

## VULNERABILITY AND RISK REDUCTION THROUGH A COMMUNITY-BASED SYSTEM FOR FLOOD MONITORING AND FORECASTING

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### *Proposed Flood Forum Session*

This paper and presentation is proposed for Session 3, International and Regional Experience: Flood Forecasting, Dissemination of Flood Forecasts and Warning Products, and Meeting Community Needs – Reports on the effectiveness of meeting community needs in other river basins, presented by experts and representatives of international and other national organization.

### *Project Summary*

This project is formally entitled Vulnerability and Risk Reduction Through a Community-Based System for Flood Monitoring and Forecasting, and is known in short as the Community Flood Information System (CFIS). Funded by USAID's Office of Foreign Disaster Assistance (OFDA), Riverside Technology, inc. (RTi) is working with the Center for Environment and Geographic Information Services (CEGIS) and the Bangladesh Disaster Preparedness Center (BDPC), to reduce future vulnerability to flood damage on Bangladesh's floodplain. Developing and strengthening capacity at the community level, the project team is building technical expertise and empowering local communities with flood forecasting information to improve livelihoods in the floodplain communities. An operational system is providing accurate and timely information on current and forecasted flood conditions for a part of Bangladesh's floodplain. The information is being disseminated to the local government and communities in a format that can be understood and used for flood mitigation at the community level. Project plans include expanding the system to larger floodplain areas through demonstration and awareness-building exercises for other flood-prone communities, government agencies, and potential development partners. The five-year project was initiated in late 2002.



**Figure 1. Bangladesh Floodplain Dwellers in Recent Flood**

### *Project Background*

The Ganges, Brahmaputra, and Meghna (GBM) River systems are some of the most flood-prone river systems in the world. Excessive floods present serious risks to the millions of people living in the floodplain areas (Figure 1). In a normal year an estimated 25 percent of Bangladesh is flooded and in an excessive flood year some 65 percent of the country is inundated. Despite constant and pervasive flooding, Bangladesh does not have an effective system for providing useful flood forecasts or other flood warning information to communities and floodplain dwellers. The present system of government-issued

flood warnings is presented in both a context and a format that are neither understood nor usable by the floodplain inhabitants.

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The goal of this project is to reduce vulnerability to damage from flooding in the floodplains of Bangladesh. We have developed a pilot operational system that produces accurate and timely information on current and forecasted flood conditions for a flood-prone area in the Brahmaputra River floodplain. The information is being disseminated to the local government and communities

in a format that is understandable and useful for flood mitigation at the community level. We are encouraging replication of this system for larger floodplain areas through demonstration and awareness-building exercises in flood-prone communities, and with government agencies and potential development partners.

### **Objectives**

The main objectives of this project are as follows:

- 1 – Develop and implement for a representative floodplain of Bangladesh an operational system that produces distributed flood information on a daily basis with a +/- 50 cm level of accuracy.
- 2 – Mitigate the potential impact of flooding by providing useful and understandable flood information to local government officials and to affected communities.
- 3 – Design and plan the distributed flood forecasting and monitoring system(s) for replication in other flood-prone areas of the country.

### **Floodplain Area and Target Community Profile**

Broadly defined, the targeted at-risk communities are the thousands of rural villages and towns in the floodplain areas of Bangladesh. Flood-vulnerable areas of Bangladesh cover more than 50 percent of the country and include a population in the tens of millions. The affected area and number of floods varies by year, but in an extreme year impacts nearly all residents of the floodplains. The disruption caused by these flooding disasters is long lasting, especially for the most vulnerable and poorest disaster victims. The study area for CFIS is representative of this flood-vulnerable population, and is being implemented within a 320km<sup>2</sup> area of the Brahmaputra (Jamuna) River floodplain in Bangladesh (Figure 2) and with a total population of about 250,000 people.

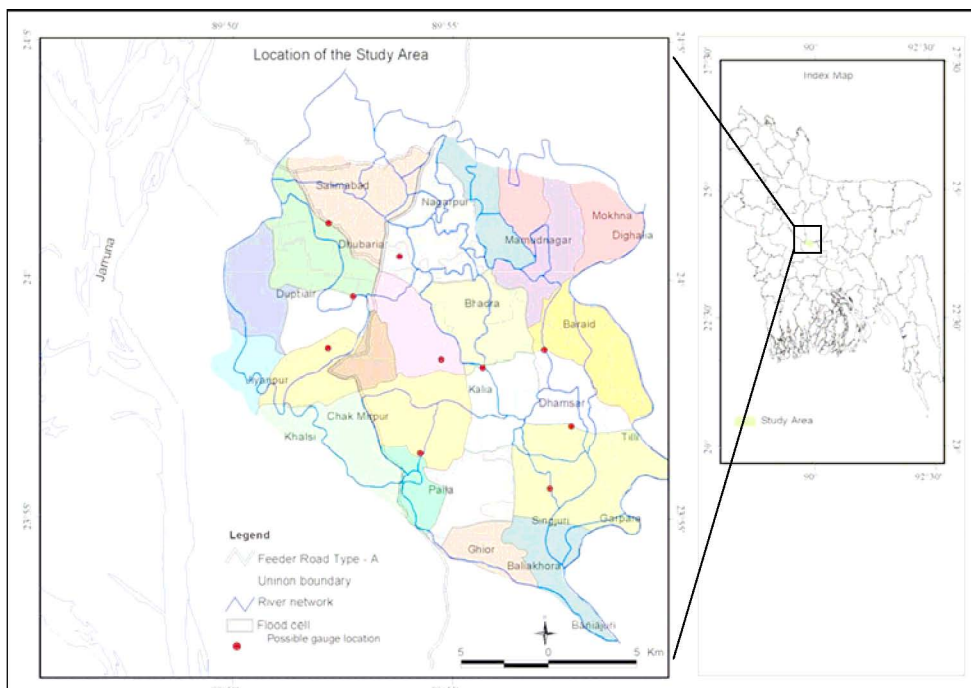


Figure 2. CFIS Project Area in the Brahmaputra (Jamuna) River Floodplain

### **Forecasting Methodology and Dissemination**



Figure 3. One of 17 Floodplain Gauges in the CFIS Project Area

The CFIS project has developed an operational system for the project area that produces accurate, local, daily flood forecasts for the target communities. Along with frequency analyses using historic data and field study, these forecasts are being used for determining risk of communities to flooding.

A relational model, called WATSURF, was developed to forecast water levels in the floodplain, based on regression relations between 17 floodplain gauges (Figure 3) and three river system gauges. The floodplain gauges were setup and maintained by the CFIS project and used to determine their relation with the established river gauges that are observed and maintained by the Bangladesh government, and for which the government's flood warning system is operated. As a GIS-based model, WATSURF extends the point forecasts for the 17 floodplain gauges to a continuous flood forecast map for the entire project area (Figure 4). From the forecast map, WATSURF extracts a specific forecast for any point within the study area and creates a short message service (SMS) text message that is transmitted to mobile phones at selected sites in the field (Figure 5).

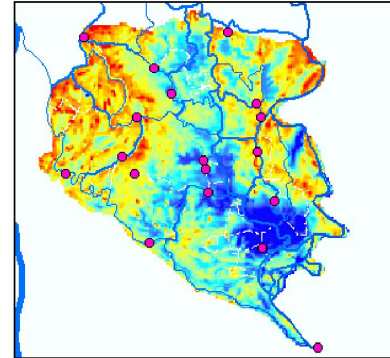


Figure 4. Example of Forecasted Flood Map for the CFIS Project Area

Individuals were selected by the local community to serve as operators, to receive the SMS message and to operate a flag system and bulletin boards for informing the community of the local flood forecast. The message and symbols were designed with active participation of the local people (Table 1). The flood warning messages, expressed in the local measuring unit 'bighat' (=22cm), were generated by WATSURF and sent via SMS to mobile phones of the flag operators, who in turn hoisted the colored flags to symbolize the flood forecast (Figure 6).

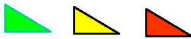

### Community Awareness

The CFIS project is raising awareness with the local people about the forecast and the flood warning dissemination methods. The information is being conveyed by a number of change agents and volunteers (Figure 7). Also, three village flood management committees (VFMC) were formed involving local elites, field level officials of the government departments and local NGOs.



Figure 6. Community-based Operator Hoisting the Flag Warning Message

**Table 1. Flood Message Symbols**

	<p>The present flood situation is represented by three colors of flag: Green – the flood is in normal range, Yellow flag – moderate flood, Red flag – severe flood</p>
	<p>Local 48-hour flood forecasts are represented by two colors: White flag – flood waters will fall, Blue flag – floodwaters will rise. The number of flags represents the magnitude of the rise or fall with each flag representing one ‘bighat’ change in water level.</p> <p>Example: two blue flags indicate a 48-hour forecast of rise of two ‘bighat’ (approximately 44 cm rise).</p>

After receiving basic training, these groups identified the local danger level, flag hoisting sites, flood marker installation sites, and developed their respective flood warning dissemination work plan. The change agents and volunteers worked with the local people to raise awareness on flood disaster preparedness, explaining the implications and interpretations of different types of warning flags. A number of information materials were also developed for effective communication and dissemination of flood warning. The change agents and volunteers performed their roles during the monsoon season and the BDPC field staff monitored and evaluated their performance on regular basis.

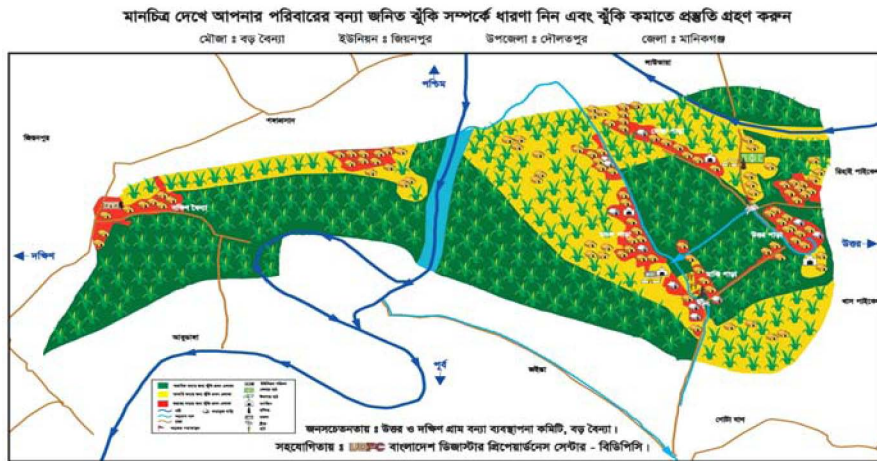
### ***Replication and Sustainability***

The CFIS project has successfully operated during the 2004 and 2005 monsoon flood seasons. During the next two monsoons the CFIS project team will continue to operate the system, but will focus on making the system repeatable, replicable and sustainable. This will require close coordination with the Flood Forecasting and Warning Centre and other agencies, such as the Disaster Management Bureau, and will require strong ties to users in local government and communities. It is expected that, over the long-term,

technical support will be provided by organizations such as CEGIS, BDPC and the Institute of Water Modelling (IWM). These Bangladesh organizations are fully capable of supporting the operations of the system in the future. As the approach is replicated in other areas, there will be a substantial economy of scale and the costs per unit area will need to be affordable.



**Figure 7. Change Agents and Volunteers Working with the Local Community**



**Figure 8. Flood Risk Map Created by the Local Community and CFIS Change Agents**