

# EXPANSION OF FLOOD FORECASTING AND WARNING SERVICES (FAP-10)

5

MODULE - 3

*Handwritten:*  
FAP-10  
BN-352  
A-441 (2)

PHASE - 2  
DEVELOPMENT



AHMED KAMAL  
TEAM LEADER

*Handwritten:*  
MFN-401-  
13-02  
*(Signature)*

AUGUST 1996  
DHAKA

## Expansion of Flood Forecasting and Warning Services FAP 10 Phase 2 of Module 3



### Report of the local consultants.

The Phase 2 Report of the Module 3 of the Expansion of Flood Forecasting and Warning Services (FAP 10) is built upon the Report of the Phase 1 and has produced six major outputs.

#### One: ANNEX 1

It has prepared a draft Flood Warning Manual for Bangladesh. It aims at providing uniformity and consistency in the use of flood warning related terms. It spells out the components of total flood warning or the Flood Forecasting, Warning and Response System (FFWRS). It describes in an easy to follow language the way flood forecasting is made, the principles of message construction and phases of flood warning messages. It also details the process of maximum dissemination of flood warning to vulnerable communities and people at the grassroots level. It also underscores the importance of flood preparedness through public education and agency plans and exercises.

#### Two: ANNEX 2

It has prepared in draft form The Flood Warning and Flood Management in Bangladesh: A Training Manual which highlights the importance of training and incorporates syllabus, training materials and duration of training.

#### Three: ANNEX 3

*ALREADY DISTRIBUTED*

It has produced model warning messages for different categories and phases of floods which can be used for preparing more specific warnings. These messages have been translated into standard Bengali as well as dialects.

#### Four: ANNEX 4

*ALREADY DISTRIBUTED*

It has developed educational materials on flood warning for inclusion in the textbooks of grades 5, 8 and 10 of the schools of Bangladesh. Special attention has been given to keep the materials simple and make them attractive.

#### Five: ANNEX 5

An Action Plan firming up proposal for using police wireless for flood warnings has been developed.

These outputs will provide a firm basis for providing an appropriate set of warning services to agencies and people at flood risk, create greater awareness among stakeholder through education, training and interpersonal communication. These outputs are aimed at meeting perceived needs of users and creating more affirmative responses among them and achieving greater social and economic benefits for the nation.

#### **Six: ANNEX 6( Preliminary Field Report)**

Instruments (questionnaire) for field evaluation of the new warning system to be installed on an experimental basis under the FAP 10 Project have been developed. The instruments have been pretested and modified on the basis of feedback from respondents. A baseline survey attempted at Goalbathan (a FAP 14 location) - a village in Sarishabari thana of Jamalpur district could not be completed due to political situation in the country. Other evaluation sites - one on the Manu in Maulavibazar district, one in Manikganj and one in sadar thana of Nawabganj district have been tentatively selected.

## ANNEX 1



Q



# Flood Warning

## Manual for Bangladesh

DRAFT August 1996

## CONTENTS

|   | Page   |
|---|--------|
| Acknowledgements  | i      |
| Foreward  | ii     |
| Executive Summary   | iii-iv |
| Chapter One : The Flood Problem in Bangladesh                                   | 1-6    |
| Chapter Two : The Total Flood Warning System                                    | 7-15   |
| Chapter Three : Flood Forecasting   | 16-19  |
| Chapter Four : Interpretation and Design of Warning Messages                    | 20-26  |
| Chapter Five : Dissemination and Communication of Flood Warnings                | 27-32  |
| Chapter Six : System Review and Improvement                                     | 33-35  |
| References :  | 36-37  |
| Appendix : Terminology of flood types, intensities and warning phases           | 38-39  |
| Figure 1 : Development of FFWRS of Bangladesh: A Conceptual Model               | 8      |
| Figure 2 : Current Flood Forecast Stations in Bangladesh                        | 11     |
| Figure 3 : The Flood Warning System of Bangladesh                               | 18     |
| Figure 4 : An Integrated Model of Communication Process                         | 28     |
| Table 1 : Flood Intensities and Classification into Phases for Warning Messages | 6      |
| Table 2 : Description of Products issued from FF&WC                             | 23     |

## Acknowledgements

The Flood Warning Manual for Bangladesh was prepared by S. Aminul Islam in close consultation with Professor Ahmed Kamal, Ms Meher Neegar and Mr. Mirza Fakhirul Islam Alamgir and with generous contributions from Dr. Peter D Walsh, WMO Consultant to FAP10.

This manual has been developed as part of the FAP 10 Project and has drawn heavily upon the concepts presented at a workshop held by Flood Hazards Research Centre, Middlesex University, England. The manual has been based upon "Flood Warning: An Australian Guide" adapted to circumstances in Bangladesh. The authors are pleased to acknowledge the major contribution which this guide has made to developing procedures for improved flood warning dissemination in Bangladesh.

A number of other foreign publications have also influenced our thinking; these are all listed in the references. Particular acknowledgement is due to Jim Elliott and Chas Keys from Australia and to the contributors to the Euroflood Project (see Maureen Fordham et al).

"Non-Structural Aspects of Flood Management in Bangladesh" by Bangladesh National Committee of the International Commission on Irrigation and Drainage (BANCID, 1995), "Technology of flood prediction and warning system for floods" by Mohammad Alam Miah and a number of other sources have been invaluable.

The contributions by the staff of the FF&WC in the workshops conducted by Dr. Peter D Walsh, were particularly helpful. The support of Mr. Gregers H. Jorgensen, Mr. Nerkez Gavranovic and Mr. Norullah of the Danish Hydraulic Institute was very useful in preparing this manual.

## Foreward

This Flood Warning Manual for Bangladesh has been prepared as part of Module 3 of the FAP 10 project. The framework for a comprehensive and integrated approach to flood preparedness and response in Bangladesh is presented in the form of a national Flood Forecasting, Warning and Response System (FFWRS) for Bangladesh. This Manual provides an introduction to and describes the principles and components of the FFWRS in non-technical language for use by a wide audience.

To set the scene, the manual provides background information on flooding in Bangladesh and explains the complexity of the flood problem in Bangladesh. It defines the components of a flood warning system and introduces the suite of flood information and warning products developed in the project. The role of public education in improving responses to flood warning and most importantly the significance of effective dissemination are amplified. It also underscores the crucial role of the Flood Forecasting and Warning Centre of Bangladesh in the whole process.

It is hoped that the manual will assist elected representatives, policy makers, officials and any others who contribute to the development of strategies for flood management in their tasks. It will also provide guidance to anyone who has a role to play in flood warning and flood response activities. The importance of an integrated approach across all agencies with a role to play in flood preparedness and response, inherent in the Standing Orders for Disasters, is fully recognised in the FFWRS.

## Executive Summary

Floods are normal events in the deltaic plains of Bangladesh. They often have disastrous consequences; great loss of property and human suffering and impoverishment of the poor all occur. The devastating flood of 1988 led to development of a comprehensive Flood Action Plan (FAP) for Bangladesh initiated by the Government of Bangladesh with support from several donor countries and agencies. The expansion of Flood Forecasting and Warning Services (FAP 10) is a important non-structural project of the Food Action Plan. It aims at providing improved flood forecasting and warning services; in particular to empower vulnerable people to cope more effectively with flood disasters.

**Chapter One** describes the nature of flooding in Bangladesh, its causes and places flood warning in the broader context of non-structural approaches to flood management.

**Chapter Two** develops the principles of the Total Flood Warning and Response System and describes its basic components: forecasting, interpretation, dissemination, response and review. It discusses the important roles that the media, public education, and participation contribute to the system.

**Chapter Three** explains how forecasts of future river levels are produced and describes how this critical role is performed by the Flood Forecasting and Warning Centre of Bangladesh Water Development Board.

**Chapter Four** discusses and explains the principles and processes required to convert the essentially technical information contained in the flood forecasts into meaningful warning messages. Simple messages are used to communicate only essential information. Particular attention is given to the needs by the people at risk from flooding in rural communities for relevant information.

**Chapter Five** covers the dissemination of warnings and the associated communications arrangements. The FFWRS uses two complementary routes to get warnings out into the community. Warnings are issued to TV and Radio for broadcast on national and local services in all appropriate languages and dialects. Warnings are also transmitted to Deputy Commissioners [using one of the Government departmental radio systems] and then onward to Thanas for local distribution. Flood Marker Posts installed in villages provide a local reference level that can be related to the warning message.

**Chapter Six** discusses the importance of regular review and refinement of the FFWRS in order to improve its effectiveness year on year by learning from experience in its application.

The flood problem in Bangladesh is extremely complex. There are a number of reasons: the country is an active delta, it has extensive flood plains into which 1,750,000 sq Km drain, and it has a extensive network of rivers and canals many of which are heavily silted. Unplanned and unregulated construction in the flood plains impedes the natural flow of water. Consequently, flooding leads to frequent and increasingly costly damages.

An effective warning system, as experience from other countries shows, can be instrumental in reducing flood damages. The FFWRS is based upon ideas developed in Australia and several European countries. It presents a flood warning philosophy to inform and guide effective flood warning practices in this country.



Four types of flood cause disruption and damages in Bangladesh - Monsoon Flood, Flash Flood, Rainfall Flood and Coastal Flood; these terms are already widely used. Normal Flood on low lying farm land is a very common feature of Bangladesh and since the expression is self-contradictory, it has been replaced by Annual Inundation. As this does not lead to major damages only forecasts are issued to agriculture officials. The three main categories of flood intensity are Medium, Severe and Catastrophic.

The phasing of flood warnings has been devised to correspond with the onset and severity of damages caused by increasing flood intensity. The Flood Watch is the first phase which is designed, in line with the Standing Orders for Disasters, to alert at an early stage the 'combat' agencies (i.e. those responsible for flood mitigation) about a possible threat of flood. No warnings would be issued to the public. Flood warnings are issued to the public for Medium, Severe and Catastrophic floods.

The recurring and complex flood problem in Bangladesh requires comprehensive reports for decision makers and executive agencies, but these are unsuitable for effective communication to the public. This requires a redesigned range of products to meet a variety of user needs. The FFWRS replaces Flood Bulletins and Flood Summaries, with a number of more functional and attractive products which includes a Daily Rainfall and River Digest, Daily Flood Bulletin and Weekly Flood Bulletin. Flood Warnings are separated from Forecasts and other products to make them stand-out as urgent and important.

The construction of effective flood warning messages may appear to be simple, but in reality it is a difficult task. Messages need to be short, informative and to create a response from their recipients. The model messages demonstrates these ingredients for the full range of flood types and severity.

The dissemination of flood warnings is a very challenging task in the flood-prone terrain of Bangladesh where the communication network is slowly developing and illiteracy is high. A major consequence of flooding is the disruption of all types of communication network and deprivation of flood information among people at the grassroots level. The manual stresses the need for developing all channels - mass media and interpersonal communication - plus making full use of local dialects for a broad-spectrum dissemination of flood warnings.

The dissemination of warnings does not automatically lead to appropriate responses among people. Understanding peoples' flood behaviour may take years to achieve and messages will then need to be redesigned to be more effective. Despite these limitations, flood warnings can assist thousands or even millions of people to undertake affirmative action and significantly reduce flood damages.

The FFWRS requires a staged developmental process which means its performance must be continuously monitored and evaluated to learn through experience and feed back from the vulnerable communities. Review and feed back have been built-in to the components of the FFWRS of Bangladesh.

This manual provides an indispensable guide to 'best practices' for the delivery of warning services by the Flood Forecasting and Warning Centre. Apart from the FF&WC the manual will be of value to other agencies and all those concerned with responding to floods. It will enable them to know how forecasts are made, to appreciate their complexity and limitations and to understand the warnings.

## Chapter One

### The Flood Problem in Bangladesh

Bangladesh is an active delta formed by deposits of mud and sand left behind by three of the largest river systems of the world - the Ganges, Brahmaputra and Meghna - as they eventually empty into the Bay of Bengal. The process of siltation, changes of the river system and tectonic movements are still going on. This makes the river basins of Bangladesh an active delta.

#### What is a flood?

Flood is the rise of water in a natural stream above the level associated with the beginning of damage. Damage usually starts when the flow overtops the natural or artificial banks in any reach of a stream. When banks are overtopped, water overflows onto the flood-plain and disrupts human activities.

\* Adapted from Encyclopaedia Britannica and Ven te Chow

About 80 percent area of the country lies in floodplain. Half of the country is situated within 8 metres above the mean sea level. Normal monsoon rainfall inundates nearly one-third of the land. Thus flooding is a normal phenomenon in Bangladesh. But, quite often it turns into a disaster which calls for protective measures.

#### What is a disaster?

A disaster is an extreme event which needs exceptional response measures requiring additional resources often from an external source. It causes severe damage and losses to the affected population and sectors of society in a way that normal activities are seriously disrupted.

\* A more detailed definition is given in the Standing Orders for Disaster

Flood disasters have been causing enormous damage to life and property and immense human suffering over a long period of time. In 1955 half of the country was affected by flooding. Catastrophic floods occurred in 1987 and 1988. The flood in 1988 affected 90,000 sq km of the area and 30 million people. A total of 1,797 people died due to flood and diarrhoea. The damage was estimated to be 50 billion taka. The spectacle of death and destruction during the flood of 1988 galvanised the government of Bangladesh and donor countries to undertake a comprehensive Flood Action Plan (FAP) from 1990. One of the major objectives of the FAP is to explore the flood problem in Bangladesh and establishment of an effective flood warning system is one of the projects in the Plan.



## **The Flood Problem:**

Discussion of the flood problem is simplified by the use of a common language describing the types of flood that occur in Bangladesh, their magnitude and impacts. An understanding of what causes floods and of flood management topics is also required to appreciate the basis on which the flood warning system has been developed.

Floods in Bangladesh occur for a number of reasons, mainly due to its physical (land-form) characteristics and those in neighbouring countries and by the region's climate.

## **Geomorphology:**

Bangladesh is an active delta comprising extensive flat and low-lying flood plains. These contain natural depressions in some parts of the country which lack natural drainage channels to evacuate the water. They are some of the first places to flood.

The river systems of Bangladesh carry a vast amount of sedimentation part of which is deposited in the river bed and thus raises it. Sediment is deposited at times of low flow. Silt decreases the channel capacity, which in turn raises water heights and causes water to flow outside the river channel. Therefore long periods of low river flow reduce the normal capacity of the rivers.

## **Hydrological:**

Bangladesh is a land of rivers. There are about 250 major and minor rivers in the country. It is the delta area of the three of the largest river systems of the world; these drain about 1.6 million square kilometres of upstream catchments into Bangladesh. The total annual run-off of surface water cascading through the rivers of Bangladesh is about 15,000 billion cubic metres per year.

The catchments experience an extremely high monsoon rainfall. Enough rain falls in an average year to cover the whole country to a depth of over 8 metres. During the monsoon season the amount of water entering Bangladesh from upstream is greater than the capacity of the rivers to discharge it to the sea.

The Bay of Bengal is a major centre of tropical cyclones with tidal surge heights as high as 6.7 metres. These surges can lead to flooding from the sea in low lying coastal areas and hold-back the fresh water flow in the rivers.

## **Long Term Environmental Changes:**

Long term climatic change, rise of sea level and other environmental changes could influence the frequency and magnitude of flooding in future. If patterns of rainfall change to give higher monsoon season rainfall more flooding would take place and may occur more often. A higher sea level will inhibit the drainage from the rivers to the sea and increase the impact of tidal surges.



### **Man-made Environment:**

The construction of embankments in upstream catchment areas reduces the capacity of the flood plains to store water. Higher flows are passed downstream and increase the flood levels in downstream areas such as Bangladesh. Abstraction of water upstream reduces dry weather flows, which in turn leads to increased siltation. The unplanned and unregulated construction of roads and highways in the floodplain, without adequate culverts, can create obstructions to flow. These unofficial structures are potentially a major cause of increasing impacts from flooding at a local level in Bangladesh. These embankments create particular difficulties for providing effective warnings since it is difficult to predict the movement of the flood waters.

### **Flood Types:**

River flooding in Bangladesh takes three main forms as a result of different rainfall and hydrological conditions. They each have a distinctive hydrograph shape (rate of rise and fall of the river) and characteristics:

#### **O Monsoon Floods**

Major rivers and their side channels overflow causing extensive areas of inundation. The rivers rise slowly and with a slow recession may stay at high flows for extended periods of many weeks. Simultaneous peaks on any of the three main rivers can cause particularly extensive flooding.

#### **O Flash Floods**

Mainly in eastern and northern rivers where short duration heavy rainfalls in the mountain catchments (mostly within India), lead to rapidly rising hydrographs, rapid runoff response and very fast flood waves with consequential damage.

#### **O Rainfall Floods**

High local rainfall intensities and long duration monsoon rainfall cause flooding due to inadequate local drainage. The hydrograph shape has a steep rising limb and a slow recession.

#### **O Coastal Flood:**

The low-lying coastal area of Bangladesh is characterized by a complex network of estuaries and tidal floodplain. This area is frequently flooded by high sea levels and waves resulting from cyclonic storms in the Bay of Bengal. When high sea levels coincide with large river flows the impact of flooding from the rivers can increase in the lower parts of the catchments, especially close to the sea.

### **Strategies of Flood Management:**

There are two primary strategies for flood management - structural and non-structural.

### **Structural Measures of Flood Management:**

The main objectives of the structural approach are physical prevention or diversion of the flood waters leading to a reduction in their impact.

These include construction of dams and reservoirs to hold flood water and its controlled release downstream and the building of embankments to prevent water inundating flood prone lands. Other structural measures include river training or straightening of channels to permit the faster flow of water and diversion into holding basins to reduce water height downstream.

### **Non-structural Measures of Flood Management:**

These develop communities to cope with the flood. Their aim is enable people to live with the flood rather than to physically control it. Non-structural measures include zoning controls, regulation of constructions in the flood plain, flood proofing of dwellings, flood warning systems, flood preparedness, public education and flood insurance.

Flood warning is an important non-structural strategy for flood mitigation. The objectives of flood warning are to enable and persuade people and organisations to become prepared for the disaster and take action to increase safety and reduce damages from the flood. Its goals are to alert the 'combat' agencies to enhance their preparedness and to motivate vulnerable people, communities and organisations to undertake protective measures. These measures include (inter-alia):

- O Stocking up on food, fodder and other essentials.
- O Construction of raised platforms for stocking up essentials.
- O Provision for safe drinking water.
- O Reinforcement of dwellings
- O Preparation for evacuation
- O Taking shelter.

These preparations are equally important in cases of breaches in an embankment or dam and should be made if local officials anticipate a breach. Warnings for breach failures cannot be issued from FF&WC since they do not have the necessary local and detailed information.

#### **O Floodplain Management Perspective:**

The flood warning system must be part of a broader floodplain management perspective with stress upon co-ordination between flood warning and other flood mitigation measures.

#### **O Disaster Management:**

Flood warning can only be fully effective within a wider disaster management policy framework that ensures local level flood preparedness. The Standing Orders for Disasters and the Disaster Management Bureau's role provide this essential framework. Local administration must disseminate the warnings to the communities at risk and be prepared to provide facilities for evacuation, flood shelter, emergency provision of food, essential medical supplies and pure drinking water etc..



## Impacts and Damages from Flooding

Four classifications of flood severity have been identified corresponding to the intensity of their impacts on the community and the magnitude of damages. These require different forms of public advice in the warning messages and form the basis for a series of phased flood warnings (see Chapter Four). Table 1 is a matrix illustrating the features of the annual inundation and three intensities of flooding. It demonstrates how with increasing severity the nature of the advice to the population at risk needs to change. It provides the basic framework for a system of phased messages, for their design, the development of publicity and educational material and for use in training.

### O Annual Inundation (Normal Flood)

Inundation which occurs every year and to which farming practices are adapted is a normal occurrence in Bangladesh. There is a contradiction in the use together of the words "normal" and "flood". "Flood" is therefore reserved for use in the context of "Flood Warnings" and applied only to those events which requires an exceptional response. "Annual Inundation" probably best describes this occurrence. No warnings are issued. Forecasts issued to Agriculture Officers at local community level enable them to issue advice on cropping and sowing to minimise crop losses.

### O Medium Flood

This affects farmers and others living in low lying areas and on land adjacent to rivers. It would cause some economic loss and damage to property but would not be extensive or too serious. Loss of life is unlikely as the affected populations already have flood response preparedness since they experience flooding on a regular basis, about every 3 years.

### O Severe Flood

This occurs as river levels continue to rise affecting larger areas and those parts of the population less familiar with flooding. It inundates some urban areas and some loss of life is likely to occur. Economic and property damages would be significant. This scale of flooding is likely to be experienced every 6 years on average. Warning messages contain outline guidance on flood response.

### O Catastrophic Flood

This is an extremely serious flood, with impacts comparable to those of 1987 & 1988. Many parts of the population would be affected and significant damage occur. Warning messages contain advice to those affected on what action they need to take, since many people, especially those living in urban areas, are unlikely to have experience in coping with a flood.

TABLE 1 - FLOOD INTENSITIES AND CLASSIFICATION INTO PHASES FOR WARNING MESSAGES  
 (\*Frequencies and inundation figures based on BANCID & Report on Floods of North Bengal in 1995)

| FLOOD INTENSITY              | ANNUAL INUNDATION  | MEDIUM   | SEVERE   | CATASTROPHIC   |
|------------------------------|--|--|--|--|
| *FREQUENCY                   | Every other year   | 1 in 3 years   | 1 in 6 years   | 1 in 9 years   |
| LIKELY STATE OF PREPAREDNESS | High through experience                                  | Some but limited   | Little and forgotten                                       | Nil in most cases  |
| IMPACT & DAMAGES:            |  |  |  |  |
| AREAS AFFECTED               | Agricultural land  | Rural Communities  | Rural and some urban                                       | Everywhere   |
| *INUNDATION                  | Limited to low areas                                     | Affects < 25% country  | Affects 25-35% country                                     | Affects > 35% country  |
| ECONOMIC                     | Minimum due to adaptive behaviour by farmers             | Some economic loss but on local scale                        | Serious economic impacts                                   | All sectors of economy likely to be affected                                 |
| COMMUNICATIONS               | Minimal effect   | Local disruption   | Serious disruption within affected areas                   | Widespread across country as a whole   |
| PROPERTY                     | Minor, if any  | Mainly rural affected  | Heavy losses with impact on urban properties               | Major losses with extensive property damage                                  |
| WARNING MESSAGE PHASE:       | (Forecasts only)   | 2. GENERAL   | 3. SEVERE  | 4. WIDESPREAD  |
| COLOUR                       |  | Blue   | Red  | Red (top of band)  |
| NEED FOR ADVICE IN WARNINGS  | (Advice comes from local advisors who receive forecasts) | Some in general terms (most will have some flood experience) | Considerable (prior experience is likely but not recently) | Total (many will have no recent experience of a flood and not have prepared) |

## Chapter Two

### The Total Flood Warning System

#### Why are flood Warnings needed ?

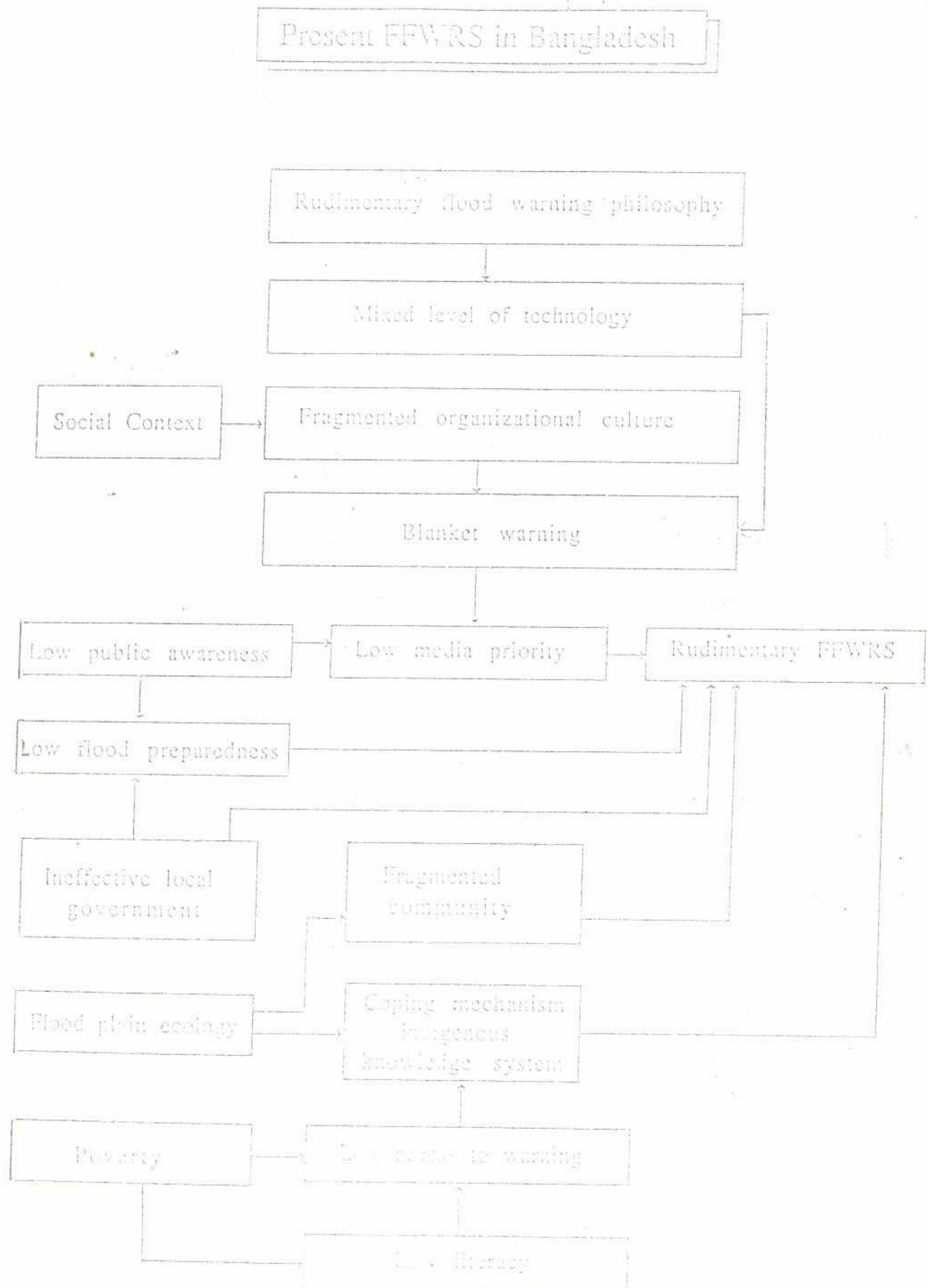
- O Flood warnings provide prior notice about the threat of impending flood hazards to enable 'combat agencies' and vulnerable people to take appropriate action for minimizing the impacts of flooding before it occurs.

#### How can the effectiveness of flood warnings be assessed ?

- O Flood warnings are effective if they persuade people to take precautionary measures for lessening flood impacts and help 'combat agencies' to become prepared and to carry out disaster management activities. The effectiveness of the warning can be assessed through an examination of the effectiveness of components of the total flood warning system.

Effective flood warning requires a total system approach. It cannot be treated as a simple process. It is a system with a number of components each of which is vitally important for achieving the goal of flood warning - reduction of damages caused by floods. It is also a process which involves co-ordinated activities over time by many agencies and people and also new activities as technology develops, new policies are initiated or environmental situations change. Therefore, it is called a Flood Forecasting, Warning and Response System (FFWRS). Figure 1 describes the present state of the FFWRS in Bangladesh. The figure makes it clear that considerable efforts and time are necessary to develop it into an effective FFWRS for the complicated and multi-faceted flood situation of Bangladesh.

The broad definition of a FFWRS is a system, which integrates flood forecasting, flood impacts, the dissemination of warning messages and the responses by both the agencies involved in flood mitigation and by the public in the threatened communities. In a more simple way, we can look at FFWRS as consisting of five components: forecasting, interpretation, dissemination, response and review & analysis.





### Components of the FFWRS

**Forecasting:** Forecasting estimates the occurrence and magnitude of a flood in advance on the basis of current meteorological conditions, water levels, river flow velocities and other hydrological characteristics.

**Interpretation:** Identification of probable impacts of flood upon vulnerable communities in advance, plus the use of signs, symbols and words to warn people about the onset of flood and its probable impacts.

**Dissemination:** Communication and distribution of warning messages to agencies involved in flood mitigation and, most importantly, to the threatened communities.

**Response:** Preparation and action by concerned agencies and threatened communities for protection against flood hazards in response to warnings.

**Review and Analysis:** Continuous monitoring of the performance of the various components of FFWRS for its improvement.

### Developing an Effective Flood Warning System:

A successful and effective FFWRS depends upon many factors. It requires a good level of forecasting reliability and accuracy. It needs good sound technological and organisational infrastructures and particularly needs effective inter agency liaison. It also requires effective communication. This means correct interpretation of technical data; easy to follow messages with adequate information and successful delivery of the flood warning message to threatened households. Messages should be delivered through all possible communication channels and be communicated in all major dialects, so that they can be followed by different regional and cultural groups. It is important to appreciate that exposure to flood warning messages does not automatically lead to protective behaviour among the threatened people.

**Flood Warning:** A notice of impending flood threat issued to the public by the competent authority (FF&WC) so that people and organisations can undertake necessary precautions or protective behaviour or help towards their achievement.

Until recently, considerable emphasis has been given to flow forecasting and modelling. This had led to a wrong notion that forecasting is the only key component of a flood warning system. Consequently, weakness of warning systems have been attributed to inadequate technological infrastructure, often resulting in further emphasis on and investment in technical solutions. It is now recognised that inadequate attention has been given in the past to the non-technical features of a warning system (eg dissemination, flood education and preparedness). As a result these have been weak elements of the flood warning arrangements in many countries.



In Bangladesh river level forecasts are made for 21 points (August 1996) on the river systems. Flooding can cover as much as 90,000 sq km (1988). Figure 2 illustrates the extent to which extrapolation is currently necessary to prepare flood warnings for Bangladesh. At the present time, therefore, forecasts cannot predict with high precision and confidence the likely extent of flooding. However, the systems can provide general warnings from which society can benefit by taking appropriate response measures.

A vigorous programme of public education about flood hazards and protective measures is necessary to achieve maximum positive responses from the vulnerable people. There must also be adequate physical facilities, other resources and trained manpower at the local level for a fully effective initial response to all flood emergencies.

An effective FFWRS consists of the following elements and development activities:

- O Implementing an integrated planning process with both sequencing and coordinating of the FFWRS.
- O Identification of all the stakeholders.
- O Establishment and definition of roles, responsibilities and of boundaries among different stakeholders.
- O Promoting cooperation between agencies
- O Identifying and resolving potential bottlenecks or conflicts among different stakeholders.
- O Developing forecasting and warning procedures:
  - good forecasts of river flow
  - simple warning messages
- O Developing arrangements for rapid dissemination
- O Creating appropriate back up procedures in case of the failure of the main system.
- O Adopting training and public education programmes for stakeholders.

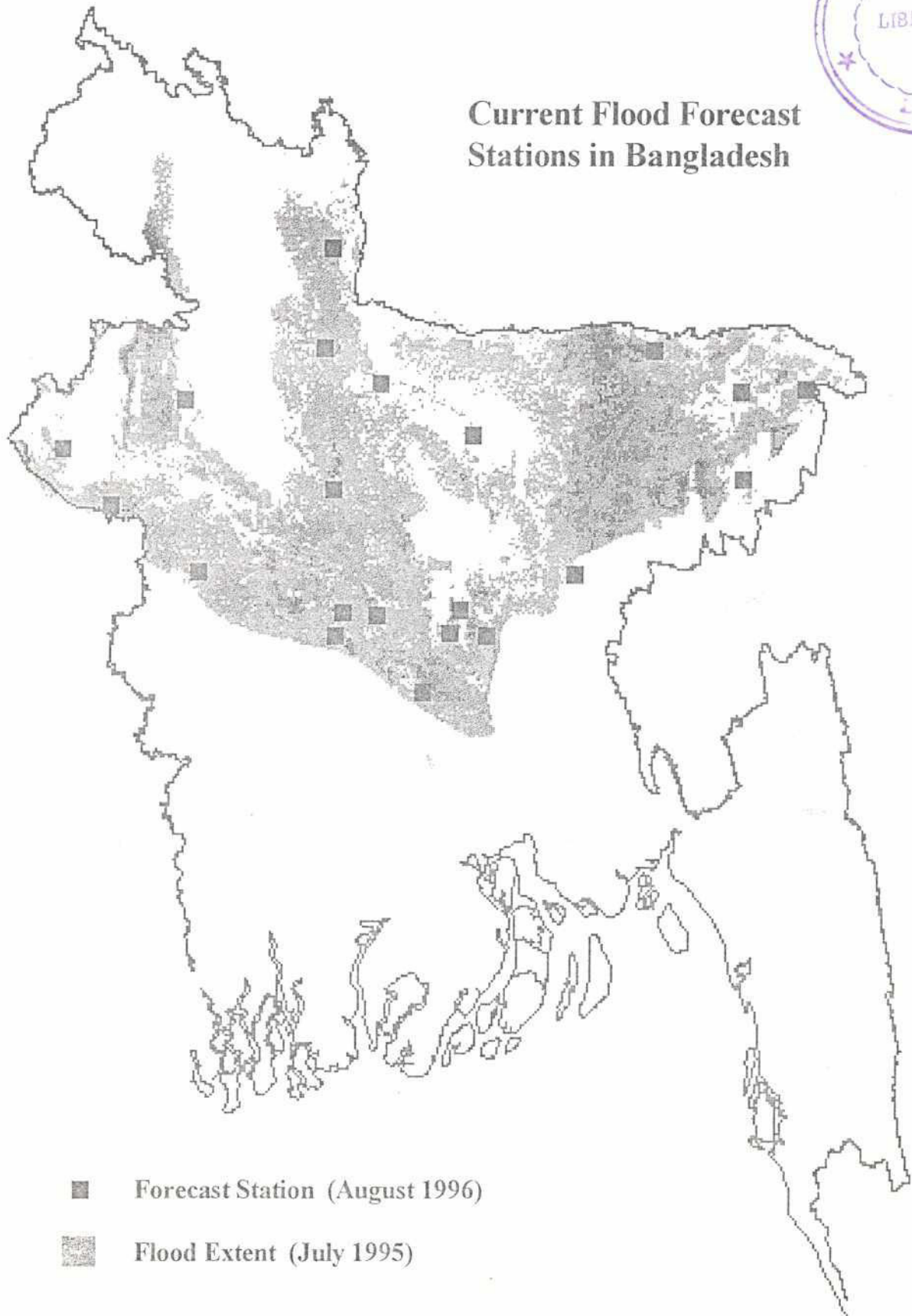
#### **Identifying "stake holders":**

In any flood forecasting, warning and response system there are a number of stake holders (agencies and groups) with different interests, roles and responsibilities. The communities at risk, which consist of a number of smaller groups scattered over different areas with varying needs, are also key stake holders.



Figure 2

# Current Flood Forecast Stations in Bangladesh



## Stake Holders in the Flood Forecast and Warning Response System for Bangladesh

|   |   |
|---|---|
| Bangladesh Flood Forecasting and Warning Centre             | Forecasting and warning.  |
| Bangladesh Meteorological Department                        | Weather forecast.   |
| Space Research and Remote Sensing Organisation              | Analysis of satellite images  |
| Bureau of Disaster Management                               | Public education, training and establishment of disaster management networks.   |
| Mass media<br>Radio, TV, Press                              | Dissemination of flood warning and feedback on flood situation.   |
| Police/Ansar/VDP  | Dissemination of warning, rescue and relief.  |
| Army(when called upon)                                      | Rescue, relief and rehabilitation.  |
| Fire services   | Rescue in urban areas.  |
| Ministry of Communication                                   | Maintain vigilance of roads, bridges, telephone and telegraphs.   |
| Ministry of Livestock and Fisheries                         | Provide veterinary services.  |
| Ministry of Agriculture                                     | Advice on cropping pattern, planting, harvesting, supply of inputs in the post-flood phase.                                 |
| Ministry of Irrigation, Water Development and Flood Control | Broad flood protection measures.  |
| Ministry of Health and Family Welfare                       | Provide general medical advice; specific advice to the sick. Provide medical services and medicines during and after flood. |
| Ministry of Relief  | Relief, rescue and rehabilitation.  |
| Bangladesh Red Crescent Society                             | Relief, rescue and rehabilitation.  |
| NGOs  | Relief, rescue and post-flood rehabilitation.   |



## Extreme Flood Events:

Catastrophic floods are a constant threat to Bangladesh. Agencies and communities must recognise that they will have to face greater flood disasters than those they have dealt with in the past. Flood Warning Systems must be robust enough to cope with calamities which are unprecedented and worse than experienced, expected or known in the past.

An important component of planning for flood warning systems is to make them robust enough to be able to deal effectively with floods which are greater than those in the past. They must be prepared for floods with return periods of more than one hundred years and anticipate a more severe event than the worst flood on record.

Long term flood prediction estimates the probability of the occurrence or return period of flood events on the basis of hydrological data over a long period of time.

If a flood has one chance in a hundred of returning with a particular severity, it is called a 'one in a hundred years flood'. However, it may be less than 100 years between any 2 occurrences.

The flood which occurred in 1988 in Bangladesh is a good example of extreme flood event with a return period of 100 years. The flood which began in early July lasted until the end of September. The whole country had turned into a mass of water body marooning 5 million people (Ahmed 1989).

| Bangladesh Water Development Board estimates of 1988 Flood Damages |   |              |
|--|---|--------------|
| Affected area  | : | 90,000 sq km |
| Affected people  | : | 30 million   |
| House damaged  | : |              |
| Total  | : | 989,347      |
| Partial  | : | 1,477,772    |
| Loss of human lives  | : | 1,657        |
| Loss of cattle heads   | : | 64,170       |

Two examples illustrate and underscore the importance and need for effective flood warning of extreme flood events. The first is a description of an experience in 1988:

"Yet the` fury of water' caught people unaware.

Another question is whether it is possible to forecast the occurrence and incidence of flood beforehand and if so, why this has not been done. In many areas, people were caught completely unprepared. Several million people were marooned and there was no warning. The city of Dhaka was gripped by flood water all on a sudden and many of them could not even manage a few hours time to shift their valuables to other places." (Ahmed 1989:11).

The flood of 1995 was again unexpected as it happened at the end of the monsoon flood season. Although warnings were issued, their dissemination was extremely inadequate. An editorial of the Daily Star (30, October, 1995) remarked:

"The daily average rainfall surpassed previous records both inside the country and as well as in the upper riparian regions. The Met Office only underlined this phenomenon in broad terms but could not predict the timing, duration and nature of an upcoming flood."

This was both an unexpected flood, as the exceptional rainfall had not been forecast, and in some places like a flash flood due to the small lead time for warning. The significance of any warning messages were not appreciated nor they did not get across clearly to the media or public.

A survey of 443 households was carried out as part of the FAP10 project in 1996. It revealed that villages rarely received any official warnings during the last flood which they experienced

### **Role of Response Agencies:**

Organisational preparedness is essential to ensure that activities such as sheltering and feeding people, giving them relief and other related operations can be rapidly mobilized.

Effective warnings require that agencies involved in 'combat' activities know what roles they are supposed to play after the warnings have been issued. There is not only a close relationship between flood warnings and agency responses, community responses also depend upon agency responses. Flood warning responses are likely to improve with the improvement of flood mitigation services.

### **Public Education:**

Public education can play an important and major role in enhancing preparedness for flood by ensuring that communities can cope better with flood disasters. The frequency of flood events and their severity require that all techniques of public education are exploited to their fullest potential.

School text books require information on floods and flood warnings. Non-formal education and adult literacy campaigns should incorporate these issues. Booklets, posters and manuals on flood should be provided to all libraries, thana headquarters and union parishads of the country. Every NGO should impart warning and preparedness knowledge about flood.

Newspaper features, radio and television talks before the flood are also important devices of public education. Displays of flood maps and action guides in schools, union parishads and Thana headquarters should be available.

Flood markers in vulnerable villages or unions indicate the level of past floods to local people and be used to link the content of the warning message with the predicted impact.

Bangladesh has a rich heritage of folk culture. Folk media, like Jatra, Jari and other forms of folk culture can be used for imparting flood information to people.



27

Planning a programme of public education needs to draw upon the 'community memory' of flooding to ensure that the ways in which flooding affects those at risk are effectively communicated. Planners must listen to those at risk as well as seeking to educate them (Australian Manual:6).

Warning messages will be most effective if they are preceded by a well coordinated and vigorous programme of public education. The winter is the best time for undertaking public education campaigns.

### **Agency Plans, Resources and Exercise:**

Flood forecasting, warning and response systems require planning, appropriate policies, organisational efficiency and financial investment. Clearly, the requirement of financial resource is only one component of a complex system of prerequisites.

Both flood warning and disaster management require substantial resources. This does not necessarily mean investment in expensive hardware or construction activities. Better use of existing facilities, technology and organisational capabilities and gradual investment in new technology can keep the level of financial investment low. For example, schools can be constructed or reconstructed for use as flood shelters.

Effective warning not only helps the people at risk, it also gives 'combat' agencies precious time to get prepared for a complicated range of tasks and activities. After the warnings, these agencies must be ready to help millions of people. This includes undertaking search, rescue and evacuation operations, managing casualties and sickness.

Reliable forecasts and effective warnings help maximise the quality of the actions by response agencies when floods are rising. These agencies must prepare Action Plans, to maximise their preparedness and practice their roles during normal times.

The agencies involved in flood 'combat' activities must be ready for warning and emergency response activities to the disaster. A great deal of planning and co-ordination is necessary for this purpose. They should also conduct regular exercises in Winter or Spring to increase their state of preparedness.

As many agencies are involved in these activities, it is necessary to allocate proper roles and tasks to each agency. This is done by the Standing Orders for Disaster of the government, which also requires relevant agencies to have Action Plans to provide flood warning and other services to vulnerable people and communities. Disasters often create unexpected situations and agencies should be organisationally flexible to cope with extraordinary situations.



## Chapter Three

### Flood Forecasting

#### Introduction:

Flood forecasting is a mainly technical activity which estimates future river levels on the basis of analysis and simulation of current meteorological conditions, the flow and level of rivers or lakes and other hydrological characteristics. The flood forecasting element of a FFWS comprises two main activities:

- ☐ Data Measurement and Transmission.
- ☐ River Modelling.

#### How are forecasts made ?

- ☐ By monitoring snowmelt, rainfall, runoff and other factors in the upper catchment.
- ☐ By measuring rainfall and river levels at important locations in the river systems of the country.
- ☐ From a forecast of tidal surges brought about by cyclonic storms.
- ☐ By using mathematical techniques and models to predict future river levels.

#### What are the critical issues ?

- ☐ All stakeholders should recognize the value and importance of flood forecasts.
- ☐ The stakeholders should understand that forecasts may occasionally be wrong.

#### Catchment Monitoring and Forecasting :

The forecasting of flood depends upon regular monitoring of the actual and anticipated rainfall and river conditions and other changes in the environment of the catchment area. As Bangladesh comprises only 7 percent of the catchment area and data flow from countries of the upper catchment is intermittent, this make it more difficult to carry out flood forecasting in Bangladesh.

Recent developments in satellite imaging provides an important database for early prediction of flooding in Bangladesh. Its use requires close coordination between Space Research and Remote Sensing Organisation (SPARRSO), Bangladesh Meteorological Department, Surface Water Modelling Centre (SWMC) and Flood Forecasting and Warning Centre.

Although forecasts 3 days ahead are less reliable than those for shorter lead times, they may be of use to some agencies. For example, the Department of Agriculture could advise cultivators through its extension workers to make changes in the cropping pattern.

### **The Elements of Flood Forecasting:**

Information on rainfall and river flows is essential to know how much water is entering the country and flowing through it to the sea. Computer models which represent the physical characteristics of the river network and the hydraulic process of water flow can transform the data through successive intervals of time to predict levels in the major river channels of Bangladesh for up to 3 days into the future and across the geographical network of the river system. In this way it is possible to make forecasts of both future and downstream river conditions. The more that is known about the volumes of water in upstream reaches the higher the accuracy of the forecasts. Where the catchment is small and the river is steep like many in the north east, rivers rise very quickly and forecasts will be limited to a few hours ahead.

The accuracy of flood forecasts depends upon a number of factors which include:

- O The data collection network.
- O Data transmission arrangements.
- O Meteorological forecasting.
- O Flood forecasting models.

A full fledged Flood Forecasting and Warning Centre (FFWC) of Bangladesh Water Development Board (BWDB) was established in 1972. This centre remains fully operative in the flood season - from 1 April to 30 September as required by the Standing Orders for Disaster of the Government of Bangladesh.

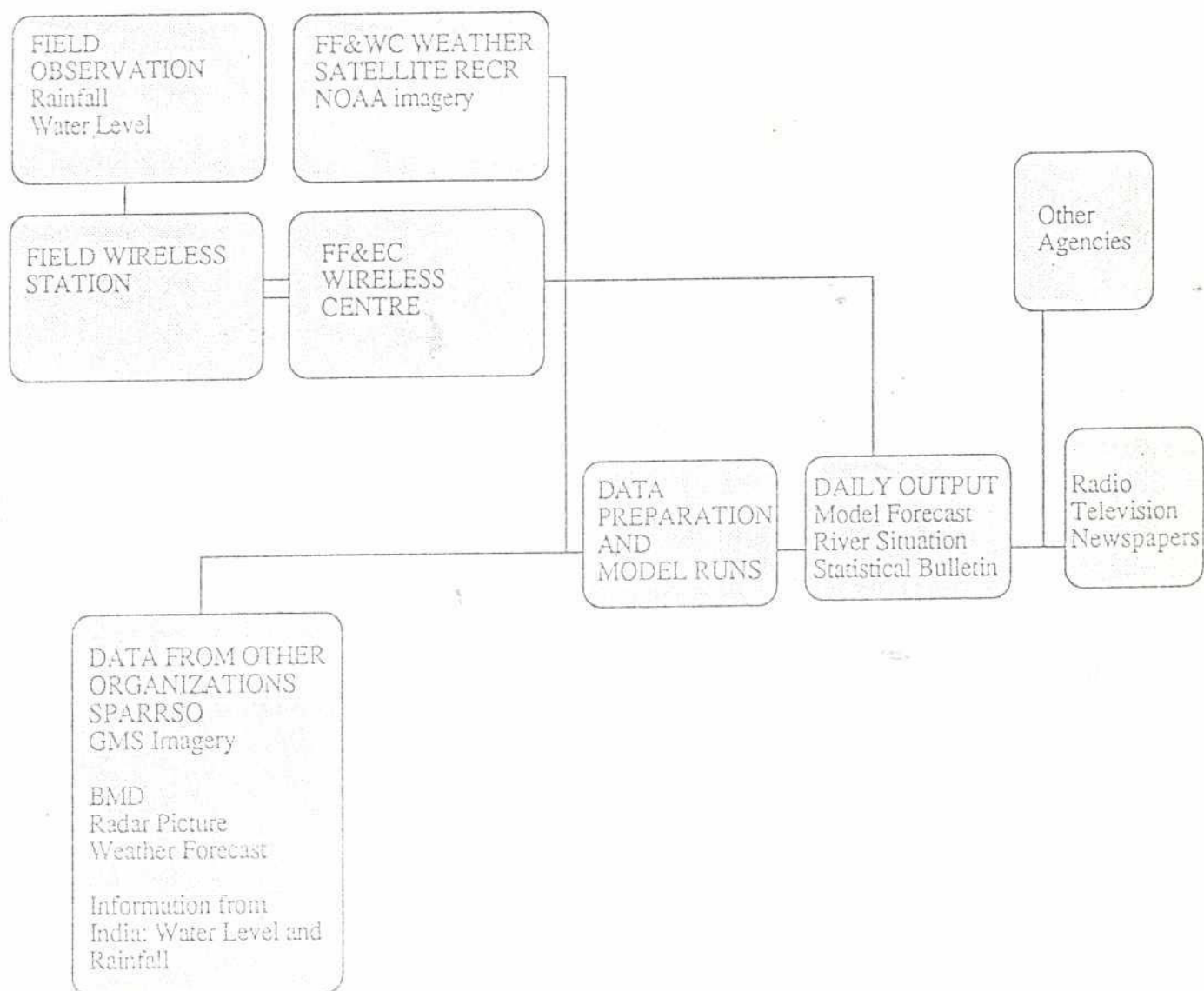
Rainfall is measured by raingauges and when available data may be obtained via SPARRSO from satellite and from weather radars operated by BMD. These can provide additional data covering a large area, including in the case of satellite, land beyond the national boundary. In Bangladesh a network of 48 raingauges is operated by BWDB to support its flow forecasting.

River flow data is obtained from a network of 47 sites on the rivers of Bangladesh. Every three hours during daylight measurements of the level of the river are made by staff of BWDB. Data from the raingauges and rain-level stations is transmitted by radio to the FF&WC in Dhaka every morning and more often during periods of flooding.

The FF&WC issues flood forecasting and warnings and disseminates them as shown in Figure 3.



## The Flood Warning System of Bangladesh



Source: Adapted from BANCID, 1995, P-17

## **User Requirements:**

The forecasting authorities must learn about users' requirements. The 'combat' agencies may require early warning, longer lead time and expected area of inundation. The Ministry of Communication may like to know more specifically the depth of inundation. The urban and rural users and users of different social classes may require different kind of information from the forecasting authorities. However, users must also be advised of the limitations which restrict the range of data that can be provided and understand the limitations of the products.

## **Co-ordination and Communication:**

If forecasting and warning agencies want a high degree of user and customer satisfaction, they must forge a communication bridge among themselves and with users.

## **Indigenous Knowledge System:**

An indigenous flood warning system has existed from the dawn of civilization. In ancient Egypt messengers are known to have rowed down the Nile to warn people about the impending flood. The local flood history and the indigenous knowledge system may be quite useful to the formal forecasting system. This is particularly important for a developing country like Bangladesh and the potential needs to be exploited.



## Chapter Four

### Interpretation and Design of Warning Messages

#### Introduction:

A warning message transforms the technical information on forecast flood levels, produced by the forecasting models, into simple language using terms easily understood by those at risk from flooding. It provides information about what is likely to happen when and in which specific areas. It also provides threatened people with advice on what to do before and during the flood.

#### Why do we need warning messages ?

Research findings indicate that messages providing advanced warning can significantly reduce loss of life, suffering from sickness and ill-health and damage to property, crops and other tangible resources. The intangible benefits are also great.

#### The Interpretation of Flood Forecasts:

#### Why is there a need to interpret Forecasts ?

Flood forecasts only provide information about the peak *height* of water at river level forecast stations on the main rivers. To be meaningful, the warning must say how far the water will spread overbank from the river (area of inundation) and how much there will be in this area (depth of inundation).

#### What are the critical issues?

- O Warnings messages must stand out and stand alone
- O Warning messages should reflect the felt needs of the people at risk.
- O Particular care should be taken when warning of catastrophic floods.
- O Warnings may occasionally over or under state the severity of flood

Separating Watches and Warnings from the routine daily forecasts and bulletins gives them a high profile. This elevates and establishes them as important and highly significant messages requiring prompt action.



১১

A redesigned range of products separates Flood Warnings from Forecasts and other products to make them stand-out as urgent and important. The FFWRS also replaces Flood Bulletins and Flood Summaries, with a number of more functional and attractive products which includes a Daily Rainfall and River Digest, Daily Flood Bulletin and Weekly Flood Bulletin. See Table 2 on page 23.

### **Whose task should it be to interpret the forecast ?**

These interpretations are ideally carried out at the local level. The operational procedures for interpretation of flood forecasts at the District and Thana level need to be developed. Recent developments in technology now make it possible to use inexpensive computers and software to prepare local level flood intelligence systems and maintain communication linkages between national and local levels.

### **Flood Marker Posts:**

Flood warnings without information on areas and likely depth of inundation lose some of their significance. The introduction of marker posts provides guidance on the likely level of flooding and helps villagers to interpret the warning messages. The marker posts are colour banded according to the severity of the flood and the warning messages advise the colour band into which the flooding will rise. An illustrated pamphlet is available in Bengali.

### **Sociological Issues in Message Construction:**

A flood warning is intended for people at risk. It is extremely important that it is issued by the agency which is recognised as an official source and has technical command over the data and its interpretation.

It is also equally important that the warning is primarily for the benefit of people at risk. They have lived with flood for centuries. They have their indigenous warning systems. A flood warning message should be founded on this indigenous knowledge system, with participation from the people. It may be refined, expanded and made technically sound by FF&WC. The message must reflect their 'voice'. It must respond to their felt and changing needs. Development must be interactive.

In constructing warning message, it is necessary to remember that there are different flood types in Bangladesh. Each type requires different forms of response from the official agencies as well from the community at risk. The impact of the flood is also related to the local land use and to the natural physical and man-made terrain.

### **Target User Groups:**

The communities at risk are differentiated along class, occupation and by gender. Different social groups are likely to require slightly different information. If extensive flooding is anticipated, it may be necessary to request the female-headed households or disabled people to move to a safer place earlier. The rich peasant may value information on depth of flooding in order to decide whether to stay at home and use a raised platform to cope with the flood or to take shelter with kinsmen in another locality. People living in *char*, *beel* and *haor* areas and along minor rivers may require

62

different or additional information. People with regular flood experiences may respond well in most cases. But, they may ignore messages of unusual floods because of their confidence in their ability to cope with it.

The flood warning produces different responses within parts of a society. Any long term flood warning, if these were ever to be issued, may prompt Bangladesh traders to hoard essential commodities and thereby provoke a rising price-spiral. It is, therefore, important to consider what secondary reactions may be created by warning messages. People show more solidarity during a time of crisis. As there might be some theft and looting, people may need to form vigilance teams.

The agencies issuing and communicating warnings might think that warnings could create panic among vulnerable people. Research on disaster has shown that it is largely a myth. Panic is mainly limited to a few cases of sudden disaster or to a few individuals. Fatalism remains a more challenging problem in order to get positive responses and affirmative actions.

The target audience includes 'combat' agencies who ideally require slightly more technical information than the general public to get prepared for rescue operation.

### **Message Construction:**

The construction of messages for flood warning appears to be very simple. But, the construction of an effective message requires collaboration among people with different skills -- people from fields of communication, psychology, sociology and artists. The warning agency should seek such collaboration for construction of model warning messages.

A standard (model) form of message may be helpful. But as the media used may be different and target groups or users are also dissimilar, a number of standard forms are likely to be more useful. The model messages should be reviewed periodically to assess their relevance as the recipients provide feedback on their value, effectiveness and comprehensibility and in the context of the changing nature of flood. Feedback from media reporting can be useful in improving the quality of messages.

Messages must be presented in a simple language and contain the appropriate information. They must be presented in a form which persuades people to act. They should contain words and images which appeal to human emotions.

A crucial aspect of message construction is easy comprehension by the vulnerable people. In Bengali, for example, there is no standard terms which can distinguish between flash flood and monsoon flood. In a peasant society with a very low level of literacy, messages in Bengali may not be understood by even a majority of the audience. Thus, construction of messages requires a great deal of attention. Ideally they need to be constructed in as many dialects as possible.



TABLE 2 - DESCRIPTION OF PRODUCTS ISSUED FROM FF&WC

| TITLE OF [PROPOSED] PRODUCTS   | TIME SCALE OF PRODUCT CONTENTS  | URGENCY & TIME OF ISSUE FOR PRODUCT   | "EXISTING" PRODUCTS   |
|--|---|---|---|
| Daily Rainfall & River Digest  | IMMEDIATE PAST<br>Recent (last 2-3 days, incl. current day's readings)    | PRIORITY<br>Issued during morning   | (Bulletins<br>(Summaries<br>(Forecasts                          |
| 1 Daily Flood Bulletin<br>2 Weekly Flood Bulletin<br>(Provisional data only) | RECENT PAST<br>Includes Immediate Past extended to past week for Bulletin | PROMPTLY<br>1 Issued during afternoon<br>2 Issued within 24 hours of end of week.                 |   |
| 1 River Forecasts<br>2 Watches & Warnings<br>3 Stand-downs                   | FUTURE<br>Up to 3-days ahead of day of issue                              | HIGHEST PRIORITY & RAPID (min delay)<br>1 Issued during morning<br>2&3 Immediate issue            |   |
| Flood Reports<br>- monthly<br>- annual<br>- special                          | HISTORIC PAST<br>Historical Record  | LONG TERM<br>[Monthly issued within 4 weeks of month end<br>Annual 2 months after end of monsoon] | Flood Reports<br>- weekly<br>- monthly<br>- annual<br>- special |



### Message Content

A flood warning message says **what is likely to happen** and **its likely impact** and advises **people the way they should act to face the crisis**. The message should be seen to come from a **credible source**.

The messages should include words as well as maps and visual images wherever possible. But at the same time they should be **simple** and **short**. For effective broadcast, messages need to be concise and to be read aloud in no more than 45 seconds. The form and content of messages should vary slightly from medium to medium. The level of uncertainty of the event or lack of information should be clearly indicated.

There should be proper prioritization of information in the message. The most important **items** must receive proper emphasis and appear early in the message.

Messages are often effective through their **latent** content, the way they are presented or because of the medium used. Both apparent and latent messages and their presentation should stress action.

### How do we construct Messages?

Flood warning messages must stand out and stand alone.  
 Flood warning messages should be simple, clear and persuasive.  
 They should convey all the essential information for people at risk.  
 They should tell people what to do to protect themselves from flooding.  
 They should provide technical information for agencies concerned with flood management.

### The Design of Warning Messages:

#### What do we mean by a flood warning messages?

A flood warning message tells the public and particularly the people at risk:

- When the flood is likely to occur.
- What is the nature of the flood.
- Where the likely impact of the flood will occur in a given locality.
- How people should respond to protect themselves from flood hazard.

## How to design flood warning messages ?

It must be easily understood by the people at risk. Messages should be prepared in the context of the indigenous knowledge system of the people and their felt needs.

In short, an effective flood warning should include the following:

- O Header/Title to highlight flood location, date and time of issue.
- O Name of Issuing Authority.
- O Order information in terms of importance.
- O Description of the areas likely to be flooded (include when possible probable depth)
- O Time for next warning.
- O Sources of advice and assistance.

### Flood Warnings Phases:

The three categories of flood intensity - Medium, Severe and Catastrophic - have increasingly severe impacts and require different forms of public advice. They, therefore, with the addition of an alert to agencies, form the basis for a series of phased flood warning messages.

A system of phased warnings has the following advantages:

- O Agencies can be alerted before public warnings are issued allowing them time to make preparations to disseminate warnings and respond to the warning.
- O Warnings can be targeted to those most at risk. Those who will only be affected by a greater flood are warned in later phases.
- O Advice in the messages can adapt to the changing impacts of a worsening flood as it affects more people and creates greater areas of inundation.

The system of phasing in Bangladesh has four elements:

#### 1. Flood Watch

The first phase is an *Alert* called 'Flood Watch' issued to 'combat' and other relevant agencies. It usually provides 24 hours earlier notice than a publicly issued flood warning and enables them to mobilise their resources and to make other preparations. It is particularly valuable to those organisations carrying out the dissemination process. No public warnings are issued or disseminated as the flood forecast is only provisional.



2. **General Flood Warning (For Medium Flood)**

This is the first level of public warning. It corresponds to the *Blue Band* on village flood marker posts. Flooding would affect farmers and others living in low lying areas and on land adjacent to rivers. It would cause some economic loss and damage to property but would not be too extensive or serious. Loss of life is unlikely as the affected populations already have some flood response preparedness since they experience flooding on a regular basis, about every 3 years.

3. **Severe Flood Warning**

This would be issued as river levels continue to rise affecting larger areas and those parts of the population less familiar with flooding. It corresponds to the *Red Band* on village flood marker posts. It inundates some urban areas and some loss of life is likely to occur. Economic and property damages would be significant. This scale of flooding is likely to be experienced every 6 years on average. Warning messages contain guidance on flood response actions.

4. **Widespread Flood Warning**

This would be issued when an extremely serious flood, comparable to 1987 & 1988 impacts, is expected to occur. It corresponds to the *top of the Red Band* on village marker posts, which is close to the level of the maximum historic flood. Many parts of the population would be affected and significant damage caused. Many people, especially those living in urban areas, are unlikely to have recent experience in coping with a flood. Warning messages contain advice to those affected on what action they need to take. Warning messages are also addressed to those suffering flooding from earlier phases as they experience an extended period of flooding with increasing impacts.



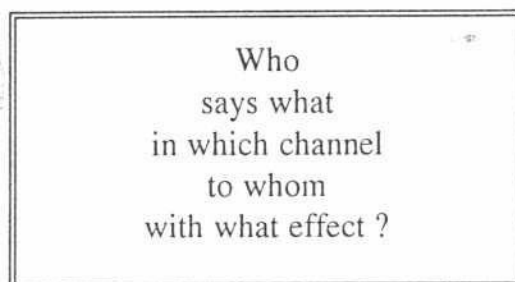
## Chapter Five

### Dissemination and Communication of Flood Warnings

#### Introduction:

Flood forecasts are useless if they are not communicated to the people with sufficient lead time, in a manner in which they understand them and in a way in which they can be persuaded to take appropriate action against flood hazards. They may not be aware of the potential benefits of preparedness for floods.

The communication process can be best described through Harold Lasswell's (1966:178) classic expression.



To be effective communication strategies must be persuasive.

#### Communication:

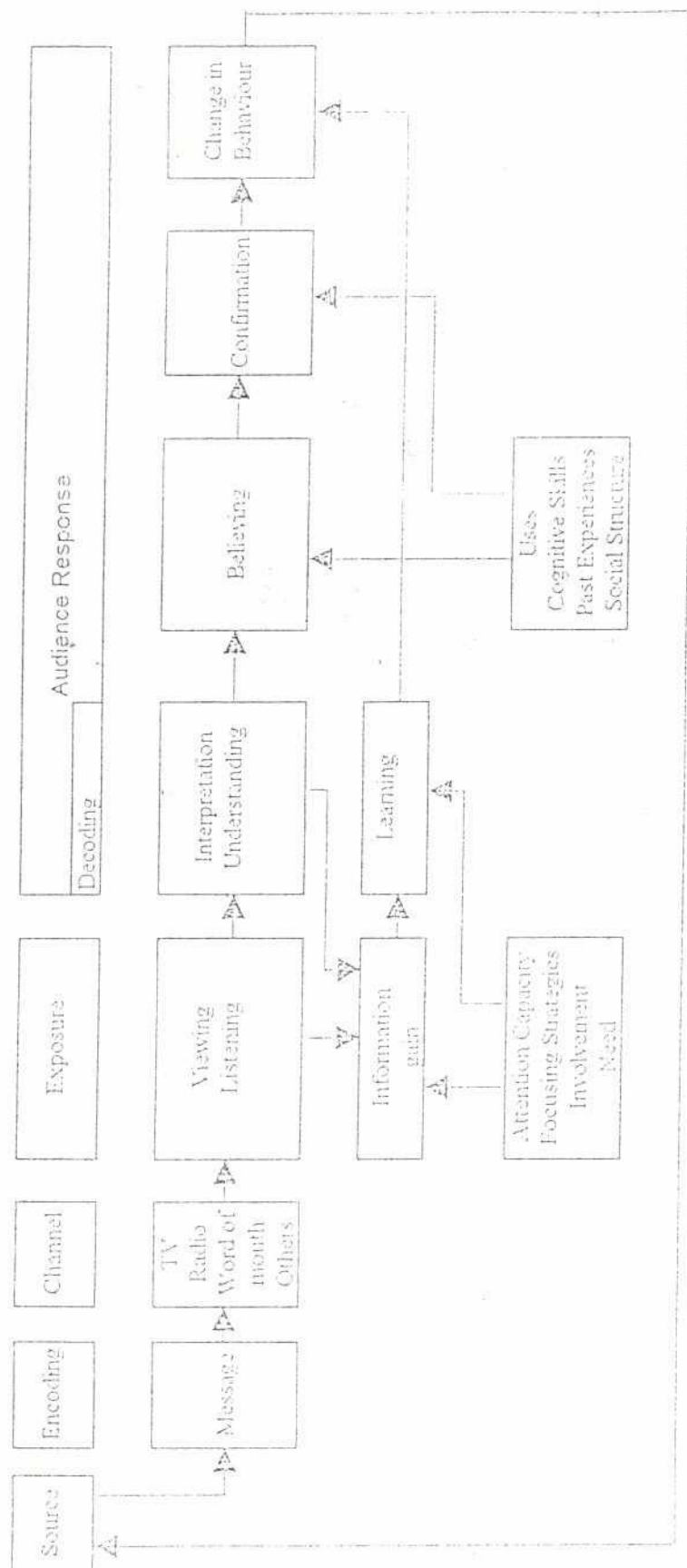
A source or sender is a person(or agency) who has a need to communicate. This need must be encoded in the form of signs and symbols which can be understood by the receiving audience. The product of encoding is message construction. The means through which messages are conveyed from the source to the receiver are called channels.

When the message reaches the receiver, he must interpret it to put meaning to it. This process is known as decoding. After decoding the message, the receiver will show some kind of response to the message.

Feed back is the final component of the communication process through which the source learns about the response pattern of the receiver and, when necessary, adjusts his communicative behaviour to bring about desired changes in the response pattern of the receiver.

As Figure 4 shows the audience behaviour is highly intractable. (Users of flood warnings are part of the audience when viewed within the framework of a communication model.) A change in audience

# An Integrated Model of Communication Process



Feed back

Source: Based on Hawkins and Pingree, 1983; Allard and Sorensen, 1988; McQuail, 1989; Porter and Samovar, 1985.

FIGURE 4

97

behaviour depends upon a large number of variables. They include: span of attention, focusing strategies, involvement and need. It also depends upon the way people define or construct social reality in terms of the usefulness of the information, their cognitive skills, past experiences, and their positions in the social hierarchy.

The complexity of the communication process suggests that it is not easy to disseminate flood warning messages to a large number of people at risk. It is specially difficult for a country like Bangladesh where villages are dispersed, communication infrastructures are rudimentary, nearly two-third of the population are illiterate, poverty is widespread and attitudes are mainly traditional. In this situation, particular care has to be taken in constructing messages and to use all available channels of communication.

In Bangladesh dissemination of flood warnings is extremely difficult because a majority of vulnerable people have no direct access to mass communication channels. Local government agencies have limited resources and facilities to pass on flood warnings to communities at the grassroots level. Thus it is necessary to deploy both traditional and modern channels of communication.

### Responses:

The purpose of a flood warning is to get the recipients to take actions which will reduce the damage caused by flooding. Even when it provides people with information and advice on response activities, the warning may not induce appropriate behavioural changes and responses. There are three major forms of responses from the people at risk.

**Fatalism:** People view floods as a kind of fate against which they have can do little. They are likely to take protective action as a last resort when the disaster closes in upon them. They require strong community pressure to undertake positive action.

**Scepticism:** People do not take the warning seriously, particularly, if they have experienced false warnings in the past. They also feel they are capable of coping with the flood as they have done in the past. They require special persuasion if flooding is more serious than the normal.

**Activism:** A smaller number of people receive and give more information than others and take initiative in embarking upon protective behaviour. They also help and support others to take protective measures.

## Modes of Dissemination:

Dissemination channels can be of different categories.

### Use of Media to Disseminate Flood Warnings:

Radio which reaches the largest number of people in Bangladesh can be productive in disseminating flood warnings. The 1995 Media survey found 18 percent of the rural people to have working radios, but more importantly, nearly 44 percent have access to radio. The peak listening hours were 7 am., 2 pm. and 8 pm.

In recent years TV has spread to rural areas. Although only 3 percent own one, nearly 31 percent have access to it. The peak viewing hour was around 9 pm.

- O Mass media, radio, TV, & newspapers, can reach a large audience, but responses may often be limited and weak.
- O Small scale channels - posters, flood markers, sirens, public address system, loud hailer, public meetings may be low in message content, but are high in terms of effectiveness.
- O Interpersonal(technical) channels - telephone, telegram, fax, wireless will be effective if person to person connections are achieved.
- O Interpersonal(non-technical) - house to house call, alert *para*(cluster of households heads), *VDP/Ansar*(rural quasi-police forces) and so on should be as effective as small scale channels.

The selection of communication channels will depend upon the facilities available and the location and nature of threatened communities. Communication channels chosen must be credible and able to reach the target users with adequate back up and feed back facilities. Successful dissemination of flood warnings depends upon the right mix of communication channels.



## Modes of Disseminating Flood warnings

### 1. General:

#### O Radio:

- \* Dissemination is quick.
- \* Reaches the largest number of the audience.
- \* Messages can be repeated and updated easily.
- \* Special bulletins early in the morning, early afternoon, and late in the evening.
- \* Interviews with specialists of the forecasting agencies.

#### O Television:

- \* Quick transmission.
- \* More credible when use made of graphical displays (eg satellite images of clouds and rainfall)
- \* Reaches a moderately large audience.
- \* Message can be repeated and updated.
- \* Animation and visual images can be presented.
- \* Disadvantage: transmission time is limited.

### 2. Specific:

- \* Telephone, fax and wireless for relevant agencies, business and industries.
- \* Loud hailers, public address systems, sirens for specific localities.
- \* Interpersonal networking from union parishad to *para* through union parishad officials, school teachers, imams(prayer leader in the mosque), VDP/Ansar.
- \* Flood Marker Posts.

A major difficulty with mass media is that there is no way of knowing how many may have missed the message or decided that it is not important. Thus mass media messages must be reinforced with word of mouth communication, specially through *para* leaders, school teachers and religious leaders.

The choice of channels should match with the urgency of the message (related to type and severity of flood) and to the number of threatened people. Most emphasis should be given to interpersonal channels of communication for the final stage of delivery.

### **Importance of Confirmation:**

The first aspect of confirmation is that those issuing warnings and passing them on should receive an acknowledgement from the recipient. The next is for the authorities to establish that warnings have reached the target populations of people at risk.

A further aspect is that people should be able to confirm what they have heard or watched or read from more than one source. People do not like to face a threatened situation or disaster and tend to ignore warnings unless they can find a source to confirm the message.

In Bangladesh it is extremely difficult to establish feed back mechanisms or assess the level of exposure to messages or their effectiveness. It will be necessary to undertake field surveys to assess the effectiveness of messages and channels and research to devise proper feed back mechanisms.

## Chapter Six

### System Review and Improvement

#### 1. Why do we need it?

**System review is needed:**

- ☐ To improve the reliability and performance of the Flood Forecasting, Warning and Response system.
- ☐ To build upon actual operational experiences in Bangladesh.
- ☐ To take into account changes in both natural and human environment.
- ☐ To incorporate new forecasting and dissemination technologies.

#### 2. What is system review and improvement?

**System review is:**

- ☐ Monitoring and critical review of some or all aspects Flood Forecasting, Warning and Response system aimed at improving its performance in future.

#### 3. How do we review flood warning system?

- ☐ Stakeholders of the Flood Forecasting, Warning Response System meet to discuss their experiences and to suggest ways of improving it.
- ☐ Regular workshops can also be an effective mechanism of review.
- ☐ The review process gives special emphasis to felt needs and suggestions from various users and, in particular, from people at the grass roots level.
- ☐ Independent surveys may be needed to gather information at field level.

#### 4. What are the critical issues?

- ☐ Review process must concentrate upon the identification of problem areas and their practical solutions.
- ☐ Review process must be constructive and not attempt to attribute blame.
- ☐ Review must underscore the measures for improving the performance of the system.



## Introduction:

The present Flood Forecasting Warning and Response System in Bangladesh is at best only approaching an intermediate stage of development (see Fordham et al). It will require many years of careful attention to achieve its full potential and enhance its performance. Independent evaluations, supported where necessary by field surveys and research, must also be an integral part of the review process. A good feed-back mechanism is vital to enable development of the system.

Regular reviews of the Flood Forecasting, Warning and Response System are essential for the development of the system in the immediate short-term and for its continued maintenance and operational integrity in the longer term. Annual reviews should include long-term planning as well as short term evaluation of the system performance. This review process should focus upon policy, inter-agency co-ordination, implementation of policy at operational level and patterns of responses by the users. Revisions should be carried out early in the winter of every year so that revisions can be incorporated into the following year's procedures.

An annual review process should include long term strategic planning in addition to current development plans (eg.FAP10) for the shorter period. The inter-ministerial consultative committee, donor agencies and NGOs should participate in such planning with a view to achieving broad consensus.

Each agency involved in flood forecasting and warning and its dissemination should also undertake its own internal review to identify constraints and problems and then undertake corrective measures. These operational reviews should be undertaken soon after each major flood or at the end of the monsoon season if only limited flooding has occurred during the year. This review process should focus upon performance of the system and identify failures or weakness in each component.

## Considerations for Review Process:

The review should include technical aspects of flood forecasting to broaden the sources of data and improve the quality of modelling. It should look closely into the types of warnings, message content and their dissemination process in order to improve them. The pattern of users responses should be investigated in terms of flood warning services, expected motivation, facilities and learning resulting from flood mitigation and developmental activities.

Flood intelligence systems need to be examined as well. The complexity of flood problem in Bangladesh will require that changed or new flood characteristics are adequately covered in flood intelligence system. It is also necessary to assess the adequacy of data bank of the flood intelligence system for improving its quality and effectiveness. Collection of local flood history and its use can make the flood impact assessments more accurate.

Both natural and man-made environments are changing fast in South Asia as a consequence of rapid increases in population and uneven development. The review must take account of major environmental changes when these have occurred, specially in upper riparian countries. Changes in natural environment include factors such as large environment modifications like deforestation, or changes in rainfall or stream channel characteristics.

The Flood Forecasting, Warning and Response System must be reviewed at least once per year and after each major flood event to check into the adequacy of data sources, accuracy of modelling & forecasts and satisfaction of user requirements. Particular attention should be given to the dissemination process which is likely to suffer from severe constraints in Bangladesh.

In order to ensure that, ultimately, the system can achieve positive responses from all the vulnerable people, these reviews should ask the following questions:

- O How many of the target audience got the warnings in time ?
- O How many of them understood the warning message ?
- O How many of them took affirmative action ?
- O What were the causes which led to the failure in achieving affirmative responses?
- O How adequate were the available data to answer these questions ?

It is also necessary to closely monitor the changing characteristics of the flood plain. As Bangladesh constitutes a small part of the floodplain, the review process requires close cooperation among South Asian countries. An exchange of flood information among Asian countries would be extremely useful for the review process.

The Flood Forecasting, Warning and Response System should be reviewed continuously in Bangladesh because environmental changes are occurring very fast in South Asia. Forecasters should be aware of these changes. Effective review process requires close cooperation among South Asian countries. An exchange of flood information among Asian countries will be extremely important for much more accurate flood forecasts.

Reviews can easily turn into mere rituals when they have been preformed for a number of years. This must be avoided if they are to remain effective. This can be achieved by changing the venue, introducing presentations from one of the participating organisations or obtaining the services of an independent chairman.

Finally, reviews must be held in a spirit of mutual cooperation and trust giving emphasis to objective unbiased and independent evaluation of past performance.



## References

- Ahmed M. 1989. (ed) Floods in Bangladesh. Dhaka: Community Development Library.
- Australian Emergency Management Institute. 1991. Flood Warning: An Australian Guide.
- Bangladesh National Committee of the International Commission On Irrigation and Drainage (BANCID). 1995. Non-structural Aspects of Flood Management in Bangladesh. Dhaka: Typescript.
- Drabek, Thomas E 1986. Human System Response to Disaster: An Inventory of Sociological Findings. New York: Springer- Verlag.
- Elliott, Jim 1995. "Flood Warning in Australia". Paper presented in the workshop on current issues in Total Flood Warning System Design, Middlesex University (10-12 September). In press.
- Emergency Planning College 1994a. Crises in a Complex Society. Easingwold, York: The Home Office.
- Emergency Planning College 1994b. A Digest of some well-known Disasters. Easingwold, York: The Home Office.
- Encyclopaedia Britannica.
- Fordham, Maureen et al. 1994. Euroflood: Flood Forecasting Warning and Response Systems. Middlesex University: Flood Hazard Research Centre.
- Hawkins, Robert P. and Suzanne Pingree. 1983. Television's Influence on Social Reality. In Ellen Wartella and D. Charles (eds.), Mass Communication Review Year book, 53-76. Beverly Hills: Sage.
- Hossain, Mosharaf, A.T.M. Aminul Islam and Sanat Kumar Saha. 1987. Floods in Bangladesh: Recurrent Disasters and people's Survival. Universities Research Centre: Dhaka.
- Keys, Chas. 1995. The Total Flood Warning System: Concept and Practice. Paper presented in the workshop on current issues in Total Flood Warning System Design, Middlesex University (10-12 September). In press
- Kreps, Gerry A (ed). 1989 Social Structure and Disaster. Newark: University of Delaware Press.
- Lasswell, Harold D. 1966. The Structure and Function of Communication in Society. In Bernard Berelson and Morris Jonowitz (eds.), Reader in Public Opinion and communication, 178-192. New York: Free Press.
- McQuail, Denis. 1989. Mass Communication Theory London: Sage.
- Miah, Mohammed Alam. 1990. "Technology of Prediction and Warning System for Floods." Paper presented at the International Workshop on Hazard Assessment and Mitigation with a Focus on Floods and their Consequences.



- Mileti, Denis and John H. Sorensen. 1988. Planning and Implementing Warning Systems. In Marry Lystad (ed.), *Mental Health Response to Mass Emergencies*. New York: Brunner/Mazel.
- Mitra, S.N. et al. 1995. Access to Media in Bangladesh: the 1995 National Media survey: Draft report. Dhaka: Mitra and Associates.
- Neal, Jeremy. 1989. Coping with Excess: The Changing Role of Flood Warning Systems in Flood Hazard Mitigation. Flood Hazard Research Centre, Middlesex Polytechnic, Publication no. 160.
- Porter Richard E and Larry a Samovar. 1985. Approaching Intercultural communication. In: Larry A Samovar and Richard E. Porter (eds.). *Intercultural Communication: A Reader*, 15-29. Belmont, Cali: Wadsworth.
- Scanlon, J. 1992. Disaster Preparedness: Some Myths and Misconceptions. York: Emergency Management Institute.
- Schramm. Wilbur. 1971. *The Process and Effects of Communication*. Urban: University of Illinois.
- Walsh P D: Miah, Mohammad Alam: Jorgensen, G.H, & Kamal, Ahmed (1996), Development of A Flood Forecasting Warning and Response System for Bangladesh, paper presented in the workshop on current issues in Total Flood Warning System Design, Middlesex University (10-12 September). In press
- Chow, Ven te. 1964. *Handbook of applied hydrology*. A compendium of water resources technology. McGraw-Hill, New York.

## Appendix

### Terminology of flood types, intensities and warning phases

#### Flood Types:

In Bangladesh, river flooding takes three main forms:

- **Monsoon Floods**

Major rivers and their side channels overflow causing extensive areas of inundation. The rivers rise slowly and with a slow recession may stay at high flows for extended periods of many weeks.

- **Flash Floods**

Mainly in eastern and northern rivers where short duration heavy rainfalls in the mountains cause a rapid runoff response and very fast flood waves with consequential damage.

- **Rainfall Floods**

High local rainfall intensities and long duration monsoon rainfall cause flooding due to inadequate local drainage. The inundation occurs very rapidly but may take many weeks to dissipate.

#### Flood Intensity

Three classifications of flood intensity are used to describe the impacts and level of damages.

- **Medium Flood**

This scale of flooding affects mainly farmers and others living on low lying land and in areas adjacent to rivers. Some economic loss and damage to property would occur but is unlikely to be extensive or serious on a national scale. Loss of life is also likely to be small.

- **Severe Flood**

As well as further flooding in rural areas some urban areas would be affected and it is probable that loss of life would occur. Economic and property damages would be significant. This scale of flooding is likely to be experienced every 5-20 years.

- **Catastrophic Flood**

This would be an extremely serious flood, comparable to 1987 & 1988 in impacts. It would be close to and may even exceed the level of the maximum historic flood. Many parts of the population would be affected and significant damages occur.

## **Phases for Flood Warning**

### **1. Flood Watch**

The first phase is an *Alert* called 'Flood Watch' issued to 'combat' and other relevant agencies. It usually provides notice 24 hours earlier than a publicly issued flood warning and enables them to mobilise their resources and to make other preparations. No public warnings are issued.

### **2. General Flood Warning**

This is the first level of public warning and is for a flood whose impacts are mainly rural as described for the Medium Flood. It corresponds to the *Blue Band* on village flood marker posts.

### **3. Severe Flood Warning**

This would be issued as river levels continue to rise leading to impacts for Severe Flood. It corresponds to the *Red Band* on village flood marker posts. It inundates some urban areas and some loss of life is likely to occur. Warning messages contain guidance on flood response actions.

### **4. Widespread Flood Warning**

This would be issued when a very major and serious flood as described for the Catastrophic Flood is expected to occur. It corresponds to the *top of the Red Band* on village marker posts, which is close to the level of the maximum historic flood. Many parts of the population and large areas of the country, including many larger urban areas would be affected.





## ANNEX 2

**Flood Warning and Flood Management in Bangladesh:  
A Training Manual**

## CONTENTS

|  | Page  |
|--|-------|
| Chapter One : The Importance of Training                   | 1-3   |
| Chapter Two : The Flood Problems in Bangladesh             | 4-7   |
| Chapter Three : Flood Warnings                             | 8-11  |
| Chapter Four : What to Do Before, During and After A Flood | 12-15 |
| References   | 16    |



# Chapter 1

## The Importance of Training

### What is training ?

Training is a process of learning - acquisition of knowledge, attitudes and skills to deal effectively with a particular range of phenomena or specific problems.

### Why do we need training for flood warning ?

Flood disasters are recurrent phenomena in Bangladesh. They cause extensive damage to the economy and immense suffering to the people. Floods cause death and injury to people. More people and specially children suffer from diseases and some of them die after the flood. The poor are the hardest hit.

In the past people have coped with flood with indigenous knowledge and limited resources and often their coping mechanism has been highly inadequate.

As the population of the country has rapidly increased and the society has become more complex, more and more people have become vulnerable to flood disaster and economic damages have escalated over time.

We have now much more knowledge, skills and resources to equip agencies, people and communities to cope with flood disasters through strong affirmative action and thus reduce flood impacts substantially.

### What is the essence of training ?

The essence of training is the development of cognitive resources of target agency personnel, people and communities. The development of cognitive resources can be viewed as increase in knowledge, skill and affirmative motivational and behavioural changes.

### What should be the training curriculum ?

The training curriculum will vary from context to context. The training needs will depend upon the nature and requirements of agencies, individuals and communities. It will also require continuous updating.

The core module should ideally consist of the following:

1. The Flood Problem in Bangladesh.
  - A. Causes of flood

- B. Nature and types of flood
- C. Strategies of Flood Management
- 2. The concept of total Flood Warning
  - A. Forecasting
  - B. Warning
  - C. Dissemination of Flood Warning in the social context of Bangladesh.
  - D. Human response to Flood and the sociological aspects of organisational and community structure and human behaviour.
- 3. Flood Warning and Flood Management
  - A. What needs to be done after the warning has been issued ?
  - B. Interfacing Warning and Flood.
  - C. Warning and post-flood recovery
- 4. Requirements of specific agencies, local communities and social groups.

Broad guidelines to be provided by the instructors.

### **What should be the duration of training ?**

In view of the constraint of resources, the basic training module should be confined to 2 or 3 days. A comprehensive module should cover a period of 7-10 days.

### **What should be the training materials ?**

The basic module should use this manual, the Flood Warning manual for Bangladesh, the ESO for Flood and the Action Plan for FF&WC by Peter Walsh. A longer list may include sections from:

Jeremy Neal 1989. Coping with Excess: The changing Role of Flood Warning Systems in Flood Hazard Mitigation. Flood Hazard Research Centre Publication no 160. Middlesex Polytechnic.

Guidelines for Effective Warning by Bureau of Meteorology and Australian Emergency Management Institute.

Technology of Prediction and Warning System for Floods by Mohammad Alam Miah.

Bangladesh National Committee of the International Commission on Irrigation and Drainage (BANCID) 1995. Non-structural Aspects of Flood Management in Bangladesh. Dhaka: Type script.

Emergency Management Australia 1995. What to Do Before, During and After a Flood.

Elliott, Jim 1995. "Flood Warning in Australia". Paper presented in the workshop on current issues in Total Flood Warning System Design, Middlesex University (10-12 September).

Scanlon, J. 1992. Disaster Preparedness: Some Myths and Misconceptions. York; Emergency Management Institute.

The comprehensive module will require a longer manual than the present one.

It may be a compilation of research reports and published materials with careful editing. A longer manual can be written also with brief excerpts from other published sources.

It should be ideally done within the framework of module 3 of the FAP 10.

### **Who will provide training ?**

The training should be provided by an external [non-governmental] training agency under government supervision.

[ Alternatively, an expanded FF&WC personnel can provide training in the winter. But it is likely to suffer from the limitations of the DMB].



## Chapter 2

### The Flood Problems in Bangladesh

Some kind of flood warning appears to have existed from ancient times. People in ancient Egypt are known to have rowed down the Nile to warn people about the oncoming flood.

With the development of forecasting technology, flood predictions have been more and more accurate.

Flood Warning is important to the government because it can reduce flood damages substantially. It can save human lives and mitigate human sufferings. Vulnerable people and communities have also a basic right to warning services. Sound warning services empower them to cope with the flood disaster much more effectively. There is also an increasing public demand for better warning services.

In Bangladesh it is the poor who suffers most from the recurrent floods. They become homeless, they go hungry and suffer from various diseases. In most floods more people die from epidemics than the flood itself.

Good warning along with more co-operative efforts at community level through conscientisation can help them remain above the level of stark poverty.

### Flood Problems in Bangladesh

Bangladesh suffers very frequently from natural disasters. Floods are common phenomena in Bangladesh. They are essential for the country's agriculture. But very often they turn into disasters and cause damage to life and property.

#### Flood:

Flood means inundation of normally dry land by a high water-stage which overflows its natural or artificial banks. The high water-stage is caused by heavy rainfall or snow-melt or a combination of both or by cyclonic storms. Historically annual floods have been associated with legendary prosperity of Egypt, China and Bengal. But very often floods have proved to be destructive.

#### Causes of Flood in Bangladesh.

Bangladesh is an extremely flood-prone country. The causes will be obvious if one looks at the physical map of the country.

**Watershed:** The terms watershed, catchment area or drainage basin are used interchangeably. In simple words it means an area drained by a stream or any other water body. A drainage basin can be very small or very large.

Bangladesh lies at the confluence of the three major rivers of the world - the Ganges, Brahmaputra and Meghna and criss-crossed by about 250 rivers. It occupies only 8 percent of a vast drainage basin, but carries 2.5 times of the water of the Mississippi River of the U.S. (length 3,780 km).

**The Delta:** Bangladesh is an active delta. It means the country has been formed by sediments carried by these rivers and it is still in the process of formation. Thus the country is flat and about 80 percent of the land comprise flood plain. A floodplain is flat land along the course of a river made by sediments deposited during previous floods. The flat landscape reduces the velocity of waterflow. Again a part of the vast amount of sedimentation which the rivers carry is deposited in the riverbed. It raises the river bed and reduces its capacity to drain water.

**Climate:** Bangladesh forms a part of the wider monsoon climate with heavy rainfall from June to September. Across the North-east border of Bangladesh lies Cherrapunji - a place in India which gets about 1140 centimetres of rain a year which is the highest in the world. The average annual rainfall of Bangladesh ranges from 1,200 mm in the west to 5,800 mm in the North-east of the country. This heavy monsoon rainfall both outside and inside the country is a major cause of flood.

**Other causes :** Destruction of forests, long term climatic changes and rise of sea level are also indirect causes of floods. Another cause of flood is the unplanned construction works in the floodplain which impede the natural flow of water.

**Types of Flood:** There are four types of flood in Bangladesh.

#### **Monsoon Flood:**

With the onset of the monsoon the heavy rainfall in the catchment area causes rivers to overflow their banks. The Ganges reaches peak flow from the middle of August to the middle of September. The Brahmaputra achieves its peak flow a little earlier. When the peak flow of these mighty rivers coincide, we have a deadly flood called a catastrophic flood.

#### **Flash Flood:**

Flash flood occurs when the heavy rainfall in a hilly area leads to the sudden onrush of water. The flash flood starts in the pre-monsoon months of April and May in the East, South-east and Northern parts of the country.

#### **Local Rainfall Flood:**

Heavy rainfall in some areas of the country leads to stagnation of water as the drainage capacity become inadequate.

### Coastal Flood:

The Bay of Bengal often gives rise to tropical cyclones during the months of April, May and June and in the Autumn- October and November. The high water waves of the cyclone often leads to the inundation of the coastal area of the country.

Floods also vary in intensity. Annual inundation is quite normal in Bangladesh and a blessing for the country. The river floods can be classified into three categories.

### Medium Flood:

A medium flood inundates a large part of the country up to 36,000 square kilometers. Its damage is limited to agricultural crops.

### Severe Flood:

In a severe flood about one-third of the country or 50,000 square kilometers are inundated with damage to crops and property.

### Catastrophic Flood:

This type of flood is expected to occur every hundred years. More than one-third or 50,000 square kilometres of the country are flooded with massive damages to crops and property and great loss of lives.

### Impact of Flood:

Floods in Bangladesh result in massive loss of property and immense human suffering. The catastrophic flood of 1988 had caused unprecedented damage of life and property.

| Bangladesh Water Development Board estimates of 1988 Flood Damages |   |              |
|--|---|--------------|
| Affected area  | : | 81,800 sq km |
| Affected people  | : | 30 million   |
| House damaged  | : |              |
| Total  | : | 989,347      |
| Partial  | : | 1,477,772    |
| Loss of human lives  | : | 1,657        |
| Loss of cattleheds   | : | 64,170       |

### Strategies of Flood Management:

There are essentially two strategies of flood management.



## Structural Measures:

It includes construction of dams and reservoirs to hold flood water and its controlled release downstream. Another structural measure is river training or straightening of channels for faster flow of water. Flood water can also be diverted to holding basins to reduce water height downstream.

The main objectives of the structural approach are prevention and diversion of flood and reduction of its severity.

## Non-structural Measures:

Non-structural strategies are aimed at providing communities with resources to cope with the flood. Its aim is to live with flood rather than control it. Non-structural measures include zoning controls, regulation of constructions in the flood plain, flood proofing of dwellings, flood warning system, flood preparedness, public education and flood insurance.

Flood warning is an important non-structural strategy of flood mitigation.

The objectives of flood warning are to enable and persuade people and organisations to become prepared for the disaster and take action to increase safety and reduce damages from flood. Its goal is to alert the 'combat' agencies to enhance their preparedness and motivate vulnerable people, communities and organisations to undertake protective measures.

These measures include:

- ☐ Stocking up on food, fodder and other essentials.
- ☐ Construction of raised platforms for stocking up essentials.
- ☐ Provision for safe drinking water.
- ☐ Reinforcement of dwellings
- ☐ Preparation for evacuation
- ☐ Taking shelter.

## Chapter 3

### Flood Warnings

The seriousness of flood problem in Bangladesh underscores the importance of flood warning which we need to understand in more detail.

The total warning system has now been conceptualized as consisting of three sub-systems-forecasting, warning and response (FFWRS).

#### Forecasting:

People often confuse flood forecasting with flood warning. Flood warning is grounded in flood forecasting, but it is much more than mere forecasting. Flood forecasting seeks to predict the staged development of flood water peaks over time and its severity. It is done on the basis of real time or near real time data collected from river and rain gauges from different river or regional locations. The satellite images of distant cloud banks are also helpful in this analysis. All these data are fed into the computer to predict about water-heights in a given locality in advance. But it is important to remember such predictions are not always accurate.

Warning services in any country generally develop through three stages as the forecasting technology improves.

#### Generalized Warnings:

This type of warning is elementary. It can broadly indicate that a flood is expected in a given region without much lead time or advance notice of the event. This type of warning is not much helpful in reducing the impact of flood.

#### Qualitative Warning:

When forecasting technology has advanced with an automated network of data collection and its complex analysis, the warning messages will be able to foretell roughly the specific area of inundation and the intensity of flooding. This type of warning is much more useful in mitigating flood hazards.

#### Quantitative Warning:

With more advanced technology forecasting is possible about the expected rise in water level at a location in the river within a specific period of time in future. This is the most useful type of warning which can substantially reduce flood damages.

A number of European countries have mapped out a five stage development process of the flood forecasting, warning and response system which is more detailed and takes into account a number of other issues.

The flood information services in Bangladesh began in early 1960s with the establishment of a flood information cell in the former EPWAPDA. A Flood Forecasting and Warning Project started operating after the independence of the country. Now Bangladesh Flood Forecasting and Warning Centre of BWDB has a network of 60 wireless stations, 48 water level and 47 rainfall Monitoring Stations. It also receives information about weather from the Bangladesh Meteorological Department.

Presently the centre provides mainly generalized warnings. But the FAP 10 Project aims at strengthening the Bangladesh Flood Forecasting and Warning Centre and enabling it provide better warning services - qualitative warnings with increasing quantitative information.

The government of Bangladesh under the framework of the FAP 10 has also undertaken to improve other aspects of Flood Warning Services- better warning messages, more effective dissemination, public education and awareness, training of agencies and staffs.

It also envisages to set up flood markers with colour bands in flood-prone villages to provide people at the grass roots level access to flood warnings.

The Colour Blue will mean medium Monsoon Flood. The colour Red will mean severe Monsoon Flood.

Flood warning can be effective only within a broad flood management programme.

Individuals and communities who are under threat of flood disaster or have suffered it require assistance in a variety of ways. This response to flood warning will be shaped to a large extent by the role of other agencies.

Vulnerable people face flood disaster through indigenous knowledge system. But it may be inadequate or mean passive adjustment to it. Public education can prepare them better to face the calamity and reduce its impact.

### **Agency Role:**

The first over-riding task of any relevant agency is to define its role in flood disaster. This role may be defined by the Emergency Standing Order (ESO) or Disaster Standing Order (DSO) in an encapsulated form. But for some agencies there will be no such predefined role.

The primary task is to define the role of the agency where none exists or translate government rules into a set of practical activities or Action Plan which are interrelated, systematic and complementary to other agency activities. Below is a list of major agencies with broad roles

Mass media

Dissemination of flood warning and feed back on flood situation.





|   |  |
|---|--|
| Police<br>Ansar<br>VDP  | Dissemination of warning, rescue and relief.   |
| Army(when called upon)  | Rescue, relief and rehabilitation.   |
| Fire services   | Rescue in urban areas.   |
| Ministry of Communication   | Maintain vigilance of roads, bridges, telephone and telegraphs.  |
| Ministry of Livestock and Fisheries   | Provide veterinary services.   |
| Ministry of Agriculture and Irrigation, Water Development and Flood Control | Advice on cropping pattern, planting, harvesting, supply of inputs in the post-flood phase.  |
| Ministry of Health and Family Welfare                                       | Provide general medical advice; specific advice to the sick.<br><br>Provide medical services and medicines during and after flood. |
| Ministry of Relief  | Relief, rescue and rehabilitation.   |
| Red Crescent  | Relief, rescue and rehabilitation.   |
| NGos  | Relief, rescue and post-flood rehabilitation.  |

Many agencies may not have flood management role, but may suffer from flood hazards. They have to take measures to reduce loss of and damage to property. They may have to protect equipments and machineries from flood-water. These agencies also need action plan for flood emergencies.

### Agency Facilities:

The role and tasks of each agency leads to the specification of facilities or resources - both material and human which it requires. The resource requirement is related to flood warning. Upon receiving flood watch or flood warning messages, each agency should spell out its resource constraint and requirement and sketch out its plan of action in terms of worst and best case scenarios on the basis of available and expected supply of resources.

### Action Plan:

Each agency should have a general action plan describing who is to do what upon receiving the flood watch or flood warning.

136

In Bangladesh there are different flood types, the intensity of flood may change or future floods may not be similar. The Action Plan should not only detail roles of each person within the decision-making process of the organisation, but also assess its requirement of manpower and resources. It should also provide scope for flexible and innovative leadership and coordinate its activities with other organisations. The Action Plan at local level should preferably have a local flood hazard map.

### Exercises:

All organisations tend to be caught up in routine activities. A flood disaster is a non-routine event. People are likely to forget their tasks in an emergency situation. Regular exercises are extremely important, specially before the flood season, to achieve peak organisational performance.

## Chapter 4

### What to do Before, During and After A Flood.

#### Introduction:

This brief Action Guide tells you what to do before, during and after flood if you happen to live in an area which can be flooded.

#### Ask:

Ask village or local leaders

or

What broad types of floods occur in your area ?

The number of times your village or locality was flooded in the past ?

How near to your household did the flood water reach ?

What was the maximum water-height your village or area ever experienced ?

Is there a disaster preparedness Committee in your village or union or locality ?

Is there a Local Flood Action Plan prepared by the disaster preparedness committee or local office of the NGO.

#### Learn:

Learn before the flood strikes you how the Flood Warning System works.

The Flood Warning is issued by the Flood Forecasting and warning Centre of Bangladesh Water Development Board located in Dhaka. The flood marker in your village will have colour bands/lights. The BLUE will mean medium and RED will mean severe flooding.

#### Important Flood Terms

There are four broad types of flood in Bangladesh - Monsoon, Flash, Local and Coastal Floods.

Annual Inundation

It will cause you some inconvenience, but no harm.

## **Medium Monsoon Flood**

A Medium Monsoon Flood is defined in the national context and is supposed to cause damage to crops in low-lying areas.

But if you live near a major river or *Beel*, the flooding in your locality may be quite severe.

So don't be misled by a Medium Monsoon Flood Warning if you happen to live in a low-lying area or near major river or *Beel*.

## **Severe Monsoon Flood:**

Higher areas are flooded causing damage to houses and other properties. If your area is subject to severe flooding, start taking preparatory measures immediately.

## **Catastrophic Monsoon Flood:**

This is a terrible and rare kind of flood which occurs once in a hundred year. But the unexpected event causes the maximum damage. It is always better to be prepared for the worst in a floodprone country.

## **Flash Flood:**

Flash Flood occurs mostly in the North and occasionally in the Western part of the country. It occurs suddenly and gives you very little time for preparation. Warning may be issued six hours before the event, but most often flood water will reach your area only an hour or two after the warning.

## **Local Rain Flood:**

It is caused by stagnation of rain water in some areas. Know if your area has ever suffered from this type of flood.

## **Coastal Flood:**

It occurs only in the coastal areas of the country.

## **Lead time:**

It means the time between the issue of warning and flooding. For the Monsoon Flood you may get two or even three days to take protective measures for the flood.

## **Danger Level:**

It is the level above which a rise of water in the river can overflow its banks and inundate the surrounding areas.



## PREPARE- Action Plan and Check Lists

You can substantially reduce flood loss and damages if you adopt necessary protective measures.

### Before Flood:

Act on Flood Warning.

Listen to your radio or watch your TV for further information. Pass on the correct message to your neighbours.

Get further information from members of local disaster preparedness committee, Ansar/VDP/Union parishad member/school teacher.

Check if you have some dry food like *Chira*, *Muri* and *gur*.

If you have a torch, procure extra batteries.

Collect kerosene fuelwood and fodder.

Collect bandage, anti-septic cream, ORS and water purifying tablets.

If you do not have water purifying tablets, you can fasten sealed water jars near your roof. Drink and preserve rain water.

Procure medicines if any body is sick in the household.

Make arrangements for safe-keeping of your cash and jewelleries.

If you can, reinforce your house and granary.

Construct a strong *macha* near the roof and secure your valuables there.

Keep your food grains in bags wrapped in polythene paper over the *macha*.

Take extra care to secure valuable papers in a sealed polythene bag.

Have match-boxes wrapped in polythene.

Wrap insecticides or pesticides in polythene bag and keep it in a safe place away from food items.

### During Flood

Secure things which can float.

If your area is short of boats, make a *bhela*.

Send Livestock to higher land.

Send children and disabled people to safer place.

If you have to evacuate, set up local vigilance team to safeguard your property.

### **After Flood:**

Drink only pure water.

Don't eat any rotten or contaminated food.

Repair and clean your house.

Help other people in resuming normal activities.

## References

- Ahmed M. 1989. (ed) Floods in Bangladesh. Dhaka: Community Development Library.
- Australian Emergency Management Institute. 1991. Flood Warning: An Australian Guide.
- Bangladesh National Committee of the International Commission On Irrigation and Drainage (BANCID). 1995.
- Drabek, Thomas E 1986. Human System Response to Disaster: An Inventory of Sociological Findings. New York: Springer Verlag.
- Emergency Planning College 1994a. Crises in a Complex Society. Easingwold, York: The Home Office.
- Emergency Planning College 1994b. A Digest of some well-known Disasters Easingwold, York: The Home Office.
- Elliott, Jim 1995. "Flood Warning in Australia". Paper presented in the workshop on current issues in Total Flood Warning System Design, Middlesex University (10-12 September).
- Fordham, Maureen et. al. 1994. Euroflood: Flood Forecasting Warning and Response Systems Middlesex: Flood Hazard Research Centre.
- Kreps, Gerry A (ed) 1989 Social Structure and Disaster. New York: University of Delaware Press.
- Keys, Chas. n.d. The Total Flood Warning System: Concept and Practice.
- Miah, Mohammad Alam. 1990. "Technology of Prediction and Warning System for Floods." Paper presented at the International Workshop on Hazard Assessment and Mitigation with a Focus on Floods and their Consequence.
- Neal, Jeremy 1989. Coping with Excess: The Changing Role of Flood Warning Systems in Flood Hazard Mitigation. Flood Hazard Research Centre, Middlesex Polytechnic: Publication no. 160.
- Scanlon, J. 1992. Disaster Preparedness: Some Myths and Misconceptions. York; Emergency Management Institute.

## ANNEX 5



### Action Plan for use of Police Wireless

## Action Plan for Dissemination of Flood Warning through official channels of communication.

The purpose of this Action Plan is to detail standard procedures for disseminating flood warnings from the FF & WC to the grassroots level in accordance with the SOD, 1995.

### Rationale:

The SOD, 1995 spell out detailed responsibilities of each government organisation. An effective warning system requires rapid dissemination of warning message through all available channels of communication. This Action Plan stresses upon 'networking' among organisations for rapid dissemination of flood warnings in accordance with the spirit and provisions of the SOD, 1995.

### Objectives:

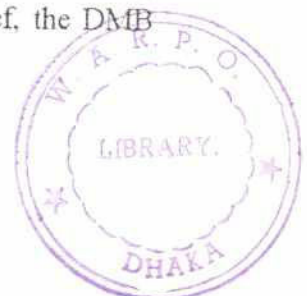
The objectives of this Action Plan is to spell out integrated operational procedures for disseminating flood warnings from the FF & WC to the village level.

The FF & WC should send the warning messages to the Ministry of Disaster Management and Relief through its liaison officer, Deputy Director of the FF & WC [there is provision for it in the SOD].

1. BWDB's wireless Network (Partial coverage)
2. Wireless operated by DMB
3. Wireless operated by Ministry of Disaster Management and Relief which can reach every district.
4. Police wireless which can reach every thana.

The control room of the Disaster Management and Relief should send the message directly to the Deputy Commissioner of the relevant district. The Deputy Commissioner should set up a flood control room after he receives flood warnings and maintain contact with the FF & WC as well as the Ministry of Disaster Management and Relief for warning updates.

The Ministry of Disaster Management and Relief should also send flood warning messages through the liaison officer of the police head quarters in Dhaka to each threatened/relevant district as or whenever required. The frequencies of the police wireless (as per SOD) should be synchronized with those of the BWDB, Ministry of Disaster Management and Relief, the DMB (along with other enlisted agencies as detailed in the SOD).



The DC or the district flood control room should transmit the message to the TNO in the relevant threatened thana through its own or the police wireless. The SOD enable the Ministry of Disaster Management and Relief to use the police wireless on a priority basis. The TNO should undertake all possible measures to effectively disseminate the flood warning message to the vulnerable people at the village level through the Chairman of the Union Parishad on receipts of the warning. The Chairman of the union parishad should set up a union flood control room and maintain regular contact with the TNO. The union Disaster Management Committee with the help of the Chowkidars, Ansars/VDP and local volunteers should disseminate warnings at the village level. In each village a member of the union parishad disaster management committee should act as liaison person. This person should be responsible for communication of flood warnings through locally appropriate methods. the government may consider employing school teachers in future as local flood warning resource persons for incorporation in the SOD.

The TNO will report back to the DC confirming the dissemination of warnings. The upward communication through the DC should reach the Ministry of Disaster Management and Relief as well as the FF & WC. Flood warnings should be communicated through as many channels as possible and there should be two way communication-downward and upward. The FF & WC the Ministry of Disaster Management and Relief, DMB and other relevant agencies should know that the threatened communities have been adequately warned.

96

# EXPANSION OF FLOOD FORECASTING AND WARNING SERVICES (FAP-10)

## MODULE - 3: PHASE - 2

### REPORT ON FINALIZING INSTRUMENTS FOR FIELD EVALUATION OF FLOOD WARNINGS IN 1996- 1997 AND PRELIMINARY FINDINGS FROM FOUR PILOT EVALUATION STUDY AREAS

AHMED KAMAL (TEAM LEADER)

S. AMINUL ISLAM

JUNE 1996

DHAKA



## Executive Summary

The responses to flood warnings are an essential element of an effective flood warning system. The expansion of flood forecasting and warning services in Bangladesh requires responses from people at the community level to new products and services. The most difficult and the most challenging task for establishing an effective Flood Warning System in Bangladesh is the dissemination of flood warnings to dispersed rural people in the floodplains.

A major objective of module 3 of the Expansion of Flood Forecasting and Warning Services (FAP 10) is the field evaluation of responses of the users to new range of flood warning products and services which the project aims at providing.

The report details the activities undertaken to finalize instruments of field evaluation of flood warnings which will be carried out in the Winter of 1996-1997.

- ☐ It has chosen four pilot villages in four different parts of the country as sites for field evaluation. The villages have been selected on the basis of a number of specific criteria which include flood regimes, regions, river basins and schooling facilities. These villages are Goalbathan of Jamalpur district, Muljan of Manikganj district, Anupnagar of Nawabganj district and Chakran Chap of Maulavibazar district.
- ☐ Two questionnaires have been developed. One has been used for baseline survey/census. The other will be used in the Winter of 1996-1997 for field evaluation.
- ☐ The baseline survey has been conducted among 443 household heads from four pilot villages. The survey found that villagers did rarely get any official flood warnings during the last flood which they experienced. Their primary sources of flood warnings were friends, relatives and villagers.

There has been rapid diffusion of radio and television in these villages. It indicates the potential of electronic media for dissemination of flood warnings. Villagers are also becoming increasingly aware of this potential. In Muljan, more developed village alongside Dhaka-Aricha highway, 45 per cent of the respondents indicated television as the most effective medium for dissemination of flood warnings. But on the whole about a quarter of the respondents gave primary importance to radio and television. The over whelming emphasis was, however, on the loud speaker/loud hailer (locally known as mike). The perceptions and felt needs of the community have been clearly articulated in their views. They want a balance between dissemination of flood warnings through electronic mass media and local level channels. The survey also highlights their information needs which should be addressed through development of the Flood Forecasting, Warning and Response System of Bangladesh.



96

# REPORT ON FINALIZING INSTRUMENTS FOR FIELD EVALUATION OF FLOOD WARNINGS IN 1996- 1997 AND PRELIMINARY FINDINGS FROM FOUR PILOT EVALUATION STUDY AREAS

21 June, 1996

The following description updates the progress of major activities related to the preparation for evaluation study of flood warnings to be carried out in the winter of 1996-97. The progress of the work suffered seriously due to political turmoil in the country.

## Methodology:

### 0. Selection of Locations for Evaluation Study.

Four pilot villages for evaluation study have been selected . These are:

#### 1. **Jamalpur:**

Goalbathan (Union-Aona) in Sharishabari thana of Jamalpur district on the bank of the Jamuna where flooding is frequent.

#### 2. **Manikganj:**

Muljan (Union-Dighi)- a village in the Sadar thana of Manikganj. Its location is near Taraghat on Dhaka-Aricha highway. It is located close to the Kaliganga. The Padma is about 22 kilometers away.

93

### 3. Nawabganj:

Anupnagar, a village (Union-Char Anupnagar) in the Sadar thana of Nawabganj. It is located between the Mahananda and Padma. It is an area of high flooding as both the rivers inundate this area.

### 4. Maulavibazar:

The last village Chakran Chap in Kulaura police station of Maulavibazar has been selected on the bank of the Manu, a flashy river in Maulavibazar.

### Criteria for selection of Pilot Evaluation Sites:

A number of specific criteria have been used to select pilot areas for evaluation studies.

### Geographical Locations:

The village Chakran Chap in Maulavibazar represents the north-east of the country. Goalbathan of Jamalpur and Muljan of Manikganj represent the north-central and the centre of the country respectively.

Anupnagar of Nawabganj lies on the extreme western border of the country. All these locations are widely spread to represent the geographical diversity of the country as far as possible.

### Major River Basins:

The pilot evaluation villages represent three major river basins of the country - Meghna, Brahmaputra and Ganges basins.

### **Flood Categories:**

The loactions represent two major flood categories of Bangladesh - monsoon and flash floods.

### **River Categories:**

Two of the villages- Goalbathan of Jamalpur and Anupnagar of Nawabganj are situated along two major rivers of the country - the Jamuna and Padma. Although the village Anupnagar is nearer to the Mahananda, it is also inundated by the Padma. Chakran Chap of Maulavibazar and Muljan of Manikganj are located alongside minor rivers - the Manu and Kaliganga.

### **Distance from River Gauge Stations:**

The two locations of Chakran Chap and Muljan are close to the river gauge station (Manu Railway Bridge and Taraghat). Two others are located at some distance from the river gauge stations.

### **Educational Institutions:**

A major objective of the field evaluation is to assess the impact of educational materials. So a key criterion for selection of the locations has been the existence of schools and a high school, in particular. Three of the selected locations have each a high school. Only Goalbathan does not have any general school. A primary school is being built there. This village may be used as a control village in assessing the significance of educational materials.

### **Village Characteristics:**

Muljan of Manikganj is a developed village. It is a major centre of NGO activities. Three other villages are quite remote. Chakran Chap of Maulavibazar is an embanked



97

village. Goalbathan is also protected to some extent. Two other villages are completely unprotected. Anupnagar is subject to flooding by the Mahananda as well as Padma. The pilot study areas do not represent the FAP 10 project area in the statistical sense. But they have been chosen with great care to represent as much diversity as possible. This will enable researchers to conduct the field evaluation in a variety of situations and gain important observations from the field.

### **Census/Survey:**

A base line census has been conducted in each village location. Surveys have also been conducted in all these four locations with a structured questionnaire. The survey focuses upon the socio-economic background of the respondents- household heads - their flood experiences, their exposure to mass media, their sources of flood-related information. The survey has covered 443 household heads from four villages of four districts and regions of the country. The respondents figured 80 in Goalbathan of Jamalpur district, 147 in Muljan of Manikganj district, 149 in Anupnagar of Nawabganj district and 67 in Chakran Chap of Maulavibazar district.

### **Interviews with stakeholders:**

Interviews with local stake holders including officers of the local administration and leaders of local communities have been done.

### **Questionnaires:**

Two selected questionnaires have been constructed. Both have been pretested and modified after pretesting. The shorter questionnaire has been used for base line survey. The longer one with additions (after completion of implementation of all interventions) will be used in the winter of 1996-1997.

## Preliminary Findings from Four Pilot Evaluation Study Areas:

The findings of the survey suggest that in the past the household heads rarely got any official flood warning. As table 1 shows their most important sources of flood warning about the last flood they experienced were friends, relatives and villagers.

Table 1: Sources of Flood Warning during the Last Flood by Area: First most Important source.

| Sources             | Areas       |          |        |          |           |          |              |          |       |          |
|---------------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                     | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                     | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Villagers           | 20          | 25.0     | 4      | 2.7      | 28        | 18.8     | 36           | 53.7     | 88    | 19.9     |
| Friends & Relatives | 60          | 75.0     | 143    | 97.3     | 121       | 81.2     | 31           | 46.3     | 355   | 80.1     |
| Total               | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 413   | 100      |

The significant fact that 80 percent of them rated friends and relatives as the most important source through which they learnt about the coming of flood indicate that they did not receive any institutional warning at any level-including the local level and the source reliability, as it happens in any disaster situation, was of prime importance to the respondents.

People come to know about the likelihood of flooding through multiple sources.

Table 2: Sources of Flood Warning during the Last Flood: Second Most Important source.

| Sources                          | Areas       |          |        |          |           |          |              |          |       |          |
|----------------------------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                                  | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                                  | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Villagers                        | 4           | 5.0      | 0      | 0        | 1         | 0.7      | 14           | 20.9     | 19    | 4.3      |
| Neighbours                       | 0           | 0        | 0      | 0        | 0         | 0        | 4            | 6.0      | 4     | 0.9      |
| Union Parishad                   | 0           | 0        | 0      | 0        | 0         | 0        | 2            | 3.0      | 2     | 0.5      |
| Newspaper                        | 2           | 2.5      | 1      | 0.7      | 0         | 0        | 0            | 0        | 3     | 0.7      |
| Radio                            | 0           | 0        | 0      | 0        | 1         | 0.7      | 5            | 7.5      | 6     | 1.4      |
| When flood water entered village | 0           | 0        | 0      | 0        | 3         | 2.0      | 0            | 0        | 3     | 0.7      |
| Frequency of rain                | 3           | 3.8      | 0      | 0        | 8         | 5.4      | 1            | 1.5      | 12    | 2.7      |
| Rise of river water              | 6           | 7.5      | 0      | 0        | 3         | 2.0      | 6            | 9.0      | 15    | 3.4      |
| Strong current in river          | 0           | 0        | 1      | 0.7      | 9         | 6.0      | 3            | 4.5      | 13    | 2.9      |
| Lighting in the sky              | 0           | 0        | 1      | 0.7      | 0         | 0        | 1            | 1.5      | 2     | 0.5      |
| Strong Wind Flow                 | 4           | 5.0      | 0      | 0        | 2         | 1.3      | 0            | 0        | 6     | 1.4      |
| Others                           | 1           | 1.3      | 0      | 0        | 1         | 0.7      | 0            | 0        | 2     | 0.5      |
| No Response                      | 60          | 75.0     | 144    | 98.0     | 121       | 81.2     | 31           | 46.3     | 356   | 80.4     |
| Total                            | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

Here the silence is extremely significant. About 80 percent of the respondents had no other sources of information. The importance of villagers decreased greatly. Yet it was quite substantial as the second most important source of information about the impending flood. Radio or the press was barely mentioned. A few others relied upon personal observation.

As table 3 shows the sources of information had further dried up for the respondents. Neither mass media nor local level leadership did play any part in providing flood warnings.

Table 3 : Sources of Flood Warning during the Last Flood- Third Most Important Source

| Sources                          | Areas       |          |        |          |           |          |              |          |       |          |
|----------------------------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                                  | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                                  | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Villagers                        | 0           | 0        | 0      | 0        | 1         | 0.7      | 1            | 1.5      | 2     | 0.5      |
| Friends                          | 1           | 1.3      | 0      | 0        | 0         | 0        | 2            | 3.0      | 3     | 0.7      |
| Neighbours                       | 0           | 0        | 0      | 0        | 1         | 0.7      | 3            | 4.5      | 4     | 0.9      |
| Matber                           | 1           | 1.3      | 0      | 0        | 0         | 0        | 8            | 11.9     | 9     | 2.0      |
| Union                            |             |          |        |          |           |          |              |          |       |          |
| Parishad                         | 0           | 0        | 0      | 0        | 0         | 0        | 2            | 3.0      | 2     | 0.5      |
| Newspaper                        | 1           | 1.3      | 0      | 0        | 0         | 0        | 0            | 0        | 1     | 0.2      |
| Radio                            | 0           | 0        | 0      | 0        | 0         | 0        | 2            | 3.0      | 2     | 0.5      |
| When flood water entered village | 0           | 0        | 0      | 0        | 1         | 0.7      | 2            | 3.0      | 3     | 0.7      |
| Frequency of rain                | 3           | 3.8      | 0      | 0        | 6         | 4.0      | 0            | 0        | 9     | 2.0      |
| Rise of river water              | 2           | 2.5      | 0      | 0        | 15        | 10.1     | 4            | 6.0      | 21    | 4.7      |
| Strong current                   | 1           | 1.3      | 0      | 0        | 4         | 2.7      | 6            | 9.0      | 11    | 2.5      |
| Lighting in the sky              | 1           | 1.3      | 1      | 0.7      | 0         | 0        | 0            | 0        | 2     | 0.5      |
| Strong wind                      |             |          |        |          |           |          |              |          |       |          |
| flow                             | 1           | 1.3      | 0      | 0        | 0         | 0        | 0            | 0        | 1     | 0.2      |
| No Response                      | 69          | 86.3     | 146    | 99.3     | 121       | 81.2     | 37           | 55.2     | 373   | 84.2     |
| Total                            | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

Over recent years there has been rapid diffusion of radio and TV in rural areas of Bangladesh. Nearly 31 percent of the respondents owned radio as can be found from table 4. But about 11 percent of the respondents only owned TV in four villages which is shown in table 4 and 5.



Table 4: Ownership of Radio by Area

| Ownership Status | Areas       |          |        |          |           |          |              |          |       |          |
|------------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                  | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                  | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Own              | 26          | 32.5     | 56     | 38.1     | 48        | 32.2     | 7            | 10.4     | 137   | 30.9     |
| Does not own     | 54          | 67.5     | 91     | 61.9     | 101       | 67.8     | 60           | 89.6     | 306   | 69.1     |
| Total            | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

Table 5: Ownership of TV by Area

| Ownership Status | Areas       |          |        |          |           |          |              |          |       |          |
|------------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                  | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                  | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Own              | 9           | 11.3     | 31     | 21.1     | 8         | 5.4      | 0            | 0        | 48    | 10.8     |
| Does not own     | 71          | 18.0     | 116    | 78.9     | 141       | 94.6     | 67           | 100      | 395   | 89.2     |
| Total            | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

A flood is a time of crises. Audience behaviour changes during a time of disaster. Radio and TV are not only sources of flood warnings, they can also provide public instruction about how to cope with flood during and after it. Table 6 shows that household heads had lower scope for regular media consumption during the flood.

Table 6: Audience Behaviour during Flood: Listening to Radio or Watching TV during the Last Flood by Area

| Frequency | Areas       |          |        |          |           |          |              |          |       |          |
|-----------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|           | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|           | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Regular   | 22          | 27.5     | 39     | 26.5     | 12        | 8.1      | 0            | 0        | 73    | 16.5     |
| Irregular | 31          | 38.8     | 74     | 50.3     | 109       | 73.2     | 42           | 62.7     | 256   | 57.8     |
| Never     | 27          | 33.8     | 34     | 23.8     | 28        | 18.8     | 25           | 37.3     | 114   | 25.7     |
| Total     | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

But this is mainly due to an absence of regular media consumption in the village of Chakran Chap of Maulavibazar which is an embanked village and might not have radios during the last flood. But irregular listening to radio and watching to TV were quite

wide spread. Regular media consumption was the highest in Muljan (53.4%) - an advanced village. But irregular media consumption was the highest in Anupnagar which was a frequently flooded village. It provides indirect evidence that people try to get flood-information from media during the flood. No effort was made to compare current media consumption with that of flood situation as flood experiences varied from location to location and audience behaviour is related to the availability of mass media. Additionally the diffusion of mass media is occurring rapidly in Bangladesh.

The issue was further explored through focusing upon the respondents' views about the most effective channels of disseminating flood warnings. Table 7 shows that an overwhelming majority of respondents preferred loud hailer - reliable local level dissemination through interpersonal channels.

Table 7 : Most Effective Media of Communication of Flood Warnings - First Preference by Area

| Media                 | Areas       |          |        |          |           |          |              |          |       |          |
|-----------------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                       | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                       | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Television            | 9           | 11.3     | 66     | 44.9     | 0         | 0        | 0            | 0        | 75    | 16.9     |
| Radio                 | 13          | 16.3     | 27     | 18.4     | 5         | 3.4      | 2            | 3.0      | 47    | 10.6     |
| Village Leader        | 3           | 3.8      | 3      | 2.0      | 2         | 1.3      | 2            | 3.0      | 10    | 2.3      |
| UP Member             | 1           | 1.3      | 0      | 0        | 1         | 0.7      | 6            | 9.0      | 8     | 1.8      |
| Ansar, VDP, Chowkidar | 1           | 1.3      | 0      | 0        | 0         | 0        | 0            | 0        | 1     | 0.2      |
| Microphone            | 51          | 63.8     | 42     | 28.6     | 140       | 94.0     | 47           | 70.1     | 280   | 63.2     |
| Siren                 | 1           | 1.3      | 0      | 0        | 0         | 0        | 7            | 10.4     | 8     | 1.8      |
| Flag & Light          | 0           | 0        | 6      | 4.1      | 0         | 0        | 1            | 1.5      | 7     | 1.6      |
| No Response           | 1           | 1.3      | 3      | 2.0      | 1         | 0.7      | 2            | 3.0      | 7     | 1.6      |
| Total                 | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

There is little reliance on local leadership - both informal and formal. TV comes as the second most important channel for disseminating flood warnings. But this view comes mainly from Muljan - an advanced village. None from Anupnagar and Chakram Chap

gives first preference to TV and only a few from these villages prefer radio. But as a whole radio emerges as the third most important channel preferred by the respondents.

As table 8 shows when the respondents were asked to list the second most effective channel of disseminating flood warnings, about one-third of them indicated radio. More than one-fifth preferred siren. About 15 per cent of them preferred local leadership. Nearly 12 per cent indicated TV.

Table 8: Most Effective Media of Communication of Flood Warnings -Second Preference by Area

| Media                 | Areas       |          |        |          |           |          |              |          |       |          |
|-----------------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                       | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                       | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Television            | 12          | 15.0     | 39     | 26.5     | 1         | 0.7      | 0            | 0        | 52    | 11.7     |
| Radio                 | 25          | 31.3     | 53     | 36.1     | 68        | 45.6     | 1            | 1.5      | 147   | 33.2     |
| Village Leader        | 6           | 7.5      | 14     | 9.5      | 32        | 21.5     | 0            | 0        | 52    | 11.7     |
| UP Member             | 3           | 3.8      | 7      | 4.8      | 4         | 2.7      | 1            | 1.5      | 15    | 3.4      |
| Ansar, VDP, Chowkidar | 0           | 0        | 2      | 1.4      | 1         | 0.7      | 1            | 1.5      | 4     | 0.9      |
| Microphone            | 5           | 6.3      | 15     | 10.2     | 5         | 3.4      | 12           | 17.9     | 37    | 8.4      |
| Siren                 | 15          | 18.8     | 2      | 1.4      | 37        | 24.8     | 44           | 65.7     | 98    | 22.1     |
| Flag & Light          | 0           | 0        | 5      | 3.4      | 0         | 0        | 5            | 7.5      | 10    | 2.3      |
| Others                | 1           | 1.3      | 0      | 0        | 0         | 0        | 0            | 0        | 1     | 0.2      |
| No Response           | 13          | 16.3     | 10     | 6.8      | 1         | 0.7      | 3            | 4.5      | 27    | 6.1      |
| Total                 | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

Table 9 shows that one-fourth of the respondents had no idea about the third most effective channel for disseminating flood warnings. About one-third of them indicated local level leadership. The radio was preferred by 16 percent of the respondents. About the same number wanted sirens and lights.

Table-9: Most Effective Media of Communication of Flood Warnings - Third Preference by Area

| Media                 | Areas       |          |        |          |           |          |              |          |       |          |
|-----------------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                       | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                       | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Television            | 4           | 5.0      | 4      | 2.7      | 11        | 7.4      | 0            | 0        | 19    | 4.3      |
| Radio                 | 13          | 16.3     | 22     | 15.0     | 34        | 22.8     | 2            | 3.0      | 71    | 16.0     |
| Village Leader        | 16          | 20.0     | 28     | 19.0     | 60        | 40.3     | 0            | 0        | 104   | 23.5     |
| UP Member             | 4           | 5.0      | 7      | 4.8      | 22        | 14.8     | 5            | 7.5      | 38    | 8.6      |
| Ansar, VDP, Chowkidar | 1           | 1.3      | 1      | 0.7      | 6         | 4.0      | 0            | 0        | 8     | 1.8      |
| Microphone            | 4           | 5.0      | 32     | 21.8     | 2         | 1.3      | 0            | 0        | 38    | 8.6      |
| Siren                 | 5           | 6.3      | 0      | 0        | 2         | 1.3      | 8            | 11.9     | 15    | 3.4      |
| Flag & Light          | 1           | 1.3      | 7      | 4.8      | 10        | 6.7      | 20           | 29.9     | 38    | 8.6      |
| No Response           | 32          | 40.0     | 46     | 31.3     | 2         | 1.3      | 32           | 47.8     | 112   | 25.3     |
| Total                 | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

The perceptions and felt needs of the community are quite clearly articulated in the views of the respondents. They prefer a balance between dissemination through mass media and local level interpersonal channels. More advanced villages appear to give greater importance to mass media. Clearly mass media will play increasingly more important role in future. But at present local level dissemination is of crucial importance. As table 10 shows about 36 per cent of the respondents thought that broadcast of flood warnings through dialects would be very effective. Nearly half of them regarded it to be somewhat effective.





Table 10: How Effective are Flood Warnings if Broadcast in Dialects ?

| Level of Effectiveness | Areas       |          |        |          |           |          |              |          |       |          |
|------------------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                        | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                        | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Very Effective         | 74          | 92.5     | 2      | 1.4      | 66        | 44.3     | 19           | 28.4     | 161   | 36.3     |
| Some what Effective    | 6           | 7.5      | 79     | 53.7     | 81        | 54.4     | 45           | 67.2     | 211   | 47.6     |
| Not at all Effective   | 0           | 0        | 60     | 40.8     | 2         | 1.3      | 1            | 1.5      | 63    | 14.2     |
| No Response            | 0           | 0        | 6      | 4.1      | 0         | 0        | 2            | 3.0      | 8     | 1.8      |
| Total                  | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

The respondents did not have any clear idea about formal flood warning. They were not able to offer many suggestions for the improvement of flood warning. As table 11 shows about one-third of the respondents had not suggestions. It is interesting that none but one from Chakran Chap had any suggestion for improvement for flood warning as it was an embanked village. Nearly half of them suggested widespread use of loud hailer/miking for providing local level warning services. Nearly 16 percent - most of them from Muljan suggested use of broadcasting for dissemination of flood warnings. It was significant that the respondents gave little emphasis upon local leadership.

The findings suggest two things. First, the indigenous knowledge system with respect to flood warning is not accessible to majority of people. Secondly, the survey may not be an appropriate methodological tool for capturing subtle and restricted forms of knowledge which a community has about the premonition of a disaster like flood. It is interesting that 95.5 percent of the respondents of Chakran Chap had no suggestion as it was an embanked village. Other items were pointed out by them earlier.

69

Table 11: Suggestions for Improving Flood Warnings by Area

| Measures  | Areas       |          |        |          |           |          |              |          |       |          |
|---|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|   | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|   | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Radio   |             |          |        |          |           |          |              |          |       |          |
| Broadcasting                                      | 4           | 5.0      | 25     | 17.0     | 3         | 2.0      | 0            | 0        | 32    | 7.2      |
| Broadcasting through TV                           | 3           | 3.8      | 34     | 23.1     | 0         | 0        | 0            | 0        | 37    | 8.4      |
| Warning through loud speaker/miking               | 18          | 22.5     | 44     | 29.9     | 133       | 89.3     | 0            | 0        | 195   | 44.0     |
| Through Siren                                     | 2           | 2.5      | 0      | 0        | 0         | 0        | 0            | 0        | 2     | 0.5      |
| Dissemination through UP Member                   | 0           | 0        | 1      | 0.7      | 0         | 0        | 1            | 1.5      | 2     | 0.5      |
| Dissemination through local Leader                | 0           | 0        | 1      | 0.7      | 1         | 0.7      | 0            | 0        | 2     | 0.5      |
| Drum beating                                      | 0           | 0        | 0      | 0        | 7         | 4.7      | 0            | 0        | 7     | 1.6      |
| More information about water level                | 9           | 11.3     | 2      | 1.4      | 0         | 0        | 0            | 0        | 11    | 2.5      |
| More information on water level in catchment area | 1           | 1.3      | 0      | 0        | 0         | 0        | 0            | 0        | 1     | 0.2      |
| Others  | 0           | 0        | 5      | 3.4      | 0         | 0        | 0            | 0        | 5     | 1.1      |
| No Suggestions                                    | 40          | 50.0     | 35     | 23.8     | 4         | 2.7      | 64           | 95.5     | 143   | 32.3     |
| No Response                                       | 3           | 3.8      | 0      | 0        | 1         | 0.7      | 2            | 3.0      | 6     | 1.4      |
| Total   | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

Yet when the respondents were provided with a check-list of items instead of the open-ended question like the previous one, they were quick to articulate their views and indicate their preferences. More than half of the respondents wanted information about depth of inundation as the first most important item of an effective warning system. About 16 percent of them underscored the importance of a local level flood warning system. About the same number of respondents stressed upon the fact that false warnings should not be issued. About 6 percent of respondents underscored the importance of frequent broadcasting. Another 5 percent thought that information about area of inundation was of utmost importance.

Table 12: Most useful Elements of Flood Warning - The First Preference by Area

| Elements       | Areas       |          |        |          |           |          |              |          |       |          |
|----------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Not Broadcast  |             |          |        |          |           |          |              |          |       |          |
| False Warning  | 8           | 10.0     | 35     | 23.8     | 5         | 3.4      | 19           | 28.4     | 67    | 15.1     |
| Issue Local    |             |          |        |          |           |          |              |          |       |          |
| Flood Warning  | 10          | 12.5     | 9      | 6.1      | 33        | 22.1     | 18           | 26.9     | 70    | 15.8     |
| Depth of       |             |          |        |          |           |          |              |          |       |          |
| inundation     | 56          | 70.0     | 88     | 59.9     | 79        | 53.0     | 2            | 3.0      | 225   | 50.8     |
| Area of        |             |          |        |          |           |          |              |          |       |          |
| inundation     | 3           | 3.8      | 1      | 0.7      | 7         | 4.7      | 12           | 17.9     | 23    | 5.2      |
| Frequent       |             |          |        |          |           |          |              |          |       |          |
| Broadcasting   | 0           | 0        | 1      | 0.7      | 14        | 9.4      | 10           | 14.9     | 25    | 5.6      |
| Information    |             |          |        |          |           |          |              |          |       |          |
| about Health   |             |          |        |          |           |          |              |          |       |          |
| Hazards        | 2           | 2.5      | 5      | 3.4      | 1         | 0.7      | 3            | 4.5      | 11    | 2.5      |
| Information    |             |          |        |          |           |          |              |          |       |          |
| about shelter  | 1           | 1.3      | 1      | 0.7      | 3         | 2.0      | 1            | 1.5      | 6     | 1.4      |
| Information on |             |          |        |          |           |          |              |          |       |          |
| roads,         |             |          |        |          |           |          |              |          |       |          |
| highways       | 0           | 0        | 4      | 2.7      | 7         | 4.7      | 0            | 0        | 11    | 2.5      |
| No Response    | 0           | 0        | 3      | 2.0      | 0         | 0        | 2            | 3.0      | 5     | 1.1      |
| Total          | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

As table 12 shows more than half of the respondents wanted warning about depth of inundation as the first priority. About 16 per cent wanted local flood warning. About the same number of people was concerned with false warning.

Table 13: Most useful Elements of Flood Warning - Second Preference by Area

| Elements       | Areas       |          |        |          |           |          |              |          |       |          |
|----------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Not Broadcast  |             |          |        |          |           |          |              |          |       |          |
| False Warning  | 1           | 1.3      | 30     | 20.4     | 9         | 6.0      | 3            | 4.5      | 43    | 9.7      |
| Issue Local    |             |          |        |          |           |          |              |          |       |          |
| Flood Warning  | 8           | 10.0     | 20     | 13.6     | 23        | 15.4     | 8            | 11.9     | 59    | 13.3     |
| Depth of       |             |          |        |          |           |          |              |          |       |          |
| inundation     | 12          | 15.0     | 22     | 15.0     | 35        | 23.5     | 1            | 1.5      | 70    | 15.8     |
| Area of        |             |          |        |          |           |          |              |          |       |          |
| inundation     | 21          | 26.3     | 38     | 25.9     | 49        | 32.9     | 13           | 19.4     | 121   | 27.3     |
| Frequent       |             |          |        |          |           |          |              |          |       |          |
| Broadcasting   | 8           | 10.0     | 5      | 3.4      | 9         | 6.0      | 21           | 31.3     | 43    | 9.7      |
| Information    |             |          |        |          |           |          |              |          |       |          |
| about Health   |             |          |        |          |           |          |              |          |       |          |
| Hazards        | 22          | 27.5     | 21     | 14.3     | 16        | 10.7     | 5            | 7.5      | 64    | 14.4     |
| Information    |             |          |        |          |           |          |              |          |       |          |
| about shelter  | 5           | 6.3      | 4      | 2.7      | 3         | 2.0      | 9            | 13.4     | 21    | 4.7      |
| Information on |             |          |        |          |           |          |              |          |       |          |
| roads,         |             |          |        |          |           |          |              |          |       |          |
| highways       | 3           | 3.8      | 2      | 1.4      | 5         | 3.4      | 4            | 6.0      | 14    | 3.2      |
| No Response    | 0           | 0        | 4      | 2.7      | 0         | 0        | 3            | 4.5      | 7     | 1.6      |
| Total          | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

Table 13 shows the respondents' views on the second most preferred items which should be included in any useful warning system. Here the emphasis is more on the area of inundation (27.3%) and depth of inundation (15.8%). Nearly 15 percent of the respondents wanted information on health hazards. The next important item was local flood warning. Nearly 10 percent of the respondents stressed upon frequent broadcasting. About the same number of respondents opined that false warnings should not be issued.

Table 14 shows the third most preferred elements of flood warnings as viewed by the respondents. Here the topmost priority was on information about health hazards. There was increased demand for information about flood shelters and roads and highways. Frequent broadcasting and information on area of inundation were quite important. There was increased salience of non-responses, but those were mainly from Chakran Chap - the embanked village.



Table 14: Most Useful Elements of Flood Warning - Third Preference by Area

| Elements       | Areas       |          |        |          |           |          |              |          |       |          |
|----------------|-------------|----------|--------|----------|-----------|----------|--------------|----------|-------|----------|
|                | Goal Bathan |          | Muljan |          | Anupnagar |          | Chakran Chap |          | Total |          |
|                | No.         | Per Cent | No.    | Per Cent | No.       | Per Cent | No.          | Per Cent | No.   | Per Cent |
| Not Broadcast  |             |          |        |          |           |          |              |          |       |          |
| False Warning  | 1           | 1.3      | 8      | 5.4      | 9         | 6.0      | 2            | 3.0      | 20    | 4.5      |
| Issue Local    |             |          |        |          |           |          |              |          |       |          |
| Flood Warning  | 1           | 1.3      | 2      | 1.4      | 24        | 16.1     | 1            | 1.5      | 28    | 6.3      |
| Depth of       |             |          |        |          |           |          |              |          |       |          |
| inundation     | 4           | 5.0      | 25     | 17.0     | 12        | 8.1      | 0            | 0        | 41    | 9.3      |
| Area of        |             |          |        |          |           |          |              |          |       |          |
| inundation     | 20          | 25.0     | 17     | 11.6     | 24        | 16.1     | 1            | 1.5      | 62    | 14.0     |
| Frequent       |             |          |        |          |           |          |              |          |       |          |
| Broadcasting   | 16          | 20.0     | 26     | 17.7     | 24        | 16.1     | 15           | 22.4     | 81    | 18.3     |
| Information    |             |          |        |          |           |          |              |          |       |          |
| about Health   |             |          |        |          |           |          |              |          |       |          |
| Hazards        | 22          | 27.5     | 45     | 30.6     | 33        | 22.1     | 5            | 7.5      | 105   | 23.7     |
| Information    |             |          |        |          |           |          |              |          |       |          |
| about shelter  | 10          | 12.5     | 11     | 7.5      | 11        | 7.4      | 4            | 6.0      | 36    | 8.1      |
| Information on |             |          |        |          |           |          |              |          |       |          |
| roads,         |             |          |        |          |           |          |              |          |       |          |
| highways       | 2           | 2.5      | 3      | 2.0      | 8         | 5.4      | 4            | 6.0      | 17    | 3.8      |
| Others         | 0           | 0        | 1      | 0.7      | 1         | 0.7      | 0            | 0        | 2     | 0.4      |
| No Response    | 4           | 5.0      | 9      | 6.1      | 3         | 2.0      | 35           | 52.2     | 51    | 11.5     |
| Total          | 80          | 18.1     | 147    | 33.2     | 149       | 33.6     | 67           | 15.1     | 443   | 100      |

Tables 13 and 14 show respectively the second and the third most important items which should be included in a sound warnings system. More than one-fourth of the respondents stressed upon the area of inundation as the second most important item. There was increased emphasis upon health hazards, shelters and the condition of roads. The health hazards featured more sharply when the respondents were asked to indicate the third most important item of a sound warnings system. More emphasis was also given to more frequent broadcasting and information about shelter.

Preliminary findings of the survey provide a broad range of views of the people at the grassroots level about the dissemination of flood warnings in four pilot villages of the country located in Maulavibazar, Jamalpur, Manikganj and Nawabganj districts. The evaluation study provides strong evidence that during the past floods people have not

৯৯

received formal flood warnings. There is a felt need for an effective flood warning system at the community level. The villagers of pilot areas prefer a balanced mechanism of dissemination - a combination of centralised dissemination through mass media and the local level interpersonal dissemination. The study also highlights villagers' views about the elements of an effective and sound flood warning system.

The feedback from the villages is stimulating and will be highly valuable in developing an effective FFWRS in Bangladesh.

