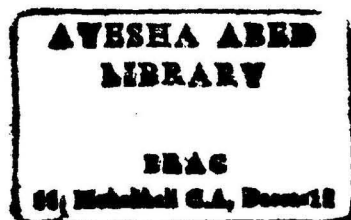


BBOOK

From Crisis to Development

Coping with Disasters in Bangladesh



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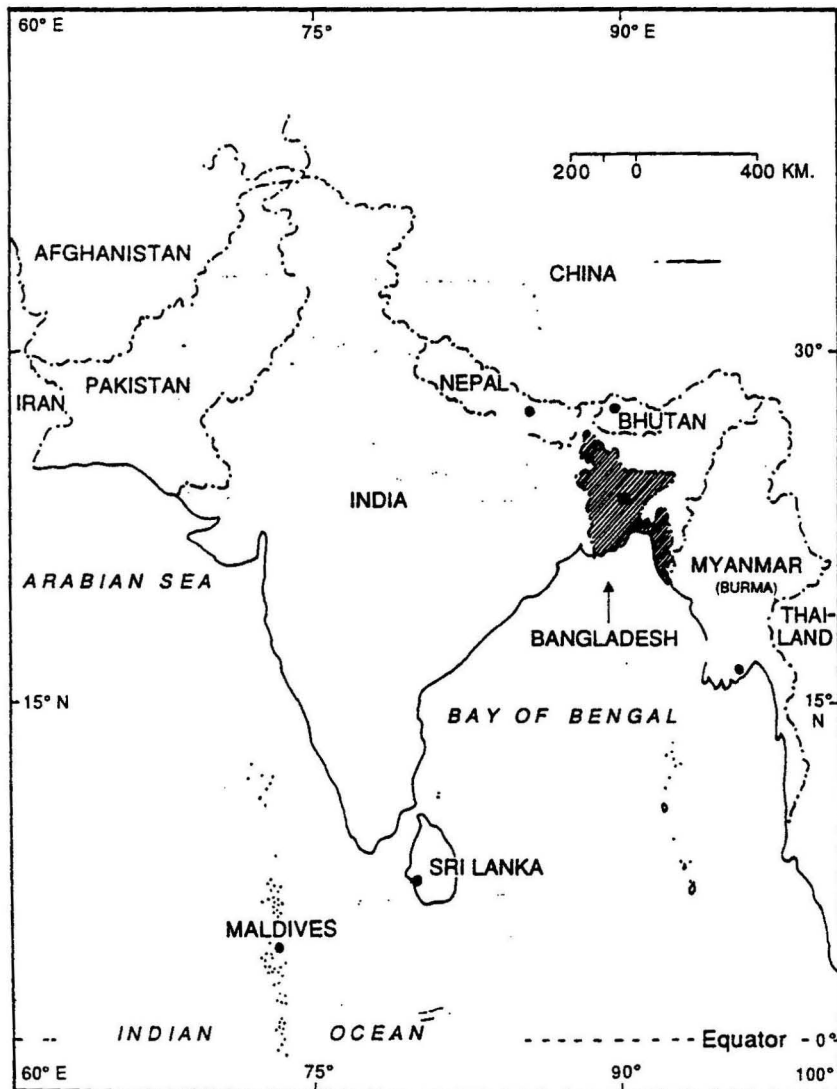
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CHAPTER VI

'CYCLONE AFTERMATH: RESEARCH AND DIRECTIONS FOR THE FUTURE

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Introduction

Comparatively few studies were undertaken in the aftermath of the 1970 cyclone than after the 1991 cyclone. The topics covered, included early assessment of health effects,¹ economic losses,² post-disaster environment,³ epidemiology of the cyclone,⁴ usefulness of shelters,⁵ people's perceptions about cyclone warnings,⁶ reasons for structural failures of semi-pucca buildings,⁷ and impact on nutritional status.⁸ The purpose of this chapter is to present and review results from some of these studies, particularly those initiated by the working group on Essential National Health Research (ENHR); this should provide insights on how Bangladesh can better respond to future natural disasters.

Background

The immediate response, following a natural disaster, is to save the survivors from death and further suffering. The 1991 cyclone witnessed massive

collective efforts by the government, NGOs, political and social organizations, donor agencies, including foreign military relief units and individuals. In addition, many research groups participated in studying the immediate and long-term impacts of the cyclone.

ENHR is an initiative to promote and foster research on health problems facing Bangladesh.⁹ On 12 May, 1991, the working group on ENHR met to review the situation and called for research into the aftermath of the cyclone.¹⁰ Following a six-day trip to the affected areas by two members of the group, a concept paper, outlining the research issues, was prepared.¹¹

On 2 June, a group of US-based researchers, who had previously worked in Bangladesh, arrived to review the health effects of the cyclone. Sponsored by United Nations Children's Fund (UNICEF), the group spent three to four weeks investigating specific aspects of the cyclone effects. Members of ENHR and other interested Bangladeshi researchers participated in this joint review.¹ Afterwards, some members of ENHR continued with previous plans for more detailed and indepth studies on the cyclone.

Methodology

While ENHR acted as a coordinating body, studies were sponsored by UNICEF, BRAC and ICDDR,B (International Centre for Diarrhoeal Disease Research, Bangladesh). In the following we provide a short methodology for each of the studies done.

Health effects of 1991 Bangladesh cyclone¹

This was a rapid assessment involving interviews with survivors, government, NGO and donor officials in Dhaka and in the affected areas, a review of records at the *upazila* and district levels and collection and analyses of water and stool samples to assess water quality and diarrhoeal outbreaks. The group, which included members of ENHR, visited Chakoria Sadar, Moheshkhali and Kutubdia *upazilas* in Cox's Bazar district, and Banshkhali and Sadar *upazilas* in Chittagong district.

Study of epidemiology of cyclone-related deaths⁴

A more detailed epidemiological study was done approximately three months after the cyclone. Twelve unions reporting more than five percent

death of inhabitants in the *upazilas* of Sandwip, Kutubdia, Banshkhali and Chakoria, were included. Information, on a total of 2,000 households, presented on the cyclone night, were collected using a structured pre-tested questionnaire. Male interviewers, who spoke the local dialect, collected the information.

A study of cyclone shelters⁵

This study was done to review the role of shelters in saving lives during the April cyclone. Two types of shelters were considered: cyclone shelters built by the government and the Red Crescent Society are referred to as "formal shelter" while the houses, schools, offices, and other permanent buildings used by people as refuge at the time of cyclone are referred to as "informal shelter." A survey was conducted on formal and informal shelters in all six unions of Kutubdia, four worst affected unions of Banshkhali and one union in Sandwip. Interviews were arranged with users and non-users of the "formal shelters" to understand the reasons for lack of use and to identify the problems faced by users.

Cyclone alerts: what people knew and did⁶

This indepth study explored people's knowledge about and response to the warnings, perceptions about cyclone and tidal bore and people's survival strategies. Several case histories, on how the survivors saved their own lives but were unable to save their children, were also documented. Indepth interviews of purposively selected households were carried out (60 in Kutubdia and 30 in Banshkhali) by a trained sociologist and her research assistant.

Survey of semi-pucca structures⁷

Experienced engineers, from a well established firm, carried out a detailed survey of twelve semi-pucca buildings partially or completely destroyed by the cyclone. The buildings were chosen from three badly affected unions of Kutubdia and three unions of Banshkhali *upazilas*. In choosing the structures, care was taken to represent different types of damage. The technique of data collection included direct observation of what remained

of the structures, measurement of different structural components, excavation for the foundation and interview with persons owning the damaged buildings. Each of the three major structural components (foundation, super-structure and roof) were analysed separately using standard engineering practices in an attempt to identify the causes for failure.

Cyclone mortality and differentials

The extensive epidemiological survey, involving 2,000 households, recorded 1,206 cyclone-related deaths, yielding a death rate of 105 per 1000 population.

Although the popular press speculated on the death toll, in our research, we were unable to set a definitive figure on the total lives lost. The exact figure will never be known. Several estimates on the number of lives lost are available. However, because of differing methodologies and assumptions, these estimates also varied, sometimes enormously. The government estimated a total loss of 131,539 lives.¹² For Kutubdia *upazila*, it was 19,133. The union *parishads* in Kutubdia made a separate survey of their own and found a total death toll of 11,000, considerably less than the government figure.¹ Using a procedure described in BRAC (1991a), a new estimate was made. According to this a total of 9,778 deaths occurred in Kutubdia which is 48 percent less than the government estimate and 11 percent less than the union *parishad* estimate. Based on this detailed study in Kutubdia and using the correction factor vis-a-vis the government estimate, the new estimate for total lives lost through the 1991 cyclone was 67,226.

Differentials

Figure VI.1 shows age-specific death rate, separately for males and females. This clearly shows that female mortality was higher than males in all age groups. It is interesting to note that the difference between male and female rates is more pronounced in the very young and older age groups, than in older children 10-19 years of age.

Table VI.1 shows the death rates by sex. Females died 42 percent more frequently than males ($p < .01$).

Fig. VI.1
Age and Sex-specific Death Rates

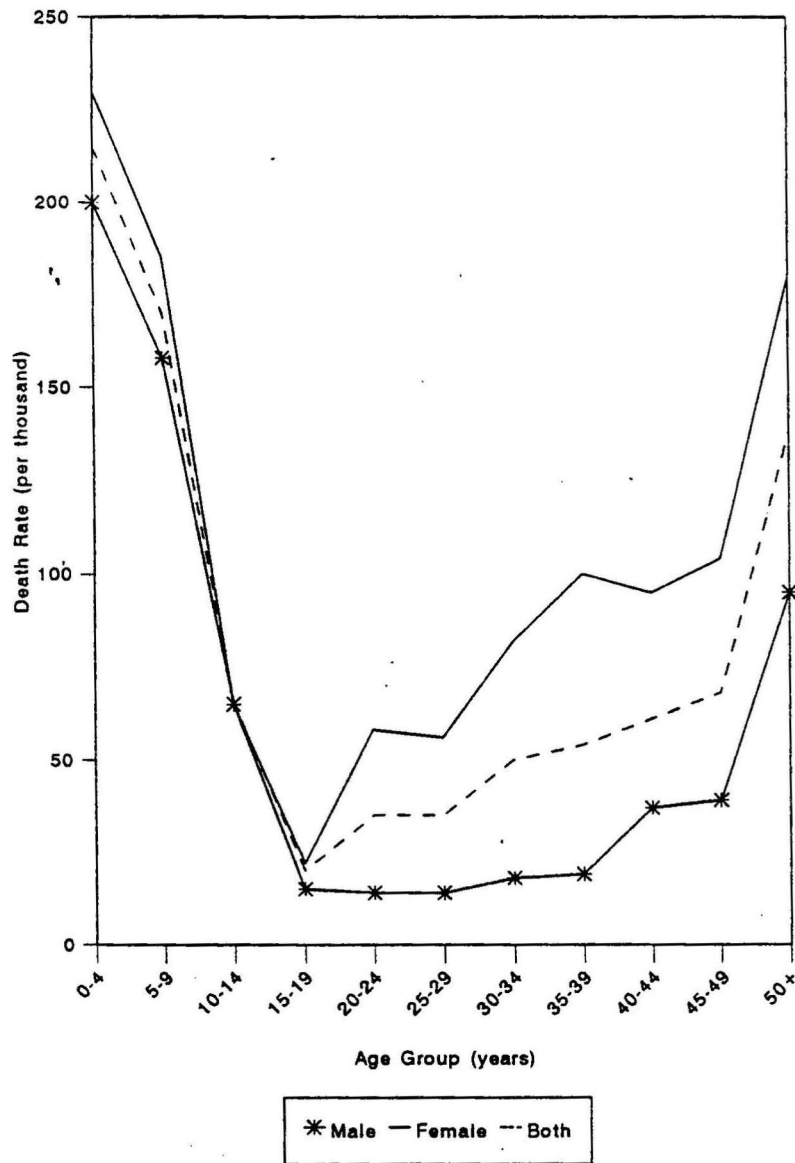


Table VI.1
Cyclone death rates by sex in 12 selected unions

Sex	Death rate per 1000 population
Male	87.1 (502)
Female	124.1 (704)
All	105.5 (1206)

Source: BRAC (1991a)

Note: Figures within parentheses indicate number of deaths. Denominators are the number of persons present on the night of the cyclone.

Table VI.2 shows the death rates by age group. Children and the elderly died disproportionately more than others ($p < .01$). Nearly three quarters of deaths occurred among children under 15 years of age. The number of deaths was lowest in 15-49 age group, but increased in older groups.

Table VI.2
Death rates by broad age group

Age Group (years)	Death Rate per 1000 population
0 - 14	154.5 (871)
15 - 49	40.0 (188)
50 +	134.0 (147)
All ages	105.5 (1206)

Note: Figures within parentheses indicate number of deaths.

Literacy seemed to protect people. While more illiterate or less literate adults died in proportion to their literate counterparts ($p < .01$).

Post cyclone deaths

A total of 49 deaths were reported in the three month period following the cyclone. By extrapolation, this represents a rate of 19.5 per thousand population per year which is more than the known crude death rate in Bangladesh.⁴ However, details on the age and socio-economic status of this group have not been analysed. Overall, the post cyclone death rate was far lower than predicted by some relief agencies.

Morbidity

Measurement of diarrhoeal morbidity was attempted by using a variation of the WHO (World Health Organization) diarrhoea survey methodology. The point prevalence of diarrhoea in children during the third week of June, was 10 percent in the studied areas which was not indicative of a major epidemic.¹ A large number of near asymptomatic people yielded positive result when their stools were cultured for enteric-bacteria. This is most likely a normal finding given high levels of endemic diarrhoea.

Observations on use of oral rehydration solution in the field were much more encouraging than the reports of surveys in normal non-emergency situations. Almost everyone whom the research team members met in affected villages knew that oral rehydration therapy (ORT) should be used with watery diarrhoea. Those with watery diarrhoea had used it in the post-cyclone period. People's knowledge of ORT undoubtedly contributed to lower mortality levels in the post cyclone period. However, recent reports from a post-cyclone study suggested that use rate of ORT had dwindled.⁸

Injuries

Minor injuries were reported in large numbers in the immediate post-cyclone period. Surprisingly few severe injuries were found in a review of hospital records. This should have been a sensitive method to detect injuries. However, it may be that most injured people were washed away

from their *kutchas* houses. Wounds from tin sheets and floating debris must have accounted for injuries and fatalities. Perhaps the immediate placement of medical teams (18 teams in Kutubdia alone!) at the *upazila* and union levels were helpful in the treatment of these injuries. Hospital records indicated that injury cases were not a problem after the second week.¹ It could be that people who sustained a serious injury were unable to swim or cling to buildings, trees or floating objects and simply perished and only those with minor injuries were strong enough to survive or that the numerous emergency medical teams treated people effectively and closer to their homes thus reducing treatment in hospitals.

Warnings

In the coastal and offshore areas, cyclone warnings are normally given through radio, TV, miking (use of portable loudspeakers) and beating of drums. However, as in many other studies, we found that inter-personal communication was perhaps the most common. The Red Crescent volunteers played a very important role in this respect. They warned the people through megaphone in local dialects and encouraged them to move to safer places. The epidemiological survey⁴ asked the respondents whether they heard the warning before the cyclone. Nearly three quarters of the people interviewed actually received the warning message, however, a much higher number in offshore islands received the warning compared to those in coastal *upazilas*. The indepth study also found differences between the unions within coastal areas.⁶ There was a relationship between warning and death rates: In Khankhanabad very few actually heard the warning, and the death rate was found to be highest in this union. In Banskhali, a coastal *upazila*, miking by Red Crescent volunteers was limited because the internal road network was poorly developed thus limiting access by *rickshaws* which carry the volunteers from village to village to "mike" the warning. The Red Crescent preparedness programmes were also less organized in coastal *upazilas* than on the more obviously vulnerable offshore islands. This is consistent with the findings that density of formal shelters was higher in offshore islands than in coastal *upazilas*.⁵ Earlier cyclones caused more havoc in offshore islands and consequently the government and the Red Crescent Society gave more attention to those areas in terms of cyclone preparedness.

Hearing the warning was not enough to make people act. At least three quarters of the respondents did not believe that a cyclone of major magnitude would batter their area. They had reasons for such a belief and shared the apparent disbelief with organized institutions such as the air force and the navy. Aircraft, ships and other military equipment worth millions of dollars were destroyed by the cyclone because they were left unsecured despite formal and repeated radio and television warnings. To many residents, these warnings simply meant another false alarm. Each year, several cyclone storms form over the Bay of Bengal and signals up to Number 10 are not uncommon. Over an eleven year period, between 1980-91, a total of 59 depressions were formed, more than five each year. Of these, 5 were "great danger signals," or one in every two years. Compared to these statistics, the last big cyclone that hit Kutubdia was in 1960 and Sandwip in 1970. The ability to motivate people to respond to an extraordinary event poses on a major challenge to the government and those who formulate the warning messages.

The last cyclone that the people of Kutubdia remember was in 1960, but was much weaker than the recent one. Several of them said, "*It was beyond our calculation that a devastating cyclone would hit in the month of Baishak*" (the first month of the Bengali calendar coincides with mid-April to mid-May). *Baishak* and *Jaistha* (May-June) the first two months indicate the driest season in the year and are not considered dangerous for tidal surges or destructive cyclones. In the dry season, the ponds, marshy lands, canals and rivers shrink and dry up. In the popular imagination, when a tidal surge comes during this time, it is first absorbed by their parched lands with little threat of flooding. A further examination of the weather systems and depression data indicated that less than a quarter of cyclones occurred during the first half of the year e.g. between January and June. There was a general belief, confirmed by weather records, that the two autumn months, viz, *Ashwin* (September-October) and *Kartik* (October-November) were the worst months for cyclones. It may be recalled that the 1970 cyclone hit Bangladesh during this time of the year (November).

A small proportion of respondents believed that the embankment along the coast was strong enough to contain any tidal surge. A small number of older respondents of Kutubdia could remember the 1960 cyclone and said: "*Though we did not believe the warnings we apprehended that a destructive cyclone would hit the area.*" On that day, they maintained, the first wind

Table VI.3 shows the number of "formal" cyclone shelters in different unions we studied as well as the number of people they serve. Twenty five shelters were identified in the study area. Population per shelter varied substantially between unions. It was highest in Kutubdia *upazila*.

The shelters varied by type of structure, capacity and age. Table VI.4 shows the number of shelters according to type. There were nine two-or three-storied cyclone shelters which were built during the 1970s and 1980s by Public Works Department (PWD) and the Red Crescent Society. In addition there were 10 community centres which are one storied concrete buildings (built during the 1960s) and six *killas* which are artificial hills with no structure. In Urir char a shelter was constructed in 1985 in response to a cyclone which claimed 40,000 lives in this small island. This shelter is named "Rajiv Bhaban" because it was made through a direct contribution by the former Indian Prime Minister Rajiv Gandhi.

Table VI.4
Shelters according to type

Type of shelter	Number
Cyclone shelter	9
Community Centre	10
<i>Killa</i>	6
Total	25

All the nine cyclone shelters had stairs to the roof and there was railing on the roof. Two community centres did not have any access to the roof which means that the roof could not be easily used. When the water rose to the roof level some people swam to the top for refuge. All the shelters except the *killas* incurred minor damages, particularly to windows and doors which were either blown away or broken, but their basic structure was not affected.

Out of 25 shelters, five had tubewells within reach but only three were in running condition. Only five had a latrine.

Utilization of shelters

All the shelters visited except for two were used to the maximum extent. The latter were used less for the following reasons: One shelter was located in a place not easily accessible to the people. There was no easily approachable road or footpath that could link it with the surrounding villages. Because most people did not move until the water was in their courtyard, the shelter was already swamped and inaccessible. In the absence of any adequate road higher than the water level road, only a few adults could manage to swim to safety. For the elderly, women and children, it was a formidable obstacle to have to swim to a shelter.

The second shelter was in a terrible physical condition. Many people used this as a place for defecation and kept their cattle there. It was a very unpleasant place to move to, particularly if people were not convinced that a cyclone of this magnitude would hit their area.

Problems in shelters

The users of cyclone shelters were asked about their experience. It was a first time experience for most respondents. Although they universally appreciated the protection provided on the first night they faced difficulties in the following days. The most common problem was the lack of latrines and drinking water. It was mentioned earlier that the latrines and tubewells were available in only three shelters. Other problems mentioned included crowding, lack of privacy, no light and no food. In spite, these problems everyone was grateful they could save their lives in these shelters.

Death in shelters

Although the shelters were most important on the night of the cyclone, they were also used for several weeks after the cyclone. People who lost their homes took refuge at night and during rains. Information was collected on deaths occurring in shelters on the night of the cyclone and afterwards. A total of 24 people died or one per shelter on an average. Of these deaths, eight (including five children) occurred on the cyclone night, all due to too many people and suffocation. The remaining deaths occurred as an after-effect of the cyclone from such causes as diarrhoea and pneumonia.

Daily use of the shelter

The shelters are used in normal times for a variety of purposes which depends on their age and physical condition. The new shelters are utilized more, particularly as Red Crescent offices or schools. The older ones are used by local influential persons for private godowns, as a place to dry paddy and for other personal purposes. The two dilapidated ones were not used except as a public toilet.

"Informal" shelter

Selected information collected on "informal" shelters showed that 75,000 people took shelter in seven hundred ninety five "informal" shelters, in 11 unions in our survey.⁵

Table VI.5

Number of informal shelters by type of structure.

Type of Shelter	Number
One Storied (tin shed) building	287
One Storied (<i>pucca</i>) building	299
Two Storied building (<i>pucca</i> & tin shed)	85
Three Storied building	2
Tin building	58
Latrine	2
Others	62
Total	795

Table VI.5 shows the type of structures of which one storied buildings were the most common. It was found that 287 of these shelters were tin roofed buildings which were mostly private residential buildings and 299 were *pucca* or concrete buildings, many of them being public buildings

such as union *parishad* offices, primary or secondary schools and health centres. Even the roof of *pucca* latrines were used as refuge.

Death averted by formal shelters and its cost

In the unions surveyed for the shelter study,⁵ the number of people taking refuge in formal and informal shelters were estimated which facilitated estimation of the population which did not take any shelter by default. It was thus possible to compute death rates among the non-sheltered population, in addition to that for the whole population. Since nearly half of the population, on average, of the most directly hit areas did not take any shelter, the death rate among the non-sheltered was double that of the whole population. Based on the number of people which the formal shelters provided refuge to and the death rate among the non-sheltered population, it was possible to compute the number of deaths averted by the formal shelters. It has been estimated that in the absence of these formal shelters, one fifth more deaths would have occurred. Based on these figures and the fact that a 2,000 person capacity shelter costs Tk 2.5 million in 1991, it has been estimated that the cost of a death averted through construction of a shelter (in a union where the death rate among the non-sheltered population is very high—approximately 413 per 1000 population) would be approximately⁵ Tk. 3,023 or US\$ 80.

Relief

More than 98 percent of respondents⁴ reported that they received some relief since the cyclone. However, 87 percent did not receive it until after the third day. Of the range of relief materials given, rice was provided to most households (69 percent), followed by *chira* (flattened puffed rice) (34 percent), pulse (24 percent) and biscuits (15 percent). Cloth was given to only five percent of households. When asked what else they needed at that time, cloth was said to be the most important for 74 percent of the respondents. This was followed by food (63 percent), housing materials (50 percent), cooking utensils and fuel-wood/ matches (27 percent). They were also asked what they needed most at the time of survey. Housing materials topped the list at 84 percent, followed by food 80 percent, a public embankment (55 percent), and cash (13 percent).

Rehabilitation and farming

When the respondents owning some land were asked three months after the cyclone whether they had resumed cultivation, 73 percent replied in the affirmative. For those who had not yet started, several problems were mentioned. Lack of farm implements, seed and draft animals were found to be a major problem in 37 percent of cases. However, recurrent influx of sea water through the breached embankment was the most frequently mentioned problem (48 percent) in resuming cultivation.⁴

Housing

Damage done to houses was investigated. The main structure of 93 percent of households was fully destroyed, and the remaining were all damaged except one percent of structures which were *pucca* and remained intact.^{1,4} This however reflects that over 90 percent of all households were *kutchra* or built of locally available traditional materials such as bamboo and thatching.

Reasons for structural failure of semi-*pucca* buildings

As mentioned earlier the structural failure in the foundation superstructure and roof of 12 surveyed semi-*pucca* buildings was analysed. Foundation failure in providing insufficient depth of foundation was observed to be the main reason in only one case of a junior high school.

The super-structure (i.e., 5 inch brick walls and 10 inch reinforced concrete pillars) of all surveyed buildings underwent some damage. Damaged walls and pillars of some of the structures were even carried away by the invading tidal surge. Surprisingly, some of the 10" pillars were also damaged. "Mortar failure" which means a much higher proportion of sand to cement ratio used than is normal for proper construction techniques was thought to be responsible for these damages. Some structural walls were constructed without using "brick bonding." Lack of skilled masons was quite evident because the quality of concrete work was clearly lower than in the rest of the country.

Roofs made of tin are notoriously vulnerable to storms and cyclones. Besides the sampled structures, the survey engineers did not find any structure in the affected areas whose tin roof withstood the high winds.

The reasons for engineering failure were as follows:

- use of sub-standard construction materials;
- low grade workmanship;
- non adherence to standard engineering practices in construction;
- apparently little or no supervision by technically qualified personnel.

It was concluded that semi-*pucca* buildings which would have enough strength to withstand a similar cyclone (wind 225 kmph) would entail an enormous cost.⁷

Sanitation

Place of defecation before and after the cyclone was investigated. While 7.3 percent households used slab (sanitary) latrines before the cyclone, this was reduced to 4.3 percent at the time of survey, which indicates that more than 40 percent of such latrines were destroyed by the cyclone. Proportion of households using no particular place for defecation remained the same. However, the proportion using pit latrines increased from 18.8 percent before the cyclone to 23.2 percent after the cyclone.⁴ Households whose sanitary latrines were destroyed probably moved quickly to build temporary pit latrines. The increase in use of pit latrines may have resulted from a promotion of pit latrines by the various agencies providing relief.

Water use and tubewells

Use of tubewell water for drinking purpose increased following the cyclone. It was 92 percent before the cyclone which increased to 95 percent after the cyclone. Use of tubewell water increased more sharply in case of washing utensils. It was 11 percent before the cyclone and 29 percent after the cyclone.⁴ This improvement could be attributed to the health education efforts that were undertaken by government and NGOs but was

more likely due to the highly contaminated surface water following the cyclone due to sea water incursion, dead animal carcasses and general debris.

Water use and availability following the cyclone were a major public health concern. This subject was of particular interest to all medical personnel and one of the studies paid particular attention to water quality.¹ To assess water use and water availability, two researchers accompanied by *upazila* and union level staff spent two days in the field examining the status of tubewells, their usage by the community and to collect water samples for microbiologic analysis.

They examined tubewells in two locations. One was Gorakghata union on Moheshkhali island, which is an *upazila* in Cox's Bazar District. All 29 tubewells visited in this location were shallow tubewells, with an average depth of 12 metres. The second area visited was Khankhanabad union in Banshkhali *upazila*. All 28 tubewells visited in this area were deep, with an average depth of 210 metres.

The researchers were impressed by the functioning of the tubewell programme. Personnel in the programme seemed dedicated and enthusiastic. During visits to *upazila* complexes, sanitary engineers, who were in charge of the tubewell programme for the *upazila*, were available in their office.

The density of tubewells in Gorakghata was much greater than that of Khankhanabad. Shallow tubewells in Gorakghata union included those installed with the support of UNICEF and the Government of Bangladesh, as well as many tubewells that had been privately installed. In Gorakghata, most of the tubewells were used by one household, or at most three. Some households even had more than one tubewell. In Khankhanabad there was approximately one tubewell per village, and the number of families using each tubewell was 145, in comparison to 13 in Gorakghata.

In Khankhanabad 27 of the 28 tubewells were identified as functioning. This area was one of the most severely affected, yet most of the wells were functioning immediately following the cyclone. Damaged wells usually required relatively minor repairs such as repair of a broken handle, which were fixed within a week of the cyclone.

For microbiologic testing, water samples were collected in sterile containers from Gorakghata and Khankhanabad unions. For each water source, the following information was recorded: source of water, depth of

tubewell, condition of the pump and platform, year installed, priming required or not, and degree of submersion at time of cyclone. Deep tubewells were defined as more than 76 metres.

Water samples were obtained from 29 shallow tubewells in Gorakghata, and from 22 deep tubewells, 4 shallow tubewells, and 2 ponds in Khankhanabad. Samples were preserved on ice and sent to the ICDDR,B laboratory at Matlab in Comilla District to be examined for the presence of faecal coliforms using the standard membrane filtration technique. Water samples from Gorakghata were collected on 17 June and analyzed on 20 June. This delay in testing was a result of the closing of the Dhaka-Chittagong road for 36 hours because of flooding. Water samples from Khankhanabad were collected on 20 June and tested on 21 June.

As anticipated the two water samples obtained from ponds were heavily contaminated with faecal coliforms. Samples from deep tubewells in Khankhanabad were largely free of faecal coliforms. The one exception to this was a tubewell that local residents had stopped using after the cyclone because the water was discolored, apparently because of a break in the pipe. Water from this well had an extremely high coliform count. Coliform counts from shallow tubewells in Gorakghata were at the level seen in routine sampling of non-cyclone affected communities such as Matlab. There was no association between the coliform count in these shallow wells and whether they had been submerged in the cyclone, whether the platform of the well was damaged, and whether they required priming before pumping. We also determined the coliform count in a container that one family used to store water that was obtained from a tubewell. The coliform count in this water container was the highest that we recorded. This contamination of intermediate (between the tubewell and ingestion) sources of water is something that has been reported from other areas and remains an important potential source of transmission of enteric pathogens.

All the previously conducted routine sampling from non-cyclone affected areas suggested that the cyclone did not have a continuing effect on water quality. This was important because reports of outbreaks of diarrhoea were reported prior to the study and continued during this study and tubewell water was implicated as a source of infection. However the absence of heavy contamination of the tubewells implies that they were not the source of continuing infections.

Drug supply to government health centres

To correlate drug supply to government health centres with drug need for diarrhoeal illness, the drugs supplied to one union in Sadar *upazila* of Cox's Bazar district from January 1990 through June 1991 was listed and matched to the disease profile of the outpatients at the same health centre. Metronidazole was provided in the greatest quantity (30,400 tablets in 18 months and 16,000 tablets for emergency relief in May), while ORS packets were supplied in relatively small amounts (4,000 packets in 18 months and 8,300 packets for emergency relief in May). Nalidixic acid had only been provided once in June 1991 (see fig. VI.2).

The total number of patients seen in May 1991 was 4,300, of which 1181 (27 percent) complained of diarrhoeal illness. Based on the diarrhoeal disease profile, the drug need for patients visiting the clinic in May 1991 was estimated to be 3,342 packets of oral rehydration therapy (3 packets for each of the 1,114 patients with watery or mucoid stools) and 1,340 tablets of nalidixic acid tablets (67 patients with bloody diarrhoea). Assuming that 10 percent of patients with mucoid stools had amoebiasis or giardiasis, the requirement for metronidazole was estimated at 6,450 tablets (645 patients $\times$ 10 tablets). The need for tetracycline was difficult to assess, since it was not known whether any of the patients had cholera. Since no deaths from dehydrating watery diarrhoea in adults were reported, the presence of cholera in this area was unlikely and the use of tetracycline was therefore probably not justified.

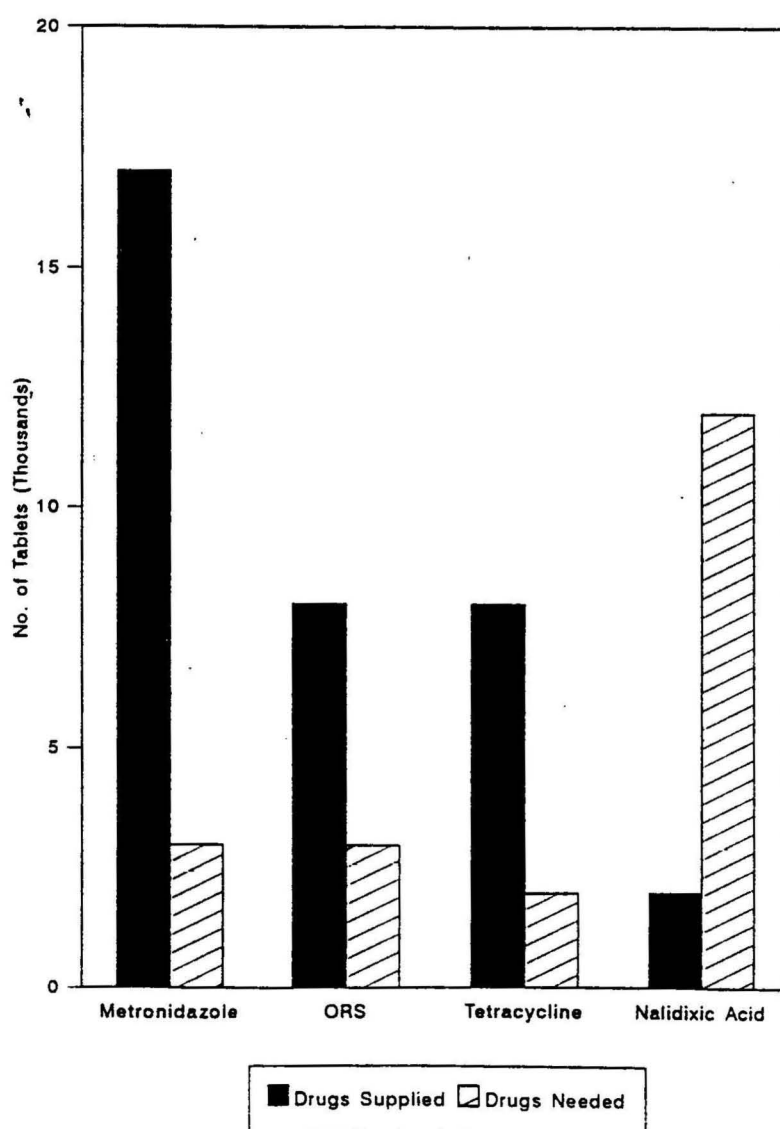
For clinic patients, there was an excess supply of metronidazole and tetracycline and an acute shortage of nalidixic acid for the treatment of bloody diarrhoea. It is possible that some of the excess supply of metronidazole was distributed to health assistants.¹

Vitamin A and immunization

Proportion of children six months to six years of age receiving the vitamin A capsule since the cyclone was investigated. On average only 9 percent received the capsule. However, it varied between the *upazilas* with Kutubdia scoring highest (23 percent).⁴

The Expanded Programme on Immunization (EPI) is heralded as one of the few social programmes undertaken by government to have succeeded.

Fig. VI.2
Drug Supply vs Drug Need for Diarrhoea
Eidgaon Union, May 1991



For example in 1990 and 1991 the programme reached 90 percent of infants with at least one injection and about 70 percent of infants were fully immunized.¹³ This compared to independent evaluation of the vitamin A capsule programme which found a coverage of only around 35 percent.¹⁴

Although vitamin capsules are much easier to administer than vaccines, which require a cold chain and sterilization, both are highly relevant public health measures after a disaster. And yet, available information suggests that both programmes suffered as a result of the cyclone. EPI coverage dropped from 62 percent to 13 percent in Chittagong area (see fig. VI.3) while vitamin A was well below the national average.

When programme managers were questioned as to why coverage declined several factors were cited. First, health facilities were damaged and stocks lost. However, these had been replaced within four weeks. Secondly, both government and NGOs rushed curative medical teams to the area and set up numerous small clinics. Available family welfare assistants and health assistants, who normally vaccinate one day per week, were completely occupied "servicing" and working in these small clinics. Thirdly, Operation Sea Angel ferried so much medicine into the affected *upazilas* that local health staff were overwhelmed just sorting, storing and later dispensing it. Fourthly, the government and medical supervisors, as usual in times of an emergency, placed relatively greater priority on curative care than on preventive public health programmes.

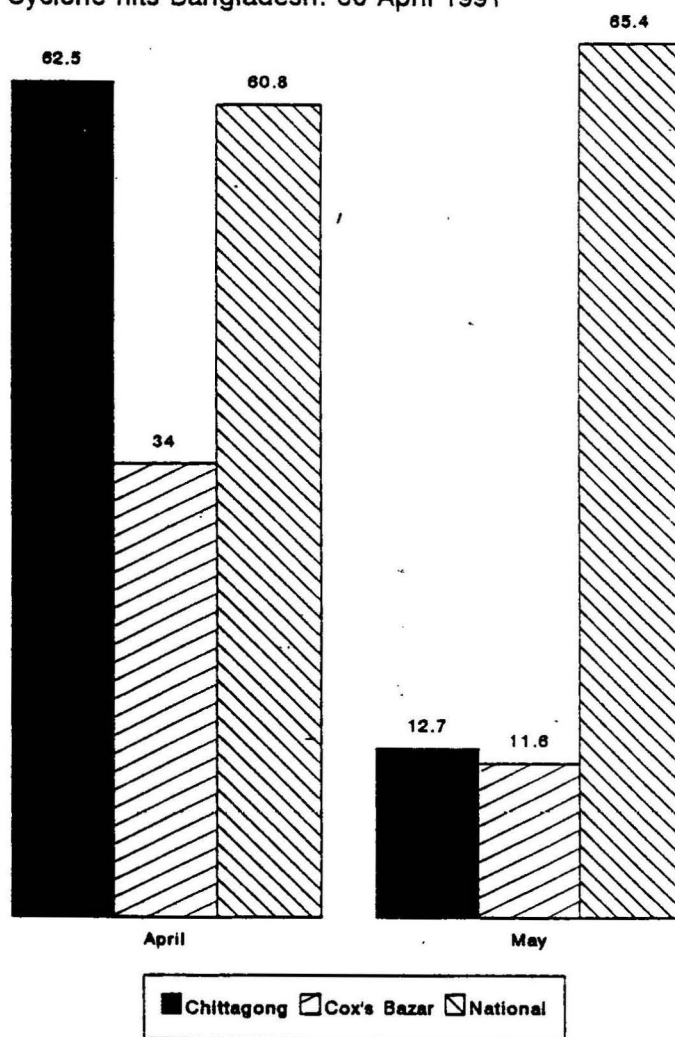
However, a measles vaccination campaign was mounted which included all pre-school children as distinct from the normal EPI programme which targeted only infants (less than 12 months of age). Accurate statistics are not available but the EPI project estimates that 100,000 under five children were vaccinated for measles within four months of the cyclone. No major measles outbreak was reported.

Nutritional status

Helen Keller International (HKI) started a long-term nutritional surveillance programme in nine *upazilas* affected by the cyclone. Collection of monthly data showed a downward trend in nutritional status of children 12-59 months of age. The mean mid-upper arm circumference (MUAC), which was the method used to assess nutritional status, decreased from 134 mm in September 1991 to 132 mm in December. The prevalence of severe

Fig. VI.3
Reported DPT3 and OPV3 Immunization Coverage
April-May 1991

Cyclone hits Bangladesh: 30 April 1991



Source: EPI Routine Reporting System

undernutrition measured by MUAC < 125 mm was extremely high. It increased from 21 percent in October to 24 percent in November 1991. Compared to this, undernutrition in Bangladeshi children unaffected by the cyclone was only 10 percent.⁸ The studies reported here^{1,4,5,6,7} were done within a few months of the cyclone and it found no major outbreak of infectious diseases. Studies done elsewhere reported an increase in some of diseases after several months of disasters.¹⁵ However, no excess mortality was reported by HKI indicating that the increase in nutritional stress did not have a corresponding increase in the risk of death.

Discussion

This chapter has presented results from a number of studies done on the aftermath of the cyclone. The death rate in 12 of the worst affected unions was 105 per 1000 population present on the night of the cyclone. Several estimates are available on the number of lives lost, mainly due to differing methodologies used. However, our estimate yielded a total toll of 67,226 which is 48 percent less than the official government estimate and compares well with the difference found for the 1970 cyclone between the estimate given by the government³ and that by Sommer and Mosley (1972). It is important to devise standard methodologies which can be used by government agencies immediately after a disaster rather than depending on intelligent guesswork.¹²

Regardless of methods used, the death rate or the total number who died in this cyclone is less than that of the 1970 cyclone. The 1970 cyclone was the most devastating of this century. Although the windspeed and the height of tidal surge were similar in the case of both cyclones,³ the 1991 cyclone caused less casualties. Several explanations might be advanced to explain the reduced mortality in this cyclone. First, there has been a tremendous improvement in the cyclone warning system since the early 1970s with the use of satellites through SPARRSO. Secondly, cyclone preparedness has taken off commendably with the launching of the cyclone preparedness programme by the Bangladesh Red Crescent Society. This voluntary effort of cyclone preparedness has organized units at the lowest administrative level in the coastal and offshore areas. More than 20,000 Red Crescent volunteers were at work in these areas to inform people about impending danger and to help remove people to safer places, if necessary and where

available. Third, the embankments made along the coast prevented the initial thrust of water, although it could not withstand the onslaught in several places where the embankment collapsed. Fourth but very important, the large number of cyclone shelters constructed since the 1970 storm saved many lives. One study estimated that at least 20 percent more deaths would have occurred if these shelters had not been present.^{4,5}

Analysis of death by age and sex shows that of deaths: Disproportionately more women, children and the elderly died, a finding similar to that of the 1970 cyclone.¹⁶ Among children less than 5 years of age, female mortality was 15 percent higher than males, which raises questions about gender vulnerability at the time of disaster. In another study a father reported the following case:

*"I held on to my 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, I helplessly released one—my daughter."*³

Literacy was found to be inversely related to death rates. Since literacy is a proxy for socio-economic status, this observation confirms the contention that it is always the socially and economically disadvantaged who suffer more, even in a natural disaster.¹⁷

Although not adequately covered in contemporary research, the few case studies which we have reported show the immense role that trees played in saving lives during the tidal surge. Not only indirectly through soil stabilization but also directly as a secure place to climb and cling to. Therefore, it is safe to conclude that programmes on afforestation in the coastal regions will increase survival prospects when another cyclone hits.

Contrary to popular expectations, post-cyclone morbidity, particularly related to diarrhoea, was not alarming. This probably has to do with the impressive work done by the government and NGOs both after the cyclone through distribution of ORS and before through promotion of oral rehydration therapy by BRAC, the government and numerous smaller NGOs. Monitoring of morbidity in the affected areas should be done as other studies indicated increase in selected morbidity several months after a disaster.¹⁵

The results of our research into the people's knowledge and perception of the cyclone warnings were mixed. Nearly three-quarters of the people interviewed had heard the warning signals but the knowledge in offshore islands such as Kutubdia and Sandwip was overwhelmingly greater when compared

to coastal areas such as Banshkhali or Chakoria where the knowledge at best was moderate.

Following the 1970 cyclone, the government and the Red Crescent Society put more emphasis on cyclone preparedness in the offshore islands in comparison to the coastal areas and this put the islands in much more advantageous situation. However, the signals themselves did not mean much to the people, mostly because they had been conditioned by previous early warnings which did not materialize.

There was a general confusion regarding the cyclone warnings. People considered Number 10 more dangerous than Numbers 8 or 9. In reality there is no difference between the three numbers in terms of the danger except for the path of the cyclone in relation to the port of Chittagong. These warnings were originally devised to warn the ports and ships, not to inform ordinary people.

Although a great majority of people heard the warnings very few took precautions in advances and most waited to see for themselves if a severe storm would hit their area or not. Their lack of preparation was explained by (a) their experience of previous false alarms; (b) scarcity of shelter space (there was on average one shelter per 7,700 population with each shelter designed to serve up to 2000); (c) swift inundation of all approach roads; (d) cyclone being of magnitude at this time of the year; and (e) fear that all their belongings would be stolen in their absence.

In order to remind the people and get prepared, two days, one in each of the cyclone seasons, could be observed as national cyclone days to remember the dead of the two big cyclones. On April 29 and November 12, the anniversaries of the 1991 and 1970 storms, emphasis could be placed on reinforcing the meaning of the warning system and the need for an appropriate and timely response. In addition, reinforced buildings within communities should be identified to serve as shelters in addition to the formal purpose-built cyclone shelters. The ability to motivate people to respond to infrequent events however deadly poses a major challenge to communicators.

The study also provided some detailed information on the existing (formal) shelters which were built by the government and NGOs over the last 30 years. The shelters were immensely helpful in saving lives. It was estimated that at least 20 percent more deaths would have occurred if these shelters were not present. Cost per death averted by the shelters was

calculated to be Tk. 3,023 or US\$ 80, which is less than the corresponding cost for many health interventions. In the final analysis it became clear that the formal shelters showed their usefulness and utility. In order to ensure better security in future construction, the planners must consider other factors such as their location, design, maintenance and normal utilization. Schools are a particularly useful for such shelter since children are more numerous and also one of the most vulnerable groups in society during cyclonic storms.

Information on relief was also analysed. It indicated how people's needs changed relatively quickly following the cyclone. Immediately after the onslaught, food was needed most and our survey shows that they received relief food within three days. But before relief came they were able to help themselves through traditional coping strategies. The second most important need at the time, according to the survivors, was clothes but only a few received clothing. Later the perceived needs shifted to housing and then to embankments to save their fields from high tides. This indicates relief priorities in a post-disaster situation which corresponds to the government phasing of post cyclone relief.

Analyses of post-cyclone situation indicated that nutritional levels of children declined in the affected areas. So did the coverage of EPI and vitamin A capsule distribution. While the effectiveness of the government machinery increased impressively in many sectors during the post-cyclone period poor performance in the above areas is unfortunate and merits further attention because public health preventive measures for the most vulnerable—the children—should be a high priority.

As mentioned in the beginning of the chapter, the impact of 1991 cyclone has been studied by more research team than 1970.¹⁸ An interesting feature is that most of these were done by Bangladeshi researchers. This shows important changes in Bangladesh's efforts to develop their resources and analytical capacities.

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13. Huq, M. (ed.). *Near Miracle in Bangladesh*, Dhaka, University Press Ltd. 1991.
14. Institute of Public Health Nutrition and UNICEF. Evaluation of National Blindness Prevention Programme, Dhaka, 1989.
15. Bissell, R.A. Delayed impact infectious disease after a natural disaster. *Journal of Emergency Medicine*, 1: 59-66, 1983.
16. Sommer, A and Mosley, W.H. "East Bengal Cyclone of November 1970: epidemiological approach to disaster assessment," *Lancet*, 13 May, 1972.
17. Brazier, C. Responding to third world disasters. *New Internationalist*, 222, 1991.
18. Chen, L.C. (ed.). *Disaster in Bangladesh*, Oxford, Oxford University Press, 1973.