

*Regional Cooperation
On
Flood Warning*

MAP

Organized by:

Bangladesh Disaster Preparedness Forum
Duryog Nivaran &
Department of Water Resources Engineering, BUET

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A Brief Report
On
Workshop
On
Regional Cooperation On Flood Warning

May 04 – 06, 1995

Workshop Coordinator:

Nayeem Wahra

Disaster Forum

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Introduction

Small flashy rivers in the border region of Bangladesh in the Northwest, north east and East are “marginalised” so far as flood forecasting and warning systems are concerned. Similar conditions are prevailed elsewhere in the region. Local people have their own understanding and wisdom regarding the incidence of calamities but they cannot manage it adequately due to absence of information and forecast. Recent day practice by issuing flood forecast does not cover flashy rivers and constraints are imposed by administrative and political boundaries. However, the need to mitigate the suffering of people from flash flood is thoroughly recognised. It is realized that simple indicators could be developed for operationalising them at local level within a framework of regional cooperation. The need for understanding the issues and option for development of community based flash flood warning for small regional –local rivers must be responded.

Nothing that such efforts would fill up the void in the existing national flood forecasting activities. a three day workshop on Regional Cooperation on Flood Warning organized by Bangladesh Disaster Preparedness Forum, Duryog Nivaran and Water Resources Engineering Department, Bangladesh University of Engineering & Technology (BUET) was held on 4-6 May at BUET. The workshop has six business sessions. Participants from India, Nepal and Bangladesh were present. List of participants are given in Appendix -1

Inaugural Session

The session was inaugurated by the Vice Chancellor (in-charge), BUET. In his speech, he welcomed the participants and other distinguished guests. He also anticipated that the outcome of the workshop would strengthen the regional cooperation in mitigating the sufferings of common people caused by flash flood. As a special guest, Ms. Belinda Coote, CR, Oxfam appreciated the collaboration of other local and international institutions whose joint effort transformed the idea into reality.

In fine, Prof. M. Hossain, Head of the Dept. Water Resource Engineering Department, BUET, thanked everyone and requested the participants and resource personals to attend to the working sessions of the workshop.

Discussion in the Workshop in Brief

The total discussion in the workshop was classified into 3 days and everyday there were 4 to 7 sessions. The brief minutes of everyday's sessions are stated below.

DAY-1, MAY 4, 1995

The first session of the first day was chaired by Prof. A. Nishat and co-chaired by prof. M. Hossain.

A theme paper on "Regional Co-operation on Flood Warning" (Appendix-II), was presented by Dr. F. Bari which formed the basis for general discussion.

The house felt that initially big scale operation is not what they are looking for. Local level operation is required at the moment. What they are asking for is not any sophisticated data at the moment. They are aiming at receiving some simple understandable warning and information for the villagers to get enough time to save themselves. Everybody felt that they need to develop a system where information can be shared between areas and regions of two neighbouring countries and states.

Some form of data exchange exists between the Bangladesh and India at Govt. level. But still information flow is not enough for the vulnerable communities. Joint River Commission (JRC) of India and Bangladesh operate for Major River only and they have no plan to include smaller rivers. An alternative system needs to be developed for sharing information on smaller rivers most of which are flashy in nature.

The house raised questions on how many NGOs are there in the concerned areas (the border areas, affected areas and also areas by which flood is caused), do the existing NGOs have the capacity to operate for this purpose? To whom and to which areas will the information be transmitted.

It was also realized that the situation of Bangladesh with India is the same as India with Nepal. Specific information and enough data are not available in any of these three countries.

The house was concerned about the behavior of “FLASH FLOOD” and “NORMAL FLOOD”. Flash flood which are different and require different approaches. It was felt that alternative small scale approaches need to be promulgated, to help the village people, where simple information is good enough for local level flood warning.

FLASH FLOOD: Usually occur in hilly areas and it takes less than 4 hours to inundate the areas. It comes suddenly and washed away everything within a couple of hours.

NORMAL FLOOD: *When inundation cause damages of life and resources then it is called flood. In Bangladesh normal flood means the flood of the plain land which is also known as padma and Jamuna basin. Water comes slowly and stands for one to two weeks time.*

At the end, the house came to the consensus that, they start with simple process, with whatever resources already exist. The three countries will collaborate and co-operate for managing flood and forecasting at the local level, involving grass root people, local community groups, and community based organization that will all help one another between and within the countries.

The second session on the first day was chaired by Mr. Tushar Bhattacharya. In this session, Prof. A. C. Sinha from India, Mr. Jeetendra B. & Mr. Gopal Shiwakhli from Nepal and Mr. Abdul Matin from Bangladesh took part in the discussion. They presented information on their respective nation’s flood warning system and networking system. All three countries expressed dissatisfaction with their existing warning and information sharing systems.

Delegates from Nepal raised the issue of the “Right to Information” which is very important everywhere. They stated that any Nepali seeking any information on any public issue from any Govt. organization can get it. Govt. has to give access to complete documentation/list of information within 3 days. If the public are not satisfied, they can take the cause to the Supreme Court. Nepal has Landmark Supreme Court ruling in this case.

- Mr. Matin summarized the flood problem in Bangladesh and stated that:
- Only 7.5% of the total catchment area lies within Bangladesh.
- 90% of the annual water flow originates outside Bangladesh.
- We need information otherwise we are vulnerable.
- In 1988 2/3rds of Bangladesh was under water.
- The 1988 flood water rose more than 1 meter in 24 hours in some districts.
- WDB did not get enough information. What does the “danger level” mean? The common people do not know.

- In 1988 there was US\$4-4.5 million of immediate damage and US\$718.6 million long term damage.
- 19,000 Educational Institutions were under water and 240,000 tubewells were flooded. There was no drinking water. Communication by air and land was not possible as the land was completely under water.
- Topographical situation – makes floods inevitable.
- Poverty – aggravates the vulnerability of local communities.
- Coping mechanisms – of the community provide learning lessons.
- Disaster preparedness- is a 365 day job for local villagers.

After detailed discussion the house felt that the information which is needed includes map, data on rainfall, water flow, water level, embankments etc. This information needs to be collected and transmitted properly and timely. The possibility of a Regional Cooperation group at the non govt. level for doing these activities should be considered. The house thought this effort should start at the field level. All activities should be local and to be built up from there.

It was also suggested that, since an informal system is working in South East Asia, whether some lessons could be learnt from them, translate information into areas of concern? Whether a mechanism of getting institutional information could be developed?

The house also realized the importance of need for information for Bangladesh before making any plans, because 90% of its annual water flow originates from outside Bangladesh and people do not know anything about it until the water reaches here and by then it is too late.

Everybody felt the absence of Bhutan from the seminar. It would have been useful if some representatives were present. Efforts should be made to identify possible networking partners.

DAY-II, MAY 5, 1995

The first session of the second day was chaired by Mr. Dipak Gyawali. The session started with the consensus to concentrate the discussions on the effects of small rivers and flash flood. Governments are already involved with the big and large rivers and we wish them the very best so that they can come to agreement satisfactory to all. Some of the existing local warning systems are quite effective and examples could be taken from there to develop an understandable system for flood warning for the “marginalized” rivers in the regional context.

The issues to be discussed were transformed into two questions:

- 1) What kind of technology is there that the existing society can use within the limits of its capability and stress bearing capacity?
- 2) What kind of society is capable of generating and analyzing the data and tools necessary for such a development intervention?

The participants were divided into two groups: *The Technology Group* and *The Society Group* to discuss the above questions respectively.

Suggestions and recommendations made by the both groups are stated below:

The Technology Group:

- Groups working in the flash flood area could be brought together.
- Plea should be made to governments about better weather forecasting collaboration.
- Information on movement of clouds & rainfall needs to be gathered, through Government, Universities and other Institutions.
- Awareness among people needs to be raised (They must listen and believe the weather forecast).
- NGOs could be selected under regional co-operation.
- Local level collaboration should be developed incorporating local people.
- Co-operation in Lower/Upper reaches must be established.
- Practicalities of communication need to be considered. (e.g. phones, network, radios are not consistent).
- Flash flood prone rivers need to be identified and then prioritized for case study.

The Society Group:

- Local level (it was agreed that existing community in the Thana or Block or ward of Village Development Communities (in Nepal’s case) will be the local level) collaboration on flood forecasting & warning will be established.
- Source of information will be identified and utilized. This was divided into two parts e.g. Formal & informal. Formal sources are Thana, Union Parishad and Blocks etc. and to identify the informal sources an investigation survey can be carried out in Sylhet in Bangladesh and Joyantipur in India.

- Information flow must exist. This was also divided into two parts e.g. Formal & Informal. Formal flow includes loud speaker, Ham-radio, Megaphone, local level government administration etc. The informal flows are floating logs, flags, and social institution like Temples, Mosques, Churches, and Schools etc.

Recommendations and findings of the two groups were then jointly discussed. It was agreed that the following points need to be addressed to in developing an alternative flood forecasting system for flashy river which will be locally managed and operated.

Summary of the above suggestions and discussions:

- Content of information
- Channel of information
- Credibility of information
- Community based participatory information system
- Information to be immediate/contemporary

It was agreed that a Research team should be developed to work in indigenous warning system, where

Analytical Tool: Data Analysis

- Slowly develop a technique
- Bring together all the technique
- Develop some kind of indicator (upstream will only give information, not interpretation)
- Credibility is important.
- 90 minutes to 2 hours response is a very good time.
- 60 minutes lead time is also good.
- Somebody should be responsible to pass messages from one place to another.

The second session of the second day was chaired by Tushar Bhattacharya. The Chairperson conveyed that work should begin with 2 to 4 rivers to identify the catchment area and if possible the affected areas. Then it will be easier to identify the starting point.

A Research Methodology was suggested:

- Visits to identify areas collect official data, select areas vulnerable to flash floods.
- Time of year (occurrence).
- Assessment of lead time.
- Identification of NGO/partners/peoples institution etc.
- Folk wisdom.

Data will be needed on Topography, slope, vegetation, soil type. Steps in developing and action programme will be,

Select study area
/
Frequent visits
/
Basic data collection
/
Analysis & consultation with participating team
/
Formulate warning system

IDENTIFIED RIVERS : Juri, Shuri, Dhalai, Dawki, Kalni.
SELECTED RIVERS : Dawki (For Bangladesh and India)
Mechni and its small tributaries to the west
(For India and Nepal)

Issues which need to be identified:

- Desires & needs for a warning service.
- Types and forms of warning.
- How to disseminate the information.
- What type of accessible information we have, how to translate that into understandable information.
- What will be the channel of information sharing?
- History of the area.
- Who will conduct research/study?
- Time factor.
- Academic collaboration (BUET Authority volunteered to encourage such initiative. At the same time we need to pursue the related Govt. and Non Govt. Organization in this regard. In this connection BUET can work as a collaborator, but the main role has to be played by the concerned NGOs.
- Identify umbrella organizations like Universities, Royal Nepal Academy of Science & Technology (RONAST) in Nepal, AIT, and Bangkok etc.

Suggested Funding:

Local Funding from local sources can be organized in the three countries (India, Bangladesh & Nepal). If work is done effectively then more fund can be organized for greater intervention. Fund

can be sought by preparing a proposal, and channeling it through DURYOG NIVARAN and member organizations.

Time Frame:

Since it was decided that local funds can be arranged a time frame with activities was also set, which is as follows:

0-3 MONTHS

1. Select the study area.
2. Make 1, 2 visits.
3. Quick compilation of past records.
4. Pre-record "Needs" of people and people's perceptions.
5. Methodology of the large pilot study.

DAY – III, MAY 6, 1995

At the beginning of the third day the Panel members (Dr. Nishat, Dr. F Bari, Dr. M Hossain, Mr. Nayeem Wahra, Mr. Matin, Mr. DK Mishra, Mr. D. Gyawali and Mr. Harry Jayasingha) held a meeting. The main concerns and gaps were discussed in this meeting. Also ideas on recommendations were brought up.

Then Group discussions with all participants were held, where the main concerns were discussed and recommendations formulated, which are stated below:

Concerns:

After the three days brain storming the workshop reached consensus on the following issues, where the main concern is primarily the marginalized vulnerable communities affected by Flash Flood.

- The house is much more concerned about the process of mitigation than the cause of flood.
- Emphasis is given on the reality of the misery and the urgent need for mitigation.
- The house proposes to stress on the implementation rather than conceptual discussion of the issues.
- The spectrum of applicable technology should match the existing social spectrum.
- It is acknowledged that gaps exist in Information Collection & Sharing and in Program Design regarding flood in the small marginalized rivers within and across the countries.
- It is also recognized that an alternative mechanism needs to be promoted which helps close this major lacuna.
- This effort at closing the gap is an activity that complements activities of Government at the national and regional levels.
- It is felt that the seriousness of the problem demands that an immediate start be made first at a pilot level to get the effort underway.
- It is realized, in view of the severity of human misery and suffering involved, that information generated by this effort should be timely and should strive for maximum credibility.

Recommendations

During the various sessions, the participants and the facilitators made comments and recommendations on different issues highlighted in the workshop. At the very end, they were scrutinized and summarized by the facilitators as,

1. INFORMATION GAP – Sharing/ Learning

Content/channel/credibility
Nepal-Bihar/India
India-Bangladesh
Study on information flow.
Use folk wisdom
Impact of operation of water control structures within and beyond one country.

2. LOCAL LEVEL COLLABORATION

Community Level – small
Alternative Institutional mechanism
Small marginalized river catchment

3. PILOT PROJECT

a) Locale of the study

Dawki (Sylhet & Jyantia, Meghalaya) & Mechi (Jhapa, Nepal & Kishanganj, Bihar)

b) Institutions involved

Umbrella support/Net work

Nepal Water Conservation Foundation/Inhured Int./ Oxfam-Nepal/Oxfam-India/State
Voluntary Health Association in Meghalaya and Tripura/University/Ronast (Nepal)/AIT
(Bangladesh).

c) Time Frame

0-5/6 months:

1. Select the study area.
2. Make ½ visits
3. Quick compilation of past records
4. Pre-record “Needs” of people and people’s perceptions
5. Methodology of the large pilot study.

d) Funding – Local for Phase-I

4. Network Extension

Bhutan

5. Institutional Arrangement for collaboration

Steering Committee

In order to pursue the recommendations, a steering committee was formed as follows:

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April 23, 1995

**Workshop on Regional Cooperation on Flash Flood Warning
May 4 – 6, 1995
Organized by Dept of Water Resources Engg, BUET, Dhaka
and Disaster Forum, Dhaka**

**Opportunities and Approaches for Regional Cooperation for the
Development of an Alternative Flood Warning System**

Professor M.F. Bari
Dept of Water Resources Engg, BUET, Dhaka

Summary

Development and operation of a successful flood warning system in Bangladesh depends upon availability of flood level and rainfall agreement provides for transmission of Indian data to Bangladesh only after certain flood level and rainfall amounts are recorded at designated stations, such initiatives have not been quite beneficial due long and tortuous transmission routes and uncertainty in receiving these upstream data. Also experience shows that a centralized Flood Forecasting and Warning Centre (FFWC) is not suitable for issuing local flash flood warnings which are better done through local initiatives and community participation. Distinction is to be made between large river and flash flood and corresponding warning system.

In view of these considerations, an alternative system is needed, especially to provide warnings of flash floods in the border areas, and to communicate the warnings through community participation in a comprehensible and easy to understand from the people in the flash flood prone areas.

The purpose of this paper is to provide some ideas about the need and approaches of developing an alternative flood warning system through regional cooperation, especially of non-government organizations who can collaborate effectively and have a good working relationship at the grass-root level and can be much more flexible in their activities than government institutions. Government institutions are highly centralized and have little flexibility in their response. They take a top-down approach and usually have weak links at grass-root levels, which constraints implementation.

The objectives of an alternative system are that it should be at an appropriate technology level, durable, and easy to operate and maintain. The idea is most appealing for providing timely, readily understood warnings to people in flash flood-prone areas. Flash flood warning systems are best developed and managed at a local scale through community participation. Such an approach can

also be of help to those in large river flood zones. Experience shows that smaller communities may not be able to take advantage of centralized activities of FFWC and their sophistication.

The development of such a system centres on an effective cross-border link and information flow and exchange relating to flood level, and rainfall, and other data that may be helpful for downstream flood warning and initiation necessary preparedness and response. This will give people sufficient time downstream people will be benefitted cost without any extra cost on the part of any upper riparian country. There are situations where both countries can have mutual benefits. For example, considering the case of India and Bangladesh, there are at least two rivers: Mahananda and Mathbhanga, which make India upper riparian at one reach and Bangladesh afterwards and vice versa. Cooperation can be developed involving countries that share both resources, and woes and sorrows of common rivers.

It is envisaged that these two basic actions will be initiated by two or three distinctly different messages/signals which can be readily understood and distinguished by all villagers. Details of the technology required to generate these warning messages and/or signals, and of the actions that villagers should take in response to the messages/signals have to be worked out by discussion with the people in the locality.

The proposed warning system will be direct, less time-consuming and at an appropriate technology level that can be maintained and sustained in rural areas.

Field investigations will be needed to identify the needs for the flash flood warning system and the requirements of the system. It will also reveal certain preparatory actions which need to be taken care of through some form of institutional arrangement. It calls for preparation of logical plans of action for villagers to follow in preparing and executing their evacuation to safe ground.

Needed institutional arrangements for the project are also briefly considered and tentative suggestions are provided.

The project may be implemented by the Disaster Forum with the cooperation of Bangladesh University of Engineering and Technology (BUET), research institutes and other allied agencies at home and in the region.

1. Floods in Bangladesh

Floods are one of the major natural phenomena capable of producing a disaster of national significance in Bangladesh. Flooding occurs in all regions although more damaging flooding due to cyclonic storm surges is generally confined to the coastal areas. In addition to the risk to urban populations, the rural community can be very badly affected by floods and extensive stock and crop losses are common. Social infrastructure is also severely disrupted during floods, particularly through the closing of roads and other transport links.

The types of flooding vary from flash flood problems in northern and eastern rivers where the time between the occurrence of the rainfall and the flooding is of the order of several hours or less, to situations where major flood peaks may take weeks to move through river systems, particularly

those in the Brahmaputra-Jamuna and Ganges basins. A flash flood is generally defined as a flood of short duration with a relatively high discharge. The Bureau of Meteorology in Australia (Cock and Elliott, 1989) defines flash flooding in terms of the speed with which it occurs, considering any event where the time between the first rain and the resultant flood peak is less than six hours to be a flash flood. Flash flooding normally accompanies severe thunderstorm activity. As a consequence of the speed of onset and the potentially high runoff volumes, it can represent a high risk to loss of life and property in some areas. It is a particular risk in densely populated urban areas and is also a threat in many less developed areas.

2. Role of Flood Warning

It has become increasingly apparent that certain non-structural techniques are suitable either as alternatives to, or in combination with engineering works. This is because all areas may not be suitable for structural solutions but more importantly because structures may be overtopped as their capacities are exceeded. Many non-structural measures are considered inappropriate for this country. These include compulsory acquisition of flood prone land, relocation, and certain types of flood proofing. Interest in non-structural measures in Bangladesh has focused on flood forecasting and flood warning systems.

Experience in the USA has shown that reliance on purely structural approach of flood hazard mitigation is inappropriate (Arnell, 1984). Non-structural measures evolve both as alternative to structural technique and as a measure to cope with events that exceed structural capacities. Flood forecasting and warning system is a non-structural measure of flood hazard mitigation, reducing the loss of lives and properties.

Flood warning systems are becoming increasingly sophisticated as flood forecasting has utilized technical advances in the use of weather radar and computer modeling. This has provided the possibility for increased lead times, and subsequently an improved services.

3. Elements of Flood Warning System

Many researchers have attempted to model flood warning systems and warnings systems in general (Williams, 1964; Foster, 1980; Ferrel and Krzysztofowicz, 1983). Much has been learned from these attempts about the theoretical barriers to flood warnings effectiveness and the key relationships that determine failure or success.

Also, flood warning dissemination procedures were seen to be affected by both flood forecasting procedures and local emergency planning within general institutional arrangements for flood warning. In turn these are governed by catchment characteristics and frequency of use.

In the research carried out in the Severn Trent Water Authority area in England and Wales (Neal and Parker, 1989), the key element in determining effectiveness was felt to be response, but that this would depend on a range of other variables. Often the range of psychological, physiological and socio-economic factors affecting response is ignored. Furthermore there is mounting evidence from England and Wales that the prime objective of the individual is not only to reduce damage but also involves attempts to minimize stress (Green et al., 1983, 1984, Green and Penning-Rowell, 1985; 1988).

Lessons from previous research indicate that, besides response one of the key elements affecting flood warning effectiveness is the level of emergency preparedness planning involved. The common conclusion is that flood warnings should not be used to try to disseminate detailed adaptive plans; rather a flood warning should be the catalyst that triggers a series of emergency measures learned by recipients through public education programmes within an overall preparedness strategy. Emergency planning can greatly enhance the potential effects of flood warning systems.

Summarizing the key elements of flood warning systems are: the methods used to warn the public and the content of the warning message, public participation which will have a strong influence on response through an increase in credibility of the message giver, an efficient dissemination process. Ultimately these relationships will determine flood warning lead time which is the practical limit to an effective response.

4. Flood Warning Services in Bangladesh

Computers have revolutionized flood warning technology in recent years, giving rise to sophisticated systems that often combine remote rain gauges and river stage instruments with powerful software on base station microcomputers.

As for any other country there is also an urgent need for reliable flood forecasting and warnings in Bangladesh, especially of severe events before they arrive. For such events, which may cause widespread loss of life as well as property and crops, maximum possible lead times are required.

Flood Forecasting and Warning Centre (FFWC) of BWDVB has a national responsibility for providing flood warning services and a fairly good flood warning system has been developed in Bangladesh FAP 10 study "Flood Forecasting and Warning" has the objective of strengthening and integrating the existing flood forecasting and warning system. One of the required tasks is the installation of a data management system on a central computer system including software to forecast the behavior of both the main rivers and possibly the eastern flashy rivers with sufficient lead time.

History of flood forecasting and warning systems in Bangladesh dates back to the 1960s when a flood information cell used to work under Director of Hydrology during flood time only. Water level and rainfall data from a number of stations used to be monitored during flood time. The water level and rainfall data were collected through telegraphs and telephones. This arrangement was very inadequate and no forecast was issued. Currently activities of flood forecasting and warning are being carried out by a Flood Forecasting and Warning Centre (FFWC) placed under Director, Surface Water Hydrology-II. In order to strengthen the activities of Flood Forecasting and Warning, a preparatory assistance was obtained from UNDP with World Meteorological Organization as executing agency. Through this assistance one Hydrological Radar and a telemetric network have been installed in Moulvi Bazar for radar based flood forecast for the flashy rivers.

However, the flood forecasting and warning services provided in Bangladesh are not adequate. Presently danger level based forecasts and warnings are issued for major rivers only. It suffers from a number of limitations and shortcomings;

- Firstly, flood warning systems fail to identify target groups;
- Secondly flood warning messages fail to provide individuals with the information they require; and
- Generally, such forecasts and warnings are of no use as it is given on the following day.

Moreover, it is required to make distinction between the nature of flood warnings for flash floods and large river floods due to characteristic difference between the two types of floods. There is a need for a separate flood warning system for flashy rivers due to several reasons.

- Firstly, it seems difficult to produce a satisfactory solution for the flashy rivers as the attempts of using weather radar to estimate rainfall intensity over Meghalaya and Tripura have not been successful (FAP 6, 1994) in the past.
- Secondly, flood forecast production time for the main river system is 4 hours. But such a flood forecasting system would not be appropriate for flash flood warning problem because by the time the 4-hr computerized forecasting process is even initiated, the flash floods will already have passed through population centres and localities.
- Thirdly, on the production of forecasts, which will now relate only to the network of the larger rivers, the early warning will be communicated only to disaster management and relief agencies and to the media. Thus any warning is likely to reach rural people since, for the greater part, they have no access to these sources of information in any form.

In view of these considerations, an alternative system is needed to provide warnings of flash floods, such as in the Northeast border areas, and to communicate the warnings through community participation in a comprehensible and easy to understand form, to the rural people scattered throughout the areas.

Conventional data collection and flood forecasting techniques are generally not appropriate for flash flood warning situations. The time delays inherent in the centralized data collection, forecast preparation and warning dissemination used for the larger rivers significantly reduces the effectiveness of flood warning using such approaches in these situations. The effectiveness of any form of warning system is ultimately measured by the extent of the response to the warnings. This response is effected by many factors; however, the need to minimize the delays between the occurrence of the event, the awareness of this by the forecasting authority and the initiation of the emergency response plan must be amongst of the most important. In the case of the regional forecasting role of the FFWC, each of these actions involves may involve several agencies.

For flash flood warning the consolidation of the actions into one agency closest to the local scene is considered the best way to achieve optimum effectiveness. Such local flash flood warning systems have proven to be effective in many communities in the US (Barrett, 1986).

Inevitably it is very difficult to forecast floods on flashy rivers in border areas, and to provide sufficient warning time to enable necessary precautionary measures and evacuation.

Because of the need to rely on Indian data, and because of uncertainty in receiving these upstream data by Bangladesh, who only receive border stations data and forecasts, Bangladesh's forecasts for severe floods are limited to generally 24 hours on major rivers, or at the most for downstream locations along main rivers, 72 hours. The situation is even worse as far as from flash flood warnings are concerned.

5. Flash Floods in Bangladesh

In some years, and often several times in such years, intense heavy rainfalls over the Indian states, such as in Meghalaya and Tripura generate dangerous flash floods in the rivers entering the Northeast Region from these states. These flash floods are not restricted in their occurrence to the pre-monsoon season or to the monsoon season; they occur in both of these seasons, and they may also occur in the dry season whenever nor-westerns hit the area as in February 1993 and March 1994.

The flash floods travel down these rivers for some 20 to 30 km, causing havoc in river-side villages, before their energy is dissipated by the merging of their flows in the larger rivers of the region. Flash flood-caused damages are therefore incurred in two separate areas of the Northeast Region.

(i) Meghalaya Border Area

This area extends from the border with Meghalaya southwards to the Rangsha and Surma Rivers, and from the Malijhee River in the west to the Lubha River in the east.

(ii) Tripura Border Area

This area extends from the border with Tripura northwestwards to the Kushiara River, and from the Sutang River in the southwest to the Sonai Bardal River in the northeast.

5.1 Damages caused by Flash flood

Flash floods generally are characterized by the rapidity with which the river water level rises to a peak level exceeding that of the river bank. The peak level sometimes occurs during night time, and is almost never reflected in BWDB water level records which are collected exclusively in day time.

The time in which such a rise occurs is typically less than a day, often less than an hour and the rise may take place instantaneously. The rapid rise in water level not only inundates riverside villages but does so with fast moving water. Flow velocities of 3 to 6 m/s typically occur during peak, flows, and anyone or anything exposed to water travelling at such speeds will experience a strong drag force for as long as the flow persists, and a strong impact if the flood rise occurs as a bore. It is these impacts and drag forces which result in people losing their lives, in dwellings collapsing, and in livestock and belongings being swept away.

It has been estimated from field investigations (FAP 6, 1994) in nine villages in the border areas of the Northeast Region, which were devastated by flash floods in 1988 and 1993 that the average losses were as follows:

- * 0.5% of the villagers lost their lives;
- * 40% of their dwellings were destroyed, and the dwelling contents lost; the latter included food and fuel stocks, cooking utensils and clothing, as well as furnishings;
- * 38% of their livestock was lost including 13% of their buffaloes, 23% of their cows, 42% of their goats, and 72% of their chickens.

The nine villages investigated in the above study are listed below together with the corresponding river:

Bhogai	Nakuagaon
Someswari	Bhabanipur
Jadukata	Maharam
Dhalai(N)	Chilabhanga
Shari	Kamrangi
Juri	Jahangirai
Manu	Rainsaf
Dhalai(S)	Hiramati
Karangi	Himagao

Such disasters appear to occur with an average frequency of about once in five years (T=5 yrs) in the nine villages investigated. Altogether there are an estimated 250 villages beside the flash flood prone rivers of the Northeast region, such with an average population of around 1,000. On this basis it is tentatively estimated that, on a regional scale, some 250,000 people are exposed at some time to flash floods, and that over a period of 100 years some 30,000 lives may be lost. The scale of disaster will, however, diminish downstream from the Indo-Bangladesh border near which all of the villages investigated were located.

The scale of these losses and damages in the Northeast Region is significant and clearly unacceptable, and it is acknowledged that something ought to be done to reduce them substantially. The purpose of this paper is to discuss some preliminary ideas relating to effectively reducing these losses and damages to a more acceptable low level.

5.2 Flood Damage Mitigation Measures

Possible flash flood damage mitigation measures include flood diversion channels, flood control reservoirs, flood protection embankments, community resettlement and flood warning system. Absence of space for storage reservoir and diversion channels, and cost of flood embankments and community resettlement leaves the flood warning system as the only feasible and practical means of reducing flash flood impacts.

6. Flood Warning System Requirements

Flash floods travel faster than large river floods and velocities upto 6 m/s (22 km/hr) have been observed elsewhere. Thus times of travel from the Indo-Bangladesh border, the farthest upstream point at which they can be detected in the river channel are likely to be substantially less than 90 to 100 minutes required by most villagers in the flash flood prone areas to prepare to evacuate.

Therefore a reliable communication system for weather data and flood information exchange in the region is essential for the success of a flash flood warning method.

Possibility exists for greatly improving the current flood forecasting and warning system on these and other large rivers by use of Indian data. Such information would offer the possibility for substantially increasing warning times and the accuracy of forecasts for these rivers, and at no extra cost to India.

The design of a flood warning system features a combination of equipment, a hydrologic model of the stream, a warning system and a plan for community involvement.

The objective of a flood warning system is to give people sufficient time to perform preparatory tasks before evacuation and enable them to move to nearby high ground or shelter. This would save human lives, livestock and property. In order to be able to design an adequate flood warning system, first one needs to consider the following:

6.1 Lead Time

Lead time may be defined as the length of time period between making a forecast issuing first warning and actual occurrence of a flood event. This is the time needed to complete preparatory tasks before evacuation. It is estimated that villagers need at least 100 minutes for this purpose (FAP 6, 1994) and for the purpose of this paper a lead time to 90 to 100 minutes may be assumed as a reasonable value.

6.2 Data Need

Ideally, the first warning would preferably be given by using one of such devices as weather radar, telemetric rain gauges and weather satellite to detect flood producing rainfall over the Indian catchment. These technologies are expensive, and many practicalities virtually make, for the near future, their application infeasible in the presently needed flood warning system. It follows that, for the foreseeable future, the first warning should be activated by obtaining information about rainfall and/or rising river stage via other alternative sources.

7. International and Regional Cooperation

The problem of flood forecasting on international rivers is well-recognized. Various UN Agencies and WHO have been particularly active in this field, working to bring about international cooperation between neighbouring countries to ensure that downstream countries have access to the upstream data needed for flood forecasting.

As far as cooperation between India and Bangladesh, a series of negotiations have been held over the years under the auspices of Joint Rivers Commission (JRC). Several agreements were reached in the past under which India would pass to Bangladesh relevant flood and storm rainfall data which were routinely collected and analyzed for India's own flood forecasting and warning system. Such data relate to major rivers: Ganges, Brahmaputra-Jamuna, Teesta, Barak (upper Meghna), and also rivers rising in Tripura.

7.1 Past and Current Experiences

Under the latest agreement of 1982, for the Gumti river basin, flood levels of Gumti at Sonamura and Amarpur and daily rainfalls at Agartala, when these exceed 50 mm, would be transmitted to Bangladesh. Sonamura is a border town just upstream of Bangladesh boarder at Bibir Bazar. Since Sonamura is only 7 km upstream of the gauging station at Comilla on Gumti, little benefit would accrue from the receipt of river levels and rates of rise.

There are major structures on the Gumti in Tripura, namely Dumra Dam and Maharani Irrigation Barrage, and it is highly likely that upstream flood levels are monitored as a matter of routine at other locations. Such possibilities are Amarpur and Nutan Bazar which are 80 km and 110 km upstream of Comilla respectively.

Brahmaputra-Jamuna and Teesta river flood forecasting system in Bangladesh comprises four gauging stations as part of 37 gauging stations of the FFWC network for which daily flood bulletins are reported. These stations are: Dalia on Teesta, Kaunia on Teesta, Chilmari on Brahmaputra, Bahadurabad on Jamuna, Serajganj on Jamuna.

For stations further upstream, under JRC agreement flood forecasting data are supposed to be received from India for the Teesta and Brahmaputra. These are: Anderson Bridge on Teesta, Domohoni on Teesta, Pandu on Brahmaputra, Goalpara on Brahmaputra, Dhubri on Brahmaputra.

The agreement also provides for the transmission of storm rainfall data from Indian stations in the Brahmaputra and Teesta basins when daily rainfall exceeds 50 mm. These stations are: Goalpara, Dhubri, Tura, Cooch Bihar, Siliguri, and Jalpaiguri.

In practice Anderson Bridge and Pandu flood data are not received. However, 3 hourly data are received once or twice a day during the flood season for water levels at Domohani, Goalpara, and Dhubri and flood level forecasts for these stations are also received with lead times of 8, 24, and 15 hrs respectively. The regular receipt of Domohani data began only in 1987.

For the Kushiya-Manu River system, there are two gauging stations: one at Maulvi Bazar on Manu (3 km u/s of barrage) and the other Sheola on Kushiya (about 80 km u/s of Sherput on Kushiya). These two gauging stations are also among 37 gauging stations of FFWC network for which daily flood bulletins are issued. Maulvi Bazar flood warning system is based on 4 telemetric gauging stations. These are Manu Railway Bridge on Manu about 30 km upstream of Barrage, Kamalganj on Dhalai about 25 km u/s of Manu Barrage, Shaistaganj on Khowai, Sherpur on Kushiya 10 km d/s of Khyshiyara-Manu confluence. Under an agreement negotiated by the JRC, flood data and 18 hr lead time forecasts for the Barak River (upstream Kushiya) at Silchar are also sent to Dhaka.

7.2 Difficulties and Delay in Data Transmission

Under existing arrangement when flood levels are at or above so called warning stage, flood data should be transmitted from Gumti to Agartala, from there by 'Flood Priority Telegrams' to the Indian Meteorological Department in Calcutta, from there to the Bangladesh Meteorological Department (BMD) in Dhaka via a teleprompter link, and from BMD to the Flood Forecasting and Warning Centre (FFWC). After flood forecast computation by FFWC, this information is to be sent back to the Gumti

at Comilla, just 7 km downstream of Sonamura across the border for which Indian forecasts might have already been made. It is understood that, unfortunately in the course of time and despite attempts to review the data transmission arrangement, much of the hoped-for cooperation in the case of Tripura river flood data has lapsed.

It also is understood that no flood data have been received for the Gumti in recent years. Furthermore the long and tortuous route by which such data was supposed to arrive under the latest agreement has made it almost impossible for the data to arrive in time for effective use, since the flood flow time from Amarapur to Comilla is likely to be in the order of 6 to 8 hours. The whole purpose of the agreement with regard to Tripura rivers appears to have been lost, namely to enable Bangladesh to obtain upstream data already collected by Indian flood forecasting. Office which would permit much earlier forecasts and therefore increased warning times in Bangladesh.

For Silchar (Assam) on Barak 3 hourly flood levels and also 18 hr forecasts are sent almost daily to Dhaka Storm Warning re (BMD) via Gauhati and Calcutta. Silchar is located at about 70 km u/s of Sheola.

Also flood data are supposed to be sent to Dhaka for Kailashahar on Manu in Tripura just across the Border. This has not been realized, and no data are received. Even if data would be received the lead time would be too short to be useful because Kailashahar data would be transmitted first to Agartala, then to Calcutta, and subsequently to Dhaka before any computed forecast can be made and sent back to Maulvi Bazar on Manu.

8. An Alternative Flood Warning System

The development of an effective flash flood warning system is seriously hampered by the target river's upper catchment being located in India. This fact points to the desirability of local cross-border links for flood forecasting data, which seems to be the only practical solution for flash flood areas if warnings are to be made for occasional very severe floods. This would be dependent on establishing some form of communication across the border, preferably by an exclusive flood forecasting link between gauging stations across the border, such as Kailashahar and Maulvi Bazar for the Manu River. What is needed is a spirit of enlightenment and technical understanding, and above all a good-neighbourly cooperation entirely for humanitarian cause.

One approach may to establish local links at a professional level with Tripura and Meghalaya area flood forecasting counterparts through Non-government Organizations (NGOs), and that flood levels and/or forecasts and upstream rainfall data should be send directly from Indian gauging station, to the corresponding gauging stations in Bangladesh. Such links and periodic meetings would be desirable and most effective in establishing a good flood warning system.

The question is one of helping downstream people. NGO's working in the field of development and agencies involved in disaster preparedness and response together with universities and research institutes can play a significant role in this regard.

First it will be necessary to establish contact with India's Central and Regional Flood Forecasting Offices, such as Tripura and Meghalaya State Flood Forecasting Organizations, preferably through

local NGOs, to ascertain precisely what data are routinely collected and what forecasts are made. After establishing these facts, it can be decided that data could be useful flood warning purposes in Bangladesh.

9. Flood Forecasting and Warning : A Simple Approach

It is envisaged that a simple but useful method can be devised for the flood forecasting and issuing warnings. A simple correlation of flood levels between an upstream and a downstream station can be established. Bu use of this relationship a rapid and useful forecast and warning can be issued. Simple correlations and historically recorded lead times could be incorporated into such a system.

It is desirable that, for flashy rivers like the Many and others, simple flood forecasting and warning activities for rare and serious floods should be achievable at local level, rather than relying on the FFWC which may have other priorities in the course of sudden severe floods. Ideally, first one needs to carry out the necessary analyses and correlations and develop a simple-applied forecasting system. This should preferably be updated each year. In summary, the proposed method is envisaged to be more of a warning system than a flood forecasting system. It only has to discriminate between flood producing and non-flood producing situations, in case of flood producing situations which are dangerous and which are not.

10. Regional Cooperation for Flood Warning System

The development of an effective flood warning system is seriously hampered due to location of upper catchment in another country. This prevents the use of rain and stream gauges where they are needed to make such systems functional.

The purpose of this paper is to provide some preliminary ideas: how Non-government Organizations like Disaster Forum and allied agencies, universities and research institutes can collaborate for developing a community-based flash flood warning system at an appropriate technology level through regional cooperation. The proposed system is envisaged to be affordable, durable, easy to operate and maintain. Such an approach can be beneficial to both upper and lower riparian countries for one river or the other. For example, rives like Mohananda and Mathabhanga traverses territories of India and Bangladesh such that either country can be upper riparian for one reach or the other and vice verse.

Disaster Forum in association with BUET and research institutions can facilitate necessary information exchange for the purpose of flood warning through informal and/or formal regional cooperation via its counterpart offices in concerned countries. Conceptually, local offices of such NGO's may obtain information on rainfall and/or river WL from site observation, media, and relevant organizations; and transmit it to any neighbouring country station which is likely to experience flood in next few hours. Upon receipt of the flood information, flash flood warning, mass communication, and related mitigation measures can be initiated. Such efforts are both desirable and justified because receipt of WL and actual or even probable estimate of rainfall in upper catchment may permit issuing forecast and warning in a timely manner. In headwater basins often warning need to be based on rainfall information only since upstream gauging stations do not exist or may not be accessible.

11. Community Participation and Institutional Arrangement

Community involvement is extremely important for the long-term success of a flood warning system. It includes the flood response plan, and a plan to test, operate and maintain system. Starting early in the project development phase, designated operators and maintenance people, community leaders, and local representatives should take part in developing the system.

NGO's working in the area of development and allied agencies involved in disaster preparedness and response can coordinate all related activities. It is envisaged that contacts will be maintained with local representatives, institutions, and concerned government agencies.

12. Plan of Operation

- (1) Identification of Issues Involved
- (2) Workshops
- (3) Case Studies
- (4) Pilot Studies
- (5) Institutional Arrangement

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Action Plan & Latest Development

Sylhet Disaster Forum:

Date of this Report: November 09, 1995

Sylhet Disaster Forum (SDF) has been formed by the participants of a workshop entitled "Alternative Early Flood Warning" in Sylhet (FIVDB Central Training Centre) on June 15, 1995. The workshop was organized by Disaster Forum, Dhaka and Duryog Nivaran (A South Asian Disaster Forum) to promote and share the ideas of people based alternative early flood warning system.

According to the decision of the workshop, SDC formulated an action plan and started working to materialize the dream.

Activities so Far:

The pilot areas have been selected for developing Flood Early Warning System. Areas-wise distribution of rivers and thanas are:

Area (Thana)	Name of River
Zakigonj, Bianibazar	Borak, Surma, Kushiya
Kanaighat, Jointa, Guainghat, Companiganj, Duarabazar	Surma, Luba, Chengerkhal, Bolai

Three groups were involved to undertake rapid appraisal in the catchment and affected areas. Three draft reports were prepared by the groups. Convener of SDF is working to prepare an integrated report where the nature of flash flood and its seriousness would be illustrated at-a-glance.

As SDF is a new organization, it looks to deal with some issues. These are,

- Flash Flood is an every year phenomenon in east and north-east of Sylhet. Almost 95% of flood water comes from neighbouring country. So without involvement of people in the other side of border (India), the warning system will not be effective.
- In India, NGOs' activities are not significant in the bordering areas of Assam and Meghalaya that led limited scope for international networking.
- It is known to many of us that Missionary Groups are quite active in the catchment areas in India. We tried to involve Churches here in Sylhet to make contact with Indian Churches, but churches' management in Sylhet is reluctant to work with

NGOs. They mentioned that without prior permission of Bishop, they could not be able to provide any support to NGOs programme.

- d. It is rather a bit difficult to undertake an alternative flood early warning system (which is people based) without the involvement of two Government as it will need prior permission from Govt. There is a scope to consider by Govt. of both countries that non-governmental networking and communication is another sort of smuggling the information between the two countries.
- e. It has been found out that catchment areas in India are hilly and upland by nature. They do not know what flash flood is. Awareness must be need for them to assess the flood hazardous situation in Bangladesh. This is another problematic area to generate information by the people in India.
- f. SDF people are looking reference materials on Flash Flood Warning. Experience from other countries in South Asia could be helpful for us.

Working Committee:

An eleven member working committee has been formed. So far two meetings of the working committee have been organized. People are enthusiastic to find out solution and reduce the losses by flash flood in Sylhet. Working Committee looks forward to continuous cooperation from national and international level.

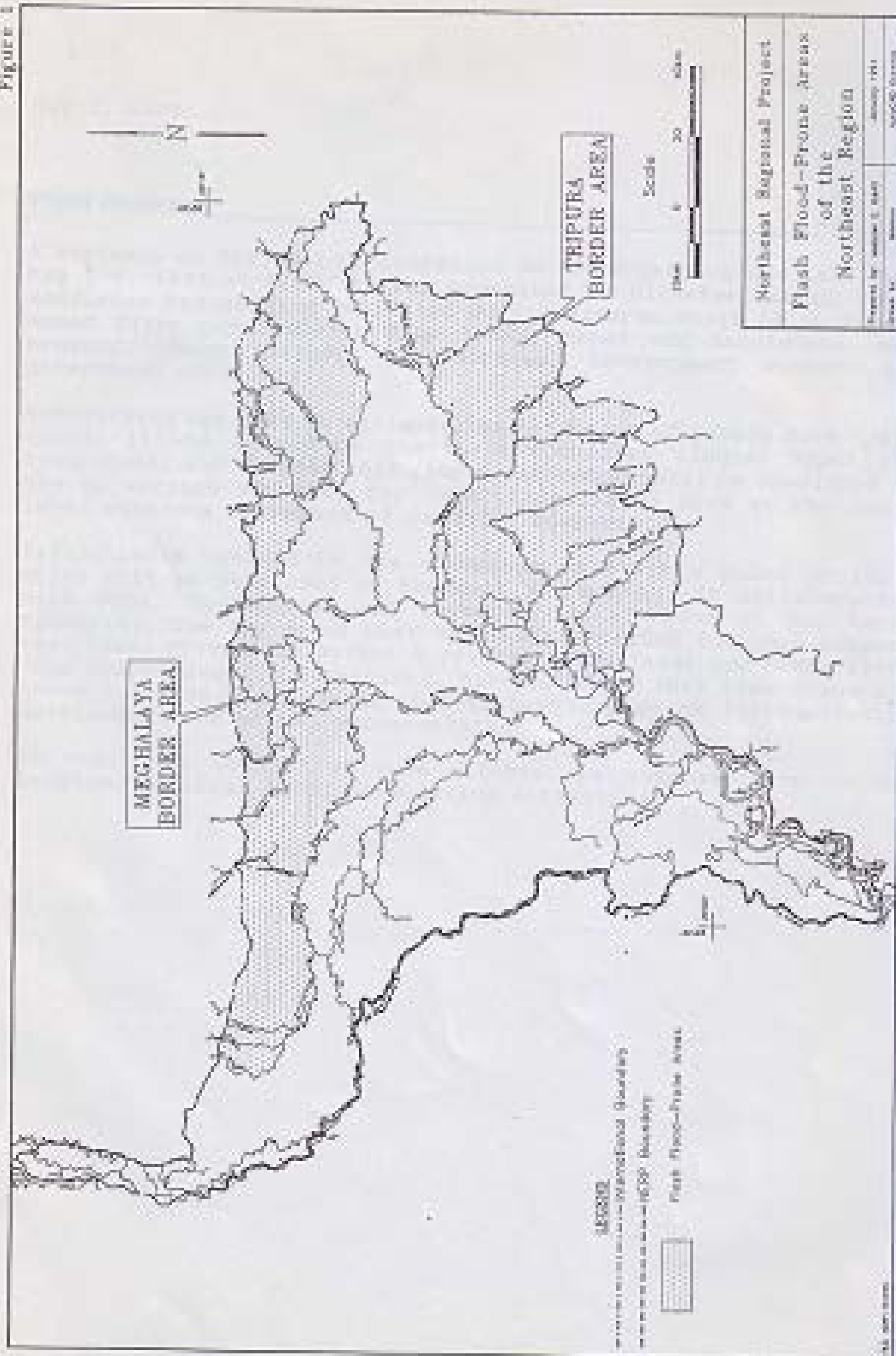
General Committee:

A meeting of general committee was held on July 22, 1995 at VARD office. Twenty four people participated in the meeting. There are organizations and individuals who want to join with us as general member. Responses from Govt. official like Sylhet Radio, Meteorological Department are not encouraging.

Workshop:

SDF is planning to hold next workshop exclusively on Flood Warning sometimes in December in Sylhet with the held of Dhaka based Disaster Forum.

Figure 1



May 7, 1995

Press Release

A workshop on Regional Cooperation on Flood Warning was held from May 4-6, 1995 at BUET. It was organized by Disaster Forum, Water Resources Engineering Dept. and Duryog Nivaran South Asian Forum. About fifty participants from India, Nepal and Bangladesh were present, which includes academicians, development workers and government officials.

Recognizing the need to mitigate the suffering of people from flash flood, it was agreed by the three countries (India, Nepal and Bangladesh) and decided that simple indicators will be developed to use as warning signals, for operationalizing them at the local level within a framework of regional cooperation.

Participants reached to the consensus to start a pilot project, which will be developed in the next six months, in collaboration with NGOs, Educational and Research Institutions of the three countries. The two areas that have been selected for that purpose are: Dawki river (for Sylhet & Jyantia Meghalaya) and Mechi river (for Jhapa, Nepal & Kishanganj, Bihar). After this timeframe all three countries will again sit together to plan on further/future development and actual implementation.

It should be noted that such efforts are complementary to the existing national flood forecasting activities.