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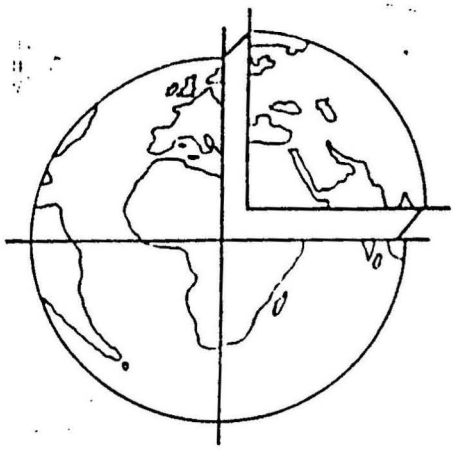

DISASTERS

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The Bangladesh Cyclone of 1991: Why So Many People Died

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Living with natural disasters has become a way of life in Bangladesh. On the night of 29 April 1991 a severe cyclonic storm, accompanied by tidal surges up to 30 feet high, battered the coastal areas of Bangladesh for 3–4 hours. Thousands of people were killed and property worth billions of dollars was destroyed. After the cyclone, several studies, using epidemiological and anthropological methods, looked at the impact of the cyclone. It was estimated that over 67,000 people lost their lives. Women, children and the elderly were much more at risk and so were those from the socio-economically disadvantaged section of the population. Cyclone shelters were few in relation to need but proved very helpful in saving lives. At least 20 per cent more deaths would have occurred in the absence of these shelters. The article documents impressive improvements in Bangladesh's ability to cope and makes recommendations for the future.

On the night of 29 and early morning of 30 April 1991, the southern coastal areas of Bangladesh were struck by a devastating cyclone accompanied by a tidal surge from the Bay of Bengal. Nearly 5 million people in 8 of the country's 64 districts were affected. In terms of human losses, this cyclone was the worst since 1970. According to government estimates, over 130,000 people perished (Government of Bangladesh, 1991), and property worth US$ 2.4 billion was destroyed (Financial Indicators Bangladesh, 1991).

Following the cyclone, several studies were carried out of its impact (Chowdhury, et al., 1992). This article presents results from four studies that examined the epidemiology and people's perceptions of the cyclone, and the usefulness of cyclone shelters constructed to provide a haven for people in the coastal areas.

CYCLONE WARNING SYSTEMS AND SHELTER PROGRAMME

The Bay of Bengal, bordering Bangladesh's southern coast, is favourable to the formation of cyclones. Of the earth's tropical cyclones, 10 per cent form in the Bay (Gray, 1968; Ali, 1980; Government of Bangladesh, 1992). The last great cyclone of 1970 claimed 224,000 lives (Sommer and Mosley, 1972).

Both the 1970 and 1991 cyclones hit at the dead of night, making it even more difficult for people to look for shelters. The main cause of death in such a disaster is

drowning. High wind only makes the situation worse. Walls of water, at times up to 30 feet high, sweep the coast. Such surges, one after another, continue their battering for three to four hours. The meteorological department in Bangladesh is equipped to detect the climatic disturbances well in advance. They were quite accurate in warning about the April 1991 disaster at least 15 hours before it hit the coast (Ahmed and Afreen, 1992).

Over the past 30 years, the government has constructed a series of concrete buildings to allow people to take refuge at the time of an impending cyclone. A total of 60 double storied coastal community centres and 40 single storied sub-coastal community centres were constructed. Following the cyclone of 1970, the government, with support from the World Bank, constructed an additional 238 multipurpose 'cyclone shelters'. In the 1980s, the Bangladesh Red Crescent Society (BRCS) and Caritas, a local non-governmental organisation (NGO), built 74 new cyclone shelters (Government of Bangladesh, 1992). The government also constructed over 150 *killas* (artificial hills), mainly to protect household animals from flooding. Following the 1985 cyclone at Urirchar (Siddique et al., 1988), the Bangladesh government, with Indian and Pakistani collaboration, built 260 nucleus houses for rehabilitating the survivors. India also built a central cyclone shelter and Pakistan a large mosque (also used as a shelter during the 1991 cyclone). But these are clearly not enough to provide refuge for even a small proportion of the vulnerable population. The houses of more than 95 per cent of the population are not strong enough to withstand such cyclones. Apart from constructing cyclone shelters, there was no systematic policy to promote the construction of concrete buildings for the protection of the public during cyclones.

Since the cyclone of 1970, the warning system in Bangladesh has undergone major improvements. Climatic depressions are initially detected from a satellite network monitored by the Space Research and Remote Sensing Organization (SPARRSO) in Dhaka. This information is then forwarded to the meteorological department which follows the path of the cyclone and issues regular bulletins on the location of the cyclone, wind speed, and the areas it may strike. These bulletins are circulated through the country's press, radio and television. There are eleven cyclone storm warning signals or categories (Table 1), depending on the distance, speed, and direction of the winds. The signals, are intended, however, more for ships and ports than for the inhabitants of the coastal region.

The Bangladesh Red Crescent Society (BRCS) has over 20,000 village volunteers, all based in the coastal areas. The Cyclone Preparedness Programme (CPP) of BRCS transmits the danger warnings to these village volunteers through a network of district and sub-district control offices. The volunteers in turn alert people through megaphones and house-to-house contact to motivate them to shift to nearby storm shelters (if available) or safer places.

METHODS AND MATERIALS

This article is based on four separate studies carried out using different methodologies (Bangladesh Rural Advancement Committee (BRAC) 1991a; 1991b; 1991c; 1991d).

Epidemiology of Cyclone-related Deaths

A detailed epidemiological study was conducted approximately three months after the 1991 cyclone to assess the extent of human loss and the risk factors associated with death (BRAC, 1991a).

TABLE 1
Cyclone warning signals

Distant Cautionary Signal No.1: Ships may be exposed to danger after they have left the harbour; there is a region of squally weather out at sea.
Distant Warning Signal No.2: Ships may be exposed to danger after they have left the harbour; a storm has formed out at sea.
Local Cautionary Signal No.3: The port itself is threatened by squally weather.
Local Warning Signal No.4: The port is threatened by a storm but it does not appear that the danger is sufficiently great to justify extreme measures.
Danger Warning Signal No.5: The port will experience severe weather from a storm of slight or moderate intensity that is expected to cross the coast to the south of the port.
Danger Warning Signal No.6: The port will experience severe weather from a storm of slight or moderate intensity that is expected to cross the coast to the north of the port.
Danger Signal No.7: The port will experience severe weather from a storm of slight or moderate intensity that is expected to cross over, or near to, the port.
Great Danger Signal No.8: The port will experience severe weather from a storm of great intensity that is expected to cross the coast to the south of the port.
Great Danger Signal No.9: The port will experience severe weather from a storm of great intensity that is expected to cross the coast to the north of the port.
Great Danger Signal No.10: The port will experience severe weather from a storm of great intensity that is expected to cross over, or near to, the port.
Failure of Communications: Communications with the meteorological warning centre have broken down and the local officer considers that there is danger of bad weather.

Rapid interviews with the chairmen of the 20 most severely affected Union[1] Parishads provided rough estimates of human casualties. The 12 Parishads reporting cyclone-related deaths of 5 per cent or more were included in the study. Half of the Parishads were in the offshore islands of Kutubdia and Sandwip; the other half were from the coastal sub-districts of Chakoria and Banshkhali (Figure 1). A total of 2,000 households were interviewed. Villages and neighbourhoods in each Parishad were chosen at random, and a listing of pre-cyclone households was made. Of the households interviewed, information on 231 was collected from neighbouring households, as all members of the original households had either perished in the cyclone or moved away.

An estimate of total deaths was attempted for Kutubdia Island only. The study included four unions from Kutubdia but, for the estimate of total deaths, the other two unions of the island were also surveyed, using the same procedure. The total number of deaths estimated for this island was compared with the government estimate and a correction factor was calculated.

The information was collected through a pre-tested structured questionnaire administered by male interviewers who spoke the local dialect. The questionnaire recorded, among other things, details of all persons present in the household on the night of the cyclone and their present whereabouts and survival status and, if deceased, when and how they died. This allowed for a separation of cyclone-related deaths (on the cyclone night and the following day) from post-cyclone deaths due to other causes.

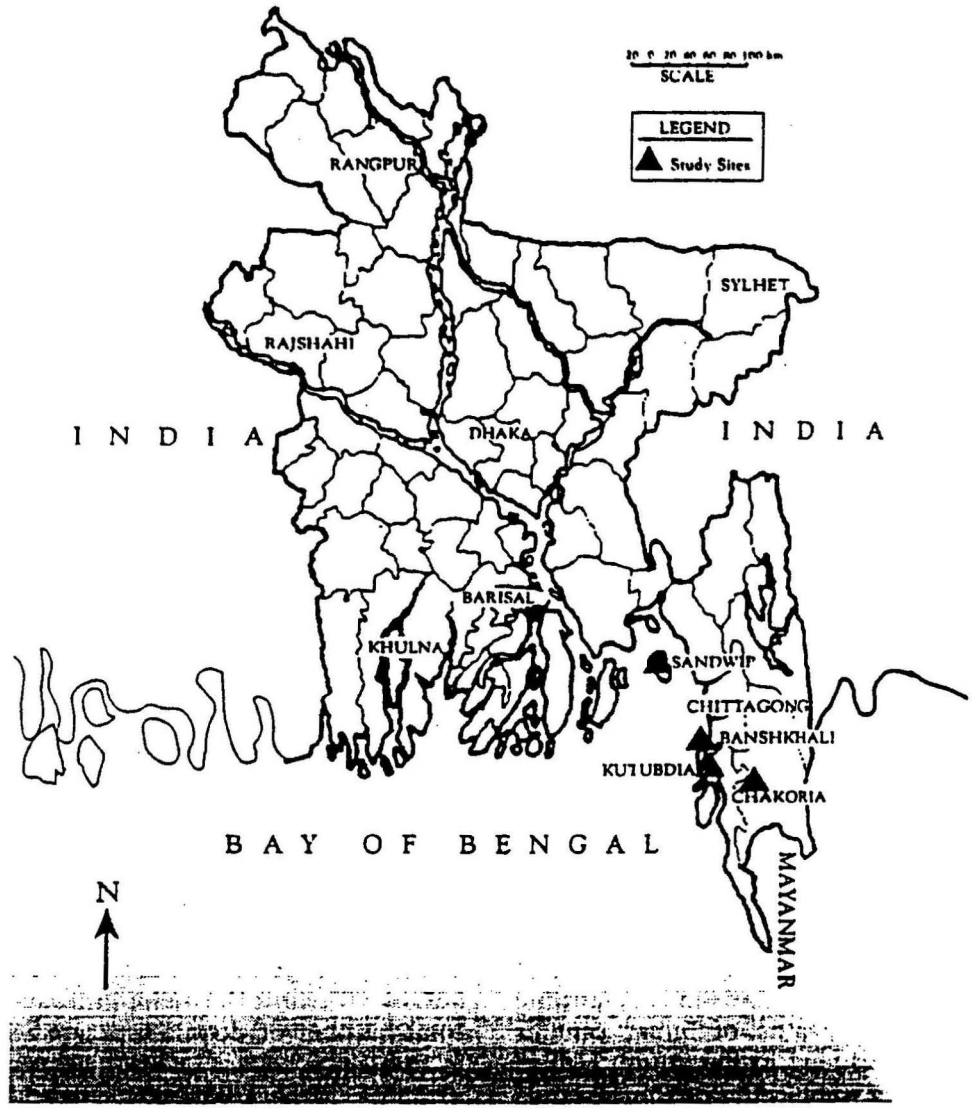

FIGURE 1 *Bangladesh: area included in the cyclone study of 1991*

Study of Storm Shelters

Two types of shelters were compared for their life saving functions (BRAC, 1991b). The first, called *formal shelters*, were government shelters purposely built in the coastal and offshore areas to provide refuge from cyclones and tidal surges. The second, called *informal shelters*, were houses, schools, offices, and other buildings used for refuge. An assessment of the use of these shelters was conducted in all six unions of Kutubdia, the four worst affected unions of Banshkhali, and one union of Sandwip. Users and non-users of the formal shelters were interviewed by trained male interviewers to determine the reasons for not using them and to identify problems encountered by the users.

Cyclone Alerts

This study explored people's knowledge

of, and response to, the warnings, their ideas about cyclones and tidal surges and their survival strategies (BRAC, 1991c). Case histories were gathered to find out how survivors saved their own lives while those of their family members or neighbours were lost. Case study interviews were conducted in Kutubdia (60) and in Banshkhali (30) by two trained female workers.

Survey of Semi-pucca Structures

Experienced engineers from a local firm surveyed the damage to twelve semi-pucca[2] buildings which were partially or completely destroyed by the cyclone (BRAC, 1991d). The buildings, chosen from the three badly affected unions of Kutubdia and of Banshkhali sub-districts, were selected to represent different degrees of damage. The engineers measured structural components, excavated foundations and interviewed the owners. For each structure, the foundation, superstructure and roof were analysed separately, using standard engineering techniques, and the causes of failure determined.

RESULTS

Mortality

The epidemiological survey in 12 of the worst affected unions registered a total of 1,206 cyclone-related deaths among a cyclone vulnerable population of 11,434. This yielded a death rate of 105 per 1,000 population or 10.5 per cent.

While the exact number of lives lost in the cyclone will never be known, several estimates are available. These, based on different methodologies, vary enormously. The government, using 'intelligent guesswork' estimated a total of 131,539 deaths of which 19,133 occurred in Kutubdia (Government of Bangladesh, 1991). The union parishads conducted house-to-house surveys and estimated that 11,000 had died (UNICEF, 1991). Using the technique previously described, we arrive at an estimate of 9,778 deaths in Kutubdia, which is 48 per cent less than the government estimate and 11 per cent less than the union parishad estimate. Assuming that a correction factor found for Kutubdia could be extrapolated for the entire cyclone affected area, our estimate of total lives lost would be 67,226.

Table 2 shows the death rates by age group in our survey. Children and the elderly died disproportionately more than others ($p<0.01$). Nearly three quarters of the deaths occurred among children under 15 years of age. Deaths were lowest in the 15–49 age group. Figure 2 shows the age-specific death rate, for males and females. Females died more than males in all age groups with the gender differences being more pronounced amongst the very young and very old. Even among adults between 20 and 44 years of age, females died much more frequently (71 per 1000) than males (15 per 1000).

The death rate was much higher in households which were absent at the time of the survey (225.6) compared to those where a respondent was present (92.7) ($p<0.001$). Sixteen per cent of the pre-cyclone households reportedly owned a functioning radio. In these houses, the death rate was lower ($p<0.01$). Literacy also seemed to be associated with the death rate. More illiterate or less literate people aged 6 years and over died than did their literate counterparts ($p<0.01$).

Death rates were also examined by the type of pre-cyclone housing. Seventy four per cent of houses were *kutcha*[3]; 23 per cent were kutcha with tin roofs; 2.3 per cent were *pucca*; and only 0.3 per cent were double storied. The death rate was highest in kutcha houses with tin roofs (107.5), followed by kutcha houses with thatched roof (89.5). These figures are downwardly

TABLE 2
Death rates by broad age group

Age group	*Death rate per 1000*	*No. of deaths*
0–14	154.5	871
15–49	40.0	188
50+	134.0	147
All ages	105.5	1206

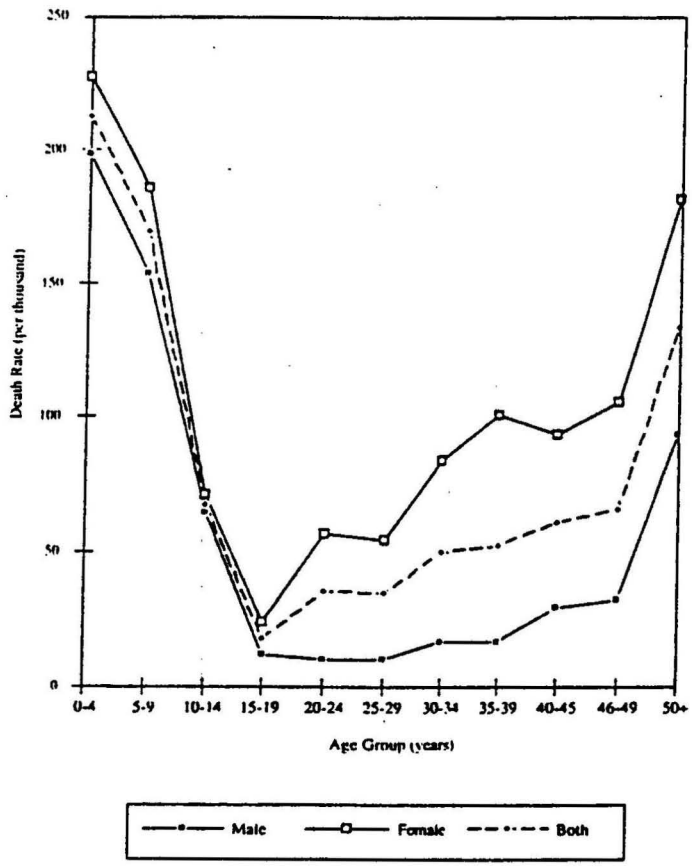

FIGURE 2 *Age and sex-specific death rates*

biased as information on housing was not collected on households which did not exist at the time of the survey. In pucca houses, the death rate was low (33.7) and no deaths were reported amongst those living in double storied buildings. Similarly, the death rate was negatively correlated with the size of a household's land holding, although it was less among the absolutely landless than among those having less than half an acre of land.

Post Cyclone Deaths

A total of 49 deaths were reported in the three months following the cyclone. By

extrapolation, this is equivalent to a death rate of 19.5 per thousand population per year, which is moderately higher than the normal death rate for Bangladesh.

Shelter

Thirty six per cent of households reported that they had located places 'nearby' to take refuge at the time of the cyclone. The principal respondent was asked whether he or she had taken refuge himself or herself and 30.5 per cent replied that they had. Of the places used as refuge, 53.8 per cent were private houses, 23.5 per cent were public buildings such as mosques, schools and orphanage, and 14.5 per cent were formal shelters. The rest took refuge in such places as public houses, embankments and trees (it should be noted that trees are more useful than is usually realised). Of the respondents who did not take refuge, 70 per cent said that they did not believe that a cyclone and surge of this magnitude would actually come.

Formal Shelters

Twenty five formal shelters were identified in the study (BRAC, 1991b). There were 7,733 people per shelter with the density being much higher in coastal areas than in offshore islands (22,000 in Sonua union in Banshkhali and 3,000 in South Dhurong in Kutubdia). These shelters have regular capacities in the range of 500 to 2000. Our estimate, based on surveyed users, showed that approximately 12 per cent of the population had taken refuge in these shelters. This shows that the population per shelter was very high compared to their capacities.

It was also revealed that all the shelters but two were used to their maximum capacity. The reasons given for the underutilization of the two shelters were their inconvenient location and dilapidated and unhygenic condition. Roads linking them with the surrounding villages were not elevated enough and were covered with water early on. Most people did not move until the water was in their courtyard. By this time the water also reached the ground surrounding the shelters. In the absence of a raised road, some adult villagers did manage to swim to the shelter but, for the aged, handicapped and young children, this was a formidable obstacle. Many shelters are not productively utilized in normal times. The physical condition of some had thus deteriorated and people felt they were unsafe. Some had been used as places of defecation and as cowsheds. Such shelters were thus seen as very unpleasant places to move to, particularly when people were not convinced of the imminent danger of the cyclone.

People were asked about their experience — for most, their first experience — of using a shelter. The most common complaint was a lack of latrines and drinking water. Only three shelters had water and sanitary facilities. Other problems mentioned included crowding, a lack of *purdah* for women, darkness, and lack of food. Although problems were noted, all were grateful that the shelters had saved their lives.

Informal Shelters

A total of 795 informal shelters were identified with nearly 75,000 people (38 per cent of the total population) taking refuge in them. Urirchar had the highest share of these buildings (292 or 37 per cent). A large number of these had been built by the government and given to the residents of the island who had lost their houses during the 1985 cyclone.

Death Averted and Cost per Death Averted

The death rate was double in the population which did not take any shelter, compared to the total population. Based on circulation from eight unions where

both the epidemiological and shelter studies were carried out, the number of deaths averted by formal shelters was calculated. It revealed that at least 20 per cent more deaths would have occurred had these shelters not been present and that the cost of averting a death through the construction of formal cyclone shelters was Taka 3,023 or US$ 80 per death averted (BRAC, 1991b).

Warnings

In the offshore islands of Kutubdia and Sandwip, almost everybody heard a warning before the cyclone struck. But in the coastal areas of Chakoria and Banshkhali, only about 60 per cent heard a warning, with substantial variation between unions. There were three major sources of the warning: megaphone (by BRCS) (19.4 per cent), radio (37.3 per cent) and interpersonal communication (43.3 per cent). It was found that the dissemination of the warnings through megaphone was done less intensively in Banshkhali (only 2.8 per cent) than in others; this was attributed to the lack of an informal transportation system (BRAC, 1991c).

Unfortunately not many believed the warning. The major reason given was previous false alarms. Each year several cyclonic storms form over the Bay of Bengal. In 1980–91, 59 depressions had formed and signals 8–10 ('great danger') were aired five times or once every two years. The last 'big' cyclone to hit Kutubdia was 30 years ago and in Sandwip it was 20 years ago.

Ideas about Cyclones

Many did not consider Baishakh/Jaistha (April/June), the first two Bengali months, dangerous for tidal surges or destructive cyclone. Ashwin/Kartik (September/November), the sixth and seventh months, were believed to be 'more likely' months for destructive cyclones. The 1970 cyclone occurred in the month of November, while more than three-quarters of cyclonic depressions between 1980 and 1991 were formed during the second half of the year.

Stories of Survival: Two Cases[4]

Ayesha (25) is a housewife of Lamshikhali union of Kutubdia. Her husband Zafar (40) is a fisherman. She had two sons and two daughters but lost all her children in the storm. In the evening of the day of the cyclone, a neighbour told her that a cyclone would hit the area. The day was gloomy but she did not believe that the cyclone would hit in that month (Baishakh). Her husband was not at home as he had gone out to sea. In the evening the wind began to blow and the speed was rising. After the 'Esha Azan' (call for evening prayers in Islamic ritual) her husband returned home and she told him about the warning. After a few minutes the tin roof was blown away in the storm. Ayesha asked her husband whether the family should go to take refuge but he did not favour the idea. At this Ayesha started for a cyclone shelter with her children and her old mother-in-law on her own initiative. But due to heavy rain and high wind they made little progress. Nizam, one of their neighbours, helped them into his house where all the members of his family were sitting on the ceiling, whch was made of bamboo. Ayesha, along with her children and mother-in-law, joined them. Suddenly someone shouted *Nona Pani Ayer* ('salt water is coming') and within moments, the tidal surge arrived and waves began to break against the flimsy wall. When they saw the water level rising, they moved up on to the straw roof. Soon a wall of sea water came and the roof was swept away.

Ayesha and all her children fell into the water. She was parted from her

children except the youngest daughter. She found a tree and tried to climb it but her daughter fell from her shoulder into the water. She herself was able to grab a branch with her hand but suddenly another wave knocked her from the tree and she became unconscious. When she woke she found that it was already dawn and that she was lying naked on raised ground, 2 to 3 miles away from her house. A stranger collected some straw and gave it to her to cover herself. She gave her husband's name and address to the stranger and requested him to find her husband. After four or five hours the stranger came back with her husband. Her husband had saved himself by climbing a tree.

Razia (30) is a housewife of Kutubdia. She studied up to ninth grade and her husband works in Chittagong, the port city. She lives in a joint family with her brother-in-law who is an employee of the local Red Crescent Society, her brother-in-law's wife and sister-in-law. She heard about the cyclone warning from her brother-in-law. The Red Crescent volunteers informed the people of Kutubdia about the cyclone. As a Red Crescent volunteer, her brother-in-law also informed the people about the cyclone. But he himself did not believe that the storm would hit the area and returned home very late at about 10 p.m. Razia also did not believe that a cyclone of that magnitude would hit her area. When the storm began to blow strongly they started for the nearby cyclone shelter which was only a hundred feet away across the main road of Kutubdia. But it was too late. When they left their house the tidal surge had begun. Her brother-in-law hoisted his daughter onto his shoulder and tucked Razia's younger daughter under one arm. They could not proceed. Razia with her two daugthers and one son climbed a tree and her brother-in-law with his daughter climbed another tree. Her sister-in-law Samsun could not climb a tree and was swept away by the tidal surge. Suddenly she felt a piece of bamboo under her legs. She caught it and again was swept away with the bamboo by the tidal surge. At last she found a tall tree and climbed it, finally saving herself.

DISCUSSION

This article has presented results from a number of detailed studies done in the aftermath of the 1991 cyclone. Other studies, using rapid epidemiological procedures, have also addressed some of the same issues (Bern et al., 1993; UNICEF Cyclone Review Team, 1993).

The death rate in the sample area was 10.5 per cent, which is less than for the 1970 cyclone, the world's most devastating this century (Sommer and Mosley, 1972). Although the wind speed and the height of the tidal surge were similar in both cyclones (Haider et al., 1991) the 1991 cyclone led to fewer casualties and a lower death rate among those affected. Our casualty estimate was 67,226, about half the government estimate of 131,539. This difference is comparable to that seen in the mortality statistics of the 1970 cyclone. While the government's estimate of mortality was 500,000 (Haider et al., 1991), Sommer's and Mosley's (1972), using extensive surveys, was 224,000.

Why were there fewer deaths in the 1991 cyclone? There are several reasons. First, there has been a tremendous improvement in the cyclone warning system since the early 1970s, with the use of satellites by SPARRSO. Secondly, cyclone preparedness has markedly improved with the launching of the Cyclone Preparedness Programme (CPP) by the Bangladesh Red Crescent Society. The CPP has set up units at the lowest administrative level in the coastal and offshore areas. More than 20,000 BRCS volunteers are at work in these areas,

ready to inform people about impending danger and to move them to safer places. Thirdly, the embankments made along the coast held back the initial thrust of the surge in many areas, although in several places the embankment collapsed. Fourthly, the large number of cyclone shelters constructed since the early 1960s saved many lives; it has been estimated that at least 20 per cent more deaths would have occurred in the absence of these shelters.

Cyclones and other disasters of this magnitude are not uncommon in other parts of the world. It is known that mortality from such disasters is highest where the socioeconomic conditions of the people are lowest (Guha-Sapir, 1991). Hurricane Andrew hit the Florida coast of the United States in August 1992, killing only a few people. Although there was no tidal surge, it had the potential to cause many more human casualties. Why then, did so many people die in the 1991 Bangladesh cyclone?

Poor housing: Bangladesh is one of the poorest countries in the world and a large majority live below the poverty line. The housing condition of the overwhelming majority of Bangladeshis is dilapidated at best. Most houses are made of straw and mud. As shown in this study, even the semi-pucca buildings collapsed during the cyclone. Only 3 per cent of the houses were strong enough to withstand the onslaught of the tidal surge and this is reflected in the death rate. Nobody died in the five two-storied buildings.

High population density: With 8,369 people per 1000 hectares (the figure for India is 2,736 and for the USA 269 (Lovell, 1992)), Bangladesh is one of the most densely populated countries in the world. Because of the shortage of land, many people have moved to vulnerable coastal areas and small offshore islands in search of a livelihood, such as fishing. Since most of them are absolutely resourceless, they are a natural prey to such disasters. Unless the general socioeconomic condition of the people of Bangladesh is improved, cyclones will continue to take a heavy toll of human life.

Too few and inadequate storm shelters: The government has been building cyclone shelters since the cyclones of the early 1960s. A shelter can provide refuge for an average of 1,000 people, but the study found only one shelter per 8,000 people in the most affected areas, and they were unevenly distributed. There were more shelters on offshore islands than in mainland coastal sub-districts, which were also badly hit by the 1991 cyclone.

Most of the shelters were used to their maximum capacity. That the shelters were very helpful in saving lives is beyond question and this has been corroborated by other observers (Mahmud, 1991). In many shelters, however, there were no stairs to the roof and most lacked latrines and an adequate water supply.

Problems with signals: The warning system, developed for ports and shipping, is misleading to people at risk. The common perception that the danger increases with the increase in the signal number is unfortunately wrong. Signals 10, 9 and 8 all communicate 'great danger' (Table 1). When the cyclone changed its course on 28–29 April, the signal was reduced from 10 to 9 and this created a false impression among the people that the cyclone had weakened (Naser, 1991).

Problems with warnings: The alert system is a joint responsibility of SPARRSO, the meteorological department, the media (press, radio and television), the Bangladesh Red Crescent Society and local government offices. Although there has been a tremendous improvement in the system since the 1970 cyclone, upgrading has not proceeded with equal emphasis in all high risk areas. As this study demonstrates, the system functioned unevenly, more warnings being received

in the offshore islands than in the coastal regions.

The most important reason why people did not take more precautionary measures was their belief that the warnings were false alarms. The warnings were not greatly heeded, even by the Bangladesh Air Force and Navy. Aircraft, ships and other equipments worth millions of dollars were destroyed by the cyclone. In an area where depressions regularly form over the sea and where 'great danger' signals are received, on average, once every two years without devastation being caused every time, there is a temptation to ignore warnings. When the signal system was first introduced, people did take notice of warnings, but most turned out to be false alarms. Moreover, many who did go to shelters lost their belongings as thieves ransacked their empty houses (Mahmud, 1991). A challenge for communicators is how to motivate people to respond to an event which is not so common.

Perceptions: There is a widespread belief that severe cyclones occur only at certain times of the year and that they are potentially disastrous only if the wind blows from a certain direction. How to deal with this obvious myth is yet another challenge for communicators.

Vulnerability of particular groups: Sixty three per cent of the deaths were in the under ten age group, whereas this age group represented only 35 per cent of the pre-cyclone population. Similarly, 42 per cent more females died than males, a pattern which is similar to the 1970 cyclone (Sommer and Mosley, 1972). The difference between male and female rates is more pronounced in very young and elderly age groups. Among children under 5 years of age, the death rate for females was 15 per cent higher than their male counterparts. Although not statistically significant ($p > .05$), this may raise questions about gender selection in a disaster situation. One study of the same cyclone reported the following case:

> A father held on to his son and daughter for dear life to keep them from being swept away by the tidal surge. When it became impossible to hold on to both of them, he helplessly released one — his daughter (Haider et al., 1991).

Even in the active adult age group (20–44 years), more women died than men. Hena (1992) has proposed the following reasons for this: (a) women are homebound, often being left at home to look after children and valuables; (b) their dress (the saree) restricts their movements and thus puts them more at risk at the time of a tidal surge; and (c) they are less well nourished and hence physically less able to deal with these situations.

The number of deaths was also related to literacy. Being educated is synonymous with being economically better-off. The economically better-off would be more likely to live in stronger and/or multi-storied buildings than the economically disadvantaged. In households with a working radio, the death rate was lower. Why the death rate should have been less amongst the landless than among those having some land was, however, not very clear. One explanation is that, being amongst the poorest, the landless might have moved more quickly to a shelter as they did not have many assets at home to bother about.

Trees as life savers: Although not adequately documented elsewhere, this study has shown the immense utility of trees as life savers. It is not known, however, whether afforestation has increased since the 1970s.

RECOMMENDATIONS

The findings of this study suggest the following recommendations.

1. Cyclone shelters have proved their

effectiveness in saving lives and they will continue to be important until socio-economic conditions improve to allow the building of better houses and/or the government is able to evacuate people to safer places in the event of an impending cyclone. What is needed for the immediate future is a comprehensive plan to build more shelters. In order to accommodate all at risk people, the present capacity needs to be raised by a factor of 8. Even if the shelters are made to accommodate double their present capacity, as they did during the last cyclone, they still need to be increased four times. This cannot be done overnight, but could be achieved over several five-year phases.

The present shelters are designed to accommodate a large number of people. Building more of these will mean that there is one for several villages, requiring people to walk some distance at a time of emergency. If smaller shelters were built they could be within easier reach of villagers and could be used as schools or clinics. It is very important that they are served by well elevated roads. Any new school, health centre or local office built in a cyclone-prone area should be designed in such a way that it can be converted into a shelter when the need arises. Immediate efforts should be made to investigate and improve the condition of existing shelters. Where necessary stairs should be constructed to the roof and latrines and drinking water installed.

2. One of the reasons why people are hesitant to go to shelters is the fear that their property may be stolen from their houses in their absence. The local elected bodies, with help from the government, could organize vigilance committees, made up of adult men, who could remain at home until the rest of the population had been sent to shelters.

3. The coastal embankment was able to contain the initial thrust of the cyclone but later collapsed. The embankment is being rebuilt, but its height should be raised and trees planted on both sides of it.

4. The value of trees in saving lives in such a disaster is often overlooked. The government and the NGO community should initiate afforestation programmes, as a priority, in the vulnerable areas.

5. The early warning system needs to be improved. The present warnings, which are directed to the needs of ports and shipping, should be revised so that they are more meaningful to ordinary people. The Cyclone Preparedness Programme should be organised in *all* vulnerable areas, not just the offshore islands.

6. Cyclone education needs to be encouraged in the schools and the mass media. Two days a year could be chosen as 'national cyclone preparedness days'. These could be those days on which the last two killer cyclones occurred (12 November and 29 April).

7. Development activities should be speeded up, with more investment in the social and economic infrastructure in cyclone-prone areas. Fortunately, several NGOs have started new development programmes after winding up their cyclone relief work. Many more should come forward to start new programmes.

Notes

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1. *Union* is the lowest administrative unit in Bangladesh, with an average population of 20,000.
2. *Pucca* is a Bangla term for a house structure made of brick and cement.
3. *Kutcha* is a Bangla term for a structure made of straw and mud (non-pucca). Most houses in rural Bangladesh are of this type.
4. These cases have been taken from Chowdhury et al. (1992).

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