Jiadhal River Catchment, Assam, India

Building community capacity for flash flood risk management

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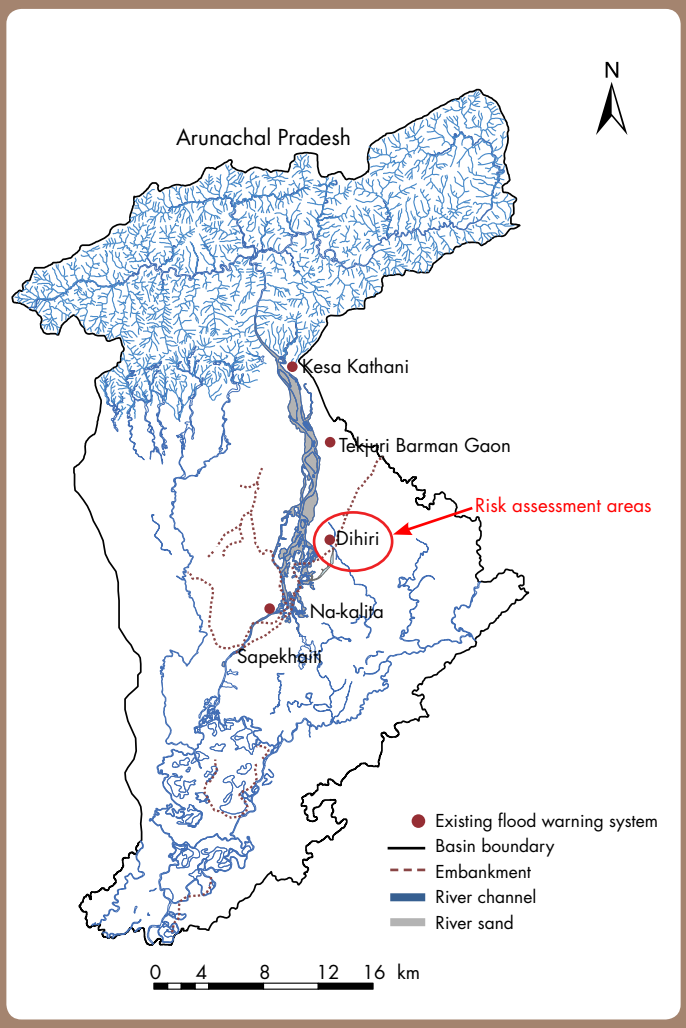
Simple, community-based early warning systems installed in the Jiadhal River have enabled downstream communities to prepare better for flash floods. To make these systems more effective, improved technology and collaboration between upstream and downstream communities and state governments are needed.

Introduction

This case study summarizes the activities and results of a one and a half year action research project conducted in 2010 and 2011 in the Jiadhal River catchment (Figure 10). The research was conducted at three spatial levels: a geo-environmental assessment was conducted at the catchment level; a smaller core of 20 flood-prone villages lying close to embankments were selected for community capacity development at the village cluster level; and two villages on the northern part of the National Highway-52 were selected for flash flood risk assessment at the village level.

The Jiadhal River spans two states of India: Arunachal Pradesh and Assam. A north-bank tributary of the Brahmaputra, the Jiadhal River originates in the lower Himalayan ranges in West Siang District of Arunachal Pradesh and flows southward through the flood plains of Dhemaji District in Assam in a complex network of channels before meeting the Brahmaputra near Majuli Island. The Jiadhal River catchment covers an area of 1,205 km^2, of which 370 km^2 (31 per cent) lie in the hills of Arunachal Pradesh and 835 km^2 (69 per cent) lie in the plains of Assam. The sub- tropical monsoon climate may be stated as the general climate for the whole catchment, with the upper catchment moist in all seasons, with a harsh winter and shorter summers at higher elevations (Hazarika

Figure 10: **Location of Jiadhal River catchment**



2003). Average annual rainfall in the catchment ranges from 2,965 to 4,386 mm, with a mean annual rainfall of about 3,150 mm.

Agriculture is the main source of livelihood in the study area; other livelihood activities include fishing, sericulture, horticulture, employment in the government and private sectors, and wage labour. The study area is inhabited by a number of

communities with different cultures and linguistic characteristics (Mishings, Ahoms, Chutiyas, Konches, Sonowal Kacharis, Bodos, and Deoris). Assamese, Mishing, and Bodo are the principal languages spoken. Hinduism is the religion of the majority of the people, and Islam is also practised by some.

The north bank tributaries of the Brahmaputra generally flow in shallow, braided channels with steep slopes that carry a heavy silt charge and are prone to flash floods (Goswami 1998). The Jiadhal River is a classic example of a flashy river and produces floods with a sudden, high discharge over a short time interval (a few hours to a day) and with a high sediment load and debris. The flashiness of the river can be mainly attributed to high rainfall in the upstream hilly catchment and the basin as a whole, and the steep piedmont zone between the foothills and the flat alluvial plains through which the river flows. Flash floods in this river are generally triggered by continuous heavy rainfall or extreme rainfall events (such as cloudbursts). The river doesn't always flow in a confined channel; the rising bed level caused by deposition of silt results in flood waters overtopping the banks quickly and spreading out like a sheet over a large area in the foothills and plains

The river frequently changes its course during flash floods, resulting in the breaching of embankments, widespread riverbank erosion, and massive inundation and destruction of the countryside, which consists mainly of rural settlements and farmland. The deposition of coarse sand and silt particles on the inundated plains can reduce soil quality making the land unfit for agriculture. This has emerged as the most serious impact of flash floods in the Jiadhal River catchment in the last three decades.

In recent times, devastating flash floods were recorded on the Jiadhal River in 1984, 1988, 1989, 1992, 1994, 1997, 1998, 2002, 2007, 2009, and 2011. In terms of monetary loss, the flood damage in 2002 was about USD 3.1 million (based on the rate of USD 1 = Indian rupees 45). About 680 villages, 9,885 km^2 of land, and 23 million people were affected by the floods of 1998, and 48 people died in floods between 1989 and 2002 (Hazarika 2010). The major flood in 2007 caused by failure of the right embankment near the bridge (National Highway-52) on the Kumatiya branch of the river devastated about 30 villages on the right bank. The flood in 2009 broke the left embankment and caused havoc in about 50 villages. In the year 2011, as many as five waves of flash floods occurred in the river with the most catastrophic taking place on 15 August 2011, severely affecting about 85 villages and 300 hectares of crop land, including a large area with standing crops. Most of these flash floods resulted in failure of embankments and changes in the river course in several places, making the floods more hazardous.

The most serious damage caused by these flash floods is the widespread deposition of sand on fertile agricultural land. About 5.72 km^2 of land lying in more than a hundred villages has been seriously affected by sandcasting (Deka 2008). Land use and land cover analysis conducted as part of this study indicates that in the last four decades (1973–2010), the area affected by sand has increased by 18 per cent and the agricultural area under both summer and winter crops has decreased by 34 per cent, which implies a direct impact on agricultural livelihoods and food security in the catchment area.

Conventional flood management in the Jiadhal catchment is based mainly on the construction of embankments and has failed to protect people from floods and flash floods. While structures such as dykes have underperformed or become counterproductive as a result of poor maintenance, non-structural measures such as flood forecasting, early warning, catchment treatment, and enhancement of adaptive capacity have been largely overlooked. It became necessary to demonstrate the efficacy of a community-based flash flood management system designed with adequate scientific understanding of the flood regime and socioeconomic systems combined with activities to increase community resilience. Accordingly, this project was conducted to:

- generate flash flood early warnings in four villages upstream using simple devices and disseminate the same through community networks to downstream areas to help people to better mitigate flash flood impacts;
- assess vulnerability and risk to populations in a high risk-prone area of the basin as a pilot through flash flood risk mapping using specifically designed field techniques and incorporating both scientific and local knowledge;
- raise awareness in the study area to sensitize communities as to best practices for flash flood risk management; and
- disseminate knowledge gained through the project to local, state, and national level policy makers.

Flood Management in the Study Area: Governance and Policy Perspectives

There is no separate policy for managing floods or flash floods in Assam or India. India's existing water and disaster management policies contain principles and strategies for flood management. At the national level, the first policy statement on flood control was made by the Government of India on 3 September 1954 (Mishra 2002). This statement envisaged three types of flood control measures: immediate, short-term, and long-term. Immediate measures include revetments, spurs, and embankments at selected sites. Short-term measures (second phase) include the construction of embankments and channel improvement covering large parts of affected areas. Long-term measures (third phase) will consist of building of storage reservoirs on certain rivers and additional embankments if necessary (Brahmaputra Board 1985).

The central government has created committees, commissions, and task forces from time to time to study flood and erosion in different regions of India (e.g., High Level Committee on Floods, 1957; the Ministers' Committee on Flood Control, 1964; the National Commission on Floods, 1980; the National Commission for Integrated Water Resources Development, 1999; the Taskforce on Flood Management and Erosion Control, 2004) and their recommendations and suggestions are also acknowledged as policy guidelines for flood managers in national and state agencies. Recently, the National Disaster Management Authority (NDMA) has prepared a set of guidelines for flood risk management to assist the ministries and departments of the national government, the state governments and local governance agencies (like the panchayat raj institutions and urban local bodies) in preparing flood management plans (NDMA 2008).

In India, flash floods are dealt with using the same strategies adopted for normal riverine floods. The fact that flash floods are distinctly different from normal riverine floods in terms of causes, propagation, intensity, impacts, predictability, and management is yet to be recognized by policy makers. Flash floods are generally not considered or investigated as a separate class of events, but merged with the overall seasonal flood situation in government reports.

The National Disaster Management Authority is the supreme administrative institution for disaster management in India; under it are the various state disaster management authorities and district disaster management authorities. These institutions are governed by the National Disaster Management Act, 2005, and the National Disaster Management Policy, 2009. With the enactment of the National Disaster Management Act, there has been a paradigm shift in disaster risk management, from a relief-centric response to a proactive prevention, mitigation, and preparedness-driven approach to conserve developmental gains and minimize loss of life, livelihood, and property. The National Disaster Management Policy captures recent advancements in the field of disaster management and allied disciplines. Through this policy, the Government of India seeks to build a safer and disaster resilient India by developing a holistic, proactive, multi-disaster oriented, and technology-driven approach through a culture of prevention, mitigation, preparedness, and response. If translated into action, the measures contained in this policy will be extremely useful for flash flood management.

The Draft Water Policy of Assam deals better with floods and riverbank erosion than the National Water Policy, although conventional structural measures retain their prominence. Integrated water resource management also receives more attention in this policy. Unfortunately, the present policy is not operational and, in the absence of other influential central guidelines, integrated water resource management is almost non-existent in the institutional mechanisms of water governance in Assam.

The State Government of Assam has adopted structural measures such as embankments, spurs, and porcupines to contain floods and resist bank erosion, including in the Jiadhal River catchment. The Assam State Disaster Management Authority and the Dhemaji District Disaster Management Authority follow routine measures for the capacity building of villagers to enhance flood preparedness by imparting training and awareness on how to deal with floods generally. The National Disaster Response Force is deployed to rescue people when major flood waves strike. The Dhemaji District Disaster Management Authority and the Revenue Department with support from the District Administration provide relief and rehabilitation to deal with post-flood situations. The Central Water Commission provides flood forecasts in terms of water level in different stretches of the Brahmaputra River, but such information is not available for its tributaries.

Methodology

To gain an understating of the geo-environmental and socioeconomic aspects of the study area, secondary information and data were collected from government reports, census reports, journal articles, research papers, dissertations, and newspaper reports. The critical observations of the research team during field studies contributed to this appraisal. To study the changes happening in the landscape in the catchment area, maps were prepared using multi-date satellite data and GIS-based analysis and interpretation. Mapping of hazard, vulnerability, and risk was done using a method designed for this study that integrates information about the physical environment derived from analysis of high-resolution Google Earth Pro Images and socioeconomic data derived from field studies using Participatory Rural Appraisal techniques. Ground verification of the results obtained from image analysis was done using standard methods for participatory GIS mapping.

Project Activities

The project had four distinct components: understanding of the nature and causal dynamics of flash floods in the Jiadhal River in the geo-environmental context of the catchment (research); piloting of a flood early warning system (intervention for disaster risk reduction); sensitizing people on flash flood risk mitigation (education, capacity building, and advocacy); and assessment of flood risk by mapping hazard, vulnerability, and risk (participatory research).

An attempt was made to collect and analyse available information and data on the geo-environmental, hydrological, geomorphologic, and socioeconomic aspects of the Jiadhal River catchment in order to better understand the characteristics of flash floods on this river, their causal dynamics, and impacts. However, limited information and data were available to develop an up-to-date status report on the river and its catchment. Long-term continuous time series hydrological data on discharge, water level, and sediment load were not available. Socioeconomic data and information at the catchment level were also not found. A detailed analysis of land use/land cover using remote sensing and GIS techniques conducted as part of this study pointed to significant changes such as deceasing forest cover, increasing the sand-affected area, and decreasing the area under agriculture.

Four flood early warning systems were installed in four flood-prone villages in the upstream section of the Jiadhal River: Kesa Kathani, No. 2 Tekjuri Barmangaon, Dihiri, and Na-Kalita (Figure 10). These villages were selected for their proximity to the foothills in the upstream section, cooperative villagers, and accessibility during floods. The instrument used in the early warning system was a simple flood alarm device consisting of a flood gauge and a rain gauge calibrated with risk levels by consulting the villagers (Figure 11). The installation and maintenance of this system is simple enough to be handled by the community. The members of the family hosting the instruments and other selected individuals in each village were trained to install, operate, and maintain the flood warning system as well as to interpret the warning sirens. A home light unit that works on LED, along with a mobile phone and charger, were given to each host family.

Awareness programmes were carried out in 20 villages where stakeholder communities were sensitized on relevant subjects such as health, the economy, agriculture, education, perceptions of hazard, vulnerability and risk, flood warning, flood

Figure 11: **Installation of a flood gauge at Barmaba village**

impact, flood mitigation measures, the governance system associated with flood management, role of civil society and the community in flood risk reduction, and good adaptation practices (Figure 12). Demonstration of the flood early warning system using a prototype formed an integral part of all awareness programmes. Awareness programmes were conducted for small groups as shared learning sessions so that both the project team and the community could learn from each other. Each programme was designed to be completed in three to four hours so as not to engage villagers for more than half a day. Twenty Village Flood Management Committees (VFMCs) were formed in different parts of the study area to disseminate flood warnings, support the project work, and continue capacity-building activities.

A cluster of 16 neighbourhoods belonging to two villages, namely, Dihiri (with seven neighbourhoods) and Kekuri (with nine neighbourhoods), located on the north bank of National Highway-52 was selected for the risk assessment study. Inhabited by the Mishing community, these villages are two of the most risk- prone areas in Dhemaji District with poor economic conditions, inadequate flood and erosion mitigation measures, and lack of development infrastructure. The village of Dihiri is virtually unprotected from floods since the old embankment collapsed in 1984 and has nearly entirely eroded away near the village. Of the seven neighbourhoods in this village, three are located on a small riverine island isolated from roads and nearby villages and fully exposed to the river; these villages contain the most vulnerable populations in this area. The village of Kekuri is partly protected by an embankment with villagers scattered on both sides of the dyke-cum-road. Two neighbourhoods live completely outside the embankment, four settlements are partly scattered on both sides, and three are protected by the embankment.

Figure 12: **Community awareness programme at Dihiri village**

Results and Findings

The project resulted in production of a flash flood training module, flash flood risk management guidelines in Assamese language, the publication of the proceedings of a workshop, production of a set of general catchment maps, generation of information and knowledge on the land use/land cover change scenario in the study area, production of risk maps, and the installation of flood early warning equipment supported by community networks.

Generating Knowledge: The project generated new information and knowledge on land use/land cover changes and channel shifts induced by floods in the Jiadhal River catchment over the last four decades. The project established the role of the river's high sediment load in increasing flood havoc and land degradation leading to loss of agricultural livelihoods.

Assessing flash flood risk: The pilot risk assessment exercise carried out on a small scale (in Dihiri and Kekuri) produced an understanding of the factors that determine risk to vulnerable populations and that are common to other similar situations. Examples of such factors include proximity to the river, the condition of embankments, presence or absence of safe shelter, transport and communication facilities, the state of development, and local governance and policy instruments. The risk assessment found that people in the study area are highly vulnerable to flash floods because they live close to rivers and embankments that are in bad shape and prone to breaching in a landscape where there are no roads for transport and communication, which hampers relief and rescue operations. In most cases there are no safe shelters nearby and those that do exist are in a dilapidated condition. The overall socioeconomic condition of communities in the study area is poor, with 80 per cent of villagers living below the poverty line; widespread malnutrition, and a lack of education, safe drinking water, and health and hygiene facilities, making them more vulnerable to flash floods.

Understanding the local governance situation: The performance of local governance agencies is critical to reducing risk in flood-prone areas such as the Jiadhal River catchment. However, lack of transparency, accountability, coordination, and efficiency in the government line agencies at the district level and in the panchayat raj institutions and autonomous district councils hamper flood management and rural development. There is no scope for the participation of communities or civil society in decision making or in the implementation of flood management projects. On the other hand, civil society organizations, students' organizations, and community groups (such as the Jiadhal Nadi Baan Pratirodh Oikya Mancha, Asom Jatiyatabadi Yuva Chatra Parishad, Takam Mising Porin Kebang, and Krishak Mukti Sangram Samiti) play an exemplary role through advocacy and activism as watchdogs over the government's performance in flood mitigation and rural empowerment programmes. They also carry out non-violent agitations from time-to-time to demand technically suitable flood management projects, an end to corruption in the implementation of government programmes, and proper compensation, rehabilitation, and resettlement packages for people affected by floods and erosion. In addition to compelling authorities to provide information on flood control schemes using the Right to Information Act (2005), these local organizations have succeeded in getting the Water Resources Department to attend negotiations with local people. Some of these organizations have participated in activities undertaken as part of this project and by other agencies pertaining to flood risk reduction.

Assessing the policy situation: The fact that Assam does not have a clear policy on flood or flash flood management hampers decision making, implementation, and coordination in relation to flood mitigation projects. Although flood management in a transboundary river such as the Jiadhal calls for joint river management between the state governments (of Assam and Arunachal Pradesh), especially in the upstream catchment in the hills and foothills, there is no formal mechanism in place to facilitate joint efforts for ecologically sensitive structural interventions, river training, or the exchange of flood information. The prevailing system of rehabilitation and resettlement does not meet the needs of flood-affected people. Non-structural measures for flood mitigation and other major recommendations from relevant commissions, as well as the guidelines and principles laid down in the National Disaster Management Act (2005) and the National Disaster Management Policy (2009), have not been implemented properly. Panchayats and the autonomous councils have not been empowered, either financially or functionally, to deal with local flood problems.

Mitigating flood impact: The flood warning instruments installed by the project have provided communities with early warning of flash flood waves on six occasions between August 2010 and August 2011: 21 August 2010 (early midnight, two villages), 25 August 2010 (night time, three villages), 4 September 2010 (night time, three villages), 4 July 2011 (morning, four villages), 17 July 2011 (midnight, four villages), and 15 August 2011 (early morning, three villages). In each of these flood events, the flood alarms woke villagers during the night or early morning drawing their attention to the rising water level. The villagers remained alert and disseminated the flood information to downstream areas using mobile phones. As a result, the downstream communities had lead time of one to one-and-a-half hours to move people and valuables to safe areas.

During the flash flood that occurred on the night of 25 August 2010, the flood warning system implemented under the project enabled the people of the village Dihiri to save livestock (mainly pigs and some poultry) worth about USD 3,500 and other valuables.

Increasing awareness: The awareness campaign and workshops organized by the project have enhanced people's understanding of the causes and management of flash floods in the area, and what they can do to proactively prepare for floods and deal with the impacts more effectively. The project has also made them aware of their rights and obligations in relation to flash flood management. Increased awareness has helped communities mitigate flood impact and cope with flash floods.

Reducing vulnerability: Receiving timely warnings of floods has reduced the vulnerability of communities in the study area to flash floods to a certain extent. Understanding how to survive flash floods in good health and with minimal loss of property has enhanced community resilience. Knowing the extent of locational risk, made possible by the spatial risk maps produced

by the project, has enabled communities to plan and take measures to make their lives safer.

Enhancing community networks: Community networks, such as the Village Flood Management Committees and links with media people, government officials, and the project team contributed immensely to the dissemination of flood warnings, reporting of flood events, effectiveness of government flood management schemes, and coordination of relief work.

Conclusion

The instrumented hydrological database and socioeconomic information available on the Jiadhal River catchment is insufficient to provide a proper scientific understanding of the changing nature of flash floods and their impacts in the study area. Flood management in the study area is based mainly on structural measures, which have not been able to effectively mitigate flash flood hazards. Community-based flood warning systems can go a long way in helping communities, as well as flood management agencies, to prepare for flash floods. However, interstate cooperation is essential to properly manage the Jiadhal River with a judicious combination of structural and non-structural measures. States must adopt flood mitigation policies of their own with specific provisions for the treatment of flash floods and upstream-downstream cooperation. The enhancement of community resilience through socioeconomic empowerment and strengthened adaptive capacity should be the ultimate goal of disaster management and development programmes.

Recommendations

- Develop a reliable and long-term hydrological and geomorphologic database using state-of-the-art instruments and techniques.
- Forge interstate cooperation for the joint management of the river catchment to reduce flash flood risk and disseminate flood information from upstream to downstream communities.
- Promote holistic scientific research at the catchment level on flash floods, flash flood forecasting, and the development status of communities.
- Provide reliable and timely forecasts and early warning of flash floods involving communities in the dissemination of flood information.
- Adopt flood mitigation policies at both national and state levels that treat flash floods as a special class of events.
- Identify and rank vulnerable communities, assess their risk, and formulate emergency risk mitigation strategies for preparedness, rescue, relief, rehabilitation, and community empowerment and development.
- Mainstream flash flood mitigation strategies in community development programmes with emphasis on increasing community resilience.