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Disaster preparedness for sustainable development in Bangladesh

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Abstract

Purpose – Bangladesh is one of the most disaster-prone countries in the world. Natural disasters adversely affect the country's economy and deter its development. Thus preparedness for the disasters, along with effective prevention and mitigation measures, is imperative for sustainable development of the country. The purpose of this paper is to examine the present state of disaster preparedness in the country with special attention to the more frequent and damaging disasters – flood and cyclone.

Design/methodology/approach – A detailed study of the effects of natural disasters, disaster prevention and mitigation measures, and institutional setting for disaster preparedness was undertaken.

Findings – Plans and programs have been formulated to manage natural disasters. In a "Cyclone Preparedness Program", trained volunteers facilitate emergency response and proper use of the multi-purpose shelters. Within an institutional framework for disaster management, several Non-Government Organizations (NGOs) work for disaster preparedness alongside the government organizations. Their formal and nonformal education programs on disaster preparedness have a common objective of promoting resilient and sustainable communities.

Practical implications – Planning and design of structural interventions for prevention and mitigation of natural disasters should be done more carefully to avoid adverse impacts on the environment. A participatory approach is essential in this process. Education and awareness-building programs need wider and easier access to the people.

Originality/value – The paper concludes that the institutional arrangement for cyclone preparedness and response is unique and efficient, and that participation of NGOs in the preparedness program contributes significantly toward sustainable development. These lessons will be important for development planning in other sectors.

Keywords Disasters, Floods, Education, Bangladesh

Paper type General review

Introduction

Bangladesh is almost annually affected by natural disasters. Sometimes the country faces multiple disasters in the same year. Natural disasters cause economic loss and often result in enormous death toll. In addition to causing damage to the ecosystem, disasters cause short- and long-term social problems. Population displacement, livelihood loss and family disintegration are among the more common examples of such problems (Elahi, 1991). Severity and frequency of natural disasters are very likely to increase in future because of climate change. This is already evident from an increasing frequency of extreme events. Thus natural disasters have negative impact on the socio-economy of Bangladesh and impose multifarious constraints to sustainable development of the country.

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In response to the frequent natural disasters, short- intermediate- and long-term prevention and mitigation plans have been formulated in Bangladesh. Implementation of these plans often faces insurmountable challenges because of adverse socio-political settings. Prevention and mitigation measures may reduce the vulnerability and hazard while occurrence of natural disasters remains unavoidable. Adequate preparedness may significantly reduce the adverse impacts of these disasters. Knowledge, awareness, resources and an efficient framework are the most important elements of preparedness of a community against natural disasters. All these elements are to be developed over a long period of time with a focused goal and a predetermined strategy. In Bangladesh, disaster preparedness education and awareness-building programs have gained special attention from both the government and non-government sectors. Consequently, formal and non-formal education programs have been successfully introduced through many government and non-government institutions. However, these programs need easier access to all sections of vulnerable people and better management of available resources to promote educated and aware communities better prepared against disasters.

Recent major disasters

The more common disasters in Bangladesh include flood, cyclone and storm surge, drought, tornado, riverbank erosion, earthquake, and arsenic contamination of groundwater. Among these, floods and cyclonic storm surges demand special attention because of their frequency of occurrence and damaging power. In recent times, the floods of 1987, 1988, 1998, 2004 and 2007, and the cyclones of 1970, 1985, 1991 and 1997 are noteworthy.

Flood

Flood is almost an annual natural phenomenon in Bangladesh. Depending on the geographical setting, floods can be classified as: river floods, rainfall floods, flash floods, tidal floods, storm surge floods and urban floods (Chowdhury *et al.*, 1997). Floods can be also broadly classified into "normal" and "abnormal" or "extreme" events. While each type of flood has its own characteristics and degree of severity, river floods and flash floods are of utmost concern to Bangladesh. The normal river floods are actually somewhat beneficial to the ecosystem. The alluvium coming with the floods and the seasonal variability in flow and water level helps maintain the ecological balance. The people in Bangladesh have developed traditional coping strategies to live with these normal events. However, the extreme floods are beyond the sustaining capability of the people. During the extreme events the floods become enormous in proportion in terms of areal extent and damage. The damage is higher if the event is prolonged (Rahman *et al.*, 2005). Table I gives a summary of the adverse effects of the most recent extreme floods. Figure 1 shows a comparison of the damage caused by the extreme events in 1987, 1988, 1998 and 2004 with that by a normal flood in 1984.

Cyclone and storm surge

Cyclones and associated storm surges are also regular phenomena in Bangladesh. Figure 2 shows the tracks and landfall locations of a few major cyclones in the Bay of Bengal. Deep depressions formed in the northern Indian Ocean and the Bay of Bengal

often transform into cyclones and are guided by the funnel shape of the bay to its tip towards Bangladesh. Other reasons for frequent devastating cyclones and surges include climatic factors in the Bay of Bengal, shallow continental shelf, high tidal range, and flat topography of the coast (Choudhury, 2001). In addition to strong wind, the surges, sometimes amplified by the astronomical tides, strike the coasts and may intrude as far as 200 km inland. During the last 125 years, 42 cyclones hit the Bangladesh coast, of which 14 hit during the last 25 years. Cyclones cause damage in three ways:

(1) strong wind;

(2) storm surge; and

(3) flooding due to excessive rainfall.

The wind speed may rise up to 240 km/hour. The height of associated surge varies from 3 to 6 meters while the average maximum height is 7.5 m during extreme events. Table II gives the wind speed, surge height and death toll during some of the extreme events. The damage depends primarily on the landfall location and population density among other factors. In the recent years, the damage has been significantly reduced because of the preparedness and mitigation efforts in the country.

Table I.
Effects of extreme floods in Bangladesh

Description	Flood year 1987	1988	1998	2004
Districts affected (of 64 total)	50	52	53	54
Upazilas (sub-districts) affected	347	346	370	263
Affected area (km^2)	28,665	33,626	37,485	20,947
Affected population (million)	24.8	35.7	31.0	33.6
Flood duration (day) above DL at Bhairab Bazar		68	78	39
Maximum WL (m PWD) at Bhairab Bazar		7.66	7.33	7.78

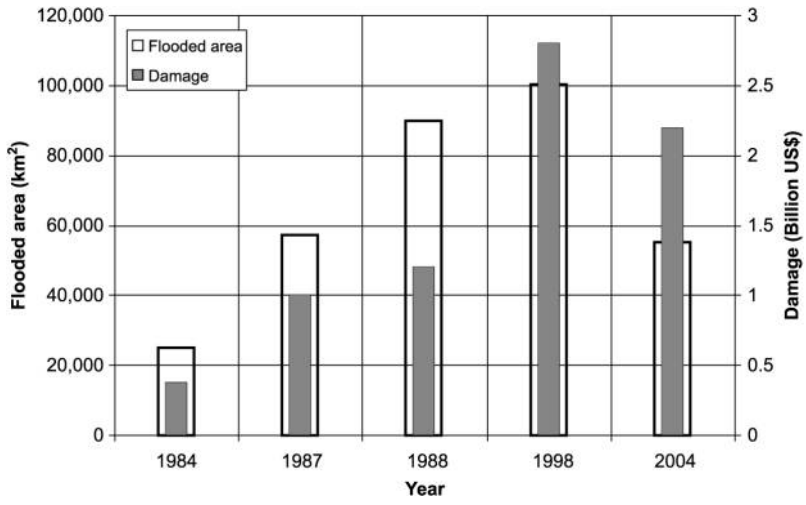

Figure 1.
Damage caused by extreme floods

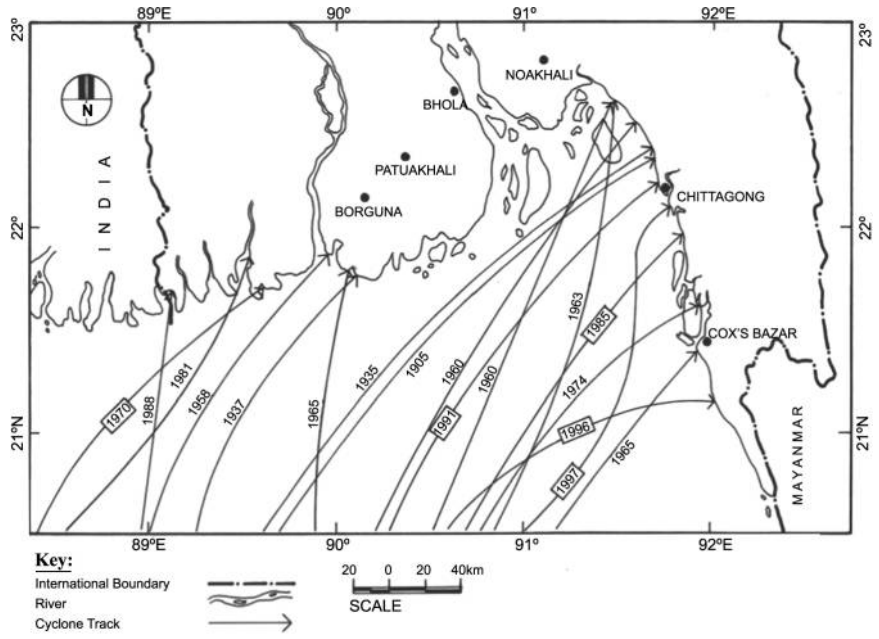

Figure 2.
Tracks and landfall locations of major cyclones

Date	Maximum wind speed (km/hr)	Storm surge height (ft)	Deaths
11 May 1965	162	12	19,279
12 Nov 1970	223	20-30	500,000
25 May 1985	154	10-15	11,069
29 Nov 1988	162	5-10	2,000
29 Apr 1991	225	20-25	140,000
19 May 1997	225	15	126
26 May 1997	150	10	70

Table II.
Wind speed and storm surge height during major cyclones

Disaster mitigation and preparedness

Structural and non-structural measures for flood mitigation

After the major floods of 1987 and 1988, the Flood Action Plan (FAP) was formulated with an aim to set the foundation for a long-term comprehensive solution to the flood problem. The FAP has 29 components to focus on regional issues, supporting studies and pilot projects (Islam, 1998). The main objectives of the FAP are to: safeguard lives and livelihoods, minimize potential flood damage, improve agro-ecological conditions for enhanced crop production, meet the needs of fisheries, navigation, communications and public health, promote commerce and industry, and create flood-free land for a better living environment. The FAP also provides guidelines for people's participation and environmental assessment. The ongoing studies alongside the FAP include extraction of local knowledge such as coping strategies of local people, and development of appropriate sanitation technology in the coastal and flood-prone areas.

The FAP became controversial during its early stage of implementation due to lack of public participation and extensive floodplain intervention. Despite the strong criticism, the FAP has significantly contributed toward flood mitigation. Over the last two decades, many structural and non-structural measures have been undertaken for flood prevention and mitigation. These measures have their merits as well as demerits (Chowdhury and Rahman, 2001). Some of the main efforts for flood mitigation are briefly summarized below.

Embankment. Approximately 7,500 km of embankment has been constructed along the major rivers. Also, loop embankments or polders have been built to protect major urban centers and coastal agricultural land. In some areas submersible embankments have been constructed for crop production and protection against flash floods. However, adverse impact of construction of embankments has been observed over the years. The major impacts include obstruction of fish migration routes and spawning grounds, and deterioration of floodplain ecosystem.

Improved gravity drainage. Quick recession of floodwater is important for reduction of flood damage. To improve the gravity drainage in both rural and urban areas, excavation and re-excavation of *khals* (canals) have been undertaken. Selective dredging of rivers has been also conducted. Excavation of canals is more effective during the post-monsoon period when the water level in the rivers is relatively low. Sometimes the wetlands are also drained locally for rice cultivation during the post-monsoon period. However, dewatering of wetlands cause adverse environmental impact and create conflict among the water users.

Pumped drainage. Pumped drainage facilities have been constructed where gravity drainage is inadequate. Pumped drainage infrastructure in urban loop embankments has been effective for mitigation of storm water flooding. However, encroachment of storm water retention areas, obstruction of drainage routes and unplanned urban development undermine their effectiveness. Pumped drainage in rural flood control projects has not been cost-effective and resulted in channel sedimentation and adverse environmental impacts.

Flood proofing. This approach adopts the traditional practice of building homesteads on high grounds above the flood level. Through several flood proofing projects homesteads, infrastructure and sanitation facilities have been raised above the flood level. The National Water Management Plan mentions success of these projects. Flood proofing is relatively risk free and involves a minimum environmental intervention.

Flood forecasting. In the recent years, significant improvement has been achieved in accuracy and lead-time of flood forecasting. Currently, river water level is forecast at 44 locations with 24, 48 and 72-hour lead-time. Although the accuracy of this forecast is quite reasonable, a longer lead-time is essential for better preparedness and loss reduction. Also, appropriate use and interpretation of the forecasting information at the local level must be ensured.

Structural and non-structural measures for cyclone and storm surge

After a major cyclone in 1985, donor-funded construction of multi-purpose cyclone shelters started in the coastal areas. Figure 3 shows a typical cyclone shelter. During normal times, these shelters are used as schools and community centers. This initiative was later formalized under a Multi-purpose Cyclone Shelter Program (BUET-BIDS,

Figure 3.
A typical cyclone shelter

1993), which included other issues such as coastal afforestation. At present, there are 2,133 cyclone shelters and accompanying *killas* (raised earthen grounds for the cattle) covering 30 per cent of the coastal vulnerable population. The remaining population will be gradually brought under the coverage of cyclone shelters (Islam *et al.*, 2006). About 32,000 trained volunteers work in the coastal areas under a Cyclone Preparedness Program (CPP) jointly operated by the Red Crescent Society and the Ministry of Disaster Management and Relief (MDMR). The volunteers are responsible for alerting people by megaphones and mikes, house to house contact, raising danger signal flag, rescue of survivors, first aid to the wounded, post-cyclone security measures, distribution of relief materials, and surveying damages caused by cyclones and reporting them to their local headquarters. During the 1991 cyclone, the CPP volunteers evacuated approximately 350,000 people to cyclone shelters and other safe places before the cyclone arrived. Other important counter-measures are summarized as follows.

Coastal embankment. These embankments were originally built for protection against high tide and salinity intrusion to support agriculture, and are effective to some extent against low-intensity storm surges. However, these structures are relatively expensive because of their height and gentle seaward slope requiring more construction materials. The risk of their breaching and overtopping is also relatively high. The adverse impacts posed by these embankments include drainage congestion and obstruction to local water-transport.

Coastal afforestation. Afforestation programs have been undertaken along the entire coast and coastal islands of the country under the Coastal Green Belt initiative. Coastal vegetation is believed to attenuate wave energy, promote accretion and reinforce the soil. Also, if managed through community participation, coastal forests may provide resources and livelihood to the people.

Cyclone and surge forecasting. The present forecasting system for cyclonic wind speed, direction and track is quite reasonable. However, there is scope for further improvement, particularly in predicting the landfall location and storm surge height, and introducing a more meaningful signaling system that would communicate the danger level to the people.

Disaster management and preparedness

In Bangladesh, disaster preparedness involves preparation of a counter-disaster plan, forecasting and warning of the disaster, maintenance of resources needed during and after disaster, and training of the related personnel (Rahman, 2001). Disaster preparedness is embedded in the broader activities for disaster management. Disaster management is a continuous process that involves activities at several stages or levels, which are: preparedness, response, recovery, assessment, prevention and mitigation (see Figure 4). With the completion of each cycle, new lessons are learnt, new measures are adopted and people are better prepared for the next disaster.

An institutional setting exists in Bangladesh for disaster preparedness under a framework for disaster management. A ministry, MDMR, is responsible for management of disasters and relief operations in the country. The Disaster Management Bureau (DMB) is a specialized staff organization under the MDMR. The main functions of DMB include: disaster action planning at the local level, training and building public awareness, information management, and logistics planning. Other bodies related to disaster management and preparedness are: National Disaster Management Council headed by the Prime Minister, Inter-Ministerial Disaster Management Coordination Committee, Cyclone Preparedness Program Implementation Board, and local-level Disaster Management Committees. In addition to these government organizations several Non-Government Organizations (NGOs) work mostly at the field level for disaster preparedness. Activities of these NGOs are coordinated through the MDMR.

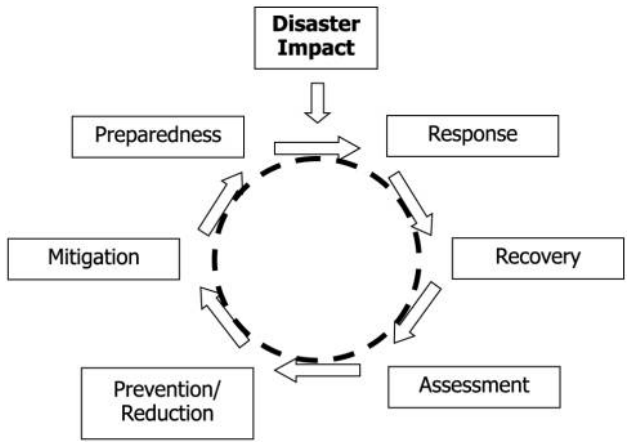

Figure 4.
Disaster management cycle

Education for disaster preparedness

Education and awareness are prerequisites for preparedness. Disaster preparedness education is provided through formal and non-formal means by both government and NGO programs. Figure 5 shows the structure of the education programs. The government-operated programs provide disaster preparedness education through the Campaign for Popular Education (adult literacy program) (SEMP, 2003) and primary-level school curriculum. There are also several awareness-building programs regarding disaster preparedness. Approximately 2,000 NGOs work in Bangladesh, of which about 190 are foreign NGOs. NGOs play important roles in rural and national development. Micro credit and public education programs are noteworthy NGO activities in Bangladesh. Many NGOs have included disaster preparedness education as a highlighted topic within their public education programs. Leading NGOs in disaster management and education are:

- Bangladesh Rural Advancement Commission (BRAC).
- Proshika.
- Gono Shahajjyo Shongstha (GSS).
- Dhaka Ahsania Mission.
- Disaster Management Forum.

Formal education

Formal education in disaster preparedness is provided at the primary school level and postgraduate level. At the primary school level the topics focus mainly on general awareness about different types of disasters and the pre-, post- and during-disaster tips. At the postgraduate level, degrees (Certificate, Diploma and Master) in Disaster Management are offered to prepare professionals (BRAC University, 2006). Course contents relate to three main aspects:

(1) pre-disaster preparedness and vulnerability reduction;

(2) post-disaster response, relief and rehabilitation; and

(3) disaster mitigation and long-term development.

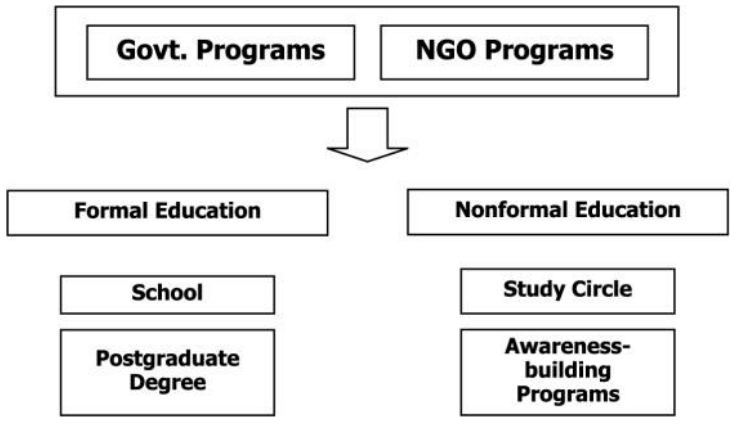

Figure 5.
Formal and nonformal education structure in Bangladesh

The main candidates for these degrees are NGOs involved in disaster management, and government departments related to health, environment, fire service, and armed forces. Other postgraduate programs such as that in Water Resources Development at the Institute of Water and Flood Management offer courses in Hazards and Risk Analysis and Risk Management, which include topics on disaster response, institutional aspects of risk management, and pre-disaster preparedness and vulnerability reduction.

Non-formal education

The government-initiated public awareness and training program is mainly conducted by the DMB. The objective of this program is to promote an informed, alert, self-reliant and sustainable community that can actively cooperate in all disaster management activities. At the local level, the program is particularly addressed to the local-level disaster management committee members, CPP volunteers, school teachers, professionals in the relevant fields, women and children.

Information communicated to the public through the government and NGO programs include: disaster risks and basic community needs, availability of government assistance programs, seasonal preparedness reminders, and post-disaster tips (Biswas and Reza, 2000). The information is communicated in several ways including study circles, workshops and seminars, public talks and presentations, leaflets, posters, photographs, radio and TV spots, features and dramas, films and videos, open-air dramas, and folk songs. The non-formal education is by far the more popular and effective way of making people aware of the disasters and giving them the knowledge to cope with the adversities.

Conclusion

Natural disasters act against sustainable development of Bangladesh. Flood, cyclone and storm surge are more frequent and damaging among all natural disasters in the country. Despite many setbacks progress has been achieved in disaster mitigation and preparedness. However, improvements are still needed for comprehensive disaster management. A national-level framework exists for disaster management in Bangladesh. Some of the programs in this framework, such as a volunteer-based cyclone preparedness program, function efficiently during cyclones. Both the Government and NGOs have active field-level programs for disaster management. These programs are particularly addressed to the local-level stakeholders. Government and NGOs provide formal and non-formal education in disaster preparedness and management with a view to promoting a resilient and sustainable society. The formal education programs are conducted at the primary school and postgraduate levels. NGOs have a relatively strong program in non-formal education.

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