MANUAL FOR COMMUNITY-BASED FLOOD MANAGEMENT

BANGLADESH

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ACRONYMS

AEZ	Agro-ecological Zones
BDPC	Bangladesh Disaster Preparedness Centre
CAFM	Community Approaches to Flood Management
CFMC	Community-based Flood Management Committee
CFMM	Community-based Flood Management Manual
CIDA	Canadian International Development Agency
ENSO	El Nino Southern Oscillation
FGD	Focus Group Discussion
GBM	Ganges-Brahmaputra-Meghna (river systems)
HYV	High Yielding Variety
IFM	Integrated Flood Management
LGRD	Local Government Rural Development (a ministry)
NGO	Non-Governmental Organization
ORS	Oral Rehydration Saline
PRA	Participatory Rapid Appraisal
RVCC	Reducing Vulnerability to Climate Change (a project)
SEMP	Sustainable Environment Management Programme
SST	Sea Surface Temperature
UNDP	United Nations Development Programme
UP	Upazila Parishad
WMO	World Meteorological Organization

1 FLOODS IN BANGLADESH

1.1 Introduction

Floods are common in Bangladesh, where floodplains constitute about four-fifths of the landmass. The floodplains are formed by sedimentary deposits that are carried by three of the largest rivers of the world, viz., the Ganges, the Brahmaputra and the Meghna (GBM) and their numerous tributaries and distributaries. The country is situated at the end of the catchment area of the GBM river systems, occupying only about 7.5 percent of the combined catchment area. Since this small fraction of the catchment area has to manage drainage of over 92 percent of the water volume, over 80 percent of it being discharged in about five months period during the monsoon, floods frequently hit and cause havoc in the deltaic plains. Impediments to drainage caused by both natural and man-made factors decelerate the recession of floodwaters, thereby prolonging the duration of floods.

Every year, Bangladesh's low-lying areas get inundated by seasonal floods. From time immemorial, people living in the delta have been experiencing *barsha* and have adapted to such annual events over the centuries and found ways to take advantage of it.

The magnitude of adverse impacts of floods becomes manifold when the effect of drainage congestion is combined with several other factors including excessive rainfall in the GBM basin, rise in river beds due to gradual sedimentation, development or rather maldevelopment practices concerning use of water resources, synchronisation of peak discharges in the major rivers, backwater effect of spring and neap tides, and other climatic factors. In 1998, the people of Bangladesh experienced the worst-ever flood in recorded history and suffered colossal losses and damages.

The 1988 and 1998 floods in Bangladesh were the two most severe in living memory, when over 60 percent of the total land area suffered flooding and about half the population was directly affected.

1.2 Types of floods

Four types of floods are often observed in Bangladesh (*Figure 1*): flash floods, riverine floods, rainfall-induced floods and storm surge floods. In a hydrological year, the flooding season may start as early as May and can continue until November. The basic features of different types of floods observed in Bangladesh

are given in Box-1, while the in-country hydrological dimensions are described briefly in Annex-I.

1.2.1 Flash Floods

The flood season generally begins with flash floods occurring as early as in late April and early May. Generally observed in the northern and eastern parts of the country, flash floods usually occur after a heavy downpour in the neighbouring hills and mountains (Khashia, Jaintia, Garo and Tripura Hills) and are characterized by a very sharp rise in the water level in rivers and subsequent overbank spillage with a high flow velocity. Flash floods are also marked by a relatively rapid recession of water from the floodplains.

BOX-1

Basic Features of Floods in Bangladesh

The following aspects summarize the basic features of floods in Bangladesh.

- Bangladesh has to drain out runoff of an area which is 12 times larger than its size. Only 7.5 per cent of the combined catchment areas of the Ganges, Brahmaputra and Meghna rivers (i.e., 0.12 Mkm^2 out of 1.55 Mkm^2) are within Bangladesh. The remaining 92 per cent are distributed over Nepal, India, China and Bhutan.
- Annually, 1,360,000 million m^3 of discharge originate outside Bangladesh. About 85 per cent of this discharge is generated between June-October.
- The amount of water which passes over the country can create a pool having a depth of about 9 meters.
- Besides water the rivers also carry high loads of silt from the steep and denuded upstreams — an estimated 1.2 to 2.4 billion tonnes of sediments are carried annually to the Bay of Bengal. The combined annual sediment load of the Ganges and Brahmaputra is estimated to be 1185 million tons. Their respective share is 38 per cent and 62 per cent.
- About 1/3 of Bangladesh or 49,000 sq. km. area are influenced by tides in the Bay of Bengal.

Types of Flood	Period of occurrence	March	April	May	June	July	Aug.	Sept.	Oct.
		Early flood			Peak flood			Late Flood	
Flash flood	Early								
	Mid								
	Late								
River water flood	Early								
	Mid								
	Late								
Flood after breaching of embankment	Early								
	Mid								
Flood due to water logging	Mid								
	Late								
Flood due to excess local rain	Mid								
	Late								

Figure 1:Types and duration of floods in Bangladesh

1.2.2 River-induced Flooding

With the onset of monsoon all the major rivers start swelling to the brim and bring flood water from upstream. Since over 70 per cent of water annually generated in the combined GBM catchment flows during the few monsoon months along the rivers in Bangladesh, the rivers cannot smoothly drain all the waters and the water level begins to rise sharply during the peak flow periods. When rising water levels cross riverbanks, spillage occurs. Such events are common in every hydrological year. However, if certain conditions arise, riverine overbank spillages frequently trigger the most devastating floods in the country. High intensity riverine floods may continue for months, as it was observed during 1988 and 1998.

1.2.3 Rainfall-induced Flooding

Localized floods are often triggered by heavy rainfall episodes, either within the sub-basin or in upper catchment areas. Bangladesh receives, on an average,

some 2200 mm rainfall annually, ranging from 1100 mm in the west to 5000 mm or more in the northeast. Local excessive rainfall often generates high volume of runoff in the rivers and creeks in excess of their drainage capacity. Such floods often occur when any or all the three major rivers are full to the brim.

1.2.4 Storm Surge Floods

About 2.8 million hectares of the coastal areas of Bangladesh consist of large estuarine channels, extensive tidal flats and low-lying islands. Storm surges generated by tropical cyclones bring tidal bores of up to 9 meters high. Although numerous embankments protect most of the southern coastal areas (excepting the Sundarbans forest), high tidal bores often overtop those. Aided by faulty operation of drainage structures, storm surges bringing brackish/saline water often get entrapped inside embankments. Storm surge-induced floods cause widespread damage to lives, crops and property. Tropical cyclones are most likely to occur during pre- and post-monsoon periods (April-May and October-November, respectively), but there have been episodes coinciding with monsoon flood peaks.

1.3 Flood Damages

Figure 2 represents areas which are generally flood vulnerable.Using the Agro-ecological Zone (AEZ) data base a national flood hazard analysis of different flood types was conducted (Figures 3 and 4).

Floodwaters submerge the marginal lands and the houses therein. Usually, the poor live in marginal lands and their houses are built of very poor material; floodwaters rot such material. Even if partially submerged, these houses are easily destroyed, with the waves carrying them away. As a result, an alternative place for living during a flood becomes a major problem for the poor.

Description of representative flood vulnerable areas chosen for the study (where PRA/FGD were conducted) is presented in Annex-II. It was mentioned in the PRA that, in a marooned area, finding a temporary job is extremely difficult. Demand for agricultural labour is at its lowest during a flood. People, particularly the poor day labourers, suffer heavily from lack of employment.

The absolute poor cannot store food, because they do not have excess food. The well-to-do households, however, usually have food in excess, but face the risk of losing it during the floods. Inappropriate food storage can cause loss of food items. Disruption of communication reduces availability of food, which in turn triggers an increase in local food prices. As a consequence, the poor face much hardship in terms of food provisions.

Table 1

Damages in the floods of 1988 and 1998

Item	**Floods in 1988**	**Floods in 1998**
Districts affected (number)	53	52
Thanas affected (number)		314
Deaths (number)		1,050
Highways and Roads damaged (km)	3,000 (fully) 6,500 (partially)	15,000
Embankments damaged (km)	35	2,000
Crop damaged (ton)	4,930,000	1,565,390
Houses Damaged (number)	N/A	550,000
Educational Institutions damaged (number)	2,700 (fully) 8,400 (partially)	24,000
Industrial units damaged (number)	N/A	11,000
Bridges and Culverts damaged (number)	N/A	20,500
Tubewells damaged (number)	N/A	300,000

Note: N/A indicates that data could not be made available.

Source: Ahmad *et al.*, 2000.

1.4 Background and Context of the Study in Bangladesh

The present manual is an outcome of a project titled “Community Approaches to Flood Management in Bangladesh” and is the Bangladeshi version of the study undertaken concurrently in three countries in South Asia—Bangladesh, India and Nepal. This manual has been developed, with financial assistance of the World Meteorological Organization (WMO), as a tool to facilitate flood-response of flood-vulnerable communities of Bangladesh. This is a part of the activities under the Pilot Study which has been designed to examine the status and potential of flood-affected communities of Bangladesh, and to develop response modalities in order

to enhance the resilience of the communities at the grassroots, given their limited resources and external facilitation.

For the Pilot Study, two small sub-basins, one along the Brahmaputra (in Melandaha/Islampur) and the other along the Mahananda-Pagla rivers, which are heavily influenced by the Ganges river (i.e., in Nawabganj sadar), have been chosen for the present study. Peak flood usually occurs in Melandaha during the peak flow periods of peak flows in Brahmaputra, mostly during early to late August. Flood season in Mahananda-Pagla sub-basin is much wider; the first flood episode occurs in early flood season, usually during late June to early July when Mahananda spills over its banks. Another episode is also common, occurring in late flood season – during late August to as late as mid-September (as observed in 2003), when the backwater effect of high stages of the Ganges creates a water pool at the confluence between the Mahananda and the Ganges. The intensity of the latter episode can be very high. Catastrophic floods are also observed, as was in the case in 1998, when peak flood season was unusually extended up to mid-September due to synchronization of peak flows of the Brahmaputra and the Ganges, compounded by unusually high local rainfall episodes.

The development of this manual was preceded by a number of field visits, extensive grassroots consultations with beneficiaries and other stakeholders alike, in the form of informal discussions and formal engagements (such as PRA/FGD and key informants' interviews). A number of ideas have been drawn from informal discussions with Mr. Saidur Rahman, Chairman of Bangladesh Disaster Preparedness Centre (BDPC) and a brief report on PRA/FGD – the latter being a product of the current activities and presented in Annex-II for reference. The manual, in its draft form, has been duly field tested in two Upazilas. It incorporated some of the novel ideas being tested elsewhere in the country (under the UNDP funded Sustainable Environmental Management Programme and also under the project titled Reducing Vulnerability to Climate Change, funded by CIDA) to increase income opportunities in flood affected areas.

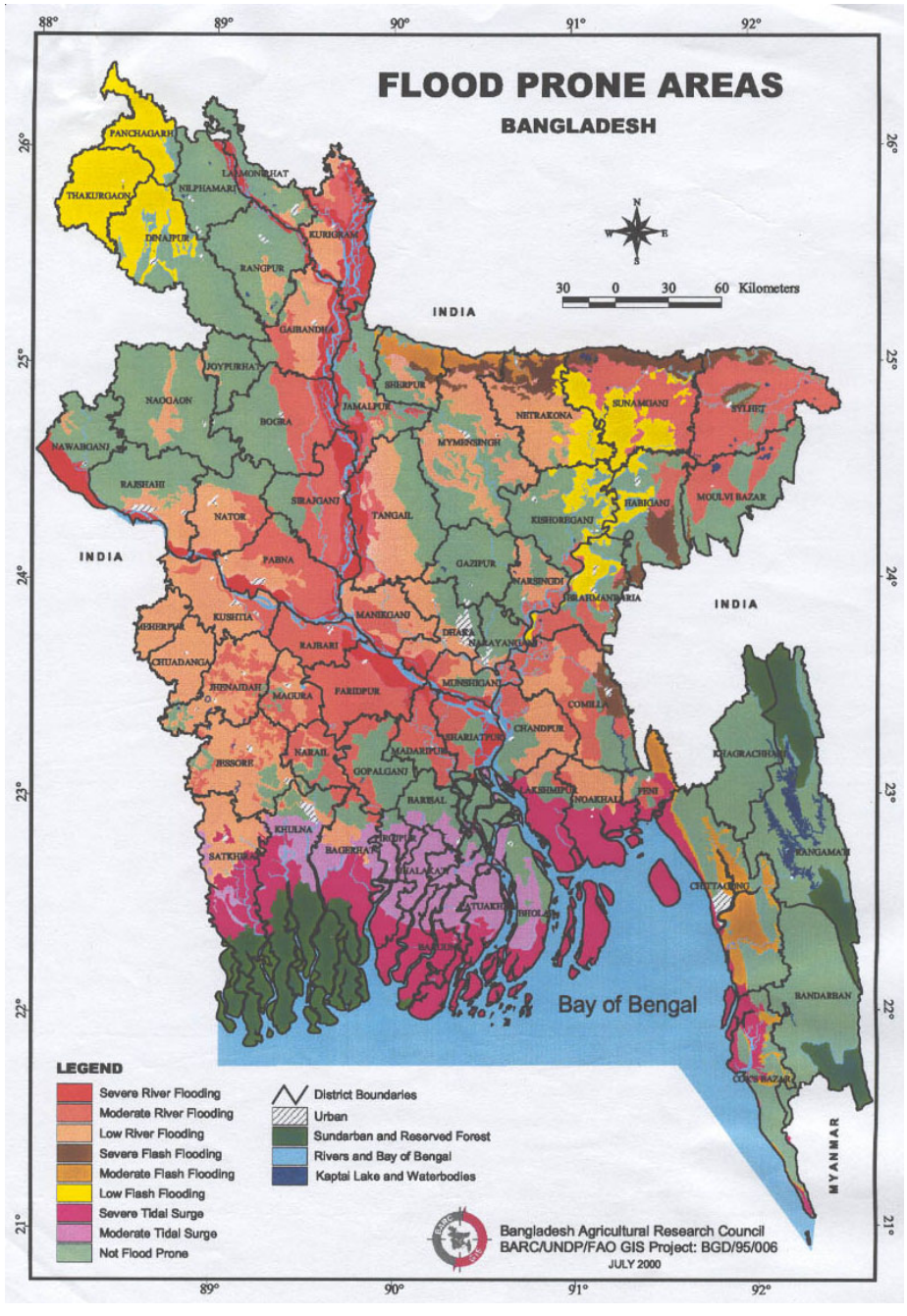

Figure-2: Map showing flood vulnerable areas of Bangladesh.

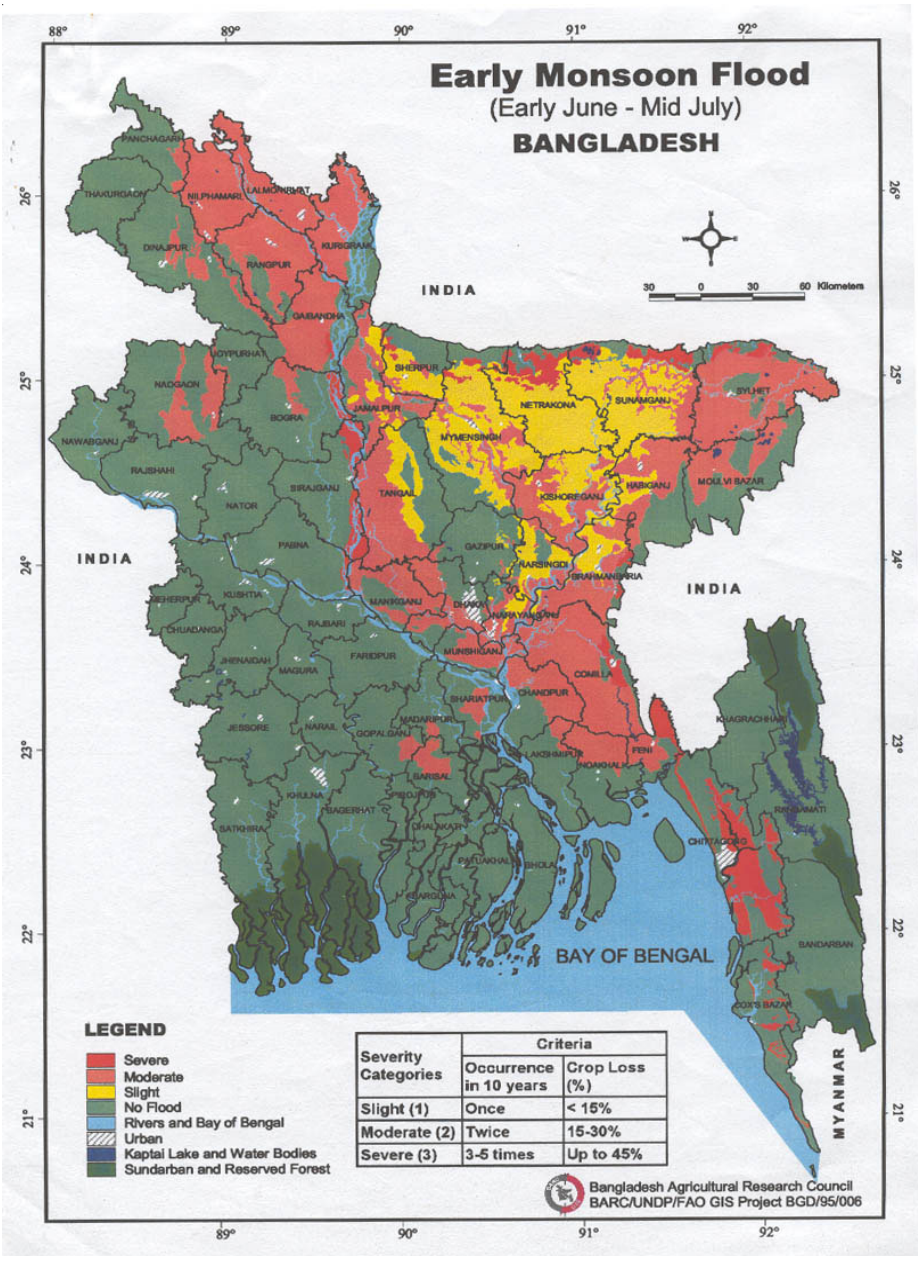

Figure-3: Map showing areas affected by early monsoon floods (early June - mid July).

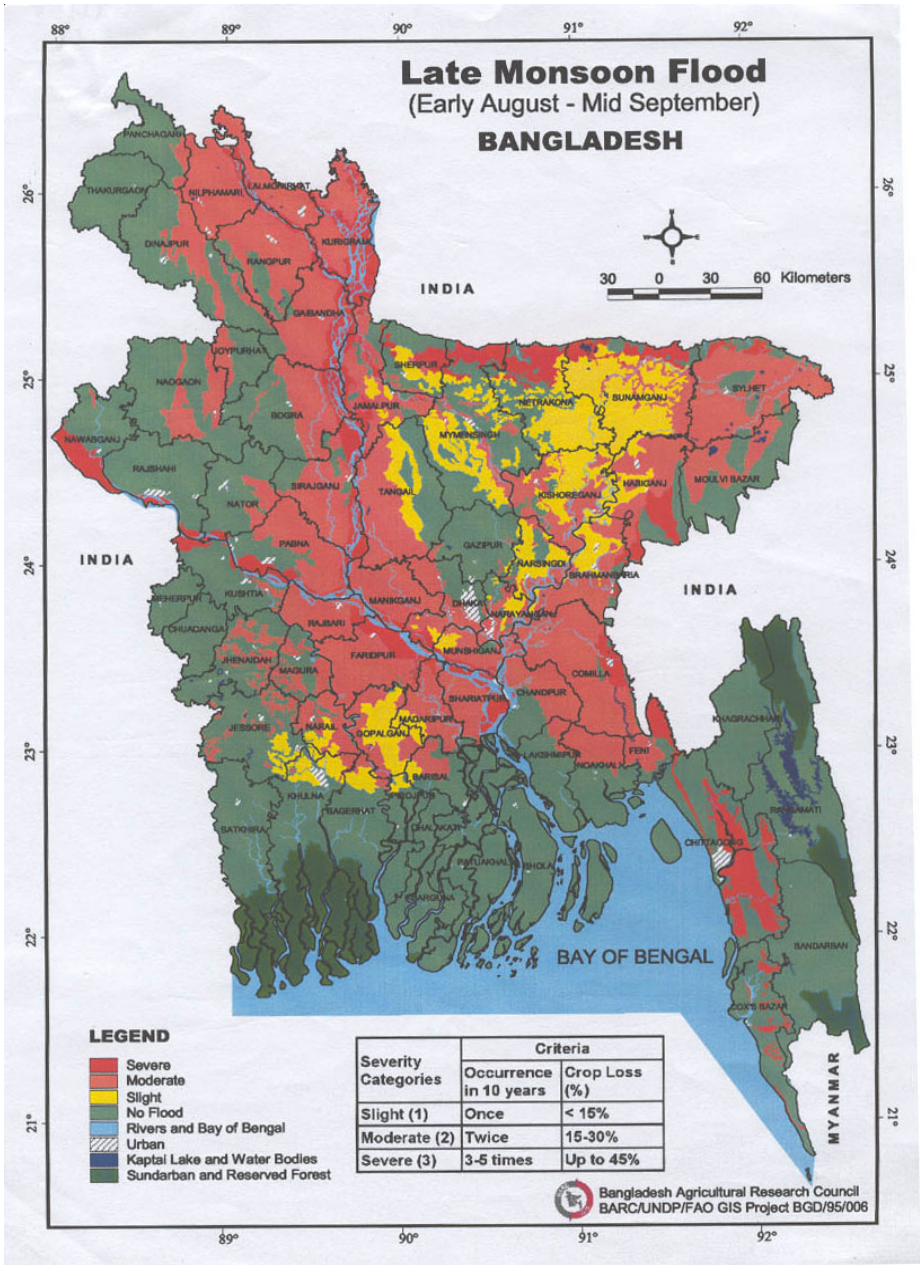

Figure-4: Map showing areas affected by late monsoon floods (early August - mid September).

2 FLOOD PREPAREDNESS

There is a general perception among people living in flood vulnerable areas about flood events which are generally damaging. According to people's perception, annually occurring low-level flood events are most usual and they do not worry about such flooding. People call it 'barsha' and often find it useful for replenishment of top soils. On the other hand, there are events, which disrupt life, to some extent cause damage to agriculture and to a lesser extent to the infrastructure. These moderate events are called 'bonna' in local terms. People also can identify unusual flood events, which they call 'plabon' or 'moha-plabon'. These are, according to local perception, most damaging – causing damages to crops and cropping potential during 'kharif' season; completely disrupting life and economic activities; lasting for a long period, often weeks together; wreaking havoc on the physical infrastructure etc. (see Annex-II). People find 'flood preparedness' as the most viable tool for them to manage floods, as reported during the PRA/FGD.

2.1 Community-level Activities

2.1.1 Preparedness for floods and minimizing negative flood impacts

In order to take measures towards preparedness, people need to understand that a flood is imminent. The general basis of information on which people tend to make preparedness decisions is rather weak, as found during the PRA/FGD (Annex-II). There is no dissemination of real-time information on floods. There are bulletins aired by the Bangladesh Radio from time to time during the flood season; however, such bulletins are often packed with technical terms and cannot be understood by rural illiterate people. People often seek information either from the Chairman or the members of the *Union Parishad* (UP: elected body at the lowest tier of the Government) and most of the time they do not receive any satisfactory information with any degree of certainty. In the absence of information, people heavily rely on natural instincts: movements of ants, lizards and the kind. Precautions taken in the past, based on such observations, have sometimes paid good dividends, but often provided wrong conclusions regarding timing and severity of the event. There is a dearth of information concerning flood forecasting and warning well ahead of time (see *Annex-II*).

Once people sense an imminent danger, they engage themselves in various informal ways to take preparedness measures. Being aware of an imminent *bonna* or a *plabon*, people start to think about a possible relocation and restructuring of cropping pattern. Such decisions are arrived at the household level, and people often do not share their intention deliberately with other members of the community. Their intention to relocate is only shared when they are questioned by their

neighbours. In the absence of a 'formal institutional approach', community-level activities often do not get due priority for community-wide preparedness.

The community concerned should take note of the following few activities to minimize negative flood impacts:

- Activate the 'Community-level Flood Management Committee's (Annex-III). If there is none, form such a Committee and assign responsibilities/ duties to the members, individually and/or in small groups.
- Quickly assess needs of the poor, females and the disadvantaged in the community. Prepare plans based on needs assessment for relocation, preparedness and relevant action.
- Identify community flood shelters based on their accessibility, location, facilities and capacity etc.
- Identify safest means and road-plans for relocation/evacuation in those designated flood shelters. Discuss it with the community people and make them aware of the shelters.
- Prepare the designated flood shelter(s) in terms of (a) cleaning up the premises, (b) preparing large-size cooking stoves, (c) sinking afresh or elevating the existing tubewell above flood danger level (Box-2), (d) making smaller rooms available for health care check-ups, lactating mothers and children, chambers for privacy of adolescent girls, storage of medicine and food items, and for storage of fuelwood/ biomass and/or kerosene, and arrange lanterns for lighting.
- Identify alternative shelters and expand capacity of shelters to prepare for the worst.

BOX-2
Emergency Installation of Hand Pumps

In emergency, hand pump tubewells are often installed in camps/shelters for community use. Efforts must be made to avoid contamination of the groundwater aquifer by the pathogen loaded floodwaters while drilling for the tubewell.

- ❖ Select a higher non-flooded ground for the installation of the tubewell.
- ❖ Install at the upstream side of the latrine.
- ❖ Maintain at least 15 meter distance from latrines.
- ❖ Do not allow pool of contaminated water around the tubewell.
- ❖ Tie the hand pump tightly with a suitable support such as a bamboo or wodden pole to avoid shaking/movement while in use.

If the aquifer is contaminated during pump installation, the well must be disinfected. The following procedures need to be followed.

- Mix 4 teaspoonful of bleaching powder in one tin of water (usually 18 litres).

- Open the parts of the hand pump (i.e., barrel, plunger, plunger rod, weight valve, bucket etc.).
- Keep the parts submerged in chlorine solution (in the tin) for at least an hour.
- Do not allow children to use the chlorine water.
- Take ten litres of water in a bucket and mix 4 teaspoonful of bleaching powder. Pour the chlorine water, after thorough mixing, into the tube (pipe) and keep it for three hours.
- Assemble the pump head, valve, plunger etc. and reinstall the tubewell.
- Pump vigorously for 30 minutes to drain out chlorine treated water from the well. When the water has the smell of mild chlorine, it may be used for drinking purpose.
- Keep children out of the site during the course of the operation.

Long-term flood resistant hand pumps

- ❖ In flood prone areas, hand pumps should be installed over raised platforms/pedestals, above flood level. The platforms should be provided with steps and railing.
- ❖ Before the beginning of a flood season, ensure that there is no crack in the base structure. If there is any, mend it well ahead of time.

2.1.2 Preparedness for floods to make optimum use of floodwaters (where applicable)

- Ensure that a few boats, maintained in working condition, are at the disposal of the CFMC to facilitate relocation of the elderly, the children and ailing/pregnant women.
- Make a few cages, using low-cost material, collect fish fingerlings and begin 'cage fish culture'. *Nilotica* and *Pungash* varieties grow very well under confinement of the cage, especially when adequate feed is supplied to the growing fish. The experience of Samadhan (a partner NGO working for RVCC project in Keshabpur Upazila of Jessore district) can be of great help to ensure optimum utilization of the floodwater and thus making it useful, instead of considering it a menace. Growing fish fingerlings in confinement, during the course of the entire flood season, would enhance income by the end of the flood season – which in turn would enhance greater financial opportunity for carrying out post-flood rehabilitation.
- Where water hyacinths (hydroponics) are available and considered as a menace that blocks navigation during the flood season, floating vegetable gardens may be established on floodwaters. Piling several layers of water hyacinths in a block can produce a floating bed where vegetables can be grown. People in Manirampur and Keshabpur Upazilas of Jessore district and Kashiani Upazila of Gopalganj district have been greatly benefited

by the application of such simple but profitable technology. The experiences of RVCC and SEMP projects can be of great help in dissemination of such innovative technologies in other flood vulnerable parts of the country.

2.1.3 Forecasting and awareness

The Government has already established a Flood Forecasting and Warning Center. However, due to weaknesses in the dissemination system, the information does not reach the beneficiaries. The current forecasting mechanism cannot meet the needs of the rural communities for flood-related information. The warning is usually disseminated only through a website, which is not even accessible to most urban areas (see PRA findings, as in Annex-II). Communities must find ways to have access to forecasts and disseminate the information in a user-friendly manner, such as utilizing local volunteers who would disseminate information by using megaphone or public microphones (as used in mosques). In addition to dissemination of information regarding forecasts, the following activities would enhance awareness concerning flood preparedness.

- Raise awareness of the community members on preparedness activities at the household levels.
- Translate flood warning into local language and warn people.
- Monitor rise and fall of water during the flood season.
- Arrange meetings on a regular basis.
- Liaise with relevant organization(s) to receive information regarding flood forecasting and warning; disseminate such information upon receipt of warning.

2.1.4 Preparedness in terms of crop selection, alternative practices, livestock & poultry, household activities (upon receipt of flood warning – formal and/or informal)

Agricultural preparedness at the community level may have little scope, especially in the absence of agricultural cooperatives. For the common interest of the community members, there may be a number of activities that would enable the farmers to safeguard their livestock, agricultural machinery and equipment, unutilized fertilizer and most importantly, seeds.

- Make arrangements for safe storage of agricultural equipment, fertilizers and seeds, preferably in a common place where vigilance is possible, even during high floods.
- Put name tags or signs & symbols, preferably printed in permanent (water resistant) ink, on each of the items to be stored in a common storage.
- Make arrangements, in cooperation with the ‘Agricultural sub-Committee’, in order to resist theft and avoid mishandling.

A number of other preparedness activities may be undertaken by each farming household in the community, as described in sub-section 3.2.4.

2.1.5 Various other modes of preparedness

- Form and activate a task force to maintain security of the flood shelter(s) and keep the peace.
- Assess needs of the community member households and liaise with local government institutions and local administration for continued relief operation during and after the flood.
- Create a healthy stock of packets/sachets of oral saline to meet the emergency during outbreaks of diarrhoeal diseases (BOX-3).

BOX-3

Technique for the Preparation of Water Purifying Packets

In areas highly affected by floods, there is often no alternative except to use the floodwater itself or water contaminated by floodwaters. Floodwaters often contain suspended foreign discrete/colloid matter which cannot be removed by using bleaching powder or liquid chlorine alone. Efforts must be made to collect clean water that is free from suspended foreign matter (sieves may be used) and then disinfect it by using a suitable disinfectant. In this regard the water purifying powder, usually a mix of bleaching powder and a coagulating agent, appears quite handy. This powder helps, when properly mixed with floodwater in a bucket, coagulation of the suspended material to form it heavy floc, which settles on standing in quiescent condition for some time. The chlorine of the powder meanwhile reacts with the pathogens in the water and disinfects the water.

The settled sludge on the bottom of the bucket can be discarded by taking off the supernatant water from the bucket and can safely be used for drinking purpose. This is easy to make, carry, and apply, and is cheap and therefore a very popular tool for the public health engineers and voluntary organizations in an emergency situation.

The Procedure: *The procedure for preparation of the Purifier Powder is rather simple. The powder is made from ingredients like alum (*fitkiree*), bleaching powder and lime (*chuna*): all such ingredients are available in local markets. The following steps should be followed:*

1st Step (For one hundred packets): Weigh 3 kg of alum, 1.5 kg of lime, and 200 gms of bleaching powder (ensure that it must have 33% strength). Keep three packets/pots separately. The alum should be as dry as possible. Try to use best quality lime. The container for bleaching powder should be resistant to sunlight.

2nd Step Grind alum into powder, spread it on a dry sheet of plastic and dry well. Keep ground dry alum in a plastic container. The lumps of lime should be ground well into fine powder and stored in a separate dry container. Keep the container air-tight to avoid the risk of melting.

3rd Step Mix required quantities of lime and bleaching powder intimately; keep the mixture in a plastic bucket. Do not mix with alum at this stage.

4th Step Prepare 200 plastic sachets with size 5" X 4". In absence of properly sized sachets, take 100 polythene packets that are generally used for germination of pot plants. Write down the mixing instructions on a page (must be legible), make 100 photocopies.

The following *instructions* should be written:

- Take one bucket/pitcher full of water (10-12 lit).
- Take ½ teaspoonful of powder from bigger packet (i.e. alum) and pour into the bucket/pitcher (*kolosh*).
- Take ½ teaspoonful of white powder from smaller packet (mixture of lime and bleaching powder), pour into the pitcher, and mix intimately with the water of the bucket/pitcher. Stir the water vigorously for ½ minute and allow it to settle. (Visible flocs will form and settle at the bottom in about 45 minutes to one hour).
- Put a four-folded piece of cotton cloth on the mouth of a second (cleaned) pitcher. Decant the supernatant slowly through the cloth-filter into the second *kolosh*. Water in the second kolosh should be free from contaminants. Keep the *kolosh* covered all the time. This water is to be used for drinking purpose only. Please note that the water will smell of chlorine.

One sachet/packet should weigh about 47 gms, which can treat about 180 to 200 liters of turbid floodwaters depending on turbidity, alkalinity etc. of untreated water. The water purifier packets should be used as quickly as possible. However, it can safely be used within a period of 2/3 months without much reduction of potency.

The packets may be stocked in strategic places such as in camps/flood-shelters in flood prone areas. Once prepared, packets may be distributed among community people. One family of 6 persons (which is the average size of a household in Bangladesh) will require one packet per week. For easier distribution schedule, there should be one designated day per week in the locality. The CFMC should maintain a roster for smooth distribution of water purifying packets, and also a register for all inputs and outputs concerning production, storage and distribution of these packets.

In every household, special care must be taken to keep water purifying chemicals out of reach of children. If, by accident, swallowed, immediately the child concerned should needs to taken to the nearest hospital.

Cost information: The cost of each of the water purifying packets should not be more than BDTk. 2.00. One community worker, ideally science students in the higher classes representing the community, would be able to pack at least 150 units per day. The whole effort for the production of 1000 packets should not take more than two days involving a total of 6 person days input.

Equipment to be kept handy The following equipment should be kept handy to facilitate preparation of the water purifying packets: (a) one stone grinder, (b) one weighing scale with appropriate weights, (c) three pans, (d) three spatulas, and (e) plenty of dry and empty polythene packets.

- In case of paucity of funds, oral saline can also be prepared at low cost. Through a participatory process (by engaging local school children), prepare a stock of 300~400 packets of oral saline formulae (BOX-4) and store in a dry cool place to meet any emergency.

BOX-4

Guidelines for the Preparation of Oral Rehydration Saline

What is it? It is a low-cost rehydration drink that is useful to fight diarrhoeal diseases.

Method of preparation: Take 1 litre of boiled and cooled water. Add (i) 2 teaspoons of molasses/sugar/ honey; (ii) ¼ teaspoon of salt; (iii) ¼ tea spoon of bicarbonate of soda (if unavailable, use salt instead). Stir the mixture well. The drink is ready.

Alternative method: Take 1 litre of water (boiled and cooled), add one 4-finger scoop of sugar/molasses and one 3-finger pinch of salt. Stir well. The drink is ready.

Do not boil or heat up the pot, keep the mixture cool. The mixture can be used up to six hours after its preparation.

Use of ORS: Give the dehydrated person (or the patient suffering from diarrhea) sips of the drink every 5 minutes, day and night, until she/he begins to urinate normally. An adult needs 3 or more litres per day, whereas a child requires 1 to 2 litres per day.

Even if the patient is vomiting, keep giving the ORS drink. If the patient is unable to sip or drink, take her/him to the nearest hospital/health care camp.

Note: The mixture can also be bought from local stores (one sachet costs around BDTk 5.00). Check the date of expiry before purchasing these sachets. The method of preparation is written on the sachet, please read it that carefully.

2.2 Household and/or Family-level Activities

2.2.1 Preparedness for floods and minimizing negative flood impacts

- Elevate, where possible, the plinth (*bhiti* and/or *bhita*) of the homestead.
- Change, if possible, the weakened pillars/stilts.
- Raise, where possible, the level of plinth of the cattle-sheds.
- Collect pipes for tubewell and raise its level upon issuance of flood forecast.
- Prepare elevated stages to: (a) store food (preferably dry food such as dry-rice, molasses etc.), seeds and fuel (biomass), (b) keep fodder, and (c) store family assets and valuables.
- Take care of family boat(s), if any.
- Collect carbolic acid from a dispensary and place it around the house (in order to avoid snake bite).
- Raise the level of sanitary latrine. If possible, connect the latrine with the raised house by a makeshift bridge (locally known as *shanko*).
- Keep a few sachets/packets of oral saline, sugar & salt, water purifying tablets, emergency first aid material etc. in a basket hanging from the ceiling/roof.

2.2.2 Preparedness for floods to make optimum use of floodwaters (where applicable)

- Collect several stems of banana plant and make raft(s).
- Prepare one removable earthen stove to face emergency.
- As indicated in section 2.1.2, practice 'cage fish culture' and/or 'floating vegetable gardens'.
- Floodwaters rejuvenate the aquatic environment in dry ponds in the neighbourhood. If such ponds are available in the locality, identify those well ahead of the flood season, take layers of soil from the silted up bed and use it to increase the height of the plinth, and encircle the pond with nets and practice fish culture.
- Compartmentalize poldered areas along the coastal zone; this would enable various activities which can only be done in an aquatic environment.
- Floodwaters help recharge groundwater aquifers, which is beneficial for all the communities across the country, especially during post-monsoon groundwater irrigation.

2.2.3 Forecasting and awareness

- Keep an eye on available sources for information regarding flood warning.
- Make strategic decisions based on available information, when to evacuate (if necessary), where to go, how to relocate (modality & transportation

means), what to take along and what to leave behind, who should be left behind for surveillance etc.

2.2.4 Preparedness in agriculture [in terms of crop selection, alternative practices, livestock & poultry, household activities (upon receipt of flood warning – formal and/or informal)

Agriculture is the major economic activity of the rural households. People living in the floodplains have been practicing a number of adaptation techniques to avoid large-scale losses due to floods. Opting for alternative crop calendar, suited to the flood condition and making best use of the remainder of the cropping season, collection of suitable seeds, making seedbeds on raised lands, storing seeds in containers hanging from the ceiling – these are all observed as traditional coping practices.

The following sub-section describes flood preparedness and awareness with a view to preserving the crop and other agricultural resources at household levels.

2.2.4.a Crop preservation

During flash floods and river-water floods, a huge quantity of *water hyacinths* and other ripe paddy specially create problems in cultivating Aman paddy. In the circumstances, a rope or bamboo fence should be made around the cultivated land. In places where this type of flood/disaster is expected, seedlings of *Sesbania* on the border of the cultivable land should be raised before the onset/increase of water and later these trees of *Sesbania* will make a natural fence.

2.2.4.b Harvesting of premature crops

In order to reduce the loss burden, it may appear to be necessary to harvest premature standing crops (*viz*., vegetables, spinach etc.) if there is a threat of such crops being inundated.

2.2.4.c Agricultural resources preservation

It is necessary to take early measures such as seed preservation for expediting agricultural activities following recession of floodwaters.

- Efforts must be made to preserve sufficient amount of seeds in each household. Preservation of seeds is a measure to ensure seed availability after the flood. Seeds of the following crops may be preserved: paddy, wheat, corn, millets, pulses, oil and potato seeds etc.
- It is also necessary to create/develop adequate number of seedbeds in the flood free areas. With prior agreement with a household, several families can be benefited mutually by sharing the burden of seed procurement and preparing a flood free land to develop the seedbed.

2.2.4.d General pre-flood agricultural activities

- For fish culture, raise the height of the banks of ponds that are at risk of inundation by floodwaters, to protect fish from escaping. At least, raise a fence with tree-branches and nylon nets firmly attached to the surface of the banks to protect fish from escapeding.
- If raising a fence becomes impossible, catch the fish prematurely and sell it to recover partial cost of production.
- It is necessary to monitor flood embankment (if any) and take precautionary measures so that it may avoid breaching. *Sesbania* and other fuel wood trees can be planted along the bank of an embankment so that it does not get eroded easily by the floodwaters.
- Seed pots can be kept hanging from the ceiling of the house and/or from the trees.
- Seedbed can be prepared/arranged on the floating platforms made of banana or bamboo plants (called *bhela*).
- Seeds can be preserved in those relatives' houses who are located on high (flood free) land.
- Plant vegetable-producing plants/herbs/creepers on raised lands (*dhibees*) in the homestead grounds to grow seasonal vegetables (spinach, gourds etc.).

3. RESPONSES DURING FLOODS

During floods, one may choose from only two major types of response: (i) living with floods while staying inside the household or (ii) escaping floodwaters and taking shelter either in non-flooded areas or in nearby flood shelters, if available. The latter response wholly depends on social organization of the refuge-seeking family and/or availability of collectively maintained temporary flood shelter(s) in the neighbourhood. In the study sub-basins, people consider both the options, while they prefer to consider staying in the homestead as long as possible (for more, please see the PRA report, as presented in Annex-II). It is found from the PRA/FGD that people value the latter option as socially derogatory and consider it as a last resort.

It is interesting to note that, living within the marooned homestead is predominantly a family-level response, while opting for relocating temporarily in a flood shelter is a community level response. However, opting to relocate to a neighbour's or a kin's house is again a family-level response measure during a flood.

- Shift, if possible, children (below 10 years of age), the old (above 60), adolescent girls, pregnant women, and lactating mother(s) in safer places (flood shelters, floodfree kin's house etc.).
- Mark safest escape routes by hanging coloured signs hanging on tress (to facilitate quick and safe relocation)

3.1 Living With Floods

3.1.1 Housing condition

- Build a makeshift high platform (within the house) and put perishable belongings there to avoid submergence.
- Protect the house from being eroded by wave activity by creating a protection belt (use '*dhol-kolmi'r jharot*' or bamboo sticks/jute sticks etc.).

3.1.2 Food and drinking water storage and handling

- Safeguard perishable food items, cooking fuel, and valuables from submergence (placing those on elevated platforms/hanging from the roof).
- Collect tubewell water. If non-contaminated water is not available, purify water before drinking (BOX-5).

BOX-5

Purifying Drinking Water by Using Tablets

Water from contaminated sources can be treated at home by using commercially available halogen-releasing tablets; freshly released halogen is supposed to kill unwanted bacteria and other microbiological elements present in water. These water purifying tablets are available on the market at affordable costs (i.e., 0.50 BDTk/tablet).

Direction for Use of Halotabs:

- Take 1.5 to 3.0 litres of water in a non-metal (earthware/glass/melamine) container with lid.
- Dissolve one Halotab (containing 15 mg Halazone USP) tablet in the water, stir and put the lid on.
- Allow at least half an hour for action of halogen.

Water is now ready to use. It will remain germ free as long as the lid is kept in place.

3.1.3 Nutrition management

- Collect locally available varieties of spinach and vegetables (*kalmi, shapla*, gourds etc.) and take them in addition to dal-bhat (lentil and rice).
- Use pre-processed dry food and take sufficient amount of water in order to avoid dehydration.
- Use spirulina supplement drinks to provide extra energy.

3.1.4 Health care and hygiene

- Keep recording the state of health of each of the family members. Transfer sick member to nearest health care center.
- Provide drinking water, fodder and animal feed to livestock and poultry, as needed.
- Avoid defecation in open water (otherwise it will be polluted and affect others), try to use sanitary latrine.
- Keep the homestead sanitary latrine connected with the house by making a bamboo-made makeshift bridge (locally known as *shako*).
- Use 'oral saline' when there is an outbreak of diarrhoeal disease. If deemed necessary, quickly transfer the patient to the nearest hospital/health care facility.
- Keep carbolic acid in small bottles (mouth remaining open) hanging along the outer sidewalls (out of reach of children) to avoid snake invasion and snakebites.

3.1.5 Crop management

When water is receding from the flood affected land or areas, fruit trees are about to fall due to soil conditions. Efforts must be made to provide support to the falling trees by holding them up with a bamboo-support and fastening the trees to the support to keep them standing. If necessary, fruits can be taken a way or trees can be pruned according to the method recommended by the Thana Agriculture/ Forest Officer. After the soil becomes dry, fertilizing and other nursing can be done properly.

Post flood jute-seed management

If there is any possibility of finding fallow land after flood from *bhadro-Ashwin* (September - October) then jute seeds can be produced in those lands by seeding or planting of cutting. After 3-4 weeks of jute seed sowing, chilli, mustard, pulses and other vegetable crops can be sown and these can be harvested before jute seeds become mature. If jute seeds are preserved properly and scientifically, it is possible to retain their active germination power for the next two years.

Homestead vegetable cultivation

It is possible to ensure the family's nutritional status by homestead fast-growing vegetables using BARI (i.e., Bangladesh Agricultural Research Institute) Homestead Horticulture Model. This model provides packages of year-round vegetable production in different regions. Local-level BARI Officials may be

contacted by the community people (farmers) for further information on this model. This model can be applied with minimum labour from the family members at minimum expense and in the small areas of homestead courtyards.

Potato and maize instead of transplanted Aman

In case of delayed recession of floodwaters, producing transplanted Aman appears to be very difficult, and the farmers cannot use the Kharif season. To avoid large-scale agricultural damages, efforts must be made to use the remainder of the season and cultivate potato and maize using improved agricultural methods and technological packages endorsed by BARC. Such alternative crops are especially suitable for cultivation on medium high land.

Fish culture

In fish culture ponds, throw tree branches so that fish feel safe and do not go astray.

3.1.6 Livestock and poultry management including livestock feed

- Safeguard livestock and poultry from submergence (placing those on elevated platforms and rafts).
- Provide water, feed and fodder to livestock and poultry regularly.
- Periodically assess the state of health of the domestic animals and birds and arrange for vaccines from Thana Veterinary Doctors. A few tips are highlighted in Box-6.

BOX-6

Livestock and Poultry Management

If the potential risk for the livestock/poultry is deemed very high, minimize loss by selling before onrush of floodwater, keep the money in a bank and start afresh after the flood.

Keep an eye on the health condition of your livestock. If needed, seek assistance of veterinary doctors stationed in the area (Thana level).

Standing in floodwater for a long time may lead to livestock diseases, particularly 'hoof disease' (*khura roag*). Take precautions that livestock do not stand in submerged conditions. Put livestock in dry conditions, preferably by building a raised platform.

Consult veterinary doctors for clinical advice.

In case of shortage of livestock feed, ensure locally available feed such as straw, water hyacinth (hydroponics), banana leaves, urea-molasses mix, millet/wheat bran, rice husk, oilseed residues, strained water after boiling of rice etc.

Collect material for storage of animal feed.

Collect material that are needed for raising platform for the livestock.

3.1.7 Communication (means of moving from one place to another)

- Create bamboo-made temporary bridges (as described earlier) to connect the household with the non-submerged roads in order to keep communication uninterrupted.
- Keep a boat or a raft handy for maintaining communication, especially for transferring sick and/or the elderly to safer places.
- Where financially viable, create provisions for procurement of at least two engine powered (fibre-glass) boats to facilitate transfer of patients to distant Thana sadar, if needed, to keep contact with Thana sadar, and to fetch emergency requirements etc. Make a periodic maintenance plan of the engines and the boat, especially during non-flood periods.

3.1.8 Miscellaneous

- Keep liaison with local government authority and local administration for updated flood bulletins and/or warnings. Keeping good contacts with neighbouring villages, Unions and Thanas would also be useful, especially in receiving information regarding flood warning. By utilizing village-level cell phones, the CFMC leaders can call FFWC to receive latest information regarding water levels for the nearest point of the flooding river.

3.2 **Escaping Floods** (temporarily relocation in flood shelters)

This community-facilitated coping measure generally requires planning, participatory operationalization, monitoring, and continuous evaluation of overall implementation of various related activities. To run a smoothly functional 'temporary flood shelter' (hereafter called flood shelter), formation of a Community-based Flood Management Committee is essential. People expressed in one PRA (in Nawabganj Upazila) that the Union Disaster Management Committee, as mandated by the Ministry of Local Government and Rural Development (LGRD), must be activated in order to facilitate CBFM activities at the Union Parishad levels (*Annex-II*).

The roles of the Committee (hereafter called CFMC) and its sub-Committees are outlined in Annex-III.

3.2.1 Preparing for temporary flood shelters

- Operationalize "Community-level Flood Management Committee". Develop a participatory management code for undertaking day-to-day activities of the proposed flood shelter.
- Clearly mark escape routes, preferably showing signs along the escape routes.
- Assess the overall requirement of space within the flood shelter and if needed, increase capacity elsewhere and/or within the premises.
- Clean up the premises, provide room for the privacy of the females.
- Check where to place cooking utensils and stoves.
- Create sufficient number of sanitary latrines, based on capacity assessment. Make cleaning up schedules for the latrines.
- Keep frequent contacts with the Thana Health Officer and make arrangements for health check-ups at regular intervals.
- Create separate spaces for storage of (a) medicine, (b) food items, (c) register books/logbooks, (d) money, (e) dry fuel etc.
- Provide rooms for treating patients, privacy of lactating mothers and adolescent girls and overall administration of the activities.
- Liaise with Local Government Institutions (Union Parishad and Thana Administration) and NGOs for various supplies (food items, drinking water, fuel, medicine etc.).
- Based on capacity assessment, assess weekly demand for various supplies. Maintain charts and logbooks on utilization and supply of such material.
- Negotiate with government authority to help create a community-based trust fund so that it may be utilized for carrying out various preparedness and rehabilitation activities, as needed. Maintain ledgers while spending from the trust fund.

3.2.2 Taking shelter in tents (flood camps)

- In the absence of a suitable infrastructure that might be transformed temporarily as flood shelter, a number of makeshift tents may also be arranged, one per family, to allow people to stay during the period of the flood. A stock of makeshift tents (made using plastic sheets over a flexible

bamboo structure roped together) may be prearranged, with the help of the local Thana-level and/or Zilla-level administration, to enhance local-level capacity to facilitate flood management. These tents may be distributed, with proper identification, as per demand of shelter-seeking families/households.

- Arrange training for the local youth/Boy Scouts so that low-cost makeshift tents may be set up.
- Help people arrange makeshift tents in a flood-free field which may be easily accessible by road/boat.
- Make arrangements for a number of 'temporary tent-based hospitals', as per demand, which should be managed by the community in cooperation with the Thana Health Officer.
- Arrange adequate sanitation and waste management facilities around the tents.
- Arrange separate tents to treat sick individuals; provide privacy to lactating mothers.
- Arrange separate tents for storage of food items, fuel, medicine, other valuables etc.
- Quickly establish community bathing facilities around the flood camp.

3.2.3 Physical relocation to flood shelters/flood camps

- Help shift marooned people into flood shelter(s) and/or to flood camps. In the relocation process, children and elderly people should get higher priority compared to adult males and females.

3.2.4 Management of day-to-day activities at flood shelters/camps

- Maintain logbooks on the activities of the sub-Committees. Member-Secretary of each sub-Committee should maintain the logbook.
- Maintain a register for all the people (community members) taking refuge in flood shelter/camp.
- Maintain designated baskets for collection of solid wastes.
- Maintain hygiene and clean up the sanitary latrine several times a day (full time sweepers may be employed on a temporary basis).
- Manage donations and maintain books on resource allocation and expenditure.
- Organize, if possible, recitation and singing sessions by motivating local children to keep up the morale of the people taking shelter.
- Liaise with government authorities for continued support for the functioning of the flood shelters and for post-flood rehabilitation and relief.

3.2.5 Maintenance of health care facilities

- Organize routine health care check ups for all inmates of the shelters/ camps.
- Maintain a separate room for treating the sick.
- Keep first aid material ready.
- Store typical medicines that are required in marooned areas, maintain logbooks to register usage patterns, check stocks on a regular basis, and try to replenish the stock as quickly as possible.

3.2.6 Miscellaneous activities

- Maintain community-level surveillance against theft/burglary.
- Maintain communication by boat/raft transportation services.
- Liaise with Thana administration for updated flood information and monitoring bulletins; disseminate such information regularly to the community.
- Monitor well-being of those who have not relocated themselves in flood shelters. If necessary, assist their flood coping with consumable/non-consumable items.
- Maintain records of successes and failures regarding the operation of flood shelters for future reference.
- Maintain traffic on the highways if those are used as temporary flood shelters.
- Maintain, if necessary, a community-based cattle shelter on a fallow raised land (places designated for weekly village market and inner banks of embankments/ polders/ highways).
- Build safe sanitary latrines (pit latrines on stilt) along highways that are being used as flood shelters.

4. POST-FLOOD REHABILITATION

4.1 Getting Back to 'Normal Life'

True to their proverbial resilience, people in Bangladesh are keen to bounce back to their usual quotidian lives despite incurring heavy losses in terms of crops, livestock, and property. As reported in the FGD/PRAs, neighbours help each other in getting back to 'normal life' following floods. Interpersonal relationship and kinship often play a vital role in deriving assistance from one's neighbours/ kins folk. Community approach to mend partially damaged houses, often by means of offering free labour, is very common. Well-to-do people sometimes employ

poor neighbours in restoration activities, thereby offering temporary employment. Sometimes access to credit is deliberately increased and offered to the poor, but often at a very high interest rate.

A community can help restoration of (a) houses, (b) sanitation facilities in each household, (c) water supply facilities at community levels, (d) commuter roads/ bridges/culverts/electric connections, (e) educational activities, and (f) health care facilities.

4.1.1 Returning home

- Return home, if taken refuge in flood shelter.
- Bring back family members taking refuge elsewehere.
- Bring back livestock and poultry, as necessary.
- At community level, help transfer of temporary refugees to their respective houses.

4.1.2 Restoration of health care, hygiene, and sanitation

- At household level, monitor health condition of the family members and perform periodic health care check-ups.
- Restore tubewell as needed.
- Restore sanitary latrine, as needed.
- At community level, help improve the environmental condition the households.

4.1.3 Repair and Maintenance of dwellings, community infrastructure etc.

- Mend the houses where necessary.
- Mend earthen cooking stove as needed.
- Reconstruct household storage facilities for (i) food items, (ii) fodder for livestock, (iii) cooking fuel etc.
- Reconstruct/mend partially or fully destroyed sanitary latrines.
- Help neighbours to mend their houses, household storage facilities and sanitary latrines, if assistance is sought.
- At community level, clean up the abandoned flood shelter and make it usable for its main purposes.

4.1.4 Restoration of means of communication

- At community level, repair breached embankments, if any, and reestablish a sense of security as soon as possible.
- Mend and/or reconstruct religious centers in a participatory fashion and restore religious activities as early as possible.

- Make community-based efforts to restore road networks by reviving the washed off rural roads and reestablishing the culverts/bridges.
- Repair, in a participatory manner, partially or fully destroyed local educational institutions (schools, madrasas, colleges etc.) and restore academic activities as soon as possible.
- Reconstruct, if needed, local markets and community centers; restore usual community-based activities in public places.
- Reestablish telecommunication network, if necessary (perhaps becoming redundant with the advent of satellite telecommunication services).
- Through community participation, reestablish electric poles and connections, if damaged.

4.1.5 Management of relief and rehabilitation programmes

- At community level, assess losses incurred by each of the community households in a participatory manner (BOX-7) and also assess the needs of households for their restoration.

BOX-7

Household-level Loss Estimation Chart

General Questions:

Name of the household head: ……..
Number of people living: …….male . …….female ……..Children below 12 …. Children below 5 …… infant/neonatal……male/female above 65.
Area under the household: ……..acres …….. decimals
Number of population affected:…… slightly …….. partially …… fully
Number of deaths during flood: ……. Cause (please narrate) ……
Could the corpse be buried? Yes/No. If yes, where? ……
Number of injured: …… Did anyone fall sick? Yes/No. If yes, for how many days? ……days.
What was the name of the disease? Cholera/Diarrhoea/Typhoid/……..(any other)
Could you provide treatment? Yes/No. If yes, how? ……
If no, why not? ……..
What was your house made of? Roof: Tile/CI sheet/biomass; side walls: CI sheet/ wood/ brick wall/other……; Floor: Cemented/mud layer/wood/others.……

A: Damaged Dwellings and Household Utility

House/Dwelling unit		Latrine (……)		Tubewell		Livestock shed	
No.	Bd. Tk	No.	Bd. Tk	No.	Bd. Tk	No.	Bd. Tk

B: Non-crop Production Loss

Livestock		Poultry		Trees		Culture (fish) pond	
No.	Bd. Tk	No.	Bd. Tk	No.	Bd. Tk	Kg escaped	Bd. Tk

C: Agricultural Loss

Seedbed lost		Seedlings drowned		Standing Crop - partially		Standing Crop - Fully	
Acre	Bd. Tk	Acre	Bd. Tk	Acres	Bd. Tk	Acres	Bd. Tk

- Reassess needs of community households and prepare a participatory plan for recovery and restoration.
- At household level, facilitate activities of CFMC for the distribution of relief material, restoration of communication systems (commuter roads/ bridges/electric wires etc.).
- By the end of April of the following year (by Bangla new year), assess how far relief and rehabilitation activities have covered, what could not be done, and evaluate the whole rehabilitation process. Document every aspects of relief and rehabilitation, including the impediments and institutional bottlenecks.

4.1.6 Interaction with government level flood relief activities

- Strengthen activities of the Community Flood Management Committee towards drawing attention of Government and non-Government organizations for adequate supply of relief.
- At community level, liaise with relevant GO/NGOs and help bring relief. Distribute relief on the basis of needs and priorities.

4.1.7 Meeting agricultural needs

- At community level, collect and distribute seedlings, as needed.
- At community level, help negotiate soft-term credits for the poor families to restore economic activities (e.g., crop production, horticulture, agro-forestry, nursery, pond-culture, small-scale industries/workshops, small-scale trading etc.).
- At household level, contact Thana Agriculture Officer for guidance in relation to selection & collection of seeds, assessment of suitability of crop for the remainder of the Kharif period, selection of feed for the livestock and poultry. The technologies suggested by the relevant government agencies towards restoring post-flood agricultural activities are suggested in BOX-8.

4.1.8 Miscellaneous measures

- Evaluate performance of the CFMC and its office bearers, document their effectiveness and identify failures. The entire operation should be documented so that pitfalls may be avoided in times of future reference.

4.2 Regeneration of Economic Activities

By attending to the meet the demand for agricultural restoration, as indicated in sub-section 4.1.7 above, a community can greatly facilitate regeneration of

economic activities in a flood-affected area. The following activities deserve special attention.

4.2.1 Increasing access to seedlings

A community may collectively look for an increase in seedling supplies from the neighbouring non-flooded (upland) areas, as has been observed following the 1988 and 1998 floods. The poor farmers may be offered seedlings as loans to make the best use of the remainder of the post-flood crop season, which may be repaid following harvest. A community can collectively negotiate with credit-offering lending institutions (banks) for soft term loans for various purposes, particularly for purchasing seedlings from elsewhere. Collectively, a community can also demand assistance of the Thana Agriculture Office for arranging seedling collection and distribution.

4.2.2 Homestead horticulture

It is necessary to take measures to grow vegetables within the homestead. Thana Agriculture Officers can play vital roles in enhancing support for extension of homestead horticulture by providing seeds of quick-growing varieties.

4.2.3 Nursery establishment

Establishment of nursery can be a profitable agro-business, which requires active support from the community itself.

4.2.4 Pond re-excavation for fisheries

A few members of a community can re-excavate an unproductive pond (*haja/moja pukur*) and start small-scale fish culture. The larger community can facilitate access to credit and other services for such local initiatives.

4.2.5 Transport

A community can easily assess the transportation needs of the local community members and run a small-scale transport business. Such an activity will also provide employment for some people.

5 MANAGING INFORMATION FOR FUTURE REFERENCE

It is a general feature in Bangladesh that following a disaster all the information relating to people's individual and collective coping and adaptation is lost due to the inability to keep records and/or poor maintenance of records. The following

activities would greatly benefit local communities if adequate attention is paid in this respect.

5.1 Mapping Resources and Services Available at Local Levels

Keep a general record of available resources that are required to fight a flood, what resources are made available by the community members themselves, what outside resources and interventions are added to facilitate their participatory activities etc.

5.2 Initiating Mechanisms to Preserve/Restore and Manage Relevant Information

A flood affected community should initiate a mechanism to preserve/retrieve and manage information on

i. Expanse of each flood that affected the locality
ii. Timing of occurrence of each flood
iii. Overall extent of damage caused by the flood
iv. Depth of water at different phases of the flood
v. Overall duration of the flood in question
vi. Where to find resources
vii. Whom to contact for which resources
viii. The specific locations of various support services
ix. Places where flood related warning/forecasts are available
x. Places where CFMMs are located/available
xi. Whereabouts of the experienced flood managers in the community
xii. Any other relevant aspect

6. CONCLUSION

It is envisaged that a manual as devised and detailed above will provide basic information to flood-vulnerable communities on what steps to take towards encountering specific problems, anticipatory or real, in order to avoid losses due to floods. The primary aim of such a manual is to enhance people's capabilities towards managing flood individually and/or collectively. No attempt has been made to suggest construction-biased and investment-intensive medium- to large-scale engineering methods. In many cases, local-level flood vulnerability can be modified to a great extent by involving such techniques. However, these do not fall within the purview of the current study-based project.

BOX-8

GUIDELINES FOR POST-FLOOD AGRICULTURAL REHABILITATION TECHNOLOGIES

A) Crop Agriculture

i) Early-Boro and early-Aus cultivation

Innovations in agricultural technology are taking place to face the post-flood situation in the field. In the meantime, research outcome has recommended extension of early Boro and early Aus cultivation. In the flash flood-prone areas, local and HYV early-maturing and early-growing Boro cultivation can reduce the risk of a disaster considerably. Imputs of early-growing varieties, as well as information regarding methods of cultivation and other precautions can be collected from local institutions involved in Agricultural Extension.

The life cycle of these varieties should ideally be 140-150 days. Such varieties are now being grown in some flash flood-prone areas.

ii) Transplanted Aman cultivation by detaching tiller

Transplanted Aman rice can be grown in some lands of the affected areas by obtaining tillers from the unaffected/relatively less affected lands. This is a measure to face seedling crisis.

From the normal plantation when 5-7 tillers are produced during 30-40 days, 2-3 tillers including their roots can be taken from each *gochha*. A satisfactory level of production can be achieved if land preparation, fertilizing, irrigation and weeds can be managed properly and tiller taking and tiller transplantation are done properly.

iii) Cultivation of late Aman variety

Sometimes, floods destroy partially or fully both local and HYV crops of transplanted Aman paddy. There are times when floods (early and mid-flood) come before plantation and recede late. This problem can be faced/solved by late cultivation of transplanted Aman. For late cultivation, *Naizershail* is prominent as food grain. It is potentially a good cultivar in the southern districts of Bangladesh including the area where water during mid-flood periods recedes slowly. *Binashail*, which was innovated by Bangladesh Institute of Nuclear Agriculture (BINA), should be sown in the seedbed in the second week of *Srabon* (last week of July) and planted in the first week of *Ashwin* (25th of September). This paddy can also be planted in the land after mid-flood. After plantation, fertilizing and other management will have to be completed according to the specific method. When planted late, it takes 125-130 days to be matured (seed to seed life) paddy. This paddy can be harvested in

the second week of *Paush* (last week of December). This type of paddy is very appropriate for mid-flood areas. As this type of paddy is comparatively tall, it yields a large quantity of straw as cattle feed. This paddy can be cultivated in all areas of Bangladesh but it is good not to cultivate this paddy where there is permanent water logging.

iv) Tillage requirements of crop cultivation

No-tillage maize cultivation in moist soil

In lands with moist soils, sometimes transplanted Aman cultivation cannot be possible and those lands remain fallow till the next cropping season (i.e., Rabi). In such a situation, no-tillage maize cultivation utilizing the remainder of the Kharif season in moist soils helps produce some food grains, cattle feed and fuel wood before the next cultivation of Boro and other crops. It is possible to go for the next Boro crop production if it is cultivated by the 2nd week of *Ashwin* (mid-October). The maize produced may be eaten early, from a very green (*kochi*) stage. Leaf of maize and stem can be used for animal feed and fuel wood.

Just after the recession of floodwater, wastes, straw, weeds and water hyacinth from the land need to be cleaned.

If the land is much overlaid with clay, seeds can be planted in the clay. Depending on the quantity of seeds if or the soil is a little hard then seeds may be planted by finger-pressing them into the soil. Sticks also can be used for making holes. Fertilizing and other necessary nursing can be done later as per methodology.

No-tillage Kheshari and bean cultivation along with maize in moist soils

After flood, no-tillage inter-cropping in moist soils can be done with the planting distance of 90x25 cm in case of maize as the main crop. Here, 25 kg of maize seeds can be sown first, followed by 35 kg of *Kheshari* (pulses) or 40 kg of bean seeds. Fertilizing and other necessary activities can be done later as per specific methodology. If water is found here and there in the land during seeding, then *Kheshari* (pulses) and beans can be sown first and after a couple of days maize can be sown. In these circumstances, there is little possibility of damage to the maize seeds in the water.

Minimum-tillage wheat cultivation

Minimum-tillage or no-tillage wheat production is possible in loam and silt clay loam; and early wheat can be cultivated, production expense can be reduced, early food grains can be achieved and cost of ploughing brought down. This technology is very helpful for poor farmers whose affordability for inputs is severely impeded due to floods. The problem of delayed harvesting of Aman paddy can also be addressed in this way. Generally, by the end of *Kartic* or the first week of *Ogrohayan* (November) wheat can be broadcast following recession of floodwaters,

particularly when there is no water on the land but soft clay. Or if there is no moist soil but the land is still soft, then with no-tillage hand plough or ploughing by bullock through 3-4 cm deep, seeding can be possible.

No-tillage mustard (rapeseed) cultivation

If the soil does not have much silt clay, no tillage mustard production is possible after flood in low land. In this methodology, only short duration Tori-7 variety can be cultivated. Seeding in lines is good to avoid weeds. After recession of floodwaters, seeding can be done by cleaning and leveling of land. In addition to mustard, sun-flower and other oil-rich crops can be cultivated.

No-tillage potato cultivation

No-tillage potato cultivation is possible in highly flooded land on floating beds of water hyacinth, water plants, and straw. After harvesting Aman paddy, late flood submerged and low land areas have significant outcome from this technology. This cultivation can be done by putting potato onto the soft soil or onto the *Nala.* Then fertilizing as per specific method and other nursing can be done.

In Bangladesh, a large low-lying area remains fallow after harvesting of broadcast Aman. Due to delayed recession of floodwaters from the land, it takes time to reach available "*JOO*" (suitable weather condition) and there is no time to cultivate potato and other Rabi crops. After harvesting transplanted Aman, it is late to cultivate potato in some medium low land (even in some medium high land) areas. In these lands, the no-tillage potato cultivation method can help solve the problem of unavailability of any late variety. This technology reduces the cost of cultivation and use of bullock draught power further reduces the cost of production of potato. This technology is very useful in the post-flood agricultural rehabilitation programme low-lying areas, particularly in *haors*, *baors* and *beel* areas of Bangladesh.

Any type of HYV potato seed can be cultivated in this way. There is no way of sowing split seeds of potato in the circumstances under consideration. Fertilizing and other nursing can be done according to the specific method.

Early variety of jute

CC-45 (*Joo Jute*) and CVE variety of jute can be sown in *Falgun-Chaitro* (end of February-March) and harvested by *Ashar* (June-July). In this way, early and late floods can be ignored. After sowing, fertilizing and other nursing can be done as per specific method. Jute cultivation is possible by using this technology in the low lying areas of land.

Late variety of jute

Green jute and D-154 variety can be sown from the end of *Chaitra* to the month of *Baishakh* in lands where monsoon water is stagnant and transplanted Aman is cultivated at a late stage.

The variety of O-4 can be sown in comparatively higher land from the beginning of *Baishakh*. This technology can be used in greater Mymenshigh and part of Dhaka, Comilla, and most of the areas of Faridpur, Jessore, Kustia, Rajshahi, Pabna and Khulna. The damage to fiber types of crops in late flood is less expected. Because, most of such crops are not available in the field at this time. But if there are seed crops then special attention must be paid. In this case if water exists for 10-15 days and plants are not submerged, there is less possibility of crop damage.

v) Use of maize leaf for cattle feed

Maize leaf can be used as cattle feed when maize matures and its *Jhul of Mocha* is about to fall. It is also possible to cut the *Mocha* from 30 cm of its tip and it can be used as cattle feed. Maize leaf is an alternative and improved cattle feed, especially following a flood when paddy is damaged and availability of cattle feed becomes a problem. In this situation, when farmers do not have money for buying rice, scarcity of cattle feed becomes a threat to livestock.

B) Livestock Management

- It is necessary to relocate livestock to the relatives' houses in flood-free areas. If the numbers are many, some can be sold out in the market.
- It is necessary to buy earlier some of the important medicine for livestock.
- Special attention needs to be paid to the cattle during a flood.
- Quick decision must be taken for relocation and sale of the livestock, depending on the forecast of the magnitude and longevity of flood.

Livestock health management

- During flood and post flood times, livestock should not drink water of ditches and of polluted cultivable water bodies. After ebbing of flood water, newly grown grass should not be fed, but some rainfall would decrease the toxicity of the grass.
- In severe food scarcity, livestock can be fed jackfruit leaf, banana leaf, bamboo leaf, *Hijol* leaf, *Babla* leaf. Livestock can also be fed Urea Molasses Block.
- Shells of snails and other mollusks (s*hamuk and jhinuk*), rice husks (*kura and bhushi*), oil-cake (*khoil*) and extra household food may be used as supplementary feed for poultry.
- Livestock face many epidemic diseases after a flood. The major diseases of animals in the flood affected areas are anthrax, diarrhoea, malnutrition, foot and mouth disease, *Kalapani, Khurarog, Bachhurer badla rog* and *gabhir bat gha rog* etc.
- The major diseases of poultry are *Ranikhet,* pox, and fever.

C) Fishery Management

- If the pond is flooded and if fish cultivation continues after the flood, it is necessary to eliminate the *Rakkhoshey* fish and other unnecessary fish by netting.
- If the cultured ponds are maintained well during the flood, the fish needs to be fed well during the post-flood period.
- If fish were allowed to go astray in floodwaters, efforts must be made to make the culturable pond flood-free. Through earth digging, the pond may be excavated, while the earth may be utilized to raise the height of the pond above flood danger levels. Once prepared for fish culture, it would be necessary to release healthy fingerlings of suitable varieties.
- In Bangladesh, there is a general tendency among fishes to suffer from skin ailments, especially during the early winter (December-January). To avoid large-scale damage to culture fisheries, it would be worthwhile to get in touch with the District Fisheries Officer to seek guidance.

Annex-I

In-country Hydrological Dimensions of Floods

Interplay of various factors plays a role in influencing the hydrological regime of a river basin and triggering floods. These factors may be categorized into two groups: climatic factors and non-climatic factors. The cause-effect relationships for each of the major factors are discussed below.

In general, a low intensity flood may occur due to climatic factors particularly, due to high intensity rainfall-induced excessive flows in rivers. But for a catastrophic flood to occur a number of non-climatic factors interplay with one or more of the climatic factors.

Climatic Factors

Three climatic factors are considered to be important in causing flood variation in Bangladesh. These are: precipitation, snow and glacier melt and El-Nino Southern Oscillation (ENSO).

Precipitation

Precipitation patterns of the Ganges, Brahmaputra and Meghna river basins are significantly different. Intra-regional variability of precipitation in these river basins is also high. Mean precipitation in the basins of the GBM rivers are 1100, 2000 and 2500mm, respectively. However, precipitation varies widely within various parts of a river basin. Precipitation in the northern part of the Ganges basin is one third of that of the coastal part. Brahmaputra basin in China (Tibet) is a rainshadow (only 400 to 500 mm) while the Indian part of the basin experiences about 2500 mm of rainfall. The Meghna basin in Bangladesh is wetter than its Indian part. Cherapunjee, the area with the highest annual rainfall in the world, is located in the Meghna basin where the mean annual precipitation is 10,870 mm and the maximum recorded was 12,700 mm. Precipitation in the three river basins are presented in Table 1.

Table 1

Precipitation in the Ganges, Brahmaputra and Meghna/Barak basins

Basin	Location (country)	Mean annual precipitation (mm)
Ganges	India	450-2000
	Bangladesh	1568
	Nepal	1860
Brahmaputra	India	2500
	Bangladesh	2400
	China (Tibet)	400-500
	Bhutan	500-5000
Meghna/Barak	India	2640
	Bangladesh	3574

Source: Mirza 1998

Snow and Glacier Melt

The snow and ice cover in the Himalayas is within a range of 30,000-332,000 sq. km. (Bahadur, 1985). It is widely believed that the waters from snow and glacier melt play a significant role in flooding in Bangladesh (CBJET, 1991) and in some river basins in India (Rashtriya Barh Ayog, 1980). Detailed information on the Himalayan snow coverage and melt processes is not known. The volume of snow water is only 0.076 percent of the mean annual flow of the Ganges and Brahmaputra rivers, indeed a minor contribution (Mirza, 1998). Snowmelt season does not coincide with the flood season in Bangladesh. Therefore, the role of snowmelt in causing floods in Bangladesh cannot be justified. Table 2 presents contribution of snowmelt to the runoff of the Ganges and Brahmaputra rivers.

Table 2

Snowmelt contribution to the Ganges and Brahmaputra systems

Name of basins	Name of tributary	Location	Snowmelt area (sq. km.)	Total average snowfall (million m^3)	Computed snowmelt runoff* (million m^3)
Ganges	Jamuna	Tejewala	1980	161	145
	Ganges	Raiwala	7965	480	432
	Karnali	-	8049	123	111
	Gandak	Triveni	4421	92	83
Brahmaputra	Teesta	Coronation Bridge	2617	46	42

*Note: * Estimated. Considering 90 percent of total average snowfall (in column 5)*
Source: Central Water Commission, India, 1988

El-Nino Southern Oscillation (ENSO)

There have been strong arguments that El-Nino Southern Oscillation (ENSO), a phenomenon that causes positive anomalies in the sea surface temperature (SST) of the southeastern Pacific Ocean and thereby warming of the ocean, induces strong monsoons in the Indian subcontinent (Parthasarathy and Pant, 1985; Choudhury, 1998). It is, therefore, believed that ENSO induces both drought and flooding in the GBM region. A study on Bangladesh monsoon rainfall has shown that there is a general trend of decrease in rainfall throughout the monsoon in El-Nino years (Parthasarathy and Pant, 1985). However, the year following the El-Nino years showed negative anomaly regarding SST (cold events). Due to a decrease in SST in the eastern Pacific, the easterly wind became strong and brought excessive rainfall in the region. From these observations it is concluded that the El-Nino phenomenon has a strong influence on the monsoon, and thereby, on the floods in the region.

Choudhury (1998) reported that the Southern Oscillation Index (SOI) sharply rose from May onwards in 1998 and El-Nino transformed into La-Nina (the cold event), causing excessive rainfall all over the country and also in the GBM region in general. These observations clearly suggest that the ENSO phenomenon acts as a catalyst to induce severe floods in Bangladesh.

Non-climatic Factors

Apart from the factors mentioned above, there are several other factors, although not directly induced by climatic factors, which influence occurrence of floods in Bangladesh. The non-climatic factors responsible for causing flood variation in Bangladesh are the following: deforestation, siltation of principal distributaries, backwater effects from sea level variations, synchronization of flood peaks of the major rivers, tidal effect, and unplanned infrastructure development.

Siltation of Principal Distributataries

Significant changes in the morphological behaviour of the principal distributaries of the Ganges and Brahmaputra rivers in Bangladesh have been noticed in the first few decades of the twentieth century. Over the years, these distributaries had lost their conveyance capacity due to excessive siltation (for example, the Old Brahmaputra and the Dhaleswari off-take of the Brahmaputra). This has resulted in floodwaters being concentrated in the south-eastern part of the country.

Backwater Effect

Backwater effect caused by spring tides in the Bay of Bengal retards drainage of the flood waters into the bay. This causes monsoon flooding in the low-lying

areas in the coastal region as well as in the central part in Bangladesh. Floods in the Halda, the Karnaphuli basin, the Matamuhuri basin and *beels* of Barisal and Khulna districts are intensified by the backwater effect. In the monsoon, the mean sea level may rise by about 60 cm due to the effect of the southwesterly monsoon wind. This also affects drainage of floodwaters adversely and raises the flood levels near the coast.

Unplanned Infrastructure Development

Unplanned construction of roads, railways and flood control embankments sometimes causes drainage congestion. Mahalnobis (1927) mentioned in this connection the railway embankments in the undivided Bengal. After the independence of Bangladesh, thousands of kilometers of rural roads and highways have been constructed. Since most of the rivers are aligned east-west and the roads are aligned north-south, the latter do not allow free flow of water and cause drainage congestion. It has been observed in the past that, in many cases, comprehensive hydrological studies including extensive modeling exercises were not carried out to plan proper layouts, drainage facilities etc. In many cases rural roads are being built according to the instruction of the local political leaders, with or without any official scrutiny regarding the design and alignment of the road. Construction of polders also have caused local interference in the passage of flood waters, as it has been demonstrated by Islam and Chowdhury (1989). These often inhibit egression of flood waters through the channels and increase retention time in the adjoining floodplains.

Deforestation

Deforestation in the upper catchment areas may influence the total volume of water available for runoff, modifying the time distribution of runoff and contributing increased sediment input to the rivers. There are opposing viewpoints in the literature about the role of deforestation in the Himalayas on Bangladesh floods (Hewlett, 1982; Hofer, 1993; Carson, 1985). Deforestation may have some role in coarse silt generation and is unlikely to have any direct link with increased runoff generation that causes floods. Generation of coarse silt instead of fine clayey silt influences higher rates of sedimentation in the flat riverbeds resulting in further decrease in river gradients. As a result, the capacity of the rivers in Bangladesh for water transport towards the sea-mouth is decreasing, and this has a significant effect on a decreasing return periodof floods.

Synchronisation of Flood Peaks of the Major Rivers

Occasional synchronisation of flood peaks of the major rivers can cause serious effects on flooding in Bangladesh with respect to spatial inundation, depth and

duration. In a normal year, flood peaks of the Brahmaputra and Ganges occur 29 days apart. The late Brahmaputra peak may occur four days earlier than the normal peak of the Ganges. In 1988 the peak-flows of the Brahmaputra (at Bahadurabad) and the Ganges (at Hardinge Bridge) occurred on 30 August and 2 September, respectively. As a result, the entire central region of the country adjoining the confluence point of the two rivers suffered an unprecedented flood in recorded history.

Examining the above mentioned dimensions of flood from the points of view of topographic and socio-cultural aspects and high influence of the regional configuration and oceanic phenomena, it appears to be almost impossible to pinpoint one or two specific cause(s) of a flood. For each catastrophic flood a number of variables are found to interplay. Figure 1 presents a schematic overview of interactions between different factors causing floods in Bangladesh. Due to such complexity the policy makers find it difficult to figure out one specific formula towards mitigating flood-induced disasters.

Annex-II

Brief Field Report
Participatory Rapid Appraisal (PRA) on Community Approaches to Flood Management in Melandaha Upazila, Jamalpur District

INTRODUCTION

This field report briefly presents the findings of two Participatory Rapid Appraisals (PRA) conducted in Melandaha Upazila of Jamalpur District in north-central flood prone areas and two PRAs conducted in Nawabganj Upazila of Nawabganj district of central-western flood-prone areas of Bangladesh. A total of four PRAs, two in each study Upazilas, were conducted during 1 to 8 October, 2003 on Community Approaches to Flood Management, where the focus was on the following: (i) how communities themselves can collectively manage various phases of floods through preparedness, during and post-flood reconstruction and rehabilitation; (ii) how community based institutions can facilitate flood management activities; and (iii) how post-flood economic recovery can be streamlined through adoption of appropriate agricultural technologies. These PRAs have been conducted as a follow up activity of the action research, simultaneously conducted in three South Asian flood-prone countries—Bangladesh, India and Nepal—in association with the World Meteorological Organization of the United Nations.

GENERAL DESCRIPTION OF THE STUDY LOCATIONS

As indicted above, two flood-prone locations of Bangladesh have been selected on the basis of their vulnerability to recurring floods and their representativeness in relation to river-induced flood vulnerability of the entire country. It is to be mentioned here that areas susceptible to flash-floods and coastal tidal surge-induced floods are not considered in this study, due primarily to lack of resources (time-wise and financial). It is understood that the characteristics of floods in those areas are somewhat different and the management of floods in those cases might require different approaches.

The first flood-prone Upazila, Melandaha is located within the Brahmaputra floodplain. The north-eastern reaches of the Upazila are demarcated by the Old Brahmaputra river, which is shared also by Islampur Upazila. The eastern part of the Upazila is bound by Sherpur Sadar (proper) Upazila of Sherpur district, while its western borders are demarcated by Islampur and Madarganj Upazilas and the southern boundaries by Jamalpur Upazila of Jamalpur district. A railway track and the divisional highway pass through the north-eastern reaches of the Upazila. The southern reaches of the area are criss-crossed by rural and brick-paved road

networks, while there is one distinct non-metalled road in the northern part of the Upazila that connects the eastern part of the Upazila to the western parts. The Chatal river, a branch of the Brahmaputra that feeds the latter, passes through a small section of the western parts of the Upazila. A part of the Chatal and the Jhinai rivers borders the Jamalpur Sadar Upazila in the south. The map of the area is shown in Figure-A1.

The floodplain of the area is characterized by sediments deposited by the river Brahmaputra. About 70% of the land falls under the Old Brahmaputra floodplain, while the rest falls under the new Brahmaputra floodplain. The relief is typically flat, characterizing meander floodplain landscape with broad ridges and basins. Upland constitutes only a quarter of the land area, while medium low to low lands constitute about one third of the total landmass. The higher parts of the ridges have lower susceptibility to flooding and these are only flooded during high to severe floods. However, the lower parts, particularly the medium low to low lands, are flooded every year.

There are a number of perennial wetlands areas in the Upazila. The important ones are: Baghdeo *beel,* Dengar *beel,* Deg-badda *beel,* Shilan *beel,* Burungee *beel* etc. The *beels* collectively occupy some 586 hectares, while the rivers occupy about 242 hectares of land. These wetlands experience deep flooding even in normal years.

The climate of the Upazila is typically tropical monsoon; the mean annual rainfall of the nearest meteorological station (Jamalpur) is 2240 mm, that corresponds very well with the average rainfall of Bangladesh. The rainy season extends from June to mid-October, accounting for nearly 80 percent of the annual rainfall. This is the season when groundwater is adequately recharged and soil moisture availability is in excess of crop requirements.

Soils in the sample site have developed in alluvial sediments deposited by the Old Brahmaputra and the Brahmaputra (i.e., the Jamuna) rivers. They demonstrate different degrees of development depending on the age of sediments and their position on the relief. In general, the soils of the study Upazila comprise a pattern of sandy to loamy soils in the higher parts of the floodplain ridges, grading into clayey texture in the basins or depressions. One important characteristic of most of the soil type is that they exhibit poor to very poor drainage of available moisture – explaining why the area is susceptible to annual flooding.

The hydrological framework of the case study site is dominated by both the Jamuna and the Old Brahmaputra. As indicated earlier, the Old Brahmaputra, which flows through the eastern parts of the area, is the principal river and the source of surface water in the Upazila. It receives the major part of its flow from the Jamuna. The Jamuna – flowing along the western part of Melandaha upazila – experiences significant bank erosion and sedimentation, causing changes in the alignment of the river bank. Flooding is almost entirely by overbank spillage from the Old

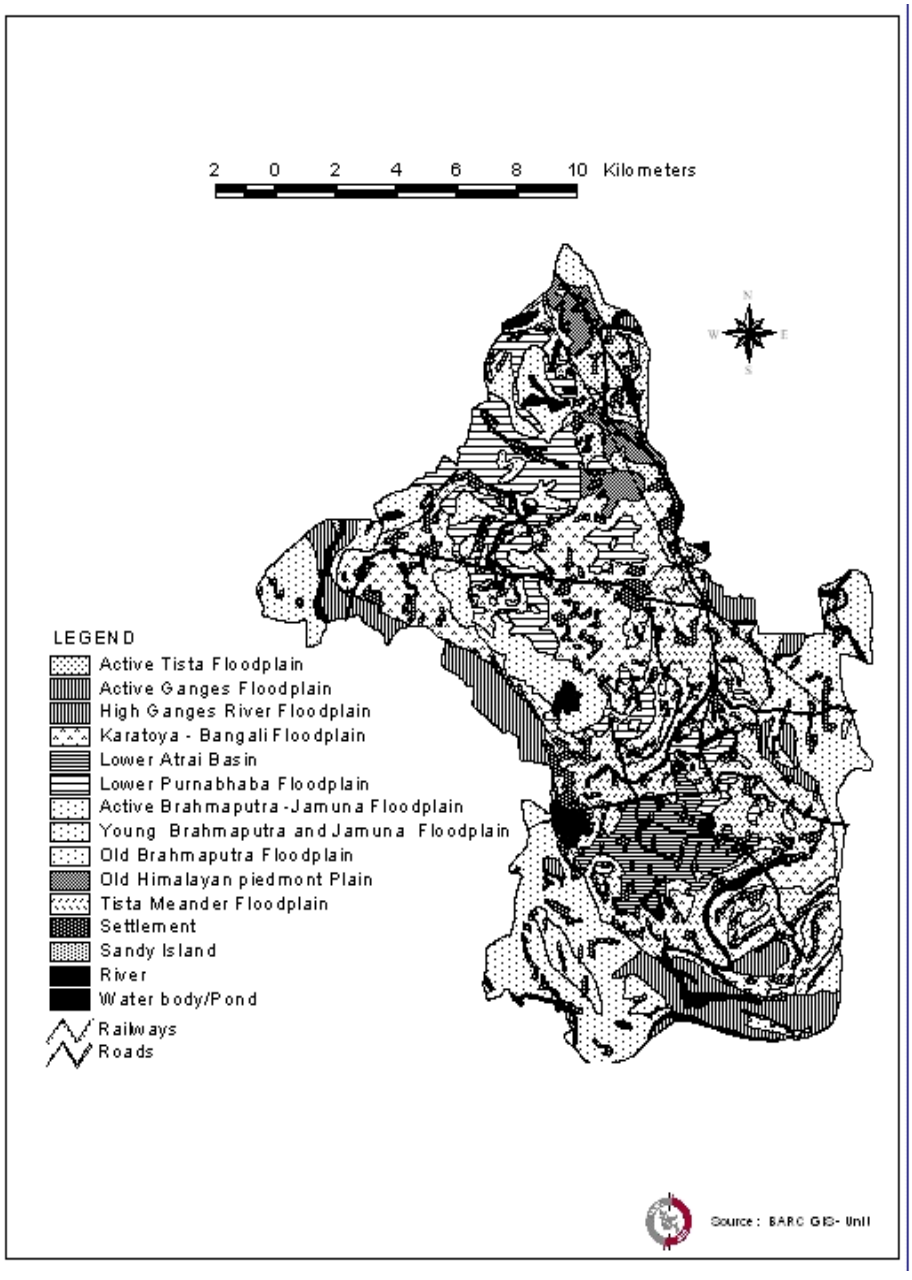

Figure A1: Physical map of Melandaha Upazila.

Brahpautra and the Jamuna, and the raised groundwater table ponded on the land by high external flood levels. The middle of the basin generally stays wet for most or all of the dry season. Risk of early flooding in basins and uncertain depth of flooding from year to year are major concerns in flood protection planning.

Two-thirds of the landmass of the Upazila is cultivable land. Farming is the dominant economic activity, offering livelihoods to over 90% of the local inhabitants. During the Key Informants' interviews it is revealed that there are about 350 ponds in the Upazila, most of which have been brought under culture fisheries in recent years. Like the rest of the country, rice is the dominant crop. Aman and Boro are the two dominant crops, occupying over 85% land coverage, while sugarcane is the only other significant crop. Aus and Aman are generally rain fed, while HYV Boro is irrigated in the dry season. Both aus and aman are vulnerable to floods from pre-monsoon flooding and monsoon flooding respectively. Other crops of lesser importance include jute, pulses, vegetables and wheat.

The second flood-prone study location, Nawabganj Upazila, is located in the Ganges-Mahananda floodplain. It also belongs to the 'High Ganges River Floodplain' agroecological region. The Upazila houses the District Headquarters of Nawabganj. The north-western reaches of the Upazila borders Sibganj Upazila while the rest of the western boundary is demarcated by the Ganges river. The north-eastern corner of it borders Nachol Upazila of Nawabganj district, while the rest of the eastern parts borders Godagari Upazila of Rajshahi district. The physical map of the Upazila is shown in Figure-A2.

The surface of the study area is largely covered with a mixture of Ganges and Mahananda alluviums. The Mahananda is a left bank tributary of the Ganges. It has a large catchment area in India to the west of the Barind Tract, but it is also fed by outflows from the northwestern part of Bangladesh through the Pagla (Tangon) and Punarbhaba rivers which join the Mahananda inside the borders of Bangladesh. A rather small branch of the Ganges, locally known as *mora* Padma, flows through the southern parts of the Upazila before falling into the Ganges. During drier months, flow of the latter river is very weak. However, during peak flood season its flows are substantial. The confluences of *mora* Padma-the Ganges and the Mahananda-the Ganges are only three to four kilometres apart. This physical characteristic creates local ponding effect, particularly during the peak-flood period, which is compounded by the strong backwater effect of the Ganges at these confluences. Consequently, despite being located in a rather 'dry zone' of the country, Nawabganj (Sadar) Upazila suffers from annual flooding. In some cases, this study location suffers from two floodings in one hydrological year: one during the peak flood period (i.e., late-August) and the other at the late flood season, at the height of peak-flood in the Ganges (i.e., early to mid-September).

The annual rainfall of Nawabganj Upazila is the lowest, representing the 'dry zone' of the country. Mean annual rainfall is around 1400 mm compared to the national

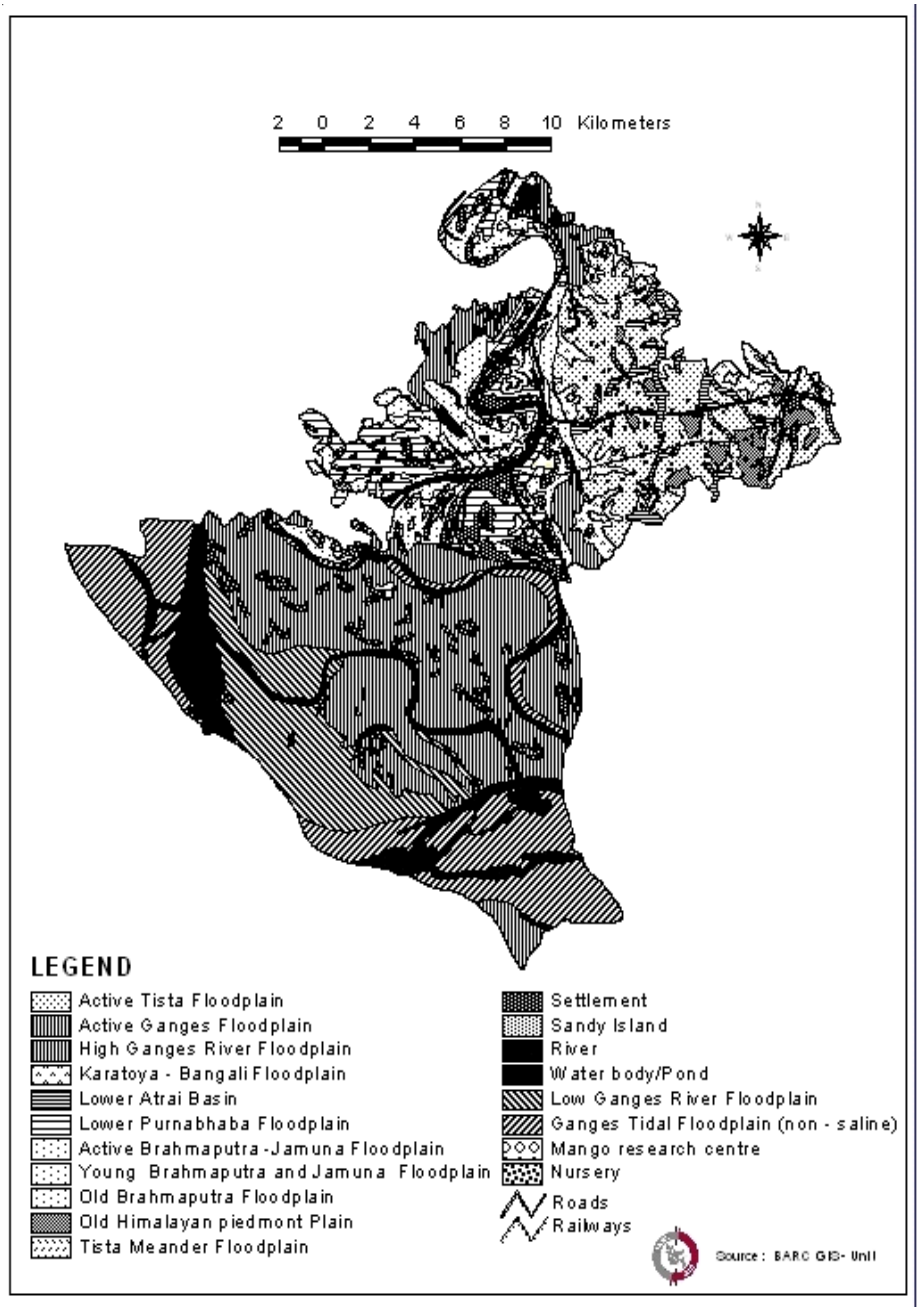

Figure A2: Physical map of Nawabganj Sadar Upazila.

average of 2300 mm. Rainfall variability is also very high. Onset of monsoon rainfall sometimes is delayed by about 25 days, which extends the pre-Kharif critical dry period by 50 to 60 days. Due to uncertainty in rainfall, this Upazila suffers from an annual drought cycle. Mean annual temperature is slightly higher than the national mean. However, summer temperatures generally are considerably higher than the national average. The number of days when the day-time high temperature exceeds the threshold value of 40C is found to be about 15 days per annum. Winter minimum temperature is again considerably lower than the national mean, the number of days featuring Tmin below 10C is found to vary between 25 and 35 days.

Although the area consists of floodplain, its relief is characterized by deep basins separated by a few high ridges – a set up that suits large-scale ponding of water. High land constitutes a little less than half of the area, while a quarter of the area belongs each to medium high land and medium low land (with 30-90 cm and 90-180 cm inundation, respectively). Some high land soils are moderately well drained, but much of these soils become wet periodically during spells of heavy monsoon rainfall. Lower ridges and basins in particular experience mainly shallow flooding from ponded rainwater and raised water table during periods of heavy rainfall. In years of exceptionally heavy monsoon rainfall extensive flooding is common. Flash floods from local runoff are also common, which inundate the deep basins. The southern part of the Upazila is particularly flood vulnerable. The right side of the Mahananda river is more flood-prone than the left side due to the protection offered by the Chapai-Nawabgabj-Rohanpur road.

The soil consists of olive brown, silt loams and silty clay loams on the upper parts of the floodplain ridges, and dark grey, mottled brown, mainly clay soils on lower ridge sites and in basins. In a broad strip adjoining the Mahananda river, the soils are infused by a mixture of calcareous Gangetic deposits and non-calcareous Mahananda deposits.

According to the Upazila Agriculture Officer (interviewed as Key Informant), the popultion of the Upazila is 1.56 million. The area consists of agricultural land, wetland, forested land and urban land. The administrative areas are subdivided by 48 Unions and 1502 villages. Despite the chronic susceptibility to floods and droughts, the area is a food-surplus area.

The Upazila exhibits a wide range of land use. Rice (Aus and Aman) is the principal crop, followed by potato, pulses, vegetables etc. in the Rabi season. Due to poor water retention capacity of the sandy loam soils, coverage of irrigation-dependent Boro is very poor in this Upazila. This also signifies that crop agriculture is predominantly an activity for the wet season and is therefore highly susceptible to floods.

Mango, sugarcane and banana are major cash crops. The area is particularly famous for producing the best mangoes. Only about 9.5% of the land is permanently

fallow, while about 75% of the land is brought under cultivation. The cropping intensity is about 192%. Only about 24.5% of the land is singly cropped. Rainfall variability, especially in the pre-monsoon region, remains a significant concern for further agricultural development.

The Upazila has about 500 ponds. However, due to erratic rainfall and poor water retention capacity, a large majority of the ponds are not properly utilized for aquaculture. Forestry, often in the form of homestead mango orchards, is popular and economically profitable. The Mango Research Institute is located in this Upazila.

FINDINGS OF THE PRAs

The participants in the PRAs generally have a comprehensive understanding of the biophysical resources, the seasonality of availability of water resources and the complex relationship of seasonal distribution of rainfall and runoff (including river flows from upstream) with crops being grown in the locality. They are aware of occurrence of 'usual floods', higher than usual floods, and 'extreme floods'. In case of Nawabganj, a general perception is that extreme floods occur when the gates of the Farakka barrage is let open by the upper riparian. They do believe that, local rainfall, even in extreme cases, cannot trigger an 'extreme flood'. People also rule out that an extreme flood can neither occur without 'floodwaters' in the major rivers nor in non-flood-peak season. In both the localities, 1998 was cited as an example of extreme flood, whereas the flood event in 2003 was cited as an usual flood. Again in Nawabganj, which was flooded twice in the same flood season, the cause of late flood was adjudged to be related to anthropogenic activities in addition to natural causes.

It is generally understood by the flood-prone people that only the big and/or extreme flood events are 'dangerous' for them, which warrant early preparedness. They also believe that early preparedness for the extreme events could have reduced their loss burden to a significant extent. However, they do not often get the benefit of early warning to get prepared for an imminent flood. They are sometimes warned by their peers and village elders, which do not provide them the impetus to take firm action due to the fact that such actions often cost them dearly. In all the PRAs, it is generally found that they do not find any source, led by government and/or non-government institutions, from where they can get reliable early warning.

People complained about current methods of disseminating flood-related information through the electronic media (radio and television). They found the information 'not so clear', 'not relevant for their locality', and often 'too technical'. People are of the strong opinion that the government agencies should employ someone, preferably at Upazila level (similar to Upazila Agriculture Officer), to provide local-specific early warning with sufficient lead time in order to allow them to consider appropriate preparedness measures. When asked about specific

measures, they could not immediately think of any specific collective measure. However, they could easily identify 'household-level preparedness measures such as (i) safeguarding food items, seeds, and valuable belongings; (ii) subject to availability of funds, safeguarding dwellings; (iii) preparing rafts and mending boats; (iv) raising a platform within the household/dwelling to avoid rising flood waters; and (v) transferring vulnerable family members to houses of relatives living in upland areas etc. Due to lack of understanding of the imminent flood, they often do not harvest cultured fish or growing vegetables and suffer losses.

Economic hindrance often do not allow poor households to increase the plinth height of their dwellings, even though it is understood that such a measure could be quite effective to avoid inundation and destruction of the dwellings. "The cost for labour appears to be quite high" – opined a number of poor farmers.

Although during-flood responses are generally perceived as 'family-level' affair, often people demonstrate a collective and cooperative spirit and help each other. People recognize that the youth generally are very helpful towards implementing community-level activities. People are of general consensus that, during 'extreme flood events', they need to relocate themselves either to flood-free highways, raised lands or to flood shelters, if there is any in the neighbourhood. Fear of possible theft in their absence is considered as the prime reason which deter many households not to relocate even if a flood shelter is accessible. However, they rely on the surveillance of the local youth to maintain law and order inside a flood shelter. People generally agree that, if proper guidance is provided, local youth can manage a significant proportion of the activities during floods. There are, however, a few activities which the local people cannot solve by themselves. According to the flood victims, there is a need for providing health care services during a flood.

People also do not find adequate sources for collection of drinking water. They are used to collect water from tubewells that have been made flood-free by raising the height above flood peak. People complained that such tubewells are scanty and many people are forced to drink 'available flood water', even though they are aware that such water could cause health disorder. There is a clear lack of information and knowledge regarding methods to make floodwaters free from pathogens. Only one person present in one of the PRAs in Jamalpur reported that he had heard about 'a tablet' that could be used before drinking 'available flood water'. However, he could not recall how much of water could be 'treated' by such a tablet and how to find that tablet. When prompted that such tablets are commercially available, people immediately wanted to know where they could find such tablets and at what cost. People have heard about 'oral saline therapy' and the use of commercially available orsaline sachets; they appreciated radio and television commercials for widespread knowledge regarding the use of such methods of treating ailing people. They opined "if we could handle stomach-related

problems on our own, half of the health-related problems could be solved without going to the doctor".

People complained that during extreme floods, they often do not see the doctors appointed by the government. They would like to see the doctors helping the ailing ones and giving medicines as needed. They are of the opinion that it should be the responsibility of the government to ensure such services and the local government should check availability of the professionals before giving them their salaries.

People find it difficult to maintain livestock during an extreme flood event. During 'normal floods', they informed that livestock can either be safeguarded by putting them on a bamboo-stem raft or relocating them in higher places such as highways. They informed that like human beings, livestock also suffer from 'stomach-related' problems due to continued exposure to polluted water. They also find it difficult to collect and offer livestock feed during high intensity floods. People complained about not having veterenary doctors in the neighbourhood to provide treatment to ailing livestock.

People appreciate the roles of the local elite, the well-to-do and government agencies towards meeting various needs at flood shelters during extreme floods. However, they complained regarding availability and distribution of relief during floods. They feel that the needs of the poor are often not met, and often inappropriate relief material in inadequate quantities are supplied to the flooded areas. People recommended that a mechanism should be established to ascertain priorities of the needy families as soon as warning of an 'extreme flood' is issued. They also opined that people who do not come out of their dwellings (often the lower middle income families) often do not receive any relief material. There is a consensus that during floods people often do not find adequate services for supplies of energy (cooking fuel, fuel for lighting etc.).

When asked whether the people would consider protection infrastructure of the Mahananda right bank, people responded positively. They understand the implications of a breach in the embankment and assured that they would voluntarily and collectively protect the embankment by offering their physical labour. People in general expressed their willingness to participate in local level hydrological planning activities, particularly in those which would eventually reduce flood vulnerability of the area. They could not, however, remember past incidents where they'd been consulted prior to planning and implementation of any water related activities.

According to flood vulnerable people in the study locations, the biggest failure in flood management is perhaps in arranging 'post-flood rehabilitation programme' in appropriate quantity and quality. They expressed a common concern that post-flood relief should match the needs of the people and such activities should be launched following a 'comprehensive needs assessment'. Since the farming

community has been represented well in the PRAs, the need for post-flood crop production and rehabilitation was given high priority. Distribution of seedlings of dominant crops (i.e., T. Aman) following a late receding flood appears to be the most important rehabilitation activity. Farmers informed that they used to procure healthy seedlings from far away non-flooded areas, whereas the measure could have been greatly facilitated by developing a local seedling bank in raised lands under the supervision of the Thana Agriculture Officer. People in Melandaha Upazila informed that the relevant Officer grow seedlings in 20 acres of land, often in cooperation with local owners of high lands, and distributes these seedlings. However, they expressed their dissatisfaction regarding inadequacy of the measure. The people in the Nawabganj Upazila have never heard of such a measure, but they understand its importance towards managing post-flood agricultural rehabilitation.

People also recommended that, given the remainder of the post-flood season following a major flood event, the Block Supervisors should come forward with innovative technologies. Farmers expressed their reluctance to grow lesser-known crops, due to not having confidence in the market response. To them, subsistence appears to be the most important consideration in making choices for the post-flood crops.

Since Boro season is the crop season following the flood period, and cultivation of Boro being input intensive, farmers expressed that government should provide soft credits on 'easy terms'. Farmers are generally afraid of 'too much paper work', which is why they do not seek assistance from scheduled banks. People also expressed their needs for credit to mend their deteriorated dwellings, and to start other income generating activities such as rearing livestock, poultry etc.

People expect government's direct facilitation towards establishment of permanent flood shelters in their locality. They also expect that government would facilitate a community based flood management plan at Union levels, which may be implemented by the local government institutions. They also expect that a significant proportion of the fund needed to implement such a plan should be borne by the government. They expressed their willingness to contribute either in cash or in kind to implement such a plan.

Annex-III

A Proposed Framework for

COMMUNITY-BASED FLOOD MANAGEMENT COMMITTEE (CFMC)

Mission: CFMC will reduce distress of flood vulnerable people by taking collective actions in flood affected/vulnerable areas.

Target area where CFMC will work: Each CFMC will design and implement people-centric flood management activities at community-levels, ideally in an area delineated by a Union Parishad (UP). A Thana generally is too large for a small Committee to handle. Moreover, every Thana, on an average, has a population of about 300,000; needs of all of the flood vulnerable population cannot be met by one CFMC at the Thana level.

Composition: An UP is the lowest tier of the governance system in Bangladesh. In each UP there are about 14 Committees to take care of various activities targeted at grassroots level. Unfortunately, these Committees have not been made functional and effective – a reality that appears to be a major impediment to overall governance system of the country. The proposed CFMC is envisaged to grow and function under the guidance and leadership available in each UP and take advantage of the presence of the local government institute, while operating with the specific goal of reducing flood related vulnerability in their working areas.

It is proposed that the CFMC be constituted by up to nine members, ideally having the following ***composition***.

Convenor:	Chairman of Union Parishad (by virtue of her/his position)
Co-convenor:	An elderly member of the UP
Members:	Headmaster(s) of High/Primary School(s) (maximum of two)
	An elected female member of the UP
	An elected member of the UP
	Head cleric of religious center(s) (mosque/temple) located in that UP (selected, maximum of two)
	Agriculture Block Supervisor working for that UP

On the basis of consensus among the CFMC, one member will be selected to work as the Member-Secretary of the Committee.

The ***general functions*** of the proposed CFMC would be to foster flood preparedness, to devise and implement flood responses, and to coordinate various flood management activities in the community.

The ***overall functions*** of the proposed CFMC will include, but will not be limited to the following.

- To help community people relocate in flood shelters;
- To negotiate with authorities of government institutions having infrastructure/facilities in the neighbourhood that may be transformed into temporary flood shelter(s);
- To make necessary arrangements [cleaning of the premises, construction of sanitary facilities, establishment of hand tubewells etc.] for making the facility useful as a temporary flood shelter;
- In case of unavailability of flood shelters, distribute tents to shelter seeking people as per demand; establish and maintain a camp on flood-free ground (or along an embankment);
- To keep records of community people who need various kinds of services while in camps/shelters;
- To arrange food, health care, medicine, water supply and safe sanitation for the shelter seeking people;
- To keep an eye on (a) safety, (b) health condition, (c) peace within the camps/shelters;
- To resolve conflicts, if any, within the camps/shelters;
- To assess needs of the community population (by household) and assess demand for various services on a regular basis;
- To raise funds (cash or in kind or both) in order to meet the demands of the flood refugees;
- To distribute relief goods and disburse relief funds as needed (adhering as much as possible to 'needs assessment report');
- To maintain ledger books on various items received and distributed;
- To arrange meetings frequently (at least one meeting an alternative days) on the operations of the camps/shelters for improved coordination and smooth functioning of the activities;
- To check whether a few marooned families still require assistance for relocation, supplies of food/water treatment tablets/fuel or any other services; and provide such services subject to availability of supplies;
- To help assess losses and damages suffered by each affected household in the community;
- To make arrangements, in cooperation/consultation with the Thana-level authorities, for providing institutional assistance to enhance quick recovery and rehabilitation following floods;

- To ensure that flood related information is timely disseminated to the community people (extensive use of hand-hold megaphones; mikes that are used for calls for prayer etc.);
- To liaise with Thana-level officials, if needed even at higher levels, for the collection of updated information regarding flood forecasting and warning; and disseminate among the community people to take preemptive measures;
- To assess damage of common utilities/facilities/infrastructure (viz., extent of disruption of electric poles, erosion of roads, breach of embankments etc.);
- To prepare a participatory 'Plan of Action' (time-bound) for the flood affected community for quick recovery/rehabilitation and assess requirement of funds for undertaking such activities;
- To organize dialogue(s) with the authorities at higher tiers of the government, including the member of the national Parliament representing the community, and to discuss possible modalities to implement the 'Plan of Action';
- To liaise with appropriate government institutions for securing funds to undertake various other activities;
- To take necessary measures before flood, so that the next flood can be managed with enhanced capacity at the community level.

In order to facilitate the activities of the proposed CFMC, a number of sub-Committees (CFMC-SC) may also be formed to deliver specific services. It is proposed that, each of the SC be headed by at least a member of the CFMC, and collectively all will be liable to the CFMC. Members of CFMC will propose SCs (viz., on relocation, sanitation, safe water supply, health care, livestock management, food preparation and distribution, storage of supplies etc.) and names of members of each SC may be proposed to the CFMC for its approval. The SCs will essentially act on behalf of the CFMC and report directly to the CFMC in its regular meetings.

In addition to these activities, the proposed CFMC will rally community support, make people aware through continued education and advocacy, plan and coordinate flood management activities, and facilitate evacuation as and when necessary to save lives.

It is envisaged that all these positions will be temporary and the services sought will be regarded as voluntary, without incurring any financial liability either by the community or by the CFMC.