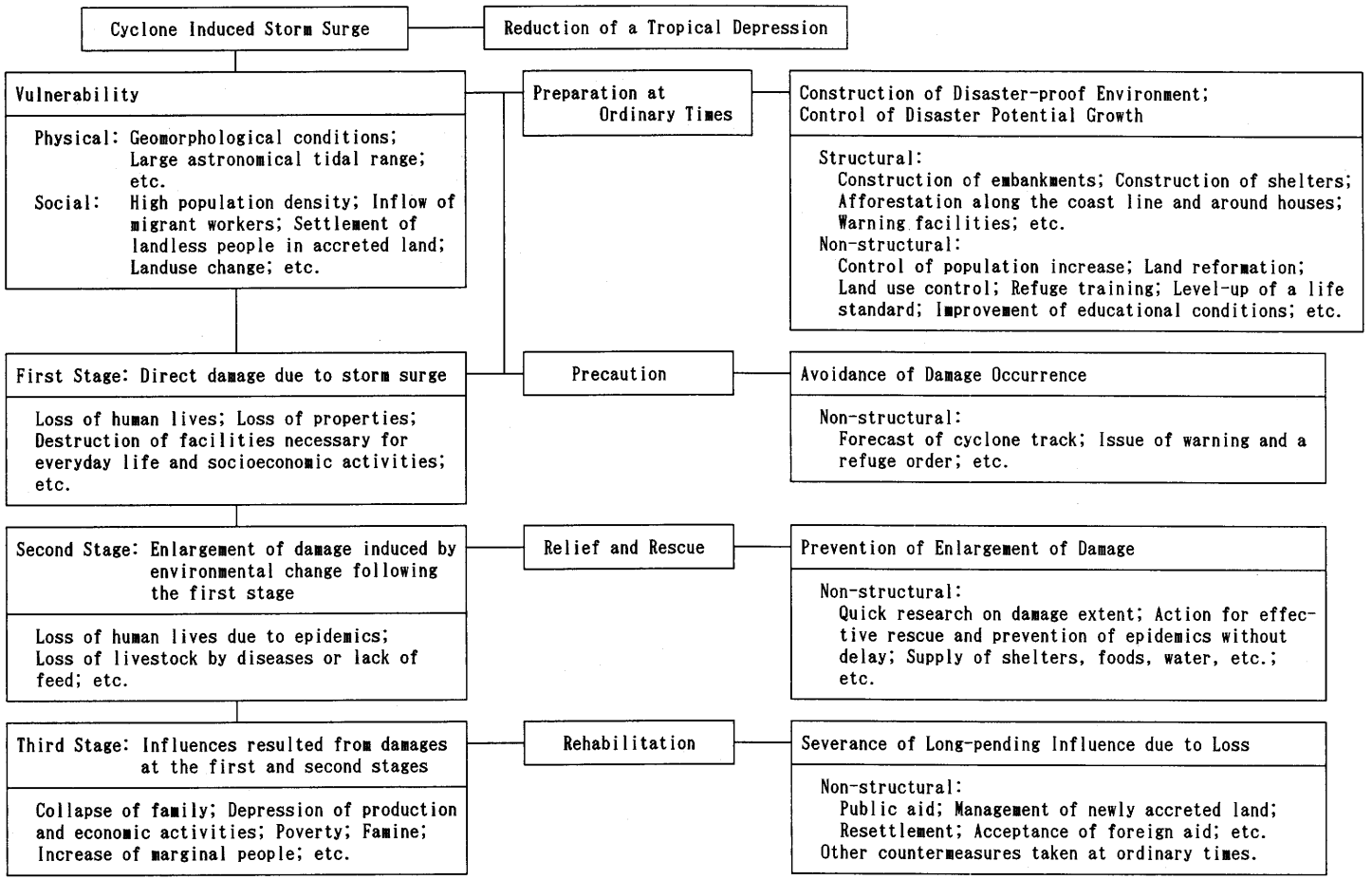

Fig. 5 Storm surge disaster countermeasure system

hand, three Japanese members of Overseas Cooperation who visited Hatiya in the end of June with a Bangladesh doctor of the Dhaka Children's Hospital reported the extent of damage. They gathered information pertaining to damage and living conditions through interviews with residents (Sakamoto *et al.*, 1991).

Though they researched only three unions out of ten, Harni on the northern coast, Char Iswar and Burirchar on the western coast, their results were much different from ZRC's ones. According to their report, the number of deaths in Harni was 3,000. Most of them were fishermen and their families. They lived outside of the low embankments constructed in the 1970s. In two villages located along the coastline of Char Iswar, 5,000 residents among the total population of 8,000 were drowned to death. Especially, all people who lived outside of the embankments lost their lives. Their number reached 2, 000. Some 3,000 people died in Burirchar where the total population was 32,000. The total number of deaths in these three unions only reached 11,000. It must be mentioned that the deaths of two other worst affected unions of Sonadia and Jahjmara is not included in this number.

ZRC reported the total number of deaths in the entire country as 131,539. Among them, only 75,523 bodies were buried. That is, more than 40 % of the dead were washed away to the Bay of Bengal. We can easily conclude that more accurate data should be indispensable. Baba (1991) mentioned that the number of deaths might be near 300,000. It is not necessary to deny this number.

Population census is carried out every 10th year in Bangladesh. Since 1991 is the census year, it is most unsuitable to attempt to grasp the accurate population now. Only the estimated number based on the 1981 census is available, and there is no data concerning migrant workers and residents removed to newly accreted land during this decade. Deficiency in accurate population data makes it impossible to calculate the number of victims or necessary relief goods exactly. It is indispensable for disaster proof and relief planning to grasp the accurate population every year and to estimate the number of moved migrant workers. The present situation of having no available administrative data must be improved.

Research on taking refuge

It was reported that although the warning of danger signal 10 had been issued and most of residents had received it through volunteers of the Red Crescent Society, many people did not take refuge. The main reasons for not obeying the warning were as follows:

a. The warning of danger signal 10 had been issued in the past, but residents were never affected severely. They judged to be safe on the basis of their experience. A normalcy bias restrained people from taking refuge.

b. If one took refuge and left his house, a stranger would occupy the house and would steal all property. Accordingly, it was necessary to stay in the house.

c. One stayed on the roof or a tree to see what would happen. Same background as that of a and b might have existed in selecting this behavior.

d. Female people were not likely to take refuge. Women in the Islamic world usually avoid squeezing themselves in a narrow place with men. Also, women have a stronger affection for livestock and want to stay near the house in order to protect them from

danger.

On the other hand, people who took refuge were characterized as follows:

a. Residents who lived near a shelter: Though the people who lived within 1.5 km from a shelter took refuge, others living more than 1.5 km apart from a shelter did not.

b. Residents who were highly educated: In other words, they are rich and men of weight. They do not worry about their property being stolen while taking refuge.

c. Residents who could leave their property, especially livestock.

Refugees did not respond to warning, but their behavior was prompted by the dangerous conditions due to high waves. Some peculiarity of residents' refuge-seeking behavior was discussed, but the fact was not clarified exactly.

Matsuda (1990) discussed refuge-seeking behavior during heavy rains in Japan. Some of the results were as follows:

a. Refuge is not sought as a preventive action before circumstances become dangerous but as the means of escape from danger.

b. Previous experience disturbs refuge-seeking behavior. Many residents misjudge what will happen.

c. A normalcy bias is recognized in all cases.

These results are common to behavior of Bangladesh people. But many different aspects are expected in Bangladesh. Fact-finding is necessary to make the warning more effective. Also, it is expected to explain what factors controlled the number of deaths to the worst affected population as shown in Figs. 3 and 4.

Fact-finding on the difficulty of living after the disaster

Simulation studies on catastrophic disasters are impossible even if a computer is used. The catastrophe of this time must be regarded as the full-sized experimentation. We have to record every thing which was recognized through the context of disaster and to learn much for making best use of it in countermeasures. It is very important to research on conditions of living after the disaster, because drastic mitigation of losses is impossible and rehabilitation after disaster is indispensable. Fact-finding on the living circumstances after the disaster will give us necessary information as follows:

a. Assessment of relief activities from resident's side: The details of relief activities are usually recapitulated by the government agencies, but sufferers' appraisal does not always coincide with donors' intention. For instance, Sakamoto *et al.* (1991) reported that one meal a day was the most for the sufferers in Hatiya even in the end of June. The Bangladesh government made residents engage in day labor such as repair works of embankments and gave rice or wheat in reward. But day labor was discontinued in the beginning of June. Though foods and daily necessities appeared on the market at that time, sufferers could not buy them for cash. Sufferers who lost the means of living cannot gain an income besides day labor.

b. Living conditions after relief activities were over: This data is useful to secure sufferer's livelihood by self-help. The national or local governments cannot procure the whole means of living for sufferers. Self-help has to be asked for sufferers. Also, since the influences on living conditions after disaster can be clarified, the necessary means to adjust the damage can be examined.

c. What kinds of adjustment were taken: People's perception on cyclone hazard can

be made clear through discussion on whether hazard experience was put to practical use or not.

Construction of cyclone shelters

Although construction of shelters is required, acquisition of a site and maintenance of shelters are not discussed full. After the catastrophe of 1970, construction of some 12, 500 shelters were planned. However, 236 shelters were constructed by the Bangladesh Government by the year 1975. The Red Crescent Society built 62 shelters after the cyclone of 1985. More than 3,400 shelters are necessary to cover whole coastal regions. But construction is progressing very slowly, because acquisition of a site has become hard recently. Volunteers used to offer a site. But much money is necessary to buy a piece of land now, because the population increase has been in need of much more land. Existing shelters have become old and where the responsibility for maintenance lies is not clear. Some shelters have not function.

In the present situation, it is necessary to make the efficient use of existing facilities and people's organization. To put it in the concrete term, a primary school must be turned to good account. Construction of a schoolhouse which will be used as a shelter in times of disaster must be pushed forward. An action committee composed of residents for school administration should be resposible for maintenance.

Community development programmes are now being put into practice in and around the shelters. The shelters are usually used as nuclei of socioeconomic activities; literacy programme, running schools, various income generating activities, etc. (Quoreshi, 1990). If maintenance of disaster prevention facilities is added to these activities, communities will become stronger against disasters.

A combination of means which fit in with every day life is required for improving the present situation.

5. Concluding Remarks

Meeting the topographic and climatic conditions, land use and crop selection are put into practice in the flood plains of Bangladesh. Paul (1984) pointed out that farmers cultivate aus and jute in comparatively higher land to avoid high standing water, broadcast aman is cultivated in low land, and transplanted aman is selected for poorly drained middle land because of its needs for a proper amount of flood water. Bangladesh farmers are adopted to normal floods. Also, human lives are scarcely lost even by abnormal floods. We can recognize the existence of disaster subculture.

But residents in the coastal regions seemed not to accomodate themselves well to a cyclone. Many people were often drowned to death by a cyclone. Cyclones which claimed more than 10,000 deaths hit Bangladesh six times recently; in 1961, 1963, 1965, 1970, 1985 and 1991. Especially, the cyclones of 1970 and 1991 claimed several hundreds of thousands of human lives. Why do such disasters occur repeatedly? Though a storm surge is classified as natural hazard, the induced damage is the product of interaction between natural and social conditions. Loss of human lives seems to follow from the very nature of the coastal region. Why do people continue to live in the hazard prone lowlands? Why

do not people take refuge before being attacked by a storm surge?

Islam(1974) interviewed 66 residents in Galachipa after the severe disaster due to the November 1970 cyclone. Roughly half of the people including migrant workers were killed in this area. Although nearly 90 % of all those interviewed replied that they expected future flooding, nearly 85 % of them stated that they will be willing to continue living in the same place. No significant variation according to a socioeconomic class, education, occupation or age could be seen in attitude.

Islam's results about the reasons why the victims did not want to move are as follows:

a. "Almighty God knows everything" is the prevailing mood.

b. The local landless or small tenant farmers, being assured of employment locally, appear not to be interested in leaving their community for a place with fewer cyclones.

c. Accordingly, a traditional inborn fatalism, limited freedom of movement and local availability of employment are factors for not moving away from hazardous places.

On the other hand, newly accreted land gave major economic advantage and subsistence for many years. Also, their behavior was largely influenced by social preferences and strong family and community bonds. Accordingly, it appears to be rational that people choose to stay in the present location even if they know of its vulnerability to future disasters.

I would like to mention two essential problems concerning countermeasures for natural hazards in Bangladesh at last. They are control of population growth and land reformation.

Large disparity in wealth exists among Bangladesh people, and the people of the lower classes are overwhelming majority. This fact brings most of social vulnerabilities and makes carrying out a comprehensive countermeasure difficult. I dare say that it is most important for disaster mitigation in Bangladesh to heighten the dignity of a human being, especially people belonging to the lower classes. Disparity between both extremes of the richest and the poorest should be reduced. Control of population growth and land reformation are indispensable for achieving this purpose.

Whatever effective countermeasures are presented, success will not be expected unless the whole social system is improved.

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