

# Adjusting to Floods on the Brahmaputra Plains, Assam, India

*Aaranyak*

# Executive summary

The central objective of the research project 'Documenting and Assessing Adaptation Strategies to Too Much, Too Little Water' is to document adaptation strategies at local or community level to constraints and hazards related to water and induced by climate change in the Himalayan region, including how people are affected by water stress and hazards, their local short and long-term responses, and the extent to which these strategies reduce vulnerability to water stress and hazards. Five case studies were carried out in four countries. The results of each have been summarised in separate documents on a CD-ROM to accompany a single synthesis document.

The Assam case study presented here documents and assesses the local and /or traditional practices of communities which have evolved from their culture, customs, beliefs, indigenous knowledge systems (IKS) and skills that have enabled them to survive water stresses and cope with hazards and disasters over the long term in the flood plains of the Brahmaputra basin of eastern Assam, India. The research was carried out at two sites: viz, the areas of Majgaon (one village: Majgaon) and Matmora (four villages: Tinigharia, Khamon Birina, Opar Khamon, Bahpora No.1) through participatory action research (PRA) complemented by secondary data in some cases. The five villages are in the Dhemaji and Lakhimpur districts of Assam, respectively. The study sites were selected on the basis of their long history of water-induced stresses and the vulnerability and adaptability of the communities to water-induced hazards such as floods, flash floods, river bank erosion, and land degradation caused by sand deposition.

The study sites are inhabited by three prominent indigenous communities – the 'Mishing' (Matmora area), the 'Ahom', and the 'Chutiya' (Majgaon) – and several Assamese caste groups such as Brahmins, 'Koibartta' (Matmora area), and a Bihari community (Majgaon). Floods, flash floods, and sand casting are the most serious water-induced stresses in the eastern Brahmaputra basin in Assam where the study sites are located. The study villages have many things in common in terms of the nature of water-induced problems, a flood history tracing back to the 1950 earthquake, impacts of floods, community adaptations, and ways of living and coping with stress. There are also significant differences in degrees and types of vulnerabilities as well as in coping and adaptation strategies, depending on the culture, traditions, indigenous knowledge systems, physical location, intensity of flooding, and extent of outside intervention.

The Mishing community builds thatched, stilt houses and granaries on stilts, while others build houses with high plinths but build granaries on stilts. People store food and save money for bad times and try to keep themselves informed about flood situations and warnings as preparatory measures, sometimes using their folk beliefs and observational experiences. They take shelter on high platforms close by or on the road or on embankments with their cattle if they are in danger of being displaced and have to move houses or villages. Transportation during floods is usually on rafts made from the wood of the banana tree and they help each other in rescue and evacuation operations. Most of the villagers are skilled swimmers and know how to use boats and rafts. They try various methods of cultivating paddy of different varieties whenever there is a slight respite from floods. Some of them have grown alternative crops and vegetables with consistent efforts but on a subsistence scale. Other villagers have engaged in alternative livelihoods, such as daily-wage labour, fishing, selling dry fish and country liquor (sometimes against cultural taboos), and providing menial labour for government projects, whereas others have migrated to get work. Their adaptive capacities need to be augmented by well-designed interventions aimed at making people more proactive and communities self sustained so that they are ready to face future hazards.

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## Introduction

Floods, flash floods, river-bank erosion, and sand casting (deposition of large amounts of sand by flood water) are the most frequent water-induced hazards in the eastern Brahmaputra basin in Assam. Located in the north-eastern region of India in the eastern Himalayas (Das 2009), floods affect this part of Assam every year; flash floods are also a normal component of the flood regime. Sand casting, although not a new phenomenon, has become increasingly devastating since the mid 1990s, especially on the northern banks of the eastern Brahmaputra valley. All of these hazards affect all aspects of the land, lives, and livelihoods of communities living in the region to a significant degree. Both floods and flash floods leave people homeless and displaced, destroy crops, damage public property, and damage development infrastructure. Victims who become destitute suffer from trauma and shock. Moreover, annual cycles of hazards cripple people's resilience and intensify the poverty spiral. Thousands of hectares of fertile land in hundreds of villages with crops, settlements, and infrastructure have been lost to the river due to frequent shifting in the river course and erosion of river banks. Sand casting has proved to be one of the worst hazards because it results in degradation of thousands of acres of farm land and wetlands due to deposition of debris, mainly coarse sand particles, by flood waters. The indigenous communities living in these areas have developed mechanisms over time that have become ingrained in their lifestyles and traditions – for example, housing, agriculture, livestock rearing, food storage, and weather and flood predictions – and these help them to cope with and adapt to the immediate and long-term impacts of such hazards.

Climate change is considered a major driving force, triggering alterations in the regional and local weather and climate systems all over the globe. These changes have, in turn, affected the socioeconomic, cultural, and political spheres of human societies (IPCC 2007). The impacts of climate change on the Himalayan region are rising temperatures, recession of glaciers, extreme rain events, increased incidences of landslides and cloudbursts, and flash floods triggered by landslides which affect the hydrological regimes of large rivers like the Brahmaputra that sustain millions of people, scores of ethnic cultures, and diverse ecosystems in the eastern Himalayan region (Singh and Bengtsson 2005; Bajracharya et al. 2007).

So far as climate change in northeast India is concerned, climate scientists have observed rising temperatures in the region as a whole and decreasing rainfall in the eastern and southern areas (Das 2004, Mirza et al. 1998). They also refer to recent drought-like situations in the years 2001, 2005, 2006, 2008, and 2009 as indicators of climate change in the region (IPCC 2007). Anecdotal references and grey literature recount other symptoms, such as increasing spells of intense rainfall in the pre-monsoon and monsoon seasons in some places, as well as lack of rainfall in post-monsoon and winter seasons in others, both affecting agriculture adversely (ICIMOD 2008). Both extreme rainfall episodes and rates of soil erosion are believed to have increased in upstream areas (Tibet in China and Arunachal Pradesh in India) of the Brahmaputra basin. There are increasing reports of floods caused by damming of landslides in the foothills of the Arunachal Himalayas. As a result flash floods have increased in the hills affecting vast areas of the flood plains. The intensity, frequency, and duration of riverine floods have also changed. Sediment load in the rivers has increased due to denudation by intense rainfall of fragile and tectonically dynamic hill slopes, scaling up the affects of sand casting.

The result of all this is that traditional coping and adaptation practices of riparian communities living in these areas, practices that had developed in response to normal climatic variations so far, have been rendered less effective against the increasing scale and intensity of the changing hazards. Consequently, communities are experiencing a phase of transition in their traditional coping strategies, adaptation, knowledge, and practices. Moreover, rapid changes occurring in traditional societies in the last two decades, especially in the economy, livelihoods, culture, and education, accruing from state-driven development programmes (or lack of the same) and forces of globalisation, have also played an important role in determining how people are now responding to water-induced stresses in contrast to responses in the past.

In terms of socioeconomics, these flood-prone areas of Lakhimpur and Dhemaji are remote and underdeveloped. Traditional coping and adaptation mechanisms against natural disasters are crucial for the survival and development of marginalised communities, especially when existing disaster management and development programmes fail to protect them against recurring floods and increasing poverty. Collapse of the indigenous adaptation practices or changes therein need to be taken seriously by researchers and planners. It is important to study how people have been living with floods in such flood-prone areas and document their specific coping and adaptation strategies, both traditional and contemporary, in the light of the history of the land and the community as well as in the context of the prevailing sociopolitical scenario. It is also pertinent to examine whether the traditional coping capacities and adaptation strategies are still useful in dealing with the changing nature of the multiple water-induced disasters as well as the social, economic, cultural, and political changes affecting the society as a whole.

The current study, carried out in five villages in two districts of eastern Assam – viz, Lakhimpur and Dhemaji – is an attempt to understand how ethnic communities in remote and isolated pockets prone to high flood risks have lived with and adapted to floods and associated water-induced hazards; whether they will be able to cope with the same disasters in future; and what can be done to strengthen their relevant coping strategies and adaptation capacities for the present and the future. Thematically, the subject of this study is similar to other case studies carried out in other countries for communities living in similar conditions; e.g., in the char lands of Bangladesh (Haque 1988; Zaman 1989, 1991, 1993; Chowdhury 2001). This study was carried out by Aaranyak, an environmental research organisation in north-east India based in Guwahati, Assam, for the International Centre for Integrated Mountain Development (ICIMOD), as part of a regional project on 'Assessing Local Adaptation Strategies to Too Much, Too Little Water'.

## Research approach and methods

### Profile of the field team

The field team in the first phase (June 2008-March 2009) consisted of eight core members – the team leader, two research associates, two research assistants, one local field coordinator, and two local field assistants. In the second phase of the project (April-September, 2009) the team was reconstituted with two research assistants, two project assistants, and two field assistants (Table 1).

### Concepts and assumptions

The field team tried to arrive at an understanding of the basic underlying concepts of vulnerability, risk, and adaptation in an empirical sense in terms of real-life experience and usage of these terms by a villager without following the formal textual definitions of the same.

Table 1: Composition of the Aaranyak field team for the Assam case study

No.	Name	Designation	Gender	Ethnicity	Qualification	Professional Background	Role	
<b>Case Study Phase I (June 2008 - March 2009)</b>								
1a	Partha J Das	Team Leader	M	Assamese (general caste)	MPhil. in Environ. Science (climatology) PhD. (floods and climate variability)	Research and project experience in rainfall meteorology, climate variability, flood hydrology, hydrological modelling, disaster mitigation, climate change and environmental impact assessment, community-based forest and wildlife management	Communication with team members, ICIMOD and other country study groups; participation in field activities; overall supervision of project activities; assessment of climate change impact/vulnerability/adaptation; report lead author; submitting reports and accounts; nodal person for the project with respect to all inputs and outputs	
2a	Nirupam Hazarika	Research Associate	M	Assamese (general caste)	MA in Economics	Project and ongoing doctoral research in economic assessment of environmental degradation, project experience in alternative livelihood assessment	Participation in all field activities, especially conducting PRA, household survey, livelihood survey, recapitulation, report writing	
3a	Dadul Chutiya	Research Associate	M	Assamese (Chutiya c.)	MA in Anthropology	Research experience in cultural anthropology,	Participation in all field activities, especially study of community history, culture and agriculture, PRA, recapitulation, report writing	
4a	Mitali Thakuriya	Research Assistant	F	Assamese (general caste)	MA in Geography	Teaching in graduate college, conducts students' field work	Geomorphological surveys, gender impact, resource mapping	
5a	Kanaklata Pegu	Research Assistant	F	Assamese (Mishing c.)	MA in Geography	Research experience in flood management, Teaching in graduate college, conducts students' field work	Geomorphological surveys, flood impact, gender impact	
6a	Robin Borgohain	Local Field Coordinator	M	Assamese (Ahom c.)	BA	Project experience in disaster mitigation,, relief and rehabilitation	PRA, resource mapping, key informant interview	
7a	Ghana Gogoi	Local Field Assistant	M	Assamese (Ahom c.)	BA	Project experience in disaster mitigation,, relief and rehabilitation	Help in field work in Maigaon, local facilitation	
8a	Trishna Doley	Local Field Assistant	F	Assamese (Mishing c.)	BA	Fresh worker, no previous experience	Help in field work in Matmora, local facilitation	
<b>Case Study Phase II (April 2009 - onwards)</b>								
1b	Partha J Das	Team Leader	See above					
2b	Ditimoni Pegu	Research Assistant	F	Assamese (Mishing c.)	MA in Sociology	Project experience in rehabilitation of flood-affected people	PRA, gender analysis	
3b	Narayan Barua	Research Assistant	M	Assamese (Ahom c.)	MA in History	Project experience in rehabilitation of flood-affected people and PRA	Community meetings, community history	
4b	Robin Borgohain	Project Assistant	See above					
5b	Rajen Saikia	Project Assistant	M	Assamese (Ahom community)	BA	Project experience in rehabilitation of flood affected people, PRA & disaster risk reduction	PRA, resource mapping,	
6b	Beauti Pegu	Local Field Assistant	F	Assamese (Mishing c.)	BA	Experience of conducting self help groups (SHG)	Facilitating field activities in Matmora, local coordination with community	
7b	Ghana Gogoi	Local Field Assistant	See above					

Vulnerability is the quality or situation of a community making it likely to be affected by a hazard. The vulnerability of a community to water-induced hazards, such as floods, is determined by a range of factors such as location (living on flood plains, proximity to rivers, or proximity to development and welfare infrastructure); physiography and hydrogeomorphology (altitude, slope, proximity to hills or foothills, state of rivers, and water and sediment yield); structural interventions (embankments, spurs, or dams); climate variability (rainfall extremes); flood management practices (flood forecasting, early warning, and state of the watershed ); economic conditions of exposed communities (purchasing capacity, savings, local inflation, and supply chain of essential commodities); social conditions (literacy, social security, and ethnic diversity); traditional knowledge (medicine and healing practices, housing types, food storage, and agricultural practices); general awareness about problems and solutions (contemporary flood management practices elsewhere); and other survival skills (managing a boat or being able to swim).

Risk means the chance of being affected by a natural hazard when a villager, a rural household, or the village as a whole are vulnerable and cannot offset the likely impact with their own capacity and resources.

Adaptation is a set of actions resorted to over the long term to reduce the adverse impacts of floods on people's lives. Some of these practices have become part of the lifestyle or culture when the benefits accrued have become time-tested. Adaptation practices evolve or are acquired over a long time span and these are effective as short-term and long-term measures of response to impacts of floods.

Coping is a way of responding immediately to a hazard in order to reduce the intensity of its impact on a short time scale. Coping can mean the adoption of ad hoc and short-term measures by villagers to save their lives or property instantaneously when they are hit by the first wave of flooding. Coping also includes intermittent measures that are not regularly or uniformly practised but which are effective in reducing vulnerability or enhancing resilience to various degrees.

The study commenced with several hypotheses which were based on a general conceptual understanding of the theoretical foundation and the objectives of the project. This understanding was aided by the familiarity of the project team with the project sites, their communities, and their water-related issues. These assumptions are that:

- i. climate change is accentuating floods and other water-induced hazards in the Brahmaputra Basin located in the Himalayas;
- ii. people have been responding effectively to impacts of floods in many different ways, knowingly or unknowingly and in a planned or unplanned manner, by using traditional knowledge, practices, and skills;
- iii. it is possible to have a good understanding of impacts of hazards and coping and adaptation of communities by observing the nuances of their individual, family, and community lives and by interacting with them continuously in a designed and organised manner;
- iv. people adapt differently to the impacts of different water-induced hazards in different situations depending on their location, environment (topography, ecosystems, or climate), economy, culture, religion, age, gender, status of development, governance (or lack of it), education, and political awareness;
- v. the poor are more vulnerable to water-induced stresses than the rich; and
- vii. traditional coping and adaptation are losing their effectiveness against the changing nature of hazards and the fluid social dynamics of indigenous societies.

### **General step-by-step approach**

The activities starting with the orientation workshop to the formulation of the final report are presented in chronological order in the Annex (Table A1)

### **Study site selection**

It was the opinion of the project team that a suitable site for this project was ideally one with a long history of floods and associated hazards going back at least thirty years and inhabited preferably by one or more indigenous communities or a mixture of different communities which have learned to live with floods over a long period of time. It was also thought preferable that populations should not have been too exposed to research and intervention so that the communities concerned had not developed research fatigue and would be friendly and cooperative.

Eight different sites were considered from the districts of Lakhimpur, Dhemaji and Jorhat (mainly on the Majuli river island in Jorhat) according to the criteria of suitability. Considerations were based on the team's prior familiarity and knowledge of these sites. Rapid rural appraisals (RRA) were carried out with the cooperation of the communities during brief two-day visits. Finally two sites were selected for the study: Majgaon village in the Bordoloni Development Block of Dhemaji District and the other was a cluster of four villages in the Matmora area in the Dhokuakhona Sub-Division of Lakhimpur District. Majgaon was selected because it represents an area chronically affected by floods where people have struggled to live with floods for more than fifty years against all odds. The village is located between two rivers – the Na-Nadi and the Jiyadhhal (also known as the Kumatiya) – both being flashy rivers with a long history of flooding and consequent devastation (Hazarika 2003).

Flooding is usually caused by heavy rain in the hills upstream from Arunachal Pradesh in the north and is often intensified by breaching of embankments along these rivers. Because of this direct causal relationship between rainfall and floods, any change in the rainfall regime as a result of climate variability is reflected in the flood patterns. This provides researchers with an opportunity to study water hazards caused by climate change. The embankment on the River Jiyadhhal has protected people from floods for more than thirty years, but breaching of the embankment has caused devastating floods from time to time. The other river, i.e., the Na-Nadi is an unmanaged river and has no embankment near the study site: thus Majgaon presented us with an opportunity to study how people deal with situations arising out of having or not having an embankment.

The Matmora area is located on the bank of the Brahmaputra River in the eastern part of Dhokuakhona Development Block. The area has a long history of multiple, water-induced hazards, mainly floods, flash floods, bank erosion, and breaching of the embankment; and the consequent impacts have increased in the last decade to a great extent. Most of the fertile farm lands have become unfit for agriculture because of successive floods in 2007 and 2008 and the depositions of sand carried from the river by the flood waters. The floods of 2007 and 2008 caused the collapse of the Sissi-Tekeliphuta embankment (also known as the Matmora embankment); and afflicted unprecedented damage on the land, houses, economy, livelihoods, and the social fabric of more than 25 villages in the area. The River Brahmaputra is of glacial origin and there is a significant input of snowmelt to its runoff, therefore the Brahmaputra basin is highly prone to climate change impacts (ICIMOD 2008).

Matmora represented a case of people who have suffered from and survived water-induced hazards over long periods; and for whom the impacts have increased in the last two decades. Moreover, villages with tribal (Mishing) communities and non-tribal (general caste groups) people are contiguous in Matmora, providing the team with an opportunity to compare different aspects of vulnerability, risk, and adaptation between the Mishing community (known as the best-adapted community in flood-prone areas of Assam) and non-Mishing communities. It also gave us an opportunity to study the extent to which cultural norms and traditions make people vulnerable or resilient. Therefore, a cluster of four villages, all located adjacent to each other, were selected in Matmora. The selected villages are: Bahpora No 1 (referred to as Bahpora in this report), Opar Khamon, Khamon Birina, and Tinigharia (a village spread on and around the embankment). The embankment plays an important role in both controlling and causing floods and influences people's decisions about where to settle with respect to the embankment. Therefore, Matmora also provided an opportunity to study how people's vulnerability and adaptation are influenced by development infrastructure like the embankment.

The people of Matmora have been trying to cope with the affects of sand casting since 2007 because this is the first time they have faced this problem on such a scale. Effective adaptation practices are yet to be developed at the community level with respect to sand casting. Catastrophic floods have occurred, such as those in 1998 and 2007, in Majgaon and the floods in 1998 and 2008 in Matmora. Usually the traditional coping and adaptation strategies are not enough to deal with these big floods.

### Field work and data collection

The field work began in August 2008 and the month of August was spent looking for suitable project sites and carrying out RRA. Actual field research in the two project sites took place between September 2008 and February 2009 over a six-month period for approximately 80 days in the first phase. In the second phase, field work was carried out between April and June 2009 for about 40 days before submitting the second draft report. An additional 10 days was spent in the field in the month of July to improve the quality of the report. A final round of field work took place during August and September 2009 for about 10 days. The field work was carried out, but not without challenges and constraints. One constraint was the arrangement of lodging for women researchers in and around the field sites. In Majgaon, where no



Figure 1: Transect walk in Majgaon and Dhemaaji in the direction of the Na-Nadi accompanied by a group of youths from the village

mainly to the weather and climate regime, flood history, community history, disaster management, economic and human development, and society and culture. Information on specific themes was collected from all relevant sources and cases without being geographically confined to the project areas; and these cover aspects such as vulnerability to floods, adaptation practices of indigenous people living in similar riparian situations, and the influence of culture on vulnerability and adaptation. Grey literature, such as newspaper reports and articles, articles published in local magazines, and souvenir publications written in local languages, was an important source of information. Newspaper reports from local correspondents captured the local issues very well, whereas articles in local magazines provided a good overview of the history, geography, and ethnic culture of the project areas. Grey literature is usually not considered to provide authentic reference sources in scientific research, and doubtful information needs to be validated with standard sources if available.

Primary data were collected at community, focused group, household, and, sometimes, at individual level. Different methods and tools of participatory rural appraisal (PRA) were used to collect the primary data such as stakeholder analysis, focus group discussions, resource mapping, transect walks, key informant interviews (open ended), semi-structured interviews (household survey with a semi-structured questionnaire), Venn diagrams, historical time lines, trend analyses, crop calendars, and informal chats (Figures 1, 2, and 3). The type of information collected through PRA includes history of the settlements and water-induced disasters, general geography and environment, changes in landscape over time, livelihood (occupational) patterns, gender vulnerability, and coping and adaptation practices. Table 2 shows the details of the types of information collected using different methodologies. The details of the PRA exercises in terms of the people involved in the study disaggregated into community and gender representation, and the monthly time table are provided in the Annex (Tables A2, A3).

PRA methodology is an effective way of collecting information at group level and facilitates direct and intimate interactions between the researcher(s) and the subject(s) in rural areas; and hence it was used as the principal method of investigation (Negi 2001). Household surveys were carried out in 50 households in both project sites using semi-structured questionnaires.

Figure 2: Focus group discussion with women in Majgaon



Figure 3: Walk and focus group in Matmora, August 2008: the field team takes stock of the flood situation and its impact on the people of Matmora during the floods of 2008



arrangements could be made, women researchers were lodged in Bahaktika a neighbouring village: in Matmora: one female researcher stayed with her relatives near Dhokuakhona, the nearest township.

Both primary and secondary data were collected during the study. Secondary data collected at the village and block level concerned the physiographical, environmental, socioeconomic, and vulnerability profiles of the sites and surrounding areas. A large amount of secondary information and data was collated through review and analysis of the available literature. The literature review looked at two specific considerations: the geographical area of interest and the theme of the study. Information on the project areas was related

Table 2: **Details of data collection**

General context or approach used for data collection	Data and info collected (qualitative & quantitative)	Level of data collection (e.g., household, community, district, etc.)	Methods used for data collection (e.g., transect walk, semi-structured interviews with ..., visual records, etc.)
Environmental context	Land use or land cover (LU/LC) change, biodiversity, natural resources, degradation of land, land restoration, creation and aggradation of wetland, soil productivity	Household and community level	Semi-structured interviews with elders, resource mapping, transect walk, focus group, historical timeline, trend analysis, geospatial analysis (remote sensing)
Climate and hazard context	Trends in rainfall, temperature, flood history, flooding characteristics, flash flood, sand casting, flood damage, droughts	Gauging station, river basin, village, north-east India	Analysis of secondary data, information from literature, key informant interview, focus group, historical timeline, trend analysis
Economic context	Household income, poverty indicators, BPL families, price fluctuation, SHG, micro-finance, access to credit	Individual, household, community, SHG	Key information interview (Panchayat members) semi structured questionnaire, community meetings, focus group of SHG
Political context	PRI, opinion on governance, support for political parties, benefit to supporters, voting in election, articulation of grievances or demands, protest campaign or movement	Individual, household and community	Semi structured questionnaire, community meetings, focus group, informal discussion or chat
Sociocultural context	Indigenous knowledge systems (IKS), cultural traits (customs, beliefs, norms), religion (sect, animism), housing type, survival skills, water and land related conflicts, power relationship, food and seed storage	Household and community level	Semi structured interview, focus group, community meetings
Demographic context	Population, density, sex ratio, literacy, migration (in and out), rehabilitation, village area	Village, panchayat, block, district	Analysis of secondary data, household survey, community meetings, focus group
Livelihood context	Existing livelihood types, preferred livelihoods, diversification of livelihoods, economic and cultural constraints, impact on natural resources, food security	Individual, household, community	Semi structured interview, focus group
Health and nutrition context	Water borne diseases, drinking water source and quality, sanitation, traditional healing system, access to health care	Household and community level	Semi-structured questionnaire, focus group
Gender context	Relative role of women and men in normal and flood time in farming, family maintenance, income generation, water management; sanitation and pregnancy during floods	Household and community	Semi structured interview, focus group
Agricultural context	Crop variety, cropping method, crop calendar, winter crops, innovative cropping practices, water harvesting or irrigation, crop marketing	Household and community	Semi structured interview, focus group
External intervention context	Agencies (GO/NGO), benefits, efficacy, dependence, attitude,	Individual and community, external agency	Key informant interviews, community meetings

Note: PRI: panchayati raj institution; GO: government organisation; NGO: non-government organisation; GIS: geographical information system; GPS: global positioning system techniques; IKS: indigenous knowledge system; LU/LC: land use/land cover; SHG: self help group

The head of the family and the women were interviewed following a set of lead questions. Questions were aimed at validating existing information or getting more detailed information on particular issues, e.g., gender impact and role, family economy and assets, and religious affiliation. Although rapid rural appraisal (RRA) was useful for identifying and carrying out a quick reconnaissance of different sites in the first stage, PRA techniques were useful for delving into specifics of different aspects of community life, and this method secured first-hand information about sources of vulnerability and examples of coping and adaptation in the community. The important PRA exercises and proceedings were recorded on audio and video, besides making field notes. Recapitulation of the audio-visual recordings and the field notes was useful for drafting minutes, analysing the data, and preparing daily and weekly field reports organised into thematic sections.

### Data verification and analysis

Secondary data collected from research reports, theses, research papers, government reports, and other documents were analysed, interpreted, and, in some instances, cross-checked with expert opinion and also with the communities at large. For example, secondary data on rainfall trends, river flood levels and flood flows (discharge), and flood damage (to households, cattle, and crops) were verified with expert and community opinions. On the other hand primary information collected directly from the community on anomalies of weather and climate, flood history, flood damage, flood relief and rehabilitation, embankments, and development infrastructure were compared with information from secondary sources and inputs from government officials. Similarly, to resolve issues arising from conflicting information within the community, opinions of relevant experts and officials were sought. For example, information from the community about the embankment on the Brahmaputra River at Matmora obtained through focus group discussion and social mapping was conflicting and confusing. The Department of Water Resources was approached for validation and correction. Information about cultural features of the Mishing community was cross-validated and corrected with the help of a folklore expert, anthropologists, and scholars from the Mishing community because the team believed that the opinions of external experts were more in tune with the overall situation of the Mishing society and also explained other information coming from the same community. In both cases some of the information and data were vindicated whereas some remained unverified. The unverified information obtained from meetings and discussions was later checked during the household surveys using semi-structured questionnaires. To identify unconfirmed and dubious information and observations, the team mainly re-applied PRA tools with different groups and individuals and sometimes with mixed focus groups. For example, information on relative gender roles in agriculture and household responsibilities in flood and non-flood periods was derived originally from focus groups of men and women separately. Conflicting opinions coming out of this process were later validated by interacting with a mixed focus group of men and women during which exaggerations from both groups were neutralised by counter points of view. Information still found to be doubtful and unverified was not included in the report. Some of the dubious information that came from particular individuals or focus groups was cross-validated with other individuals and focus groups from the same village at a later date. Sometimes the same individuals and focus groups were approached with the same questions to affirm their earlier opinions. On occasions they would negate information that they had given earlier and would come to a unanimous opinion about conflicting information. Moreover, the team members also used to brainstorm amongst themselves about the moot information and tried to settle matters using their own judgement. Often it would require going back to the village to get reassurance about information before making a final decision.

### Challenges and shortcomings

The four main challenges encountered during field work were: (i) limitations of PRA techniques in general; (ii) community expectations of benefits out of participation in the PRA; (iii) exaggeration of problems by the community; and (iv) inadequacy and unreliability of secondary data and literature. PRA techniques have their own advantages because information comes directly from the community to the researcher. Nevertheless, the information derived from PRA, especially when it seems doubtful and conflicting, needs to be carefully validated within and outside the community. Often women would not respond frankly to male surveyors, especially when gender-sensitive questions were asked. Moreover, there was a general reluctance of some women to speak freely while in groups. The female researchers in the team would then deal with women separately in focus groups or individually during visits to houses while interacting with them in a more homely atmosphere. In such cases the women's views were recorded through semi-structured interviews or informal chats.

The main approach used for this study was participatory research in which PRA techniques were the principal methods and tools of investigation. Use of structured questionnaires is not considered preferable in this approach. In this case, however,

detailed and quantitative information was necessary in order to understand the prevailing socioeconomic conditions of the target populations in relation to, for example, family income, relative differential benefits from different livelihoods, and extent of educational qualifications because these are meaningful parameters for assessing vulnerability at family level. Such information is best derived through sample household surveys with structured questionnaires and, hence, the team carried out household surveys in the first phase of the work to seek specific information through semi-structured interviews with open-ended and semi-structured questions. These household surveys served several purposes. They were useful in generating detailed information at family level. People liked to divulge information about sensitive issues (e.g., women's health problems and sanitation during floods) during these personal sessions. People, especially women who remain silent in group discussions, open up during household interviews. In the second phase household surveys were not included because the information required had been collected during the first phase and, in the second phase, field surveys focused on exploring adaptation practices, and for these household surveys were not necessary.

The second challenge was the expectation of the community that material or financial benefits would be forthcoming in return for their participation and cooperation in the PRA. In the initial stage the team was frequently asked what the people would gain by cooperating with the researchers. In response, the team made it clear that the investigation was purely for research and that there was no plan to provide tangible benefits to the community. They did state, however, that indirect benefits might accrue from the work since the results of the survey would go to policy makers with specific recommendations for reducing vulnerability and strengthening adaptation skills in the community. Government assistance would then include the right kind of disaster mitigation and development intervention plans. (The attitude of the communities was not surprising because they are facing a great deal of hardship in their struggle for survival and existing government programmes have never provided them with enough protection against floods nor given them sufficient support to recover from flood impacts. It should be stated also, however, that although conventional relief and rehabilitation programmes are not adequate and effective enough, they have made some people dependent on external aid.) Once the purpose of the study was explained, people cooperated wholeheartedly with the team and requested us to pressurise the government to solve their problems (e.g., by repairing or constructing the embankment, by providing them with work or job opportunities, and so on). In some cases people assumed that such studies occur to identify beneficiaries for relief and rehabilitation (R&R) and they grossly overstated their losses, damage, and problems. Such overestimates were not difficult to detect due to the familiarity of the team with the ground realities. Cross verification was carried out with the help of other individuals and groups in the same village to ascertain the real figures.

Building up a rapport with the community in such poverty stricken and marginalised locations is always a challenge. It was not difficult for the project team to win the trust and confidence of the communities because the team was always sincere, honest, and transparent with the community in its approach. Moreover, the team had several members who belonged to the ethnic groups from the project sites who were instrumental in breaking the ice and building trust. It should be mentioned that having local individuals in a study team is useful, but, at the same time, it can also happen that some respondents will not talk freely in the presence of surveyors who are from their own areas. They are more comfortable with outsiders. This happened during discussions on local politics and political affiliations. Similarly, being familiar with the sites and the issues is advantageous, but it might give rise to a sense of over confidence in one's own judgment and opinions. Such situations, however, occurred only in the beginning and, as the team and the communities became more and more familiar with each other with increasing mutual rapport and trust, such problems became insignificant.

Collecting data from secondary sources, especially those from ill-maintained government sources can be unreliable at times, and it may not be possible to verify everything against any other existing data, PRA results, or external expert opinions. Absence of essential secondary data and information, lack of relevant government reports, or insufficiency of scientific and grey literature sometimes constrains the scope of studies like this one.

## **Impacts of water stress and hazards on livelihoods**

### **General characteristics of the study sites**

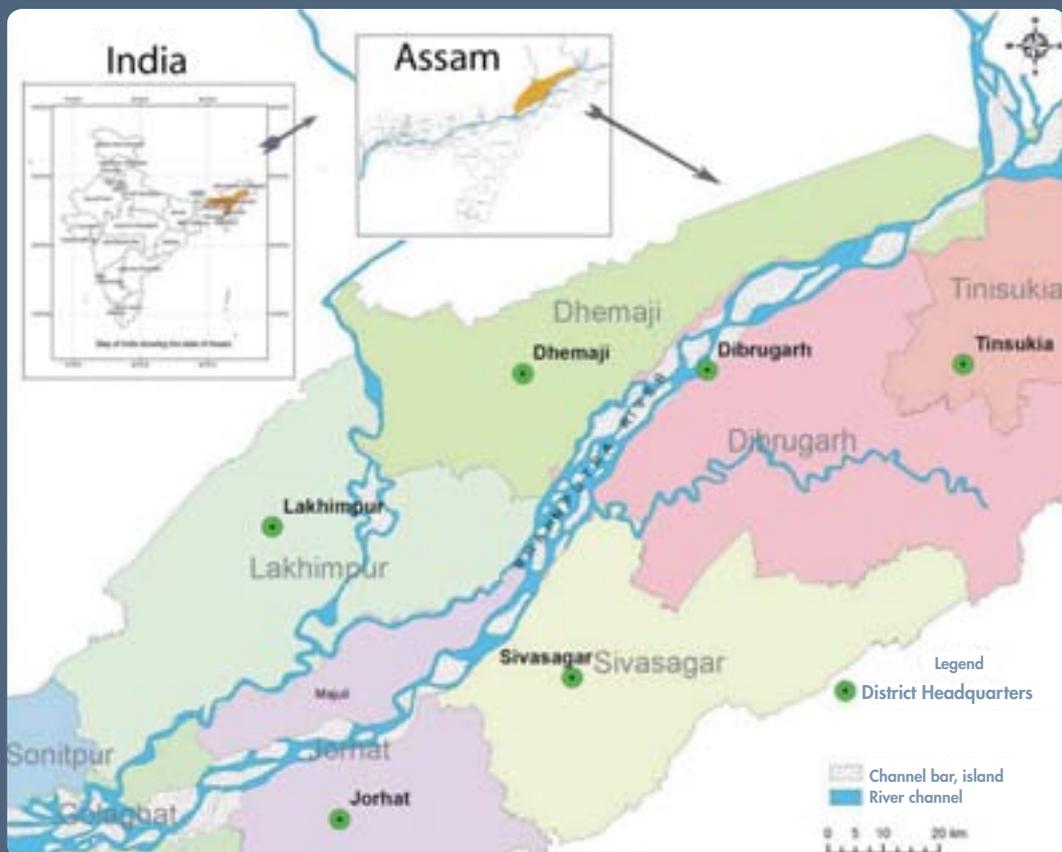
Of the two study sites selected for this work, one is Majgaon, situated in the southern part of the Bordoloni Development Block of Dhemaji District about 2.5 km away from Bordoloni Chariali (an assamese word meaning a junction of four roads heading in different directions) on National Highway 52. It is situated between two rivers, the river Na-Nadi on the western border of the village and the river Jiyadhhal that flows through the eastern flank of the village about two km away from it

(Figure 4). There are 68 households in the village and its total population is 283 with 138 males and 145 females (May 2009). About 70 individuals are minors (less than 16 years). The villagers belong to three different community or caste groups; viz., the Ahom (37 households), Chutiya (18 households), and the general community (three households) amongst whom the first two are ethnic communities constituting the dominant population and the third one is a caste group. All three groups belong to the scheduled castes, a category of underdeveloped and marginalised people, and, therefore, are provided with special privileges and advantages by the Indian Government for socioeconomic and educational improvement.

As a whole, the village is an underdeveloped one devoid of telephones and electricity, good roads, or public transport and communication. The people are poor in general with 57% of the households living below the poverty line (BPL): 45.04% of families in Dhemaji district, 22.3% in Assam as a whole, and 28.3% in India as a whole live below the poverty line (DES 2007; DES 2008). Only a few (five out of 283 people) of the villagers use personal mobile phones and only one household has electricity generated from solar power. There is a common village headman for four neighbouring villages (Majgaon, Choukhangaon, Burhakuri, and Bahaktika): he belongs to Bahaktika. Majgaon has no representative of its own in the village Panchayat (a village-level agency for local governance which has members elected by local people). Most of the people are followers of the Srimanta Sankar Dev Sangha, a religious sect that follows the sociocultural and religious practices propounded by the 15th century saint and reformer Srimanta Sankar Deva. There is one 'Namghar', and two schools in the village. (A Namghar is a traditional community prayer house/hall and an important socioreligious institution in Assamese society, a contribution of the Neo-Vaishnavite religion propounded by Saint Sankardeva in the 15th and 16th centuries.)

The village has suffered from floods (normal riverine floods and flash floods as well as rain-induced floods) since 1950 after the aftermath of the earthquake on August 15 of that year. The village is flooded every year, albeit with varying intensity, and it remains inundated to various degrees during the rainy season (April/May to September/October) for at least 120-150 days on average (Figure 5). Government intervention in the village has been limited to occasional distribu-

Figure 4: Location of study sites in Assam in the Lakhimpur and the Dhemaji districts



tion of relief and rehabilitation materials, compensation for flood damage, and construction of an earthen road and culvert. The Indo Global Social Service Society (IGSSS), an international development agency, has provided the village with tube wells, ring wells, high-rise platforms, high-rise seed banks, medical treatment, and community boats through a rehabilitation programme it carried out in the village during 2007 and 2008 through a local non-government organisation (NGO) called Amateur.

The villages in Matmora are located about five km from the town of Dhokuakhona on the west (Figure 6). In May 2009 the team counted 128 households in Bahpora village, 33 households in Opar Khamon, 70 households in the Khamon Birina, and 22 households in Tinigharia. The villages of Opar Khamon, Khamon Birina, and Tinigharia are entirely populated by the Mishing community, a major ethnic tribe of Assam. Bahpora village is a non-tribal village with a mixed population of Koibartta (a traditional fish trading community with scheduled caste status), Brahmins (an upper caste group), and the Bihari (a migrant population from Uttar Pradesh, a north Indian state) who came to the village about four decades ago. Tinigharia has people who were displaced from neighbouring villages (Matmora, Janji, Bali, Arkep, and Modarguri) that were fully or partly eroded away by the Brahmaputra at different times since the 1960s.

Human pressure has worn away the embankment and made it weak in many places. The existing embankment was built in 1962 and, at that time, passed through several villages like Tinigharia and Matmora. Almost the entire landmass of Matmora



Figure 5: Life in too much water, a scene from Majgaon in the rainy season: villagers live in and around water six months a year

Figure 6: Location of Majgaon between Na-Nadi and Kumatiya (Jiyadhah) rivers

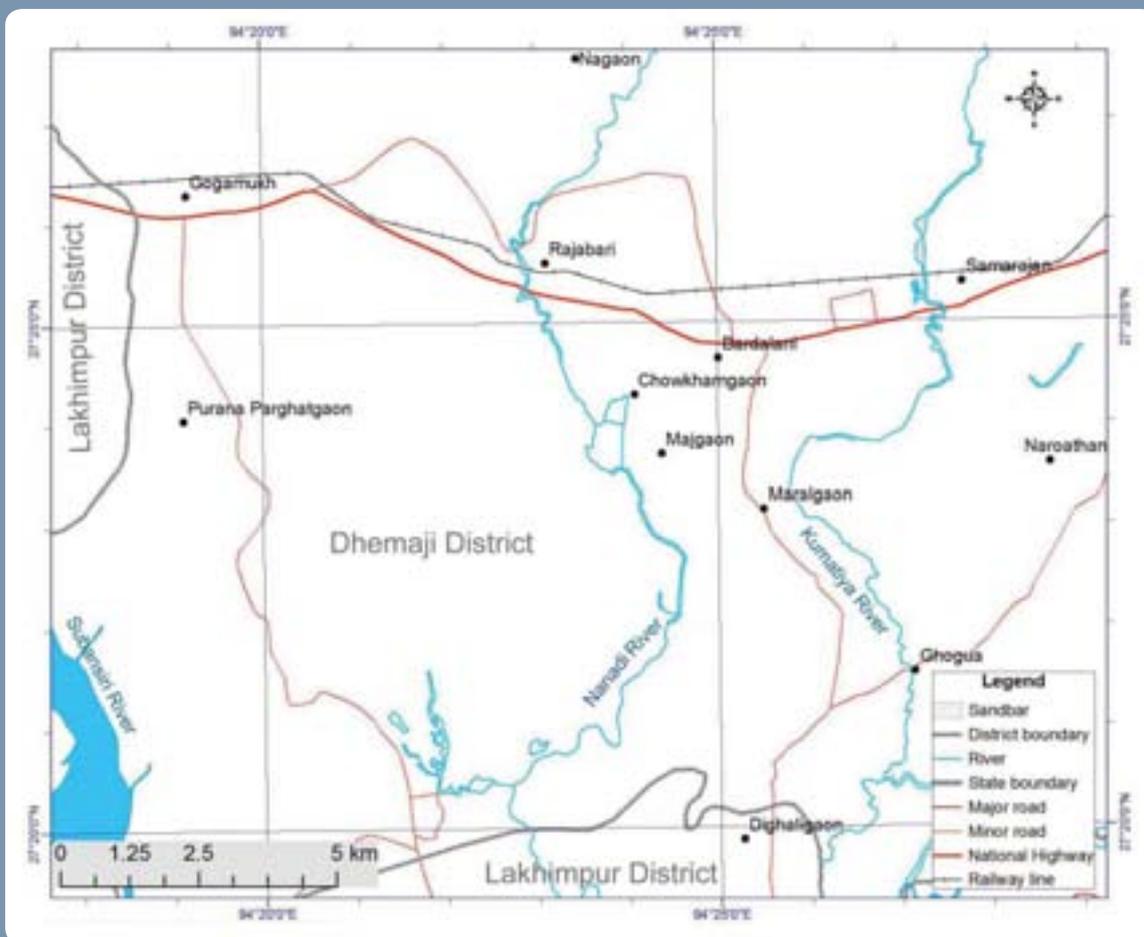




Figure 7: River bank erosion in Matmora, June 2008

in the Lakhimpur district as a whole. Having seen their present conditions, it is hard to believe that many of these families were self-reliant farmers until the late 1990s. While the Mishing people observe both Hinduism as well as their traditional religious practices, the other caste groups in Bahpora village are Hindus only. The Koibartta community in Bahpora belongs to the Mayamoria Vaishnavite sect, a branch of the Neo-Vaishnavite religion propounded by Aniruddha Dev, an eighteenth century religious reformer. As with Majgaon, Matmora has a history of floods occurring over the last 58 years in the aftermath of the 1950 earthquake, with major floods occurring twice or thrice a decade. The general profiles of the five villages in the two study sites are presented in Table 3.

village has been engulfed by the Brahmaputra over the years (Figure 7) leaving only five households in the south-western corner of the village. In Tinigharia, half of the village on the country side of the embankment survived and people settled down by just clinging to the embankment and its sides (Figure 8). All of these villages are poor and underdeveloped with a high percentage of BPL families; viz., 100% in Tinigharia, 85% in Khamon Birina, 75% in Opar Khamon, and 87% in Bahpora compared with 35.59% of rural BPL families



Figure 8: Vulnerable shelter – settlement of Tinigharia village on the old embankment of Matmora

Table 3: General profile of the villages in the two study sites (static picture as of today)

Village	H/H	Community/ Caste Group	Population	Site	Location (Lat)	Location (Long)	Altitude (masl)	Block/District
Majgaon	68	3 (Ahom, Chutiya, Baishya)	283	Site 1-Majgaon	N 27°23.714'	E 94°24.301'	60	Bordoloni (Dhemaji)
Bahpora no	128	3 (Koibartta, Brahmin, Bihari)	557	Site 2-Matmora	N 27°12.272'	E 94°29.202'	64	Dhokuakhona (Lakhimpur)
Opar Khamon	33	1 (Mishing)	147	Site 2-Matmora	N 27°33.784'	E 94°39.646'	70	Dhokuakhona (Lakhimpur)
Khamon Birina	70	1 (Mishing)	336	Site 2-Matmora	N 27°12.183'	E 94°31.286'	73	Dhokuakhona (Lakhimpur)
Tinigharia	22	1 (Mishing)	150	Site 2-Matmora	N 27°12.320'	E 94°31.517'	75	Dhokuakhona (Lakhimpur)

The history of floods for the villagers is also the history of the rise and fall of the embankment entwined with progressive shifting of old villages and migration of the inhabitants to new locations. Villages like Matmora, Janji, Bali, Arkep, and Modarguri were originally (in the 1950s) located on the bank of the River Brahmaputra, about 10 kilometres to the east of the present study site. With the construction of the first embankment on the Brahmaputra in that area in 1952, the westward movement of the river began to break through the confinement imposed by the embankment. The embankment

has been reconstructed at four different stretches in the area to date to keep pace with the movement of the river. Consequently, the original locations of these villages were engulfed by the river and the people from the villages shifted to new places, always on the river bank, moving back westwards with the river. The river has advanced towards Dhokuakhona town by 10 kilometres at least in the last 5 years; the embankment was reconstructed four times; and the villages were dislocated six to eight times. Floods became more acute and frequent (three to five deluges a year) after the catastrophic floods of 1998 when a stretch of the embankment, about two and half kilometres' long, was washed away rendering the whole embankment in that area weak. Since 1998, Matmora has experienced floods annually with the average period of inundation each year being more than 50 days.



Figure 9: The Matmora deluge in 2008

People were much better off even five years ago, but they are poverty stricken now and marginalised because during the flood in 2007 a complete breakdown in the agricultural system occurred when a large area of agricultural land was affected by sand deposits for the first time. No government intervention worth its name has taken place in the area, apart from occasional repairs to the embankment on the River Brahmaputra, and those too have been carried out in a piecemeal manner, leading to frequent breaches; and these breaches in turn caused devastating floods in 2007 and 2008 (Figure 9). Routine relief and rehabilitation facilities provided to the villagers affected are far too inadequate given the scale of damage and destruction. Non-government organisations (NGOs) like the Red Cross Society, Rural Volunteer Centre, and the 'Takam Mishing Porin Kebang' (TMPK), a union of students from the Mishing community, helped the victims with rescue and relief resources in 2007 and 2008.

The two sites are similar in the types of water-related hazards they experience and in other geo-environmental features. But they are also markedly different in certain demographic and sociocultural features. Both sites are subjected to regular episodes of floods and flash floods. Whereas in Majgaon chronic flooding occurred almost every year since 1950, however, Matmora was affected only during major floods between 1950 and 1998. The earthquake in 1950 had a direct impact on the Majgaon area. A big flood on the River Subansiri caused by a landslide dam outburst flood (LDOF) immediately after the earthquake brought many changes to the landscape and environment of Majgaon where marshy lands and wetlands were filled with silt and debris in some places and depressed areas were created in others. The Matmora area was not directly affected by the 1950 floods as such. Both areas have borne the impacts of debris and silt washed in by floods. In Majgaon, however, there were less silt deposits than in Matmora in terms of intensity and scale because of the presence of rivers that are much smaller than the Brahmaputra. Therefore, the problem of land degradation is more serious in Matmora than in Majgaon. Whereas in Majgaon many of the silt-affected areas have become cultivable and others are recuperating fast, the sand-laden areas in Matmora will take a very long time to improve – more than 10 years according to locals—and recover naturally; and that too provided there is no more sand deposition. If more sand casting occurs, the time taken for reclamation will be longer than ten years. Import of silt and debris has had a positive impact in the Majgaon area because waterlogged areas and marshes have risen because of silt deposits and become cultivable over the years. In Matmora, however, sand casting is a curse. Apart from the colossal blow to agriculture because of the degradation of fertile lands, many inland fisheries and wetlands filled up, affecting fish production and fishing as a livelihood.

### **Current livelihood system in 2009 and existing vulnerabilities**

The prevailing livelihood scenario is similar in both study sites, except in the case of agriculture. In Majgaon agriculture is still the primary means of sustenance and paddy is the staple crop. Although they do not grow seasonal rice varieties like 'sali' (summer) paddy because of damage by flood waters, they manage to grow 'bao' (deep water paddy) in normal flood years. 'Bao' is a local variety adapted to a watery environment, and it is not easily affected by floods.

In Matmora agriculture is no longer the main occupation. The area was one of the major rice producing belts of Lakhimpur district until 1998. Agriculture, mainly cultivation of paddy, has been affected by increasing floods since 1998. Finally, the



Figure 10: Sandscapes in Matmora after the 2008 floods

earn enough to survive. People engage in daily wage labour, fishing and sale of dried fish; carpentry; sale of driftwood, country liquor (Figure 11), and milk; and migrating to other places for menial labour such as pulling rickshaws and hand carts and working in factories.

In Majgaon about 51% of the population, both men and women, earn daily wages outside the village. At least 23% of the households have taken up fishing and about 14% make liquor. All three communities are involved in these activities. Three households sell milk which they buy from Majgaon and two neighbouring villages and sell to hotels in nearby towns (Gogamukh, Dhemajji) for a profit. There are at least five other households where members trade in rice as middle men: they buy rice from Majgaon and nearby villages and sell it in Bordoloni. Rearing livestock, especially ducks and pigs, is a useful source of non-farm income. Rearing chickens used to be common but it became unfeasible when chickens succumbed to the flooded environment: disease killed off the poultry population. Fish become abundant in floods waters and fishing is an important seasonal occupation in Majgaon; but until the 1980s fishing was mainly for domestic consumption, now it is a profitable occupation which includes the sale of dried fish. About 12 households in the villages belonging to the Ahom and Chutiya communities are in the dried fish business. The total turnover in 2008 in the village was about Rs1,50,000 (\$US3,125) according to participants at a focus group discussion who are involved in the trade. A number of young men and women have migrated to other parts of Assam and even to other states in India such as Nagaland (east of Assam, a hill state in northeast India) and Kerala (in the southern part of India) in search of greener pastures.

In Matmora large numbers of people are engaged in daily and weekly wage labour in menial occupations (e.g., earth-works, construction of roads, building houses, agricultural labour, and building bamboo fences) in nearby villages and urban areas like Dhokuakhona town. People from 90% of the Mishing households in Opar Khamon, Khamon Birina, and Tinigharia are involved in such work. Currently, construction of a new embankment and related infrastructure by the state Government of Assam through a Malaysian company has become a source of employment for many workers from the three Mishing villages. Some are finding employment in another state government project which is installing reinforced concrete (RCC) porcupines in the river near the breached embankment close to Tinigharia. (A porcupine is a mesh of poles

Figure 11: A liquor corner selling 'apong' or traditional rice beer in Tinigharia village: selling of liquor is a thriving source of income in Matmora



consecutive floods of 2007 and 2008 left almost the entire area of agricultural land in Matmora irreparably damaged. Sand deposits covered the entire landmass up to an average height of four to six feet (Figure 10). The once fertile paddy fields are now totally unfit for any type of conventional agriculture. For the Mishing community living in the three villages of Tinigharia, Khamon Birina, and Opar Khamon agriculture is no longer possible. In Bahpora (a village of non-Mishing communities) village there are still some patches of land that are not too degraded and people manage to grow rice and vegetables, although in much smaller quantities than before. In the absence of agriculture, people have resorted to other work, virtually anything they can find to

made of bamboo or concrete erected in the river near the banks to divert the current away from the bank and thus arrest erosion.) Women work as labourers also in road and embankment construction. Weaving is an important income-generating activity for women. Garments using traditional Mishing motifs are in demand in many parts of the state. The lack of initiative in creating good marketing channels, however, means that their products are sold to middlemen who visit households and buy the products: thus the women are deprived of a good deal of profit. Earlier, Mishing women's weaving activities were limited to fulfilling domestic needs but, in a fragile livelihood scenario, selling hand-woven clothes becomes an important source of income. Some people

collect driftwood from the bed of the Brahmaputra River, even risking their lives at times, and sell the timber. Others make wooden furniture from driftwood and trees in and around the village and sell it. A few of are skilled boat makers and they are always in demand in the area. There are villagers who are cutting down the remaining trees in the villages and selling them outside as fuelwood. Wage-earning opportunities are limited in comparison to the large population of those seeking work and it is becoming impossible for some even to have two meals a day; and this makes them feel helpless and more vulnerable to stress.

Bahpora is relatively less affected and the people are better educated and better off than those in the Mishing villages. About 10% of the villagers have regular jobs (government, semi-government, and private). About 40% of the families are engaged in horticulture (e.g., growing pumpkins, water gourds, radishes, and green chillies) on a small scale, mostly in home gardens and on other small plots of land. One group of farmers from eight households grew 'boro' paddy as a cooperative. The paddy was grown on a waterlogged plot of land using water pumps for groundwater irrigation. Some youths (15%) belonging to all three communities, but mostly from the Mishing community, have migrated to the upper Assam districts of Tinsukia, Dibrugarh, and Sibsagar to work as rickshaw pullers, cart pullers, and menial labourers. Ten young men from the village are working in other states such as Nagaland and Kerala. Although the traditional livelihood of the Koibartta community is fishing, many families from the community in Bahpora, particularly those who are fairly well educated and better off economically, do not fish. This seems to be a result of caste consciousness and an attempt to get rid of the stigma of belonging to a caste ranked low in the social hierarchy of Assamese society. There are others from even poorer sections who are involved in fishing. Rearing chickens and making or selling liquor is strictly prohibited in Bahpora village among the Koibartta community. This is because of a diktat of the Mayamoria cult that they follow and these two practices have not developed into alternative livelihoods in this community. This seems to have influenced the other two communities in the village also because they too abstain from selling liquor.

### Patterns of change

There is no written history of the study sites. The past of the village was reconstructed back to 1950 based on anecdotal evidence and oral history only. In the case of Majgaon, the village was inhabited well before the commencement of British rule. Even during the rule of the Ahom kings the village was in existence, but not exactly in the same location as today. The ancestors of the family of the Tamulis, the most well-to-do household in the village, are said to have occupied superior positions in the British administration. A canon ('bortop' in Assamese) that is more than 300 years old and which the family has had for at least six generations records the age of the village. The Assamese word 'maj' means centre and 'gaon' means village. The village is called Majgaon because it is located in between the villages of Choukhamgaon and Burhakuri.

Nineteen-fifty was a crucial year for the study sites in particular and for the whole of eastern Assam in general because of the Great Assam Earthquake (8.6 on the Richter scale) that took place on the 15th August. This earthquake is remembered by elderly villagers as an epoch-making event in their lifetime. Majgaon was rich in agricultural and natural resources before 1950 and the farmers enjoyed good harvests of various crops, paddy being the main one. According to the elders there were 35 households in the village at that time. The earthquake and the consequent floods in the Subansiri (flowing at that time about 10 km away to the west) and other rivers in the area changed the landscape and the lives of the people for ever. Rivers changed their courses and new channels were formed. Depressions and low-lying areas were created that later became wetlands and marshes. Existing marshes and peatlands were turned into plains when they were filled with riverine silt and debris. The beds of the Brahmaputra River and its tributaries like the Jiyadhhal progressively rose as a result of increasing sand deposits on the river bed originating from accelerated soil erosion upstream in the hills and increased sediment loads in the river in the aftermath of the earthquake. Consequently, rivers became unstable and flashier; began to cause more frequent and bigger floods; and carried more silt and debris, thus making floods a permanent annual feature of these areas (Goswami and Das 2002).

In the case of Majgaon, the cycle of changes in topography and degradation of fertile land due to deposition and natural reclamation has continued for the last fifty years. As of now, large areas of paddy fields have become uncultivable (wasteland or fallow) or less productive due to silt deposited (up to four feet on average) (Barua et al. 2003) when the village was hit by catastrophic floods from the Jiyadhhal River in 2007. The wetlands and marshes ('beel' in Assamese) in the southern corner of the village filled in over the years and have now become a plain field fit for cultivation, something

Table 4: Historical timeline of study site I, Majgaon (conducted on June 4, 2009)

Changes	Events	1950-1962	1963-1998	1999-2009 (May)
Environment and LU/LC	Major floods	1950, 1952, 1958, 1962	1972, 1978, 1988, 1996, 1998,	1998, 2000, 2004, 2007
	Degradation of water bodies (rivers, wetlands, fisheries)	Siltation and filling up of wetlands (marshes, swamps)	Siltation and filling up of wetlands	Destruction of natural fisheries near the village
	New land occupation		Newly formed plains near Na-Nadi were occupied for farming	Some families settling on the occupied lands
	LU/LC change and land degradation		Silt casting on a minor scale	Siltation after 2007 floods made a large area of marshy land cultivable
	Change in resource use, management, availability, state of the resource	Wetlands were buried by siltation,	New land available for use, Farming on river levee, Kukurmari reserve forest completely denuded, general decline of vegetation and home gardens	Farming on river levee, disappearance of wetlands because of siltation, creation of new land for agriculture
Sociopolitical events		Language movement	Assam agitation (1979-1984), insurgency	Insurgency, general deterioration of law and order situation in the state
Major development (Infrastructure)	Construction of embankments	Embankment on river Jiadhah in 1964		
	Breaches of embankments		1986, 1988, 1998	2004, 2007
	Roads	Old road through the village in 1965	Present road connecting the village to the Bordoloni marketplace and Burhakuri in 1990	
	School	The lower primary school founded in 1955		The middle English school was set up in 1999, it has been defunct since 2007
	Public water pumps (tube and ring wells)		Eight during 1988-1998, became defunct	Twelve during 2004-2007 by a non-government organisation (NGO)
NGO interventions (relief and rehabilitation)				2007 -2008 by IGSSS and Armature, a local NGO
Local institutions	Fish cooperative		Operated first in 1965	
	Women's self help group			Six surviving, established between 2001-2008
	Disaster management committee			After 2007 floods
	Youth group			Youth Club formed in 1999
	'Gram sabha'/village assembly		Started in 1973(approx)	
	Village defence committee (VDC)			2001 onwards
	'Nam Ghar'/Vaishnaviti religious institution	Established 1955		
Major economic events/change				The National Rural Employment Guarantee Act (NREGA) came in 2008-09

the villagers welcome as a positive impact. Table 4 shows the results of a historical timeline analysis carried out for Majgaon in June last. The analysis showed distinct trends in some phenomena related to various changes (Table 5).

The history of the Matmora area in the last 55 years is a history of continuous alterations in geography by the Brahmaputra River, rewriting the fate of the people as it redefined the morphology of the area. It is also the history of a people's struggle to survive and sustain themselves on the banks of the river through adaptation. It is also a story of how the embankment has intruded into their villages again and again as attempts were made to contain the flood water and the movement of the river. The river could not be contained by the earthen embankments and burst out of confinement in many places. In an active flood plain, the morphology of which is determined and changed frequently by the water in the river, settlements and locations are only temporary identities in space.

People had to shift their villages periodically, depending on the movement of the river and its branches (braiding channels and distributaries) and consequent cycle of erosion and deposition. The present location of the Matmora village is its fifth transit location in the last 50 years. About half a century ago, the original Matmora village was situated far to the east about eight kilometres from its present location on the bank. It was there that an embankment now known as the Sisi-Tekeliphuta dyke (Matmora embankment) was constructed for the first time in 1954 to contain the river's movement and stop flooding along its bank. Figure 12 a, b, products of the community mapping exercise of the people of Tinigharia and Matmora, are sketch diagrams of the westward movement of the river showing the shifting locations of the embankment and Matmora and other neighbouring villages from 1954 to 2008. Shifting of the river course has led to reconstruction of the embankment in other locations four times to date (1958, 1964, 2007, and 2009). During the same period people from the original Matmora village moved six times (1954, 1957, 1961, 1963, 1966, and 1968) to different locations. It should be

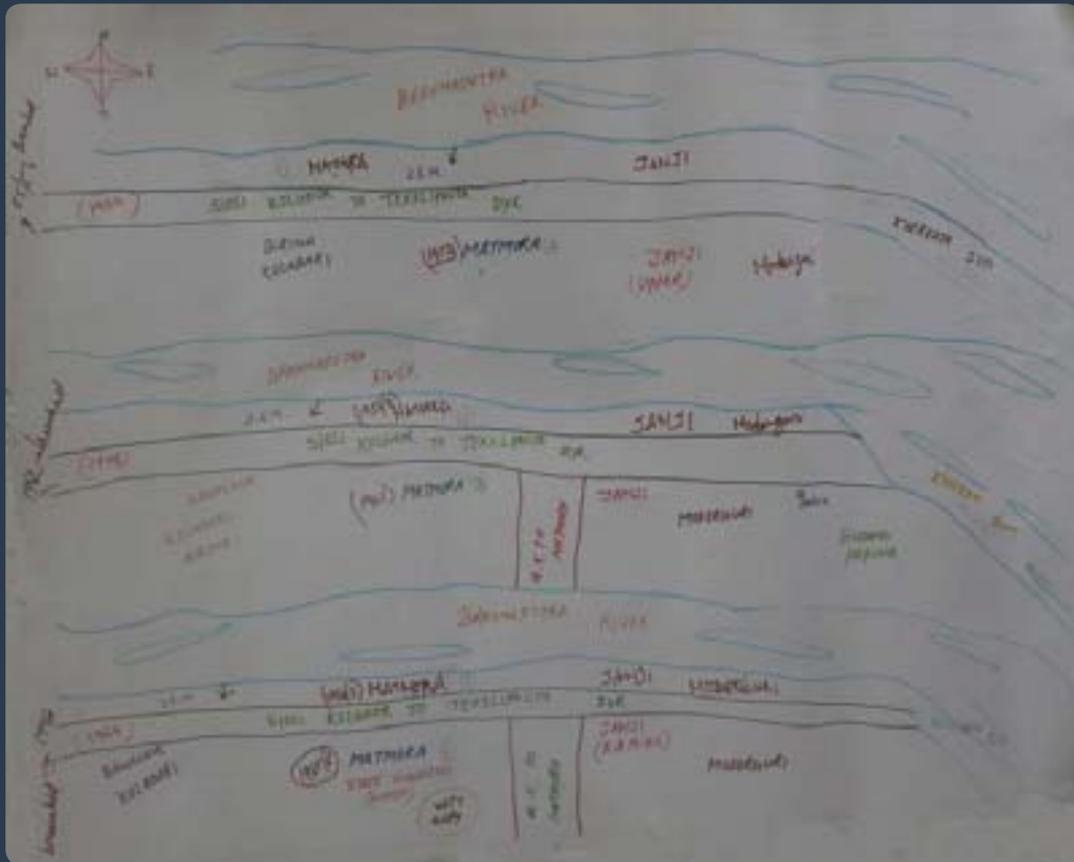
**Table 5: Trend analysis of study site I, Majgaon (conducted on June 4, 2009)**

Changes in	Entity/Parameter	1950-1962	1963-1998	1999-2009(May)
Environment	'Forest' cover (trend)	-	-	-
	Floods (frequency)	+	++	+++
	Floods (intensity)	++	+++	+++
Land	Fragmentation	+	++	++
Agrobiodiversity		-	-	-
Land use	Conversion of forest into settlement and/or farmland	+	+++	++
Socio-economic	Population (trend)	+	++	++
	Subreligious groupism (new sect or cult)	NT	+	+
Livelihood changes	Subsistence agriculture	-	-	-
	Livestock rearing	-	-	-
	Non timber forest product	-	-	-
	Livestock sale	NT	++	++
	Subsistence fishing	+	+	+
	Trade in fish	NT	++	+++
	Alcohol sale	NT	+	++
	Weaving for own use	+	++	+
	Sale of weaving products	+	++	++
	Milk sale	NT	+	++
	Labour work (road, embankment, and agriculture)	+	++	+++
	Conversion of settlement/agri into forest land		+	+
	Migration (permanent/seasonal)	Not observed	+	Not observed
Development	infrastructure	+	+	+
	Remittances			
Participation in politics		NT	NT	+
Community initiatives		+	NT	NT
Political consciousness		+	+	++

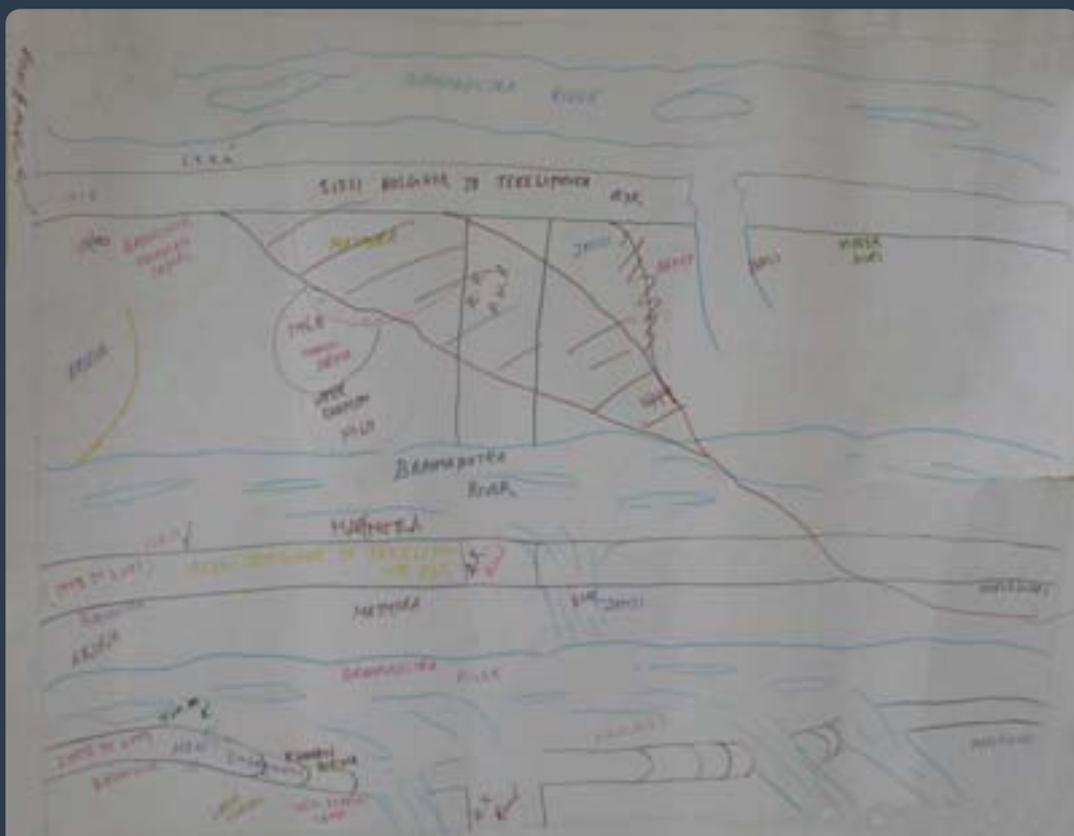
- decreased a little; - decreased much; -decreased a lot; + increased a little; ++ increased much; +++increased a lot; NT = no trend

Figure 12: Shifting of the Matmora village during due to erosion of river bank, embankments and shifting of the course of the Brahmaputra River. Map prepared during a PRA session by the community of Tinigharia village, Matmora

a) 1954-1998



b) 1998-2009



noted that, as the river was moving westwards crashing and fracturing the old embankment, the embankment also kept shifting in the same direction and had to be reconstructed in a new location each time the river shifted. In the process the river consumed the land on its northern bank in villages like Matmora. As a result the villagers kept moving backwards (westwards along the line of advancement of the river) and resettled on the river bank, retaining the name of the village each time. Each time the people of Matmora had settled in a new location, the embankment would be built nearby on the river side. To protect themselves they would shift the villages to the country side of the embankment. This process has been going on for more than five decades: during this time the river has advanced more than 10 kilometres, the embankment has been rebuilt four times in new locations, and the Matmora villages (along with neighbouring villages like Janji, Arkep, and Modarguri.) self-initiated their own resettlement and rehabilitation, and these features have become an integral part of their lives and an important adaptation mechanism with respect to the behaviour of the river.

Part of the embankment was breached and washed away by the river in 1998 and the river devoured almost the whole of Matmora, except for five households in the south-westernmost corner of the village who are still living there, whereas others left over the last 10 years to places both near and far. Some people resettled by themselves in nearby villages and on the embankment, while others left for other areas, although no-one knows where. A wider portion of the same stretch was swept away by the river again in 2007 and 2008 leaving the people open to the river. To close the breach, the state government began to construct a new embankment using geo-fabric tubes in May 2009. It will join the old embankment (constructed in 1964 in that position) at Baghchuk and Baligaon respectively in a semi-circular route. Khamon Birina, Tinigharia, and other settlements along the old embankment have been situated on the riverside. The All Assam Miri High School, which is more than a century old has moved nine times: it came to its present location in Khamon Birina after the 1998 floods. This school was completely buried under sand in the 2008 floods (Figure 13) and is now running from a temporary shelter. Being left outside the new embankment it will move again in the near future for the 10th time. More than 200 households and about a 1,000 people have been left outside the protection of the new embankment. There is no option for these people, especially those from Khamon Birina, to move to another place. If they join the settlement on the old embankment it will result in further deterioration of the embankment from human pressure.

It is relevant in this context of a dynamic riverine environment to raise the question of land rights and land access with respect to the continuous loss and gain of land and people's need to occupy new land for settlement and agriculture. Whereas many Mishing villages are constantly losing land and being compelled to shift to other locations, some stray populations have occupied newly-created sand bars (river islands) in the river. It is considered a traditional right for the Mishing community to occupy unused riparian land to establish new settlements or for agriculture. They have been doing so for many years. There is no strict rule or law regarding land rights over mid-river islands which are temporary entities. Moreover in the past there was no population pressure or not much competition from other communities over land on river banks. Moreover, the Mishing community has a strong sense of kinship, cooperation, and support for their fellow community members. Therefore, it was never a big problem for the people rendered landless and homeless by the rivers to settle down in another area. All these factors have helped them to adapt to the impacts of floods and erosion in the past. In the changed situation, however, land has become scarce and the population has increased, hence there is not enough land in the area where people can establish new villages. That is why in the nineties people began migrating in small numbers to different places.

About 150 families lived in Matmora village in 1998 when the river flooded the whole village. Only five families managed to stay back in the remnants of the village at that time; and the rest migrated to various places: about 30 families shifted to the embankment and nearby villages. Since the river is proceeding towards Dhokuakhona town, it will not be possible to resettle people affected by floods and erosion on a large scale in future. Thus shifting villages as the river changes course is not a viable adaptation strategy now.

The embankment constructed in 1964 in the present location provided protection to the villages for 34 years before succumbing to the river in 1998. It was a period

Figure 13: A school buried under sand: the All Assam Miri Higher Secondary School at Khamon Birina village, Matmora



of relative stability and prosperity for Matmora. Although floods kept on occurring, this area was not seriously affected. Rather moderate intrusions of flood water helped to nourish the soil with natural nutrients. It was a time when Matmora flourished as an educationally advanced and agriculturally rich area.

The landscape of Matmora started to change significantly from the flood of 1998 onwards. The land immediately facing the river became sandy and the river advanced towards the villages, eroding the embankment. Sand casting became a serious menace after the 2007 floods: it was all pervasive after the 2008 floods. Sand casting is not an entirely new phenomenon since it has been happening on river banks and in neighbouring villages (Janji, Bali, and Arkep) from 1998 onwards. Nevertheless the scale and intensity of sand deposition in Matmora was unexpected. Living on sand is an experience that is quite different from living on fertile green floodplains and the villagers found it hard to cope with sand casting since their existing coping and adaptation strategies were not enough to deal with this new experience. It came as a shock rather than as a slow creeping change (e.g., flooding, erosion, loss of land, and need to shift) without giving people much time to get ready to respond.

After the two successive floods in 2007 and 2008, the landscape changed completely into a desert of sand all around. Transport is only available in privately-owned vehicles (mainly motor bikes) and public transport (four wheelers) from the town to the river port. Horse-drawn carts have replaced the traditional bullock carts because horses walk better and faster on sand than bullocks.

In terms of other changes, Majgaon was rich in natural resources; viz., forest cover, vegetation, and home orchards, until the 1970s. It has now become barren, devoid even of common trees, vegetation, and biodiversity due to changes in the micro-climate and gradual loss of soil productivity. The flourishing home orchards and home gardens in the front and backyards of each household exist only in the memory of elderly people. The Kukurmari reserve forests, on the western bank of the river Na-Nadi about three kilometres from the village, used to meet the needs of a number of villages in the area for fuelwood, fodder, cane for commercial use, bamboo and other forest products. With increasing impacts from floods and consequent impoverishment, the forest was overexploited and completely denuded by the late 1990s. Common trees, such as papaya, areca nut, banana, and coconut, which are an integral part of any village environment in Assam are absent or rarely seen in this village. The old trees died after being submerged under water for months together year after year and fresh saplings get little opportunity to survive.

Coming to the case of Matmora, this area had a small population and was thickly forested when the first embankment was built in 1954. At that time there were approximately 20 to 22 domestic elephants in the area which were used for felling trees and carrying logs for house construction. About 25 families lived there then. With increasing population and periodic shifting of the village, people disintegrated into many units, forming several new villages.

People from both the sites indicated that there are changes in the local climate. In Majgaon the local climate has become warmer in summer and summers have become longer. Intensity of rainfall has increased and so have flash floods which are becoming stronger with rivers now carrying more sediment than ever. In Matmora, the climate, according to the locals, has become hotter and sultrier, whereas monsoon rains are now irregular and unpredictable with storms and heavy rains occurring more frequently. The micro-climate has assumed the properties of arid and deserted areas with groundwater sinking further below the surface and soil layers underneath losing moisture.

The overall impact of floods on the landscape, lives, and livelihoods has also brought about significant changes to the socioeconomic conditions and cultural milieu of the villages in both the study sites. From a state of self sustenance the people have been reduced to penury. Social norms have been broken by the compulsion to adopt new ways of making a living. Traditionally, the Ahom or the Chutiya community fish or make wine for their own use, not for sale. Similarly, the women usually do not work in menial occupations. The same holds for the Mishing community in Matmora also. They have overcome social norms and mores to cope with deteriorating economic conditions. Being specific to Matmora, once famous for its agricultural prosperity, the area has changed into a scatter plot of impoverished, helpless households. The same farmers, who proudly claimed that they didn't need to buy anything except kerosene and salt, now have to buy everything for their survival and they cannot afford to do so. They are no longer celebrating customary festivities like the 'Dabaru Puja' and the 'Uram' Festival just because they cannot buy the commodities needed for the celebrations. 'Donyi-Polo' (the sun and the moon god) festival and the celebration of the 'Ali Ai Ligang', their main cultural festival, is now-a-days marred without the usual fanfare.

## Impacts on livelihoods

The impact of water stresses and hazards on all aspects of people's lives and livelihoods is remarkable and profound at individual, family, and community levels (Barua et al. 2003; Barthakur 2000). It is, in general, true that villagers have become poor, marginalised, and more vulnerable to environmental as well as socioeconomic changes because of the impacts of floods and associated hazards over the years. Each year, floods leave them more susceptible to the next year's flood, creating a vicious cycle of impacts and vulnerability. Within a community or a site, however, communities or families are impacted in different ways depending on the environmental, socioeconomic, and cultural characteristics of the groups or families. There are a few households and individuals at both sites who are doing better than others in spite of the fact that they share the same experiences of water stress and hazards. For example, in Majgaon, two families who have workers employed by the government, the family owning a tractor, two families with a grocery shop, three families involved in the fish trade, and one family selling milk are the ones doing well in comparison to others because they have a regular source of income. Similarly, in Matmora, those Mishing families which have people with jobs or businessmen are doing better than others. Within Matmora, the Bahpora village is less affected than the other three villages because Bahpora is the furthest away from the river in terms of physical proximity and therefore has suffered less from inundation and sand casting, making agriculture and horticulture possible for some villagers, although in a very limited way. Moreover, the general economic conditions (in terms of monthly or annual income, conditions of houses, and so on) of the people are better than in the other three villages. There are more people with higher education, jobs, and businesses in this village than in the others. Within Bahpora, the Koibartta and the Brahmin community are in a better state than the Bihari community because the Bihari community has less land, less educated people, has no job holders, and its social security network is not as strong as those of the other two communities. Some families in Matmora villages purchased land plots in safer areas in their better days, and they have proved useful now for building alternative homes; and, thus, some people are migrating temporarily or permanently. Those families that have people in government or private jobs are doing quite well and those who have adjusted to other livelihoods, such as carpentry or weaving, are also benefitting from these enterprises.

Overcoming cultural barriers to cope with floods through adopting new livelihoods and other unorganised activities has affected the social fabric and caused social instability. For example, trading in fish and country liquor is considered socially unacceptable among all the communities in Majgaon as well as among the Mishing community of Matmora. People in the past used to fish in the rivers and in the small water bodies, such as marshes, wetlands, ponds, and water-logged paddy fields, for their own consumption only. It was back in the late 1980s that trading in raw and dry fish started in both sites on the initiative of individual entrepreneurs. In Majgaon, five young men first started trading in raw fish and preparing dried fish in 1986 in an attempt to earn money by adopting a trade for which there is a conducive environment and which needs little investment. It not only turned out to be profitable for them, but it encouraged others to engage in this occupation also. Society at large, however, the elders in particular, didn't approve of this activity and the young men were instructed to do penance in the 'Namghar'. The young men accepted the punishment, did the penance, but soon resumed fishing because they could see no other viable alternative. They were scolded and punished again. This cycle of action and reaction went on for some time. Meanwhile more people took to fishing and to trading in dried fish. It was found to be a good income-generating option. Slowly the sanctions and opposition became weak because society could not provide any feasible alternative; neither could it ignore the money that was coming to the families. There are now more than 15 households engaged in the fish trade and more people are becoming attracted to it.

The fish trade is governed by a cooperative society called Kumotiya Fishery Cooperative. The cooperative takes potential fish-bearing areas (e.g., a particular stretch of the Na-Nadi, small rivulets like Singijaan and Gogajaan that are tributaries to the Na-Nadi, and nearby wetlands) on lease from the government and sublets the same to the local 'mahaldar' (contractor). Earlier the villagers of Majgaon used to work only as fishermen or 'Jaluwoi' (a person skilled in using the fishing net), later on some of them, the more experienced and seasoned ones, became contractors with small holdings.

The fish trade is a seasonal activity that lasts from June to October. It depends on the availability of fish and the seasonal surge of fish in the water bodies which, in turn, depends on the occurrence of timely rainfall and the water levels in the rivers and water bodies. Normal flood conditions are conducive to a good catch, but large floods are harmful because the fish stock is washed out of the water bodies during a strong flood wave. Fishing continues for days and weeks during which the villagers camp near the water bodies. They sell the raw fish to the traders who visit the fishing site. These local traders are actually middle men who resell the fish at higher prices in nearby towns. They belong to the Koibartta community from nearby villages. They dry the smaller fish on bamboo platforms for a few days and sell the dried fish either

to the trader or take bagfuls of dried fish to Jagiroad (in Morigaon District), which is the location of the biggest dried-fish market in Assam. Selling fish in Jagiroad is more profitable than selling to middlemen near the village. Notwithstanding all the progress, even now there are some people, albeit few in number, who look down upon fishing. Such attitudes come from the comparatively better off people who have other sources of income. The villagers are yet to overcome biases against the fish trade. For example, there are people who sell rice in the market but won't sell fish although, back in the village, they engage in the fish trade. It is mainly men who engage in large-scale fishing business. The women fish in smaller groups, and mainly for their own domestic use. They also sell fish to middlemen if they have a surplus.

The situation in Matmora is similar, but the fishing is carried out mainly in the Brahmaputra River and it is a round the year occupation, unlike in Majgaon where it is restricted to the rainy season. The fish trade is carried out through a cooperative made up of people from several neighbouring villages, mainly in the Bandena area about five kilometres from Matmora. But commercial fishing on the Brahmaputra is not possible for everybody because boats are essential for this.

Making traditional wine for household use is a traditional practice for the Ahom and Chutiya communities in Majgaon and the Mishing community of Matmora. In course of time selling country liquor (of inferior quality to the traditional wine) has become a thriving business in these villages, a business which has also broken the barriers of social norms. In Majgaon about 10 households are involved in making liquor and selling it from their own houses. In Matmora they sell it from their houses as well as from shops openly. These are considered illegal activities by the Excise Department which raided the shops and houses and confiscated the equipment in Majgaon. In Matmora no such action was taken. According to the people of Matmora the officials are sympathetic to them and realise that they should not be deprived of this vital source of income. In both places it is the women who prepare and sell the liquor, whereas the customers are men.

A sociological impact having wider ramifications for the state as a whole is the growing frustration and unrest in the youth from flood-affected families. There are instances of unemployment, impoverishment, and grievances against bad governance leading some youths to join insurgent groups: such groups try to recruit young men and women from poor families, alluring them with money and guns.

Floods have existed in Majgaon for more than fifty years, but the impact on livelihoods was moderate until the 1970s because floods used to be less damaging and less frequent at that time, the population was smaller, and life was simpler and less expensive since development ideas were not there to raise aspirations. The social security network was stronger also, and the support base of natural resources, both within and outside the village, was still there to see people through if crops failed. With the changing hydrological regime of the rivers (probably partly attributable to degeneration of watershed health and partly to climate change), floods have become more destructive, more frequent, and silt deposits have become the new menace with flash floods increasing due to frequent cloudbursts and breaching of embankments.

Both women and men are affected in different ways and to different extents in activities related to family responsibilities and livelihoods. Women are severely affected both during and after floods because of the physical and mental hardships they face in looking after the family kitchen and the children. Usually it is the women who arrange for or collect water for drinking and other domestic purposes during floods. In Majgaon women go out in search of tube wells, and ring wells that are placed higher up from the floodline and hence are not submerged under water: sometimes these wells are located kilometres away from the village. They use rafts made of banana tree stumps (called 'bhur' in Assamese) or country boats, often operating the raft or the boat themselves. In a typical marooned situation which continues for several days to several weeks they can experience a lot of difficulty in cooking, attending to children, and taking care of livestock and poultry. Hardships increase all the more when they are taking shelter on raised bamboo platforms inside the house as this is often a makeshift arrangement within a narrow space. Maintaining health and sanitation is the greatest challenge for women during floods. They have to sail to isolated places or to places covered by trees to bathe or to respond to nature's call. Life becomes very difficult for pregnant women especially in flood times. Cases of child birth occurring in boats or in shelter camps or in confined conditions at home are common.

The Mishing women of Matmora are less impacted than the non-Mishing women. The Mishing women are more comfortable in the water, they can swim, can manage boats and rafts, and they live in houses on stilts that are more convenient than the temporary raised platforms of non-Mishing households. In Bahpora only a few women know how to swim or how to manage boats. In Majgaon harvesting of paddy is carried out by women. By the time the paddy is cropped the fields are submerged in water and in the case of early floods, the water level is quite high in the fields. Women usually wade through water and stay immersed in water for long hours during crop harvesting. In both the non-

Mishing villages (Majgaon and Bahpora), there are several women who have been married into the villages from areas that are not flood affected or not as acutely flood affected as their in-laws' village, and they are not equipped to cope in highly flood-prone areas. It is difficult for them to manage in a situation and against the impacts which are new for them and, hence, they find themselves more vulnerable than others. Other problems of non-Mishing women are similar to those faced by women in Majgaon.

In Matmora the embankment was effective in protecting the villages from high floods until 1998. It was easier for people to recover and recuperate from the impacts because the river was about three kilometres away from their villages. The communities rather benefitted from floods when the soil received nutrients from the silt brought ashore with the flood waters. Floods became increasingly damaging after the first big collapse of the embankment during the 1998 floods. The embankment was not repaired nor rebuilt properly for a decade. The 2008 floods left at least 500 families homeless and converted the villages to deserts.

The poor are more vulnerable to the direct and indirect impacts of floods in both areas. The families below the poverty line cannot afford to own boats and therefore are dependent on the help and cooperation of others who have boats. In times of urgent evacuation or medical emergencies, they are more prone to be affected adversely. Temporary rises in the prices of essential commodities during and after floods also limit their capacity to sustain themselves during trying times. Table 6 shows the average fluctuations in prices in normal times and during floods in the study sites.

Table 6: **Average fluctuations of price in normal and flood times in the study sites** (Source: Project survey)

Commodities	Majgaon		Matmora	
	Normal period (in Rs.)	During flood (in Rs.)	Normal period (in Rs.)	During flood (in Rs.)
Rice	15	18	14	18
Kerosene	12	22	14	16
Potato	10	15	7	12
Lentil	70	75	60	70
Mustard Oil	80	85	80	100
Onion	24	26	24	35
Turmeric	5	30	5	30
Salt	5	7	5	7
Sugar	22	24		

### The broader context

Both the study sites are prototypes of many other areas in Lakhimpur and Dhemaji districts which face similar problems of flood, erosion and sand casting to different degrees. They are like a hundred other places in Assam which are affected annually by floods. The Brahmaputra valley, which makes up more than 75% of Assam's geographical area, has the most fertile land in the flood plains, and it is very densely populated. While ethnic tribes and communities have traditionally occupied the river banks, the migrant populations from Bangladesh and other parts of Assam have peopled the river islands that are essentially sand bars called 'char' and 'chapor'. Some indigenous communities, like the Mishings, also live on such sand bars. The geomorphological composition of the river banks and the islands being similar, the Brahmaputra and its tributaries affect the entire valley almost to a similar degree in terms of floods and erosion. The only difference lies in the fact that the north bank tributaries are flashier and more silt laden than the south bank tributaries and that, as of now, the problem of sand casting is more acute on the north bank than on the south bank. Therefore, the problems and concerns regarding the nature of floods, their impacts, and, to some extent, community coping and adaptation patterns seen in the study sites are not very different from those seen in other flood-prone areas of Assam. The adaptation mechanisms are different, however, depending upon the physiography of the locations and the cultural traditions of the communities concerned. The vulnerability and adaptation scenario in these study sites also has a lot in common with 'chars' and other riparian areas of Bangladesh as well as some areas in the Terai region in Nepal, as found during the literature review carried out for this work. Similarities can be found too with many other riparian areas in India (West Bengal and Orissa) and other countries in South Asia (Myanmar, China, and Bhutan).

## Responses to water stress and hazards

### Experiences of past water stresses and hazards

#### Individual and community memory of past events

In both the project areas, elderly people, mostly men and a very few women, vividly remember the years when they experienced big flood events, especially those that occurred after 1950, the year of the great earthquake. The younger generation remembers only a few floods, mainly those that have occurred since the 1990s. Immediately after the 1950 earthquake, the River Subansiri was blocked on the hills of Arunachal Pradesh (formerly the North East Frontier Agency, NEFA). Water levels and flows decreased so drastically in the Subansiri River near Gogamukh (in the immediate downstream area below the foothills) that one could cross the river in peak monsoon season even without getting one's 'tioni' (a loincloth that covers one up to the knees, used in villages while bathing in the river or in the open) drenched. After four days the blocked water burst out and cascaded downstream on August 19 causing one of the most devastating floods in public memory. This was four days after the earthquake. Such floods are called 'Pahar Bhanga Pani' (water that breaks the hills) or 'Bolia Pani' (wild water). What is actually meant is a flash flood originating from a Landslide Dam Outburst Flood (LDOF) in the Arunachal hills (Goswami and Das 2002). Although the people of Majgaon were severely affected by this flood, its impact on Matmora was not serious although the level of the Brahmaputra was high during that time.

People from both sites are of the opinion that floods became regular and devastating in eastern Assam after the earthquake in 1950 because the Brahmaputra and its tributaries became shallow with beds rising due to carriage and deposition of excessive sediment in the rivers. Silt was deposited up to six or seven feet high in many places in the Subansiri valley. Majgaon suffered from heavy floods in 1962, 1968, 1988, 1992, 1996, 1998, 2000, 2002, 2004, 2007, and 2009; and the major flood years for Matmora were 1962, 1968, 1984, 1988, 1998, 2004, 2007, 2008, and 2009. The years 1962, 1988, 1998, 2007, and 2009 were common years for major floods for both the sites and for the entire Brahmaputra valley. In recent major events floods have become more devastating, mainly because of breaches in and erosion of the embankments.

People have to move to safe places during major floods. The people from Majgaon took shelter in Bordoloni Higher Secondary School (four kilometres away in the east of the village) in 1988; in Gogamukh Higher Secondary School in 1992, and on the high-rise platform in the village in 2007 and 2009. For the Matmora people the only safe refuge during floods is the embankment. The community memory of the people of Matmora is of the river changing course, the Brahmaputra moving westwards, relocation of the embankment, and shifting of the villages to match the movement of the river as described earlier.

The community has learned its lesson from the experience of these floods. In the first place they have understood the nature of flash floods and how flash floods are unleashed suddenly due to excessive rainfall on the hills, bursting of natural dams caused by landslides in the hills, and breaching of embankments. They have learned to correlate heavy rainfall in the hills upstream from the rivers to probable floods in their areas after some time. They have learned to anticipate flash floods based on observation of heavy rains, information about LDOF, or by monitoring the conditions of the embankments. Even rumours or hearsay common during floods alert them. They are also aware of the fact that they might face similar situations again in the event of another incident of cloudbursts or embankment failure in the future. Now they know that continuous rainfall for three to four hours in the hills to the north can cause flooding in Majgaon from the Na-Nadi (which has no embankment near the village) after six hours. Similarly, people in Matmora expect flooding after a time lag of 10-12 hours after the Arunachal hills receive heavy rainfall. People have also learned to monitor and identify weak and vulnerable portions of the embankment that may cause breaches in or collapse of the embankment leading to floods. This clarity in linking heavy rainfall to floods is an important factor for them and helps prepare them to face the resulting situation.

Three villages; viz., Janji, Arkep and Bali in the Matmora area came to be heavily eroded and silted during the 1998 floods, and, even after 10 years, the soil in the remaining parts of the three villages is not fit for cultivation. Learning from this example, the people of Matmora are mentally prepared for hard days ahead when they may have to survive without agriculture for another decade. They have also heard about similar phenomena in areas of Dhemaji district where soils have long remained uncultivable. This has, in one way, made them pessimistic about the future and, on the other hand, has made some of them desperate enough to try locally-developed techniques for growing vegetables in home gardens. As a result, many villagers have started growing vegetables like pumpkins, gourds, green chillies, and lemons using pit culture. It was found during focus group discussions with different communities that their memories and recent experiences refer

to almost the same events of hazards and stress. Women, however, consider drinking water as a stress if not a hazard during both floods and lean seasons. The drinking water sources are not adequate in the villages and water for domestic consumption is not easily available during and immediately after floods. The fact that it is the women who traditionally collect and manage water for the family means they consider water scarcity to be one of the priority issues.

### Historical perceptions of vulnerability and risks at local level

Community perceptions are the results of memory, experience, and learning from past events of floods and associated hazards. They have both commonalities and differences from one site to another and from one community to another. In general, people have come to realise that normal floods have occurred and will continue to occur regularly, but catastrophic events happen periodically (e.g., at an interval of three to four years). Flash floods occur suddenly without giving much time to monitor the situations and prepare for them. Embankments are both a symbol of safety and a source of sorrow. Embankments have protected people physically from floods and provided safe shelter for them during floods. Yet it is because of the failure of the same embankments that floods have become destructive. Floods and flash floods are a direct result of heavy rainfall upstream in the hills. Observation and knowledge of rain in the hills is an indication of probable floods in the next 12-24 hours. Although there is no periodic pattern in the major flood cycles, more recently the frequency of heavy rain has suggested an increase in the length and intensity of the rainy season and also the number of deluges and major floods for which the poor health of the embankments act as an accentuating factor.

In Majgaon flooding from the river Jiyadhhal when the embankment is breached has always brought heavy loads of debris and silt. In Matmora the amount of coarse sand particles in the Brahmaputra flood waters increased causing widespread sand casting. Additionally, because of the embankment the flood waters cannot recede quickly from the villages and, as a result, the villages remain inundated for a long time (a week to more than a month). Longer periods of inundation mean increased deposits of silt and sand augmenting the scale and intensity of sand casting. Thus it can be seen that, in coming years, floods might become even more devastating. Such perceptions help villagers' preparedness.

Floods in these areas cannot always be assessed in a strictly hydrological sense, i.e., in terms of fluctuations of water level (gauge readings), because they are caused not only by overtopping from the rivers, but also arise because of drainage congestion impeding the recession of river-borne flood waters towards the river (true for both sites) as well as localised rain-induced water logging in a low-lying topography, as seen in Majgaon. Such circumstances are not reflected in local hydrological records. This is an example of how embankments sometimes increase flood hazards. It also shows why people consider rain and embankments as very crucial factors influencing their vulnerability and risks.

Collapse of the Matmora embankment in 2008 left the villages open to the river and they knew they would face high floods the coming summer unless the embankment was repaired immediately. Since many households were badly damaged in 2008 and the villagers could not afford to repair or rebuild their houses, they were already preparing to move to the embankment when they encountered the first wave of floods this year (2009). Staying on the embankment is a common practice for the villagers here during floods since it is the nearest high and safe place. The entire Matmora area was flooded again in July of 2009 since repairs to the breached portion of the embankment could not be completed, vindicating the villagers' fears. People rushed to the old embankment, as usual, for shelter.

In Matmora people received protection from the embankment prior to 1998 and the villages flourished in agriculture and education which made them self-reliant communities. Their farming, settlement, and other livelihood pursuits, however, were influenced consciously or unconsciously by a sense of safety and security provided by the embankment, which they took for granted. In other words their ways of living in a flood-prone area would have been different had the embankment not been there. People have been so dependent on the embankments that they think having an embankment on the river will solve all their flood problems. That is why in Majgaon they want an embankment on the Na-Nadi which is still an unmanaged river, and why they would like to have the existing embankment on the Jiyadhhal repaired and strengthened. Similarly, in Matmora, in spite of repeated failures of the embankment in different stretches since 1998, communities still favour proper repairing and reconstruction of the breached section of the embankment as the first precondition for flood management. Although villagers consider embankments a panacea for their flood woes, there are other opinions that see embankments only as ad hoc short-term measures of flood mitigation that may not be efficient, sufficient, or desirable as a long-term measure for flood management. Experience from elsewhere in India (the Kosi River deluge of 2008 in Bihar, for example) also shows that, in some cases, embankments have actually exacerbated the impacts of floods rather than mitigating them.

Another perception prevailing amongst the villagers in both study areas is that agriculture is and will remain totally impossible on swampy or sandy soils; and this is based on their observations from other places that have experienced similar problems and have not yet recovered. Therefore there has been no serious attempt to grow alternative crops on degraded lands or to grow staple crops using changed techniques. Agricultural experts think that it is possible to grow some types of crops in swampy ('boro' paddy) or moderately silted land (winter vegetables) in Majgaon and even in the virtual desert-like conditions of Matmora. They point to the inhabitants of 'char' (sand bars or islands in the Brahmaputra River) lands in western Assam and their agricultural techniques. Some of these 'char', inhabited mainly by immigrant Muslim people, are seasonally under water every year and the people have devised successful methods of agricultural production, especially for vegetables, on sandy soils. Proper exposure of the farmers of Matmora to the 'char'-land communities will motivate them to learn from their agricultural model and enrich it by their own indigenous innovations. Communities now look for guidance, training, and intervention from government or non-government agencies to help them farm and increase productivity. On occasions such attitudes become a mental constraint that limits people's adaptation to their environmental conditions. It prevents them from using their indigenous agricultural knowledge to experiment with different options for agriculture and horticulture. It has limited their opportunities for growing more crops for subsistence. This is a more valid criticism for Majgaon where the situation is not entirely hopeless, but yet villagers have not done their best to experiment with best practices.

One dominant perception of the administration and policy makers is that the Mishing community is deeply rooted in a riparian environment and therefore it will not move to areas with different environments away from the rivers. The results of this research show that this perception used to hold good in the past, but it is a myth in the present context. Hundreds of people have shown themselves to be in favour of leaving their present villages where they see a bleak future ahead, and they are ready to go and settle in any place where there is enough land for settlement and agriculture. Many of them would not like to live near a river again and would prefer to live in a forest or near the foothills. This is a significant diversion from the popular perception about the locational preferences of the Mishing community. There are a few people, nevertheless, in particular elderly villagers, who would still be reluctant to move to a non-riverine environment.

Because of this wrong perception, planners and administrators could not read the change in attitude that is taking place under dire circumstances. Therefore, they have always underplayed the need for rehabilitation of flood-affected people who have become homeless or landless and who see no hope of a secured future free from vulnerability and risk in the areas in which they are living now. Policy makers are also completely oblivious of the fact that periodic migration on a local scale triggered by the shifting courses of rivers and construction or breaching of embankments has been the very essence of the struggle for survival for the Mishing population in Matmora. They have always resettled themselves in new places after their old villages have been washed away or devastated by the river. Migration is not new to them.

People are unanimous in the opinion that floods were more beneficial in the past and are more destructive now. This indicates the changing nature of flooding. It may mean that floods have become more intense (discharge, flood level, area of inundation, and increased period of inundation), more frequent (more flood waves in a season), and more damaging (more adverse impacts on crops, land, houses, livestock, human life, and the environment). It also means that sediment and silt are increasing with large and coarse sand particles being deposited rather than fine silt particles carrying nutrients.

### Community initiatives

Three different attempts have been made by the communities to solve their own problems in relation to floods. The first example is from Majgaon where the community made several attempts to push the river Na-Nadi away from the village in a bid to get rid of the floods. In 1982 people from three villages in the area (Majgaon, Burhakuri, and Chowkhamgaon), all suffering from the flooding of the Na-Nadi, met and decided to place locally-built spurs on the Na-Nadi to divert it further west from the fields. The initiative failed to take off. Then the villagers demanded that the government solve the problem and submitted a memorandum to the Deputy Commissioner of Lakhimpur district asking for spurs and embankments on the Na-Nadi. When they received no response, in 1985 they requested the Deputy Commissioner to provide a sluice gate to drain out the water (that collects from the rivers or the rain) from the village to the Na-Nadi River. The authorities turned a deaf year to this request also, so they blocked the river at Lakhpathar in 1986 by building a checkdam in an attempt to divert its course. The very next year, the structure was washed away by the first wave of floods and the river returned to its original course.

The second example is from Matmora. People from five villages in Matmora; viz., Opar Khamon, Khamon Birina, Janji, Arkep, and Bali, where the impacts of flooding and erosion have been greatest over the last decade, made an attempt to clear a nearby reserve forest in Lakhimpur for resettlement. The propriety of such an action is questionable, because it is illegal to cut forests and convert forests to settlements without proper permission. The reserve forest in question should have been de-reserved first for such a purpose, and this involves a long official procedure. Their actions were, nevertheless, unofficially endorsed by local political forces. Later on, however, when the spade work was done by the community, the land was taken over by the same political forces to set up tea gardens and the people were not allowed to use the land. Although it was a misadventure on the part of the community, it shows how motivated they are to solve their own problems.

The third example, also from Matmora, is a very recent one. The Government of Assam began repairs on a breached portion of the Matmora embankment from the month of May 2009 with financial assistance from the central Government. For the first time in India, a new technology, the geotextile fabric technology, was used (Figure 14). The alignment of the new embankment, however, was done in such a way that the entire village of Khamon Birina was left on the side of the river, leaving the people of the village out in the open facing the river. The villagers, with support from neighbouring villages, demanded the realignment of the embankment and inclusion of Khamon Birina on the country side so that they also would be protected by the new embankment. Their demand is being denied by the department of the state government (Department of Embankment and Drainage, E&D in short), and they resorted to protesting against this injustice and tried to stop the construction work. The officials used police force and resumed the work. Considering that it was one of the villages worst affected by the previous year's flood, people demanded resettlement elsewhere and were prepared to move to the old embankment anticipating floods again in the summer of 2009. When the floods came in July 2009, all the villagers moved to the old embankment.

#### Individual and community attitudes towards external help in relation to natural hazards

It is the primary responsibility of a government to provide relief materials (such as food, clothes, plastic sheets, and medicines) during floods and aid for rehabilitation (such as housing materials, tube wells, and cash) in the post-flood period to help communities survive the floods and return to normal life as soon as possible. Relief and rehabilitation work in Assam is looked after by the district administration with support from the Department of Revenue and Disaster Management. It is a common practice for non-government organisations and development agencies to help the district administration and the people by providing relief and rehabilitation materials. Communities suffering from floods for a long time and getting relief and rehabilitation support are sometimes seen to have become too dependent on external help. Such an attitude hampers individual or collective initiatives to cope with stresses using their own resources. This so called 'aid dependency syndrome' has crippled the capability of many communities to adapt. The communities from the present study sites are no exception. They would often complain about not receiving adequate relief and rehabilitation assistance from the Government or about disparity in distribution of relief materials. Their dependency on the Government is rather limited, nevertheless, given the fact that there has never been adequate support from the Government in the past. At the same time they would also look to non-government sources because of the benefits they had obtained from NGOs in the past. External aid is most needed during floods, especially when people are marooned because, in such times, their very survival is at stake. Within the community, the levels of expectation and dependence vary depending on the extent of damage suffered in previous floods and the economic condition of the individual or the family.

In principle everybody would welcome external help and would like to get as much as possible; but life does not stop even if outside help is not adequate. The fact that they have survived floods for so long shows their resilience in a way. In both Majgaon and Matmora, even in the absence of sufficient external support, people have managed to sustain themselves by diversifying their livelihoods and changing their agricultural practices to a certain extent, so far even overcoming the barriers of cultural norms. There is not much difference in dependency patterns between the

Figure 14: The last hope: ongoing construction of the new embankment in Matmora where geo-tube technology is being used for the first time in India.



communities. Although Bahpora village is less affected than other villages in Matmora and people here are better off than others, the level of expectation of external help is the same. Moreover, dependence on external help is not limited to material benefits. They also expect outsiders (including the project team) to influence and convince the Government to meet their requirements and ensure that they get their due. In Matmora they often requested non-state visitors (such as journalists and researchers) to ensure that the embankment is repaired and built properly. They will do their best to sustain themselves through their own efforts without external help, even in the current degraded and deserted conditions, once they have a good embankment in place to protect them from the twin disasters of flood and erosion.

## Monitoring change

### Traditional and /or local early warning systems and signals

There are no effective arrangements on the part of the Government for dissemination of forecasts and warnings about rain and floods to the people of remote areas like the study sites. People are rarely aware about the routine weather and flood forecasts of government agencies like the Indian Meteorological Department (IMD) and the Central Water Commission (CWC). The few who do know about such information and get it from news-papers or television have little faith in it. Therefore people generally depend on their own observations of the weather and environment, intelligence, and traditional knowledge, and, to some extent, on folk beliefs to predict rainfall and floods. Long experience of living in flood-prone areas has equipped villagers with the knowledge and intelligence to read the nature of weather and the rivers and anticipate rain and floods by observing natural phenomena.

Seeing grey and black clouds in the sky means rain in the next couple of hours, dark clouds on the horizon and lack of visibility of the distant hills warn them about the possibility of rain in the hills and consequent floods in a matter of three to four hours in Majgaon and six to twelve hours along the Brahmaputra in the Matmora area. Villagers have an idea of how soon a flood wave will come and how severe it can become by observing the aspect of the rising waters and the current in the flow and, accordingly, they prepare to endure the floods from their houses or to leave their residence for safer places if required. Apart from observational skills, folk beliefs also contribute to the repertoire of predictive knowledge about floods. Some of these beliefs are listed in Box 1. Faith in such beliefs is weakening now, especially among the younger generation who know

less about these folk beliefs and folklore and do not take them seriously. The elderly people are of the opinion that some of these folk beliefs are no longer effective since the nature of the weather, rainfall, and floods is changing. There is a general agreement that, today, the indicators mentioned in folk beliefs, especially those dealing with animal behaviour or changes in the environment are not reliable, whereas they were found to be useful by people in the past. Other traditional indicators, especially those based on observations of the weather, as mentioned above, are still thought to be valid. One new practice is to assess the probability of embankment-induced floods by monitoring the weak and erosion-prone parts of the embankment. For this they identify points where there is undercutting of the embankment by water and observing penetration of water into the soil and bubbling in the water. Occasional news from the media about release of water from the natural landslide-induced dams in the hills also gives an indication of upcoming flash floods.

People back in 1950 could anticipate floods in the Subansiri River by observing a sudden fall in the water level of the river right after the earthquake. Proving them right, the entire area was inflicted by a catastrophic flood within a week. The temporary reduction of flow and water level in the river was a result of the water in

#### Box 1: Traditional and folk beliefs about the occurrence of rainfall and floods

1. Flowering in the mango tree indicates floods are coming.
2. Flowering of jack fruit implies good productivity of paddy and soil.
3. Rainfall on 'maghi astami' (the eighth day of the month of Magha coinciding with 21/22 January in the English calendar) in a particular year augurs floods in that year.
4. Cows behave erratically just before a flood.
5. If cows are found to be standing in the cowshed in the morning of the day of 'Garu Bihu' (usually the first day of the 'Bohag' month coinciding with April 13/14) the next season will have floods. Floods will be more severe than usual if the colour of the cows found standing is blackish. If the cows are found sleeping or lying down on the ground, it signifies a floodless year ahead.
6. Frog calls are indications of rains ahead; uninterrupted frog calls imply heavy showers and probable flooding.
7. It rains when there is thunder (roaring of clouds or thunderclap) in the northern sky in the rainy season.
8. If there are no fish or few fish in the early rainy season, there will be floods

the river being blocked by a landslide-induced dam in the hills of Arunachal Pradesh. Villagers heard about the blocked water from rumours and hearsay. After 58 years, the media played a role in informing people in the months of May 2009 that a landslide dam had formed on the Brahmaputra in Tibet, and that it might burst at any time posing threats of flash floods in downstream areas of Assam. There was also an official warning by the district administrations of Lakhimpur and Dhemaji through the public address system, and in the newspapers on May 29, 2009, about this possibility. It was widely reported in the local and national newspapers that Matmora received moderate floods on the morning of May 30; but the people had time to prepare for the floods and did not suffer much except for damage to standing crops ('ahu' and 'boro' paddy).

There is no organised or institutional local early warning system in place in Majgaon and nearby areas. Usually people who observe increasing levels and flows of water in the Na-Nadi or Jiyadhhal rivers pass the message on to others in their village or in nearby villages verbally and the message is spread quickly throughout the whole area. In urgent cases, when the embankment is about to breach or has just breached, people warn others by whistling, shouting, and making noises. In the old days people used to pass the message of advancing water on to nearby villages by beating drums and cymbals in the 'Namghar'. These practices are no longer in vogue because all of these places used by the community in the villages adjacent to the Jiyadhhal embankment were heavily damaged by floods. There are no drums left in working condition and the villagers do not have the means to repair the 'Namghar' or the drums. In Majgaon people have, in the last two years, used a microphone donated by the Indo Global Social service Society (IGSSS) to inform people about weather and flood conditions based on news aired by the local radio and television channels.

In Matmora, river watching is a favourite pastime during the rainy season. People often gather on the river bank and monitor the flow and level of water in the river and discuss the possibility of floods. This way they can form a fairly good idea of whether flood waters will enter the village. Information about the state of the river becomes known to everybody through verbal communication. Long back the Mishing community used two traditional instruments, the 'Le-long' and 'Mabong', which have sounds like cymbals, to warn people within a distance of three to four kilometres about advancing and rising waters. The practice has disappeared with time, so have the instruments.

Villagers from about 10 different villages in the Matmora area have organised the monitoring of the embankment in every flood season since 1998 when breaches in the embankment became a regular event. Representatives from every village gather on and near the embankment in the evening and they monitor the embankment for the whole night. With rising water and flow momentum, the incursion of water into the soil and breaches of the embankment increase in a typical flood situation causing masses of soil to slump into the water. In such a situation new holes and breaches develop in the weak portions of the embankment. The villagers use bamboo or wooden pole flares and torches to find all these places, after which the cavities are plugged with bags or sacks of sand. This needs to be done continuously throughout day and night. When the E and D Department takes such measures to save the embankments or dykes the villagers help them wholeheartedly to protect themselves from probable danger. In both areas people now use mobile phones to disseminate flood warnings sourced from official forecasts or community observations. Usually these are individual initiatives rather than collective efforts.

**Time thresholds and emergency measures** – For the community it is always a crucial decision to decide to leave their houses and go to safer places because of the considerable effort and hardship involved. Hence many villagers try to endure the floods as long as possible. They move to other places only when it is no longer possible to stay in their own homes. People do not leave their homes in normal floods since they can survive in stilt houses (Mishing community) or on in-house raised platforms (Figure 15) or granaries on stilts (non-Mishing communities) inside the house and can travel for essentials on boats or rafts. It is only in major floods when the floors of the stilt houses or raised platforms are submerged or the house itself is seriously damaged that they leave for the nearest safe shelter. For example, people in Majgaon have endured most of the annual floods in the village itself. It was only in 1988, 1998, and, recently, in 2007 that they had to move to shelter

Figure 15: A raised platform inside a house gives shelter during floods: adaptation practice of non-Mishing communities in Majgaon



camps because those were very large floods. While this is the usual practice, the time threshold for making decisions or moving is different for different families.

People who are poor do not have boats or strongly built houses and leave early for safe places. For example, in Matmora many families in Opar Khamon didn't move in the 2008 floods because they had houses in good enough condition to survive the floods. But most of the villagers in Khamon Birina, where houses were in poor condition, took shelter on the embankment. Some of the families from the scheduled caste (SC population) in Bahpora village come out to the road for shelter immediately after the floors of their houses were submerged. The reason why this happened is because they were living in normal Assamese houses or mud houses (thatched roofs, walls of bamboo with mud plaster, and earthen floors) with the foundation raised two to three feet. Such houses are the first to be submerged by the floods. Once under water, they quickly become unhygienic and smell. Some people prefer to stay on raised platforms (made of bamboo) outside the house. Those who cannot make raised platforms, or do not like to stay on them, come out to the road and stay in makeshift houses.

Usually people have to leave their homes when the flood is caused by embankment failure or when there is a flash flood originating from an extraordinary cloudburst or landslide dam outburst flood (LDOF). Embankment failures are largely anticipated because they happen over a few days and people are informed through the local network, as mentioned earlier. Hence people get time to plan their evacuation. There may be a few families that fail to move or act promptly because of lack of awareness or manpower, and these families suffer more than others. In the case of a sudden surge of water from upstream (e.g., caused by cloud burst or LDOF) that could not be predicted or monitored, local evacuation is disorganised resulting in chaos and there is damage to personal property and lives.

What people take with them when they go to safe places depends on whether the evacuation is planned or sudden. Normally they carry rice, 'apong', vegetables, valuables (jewellery, cash, land documents, educational certificates, and books), dry food items that they have stored for an emergency, minimal amounts of clothes, and livestock. When people know when and how to leave they can choose the items carefully but, when the wave is sudden, usually they carry the bare minimum they can gather at that moment. Usually people know where they have to go, because normally they have pre-identified shelters such as the nearest high and dry ground, the road, the embankment, the high-rise platform, or the school building. In the case of catastrophic events, however, people have no idea where to go because the strong currents in flood waters prevent them from proceeding in a particular direction or the nearest safe place may be overcrowded.

In general it is the women of the family who store the food and keep essentials ready for possible moves. Men repair or manage the boats, and prepare the fishing gear. If there is enough time the women also take the weaving equipment with them. Activities related to preparations for emergency exit or evacuations are slightly different throughout the communities in Matmora depending on the proximity to sources of hazard and the distance to the chosen safe place. These activities also depend on the economic conditions of a family. The Mishing families have almost round-the-clock preparedness with material to be shifted kept separately. Their villages are the first ones to be affected by floods and the embankment is not very close. In Bahpora, which is about two kilometres away from the river, preparations are made usually when an alarming increase in the river-water level and flow in the mainstream of the Brahmaputra or its small inlet channels is observed. Most of them run out to the road for shelter. Some families who have tall granaries cum emergency shelters keep things ready in the granary in advance. This is also the case with the Bihari community.

**Safe places** – In general people do not have any difficulty in identifying or finding places where they can take refuge before, during, and after floods. For example, in Majgaon there are zones of higher grounds within the village of Majgaon where people can initially take shelter. Ideally the road that goes through the village and the high-rise platform constructed by IGSSS in the village are the other two safe places that people used in 2007, 2008, and 2009 for both people and livestock. In a catastrophic flood, people go to National Highway-52 at Bordoloni 'chariali' (square). In Matmora, the people of Bahpora usually come out to the road (connecting Dhokuakhona and Matmora) whereas the people from Khamon Birina go to the embankment which is the nearest high ground for them. The Opar Khamon people generally like to stay in their own houses as long as possible and, if needed, they come to the road. There is another high-rise platform in Baghchuk village, about three kilometres from Opar Khamon and Khamon Birina, where some people go if they don't get protection in other places. A few families from Opar Khamon and Khamon Birina even reserve a space in advance on the embankment so that they can stay there whenever needed. This is not a normal trend because people are accommodative and help each other in a kindred spirit at any point in time. During and after the 2008 floods people took refuge on the road and on the embankment. There is no question of moving for the people of Tinigharia village since they are already located on the embankment.

Some families in Khamon Birina whose houses were badly destroyed in 2008 didn't see any use in investing money in rebuilding house since the village was already placed outside the new embankment. Being open to the river and deprived of protection the village was bound to be flooded in 2009. Some families had no resources to rebuild houses. In many cases the height of the original stilt houses (more than five to six feet) was reduced by the sand deposited to only one to three feet. It would have been prohibitively expensive for most of the villagers to elevate their houses to the original height. What is more they knew they could not survive the floods by staying in houses that were already damaged badly and becoming almost grounded. The villagers were already planning to leave for the embankment in the first week of June 2009 before the next wave of floods came. A few households had already shifted to the embankment at the beginning of the rainy season in May 2009. When the floods came in July 2009, people moved to the embankment as planned because they had no other option.

It is interesting to note the preferences of different communities and families in Bahpora for different safe places. The SC community readily come to the road because their grounded Assamese type, mud and thatched houses become unhygienic when the house is submerged in water and also because too much movement to and from the house causes physical damage to a house under water. The Brahmin community like to stay inside their houses on raised platforms or in stilted granaries with space to accommodate the entire family during floods. They do not like to come out to stay on the roads with other people because they think cleanliness, health, and sanitation are at stake when they live on open roads. The Bihari community also prefer to stay in their own neighbourhood as far as possible rather than come out to the road because the road is at a distance from their colony. We see the possibility of other factors influencing their preferences for not using the road as a shelter also. For example, caste considerations could be another reason why the Brahmin families are reluctant to live openly with other communities in the same place. Similarly the Bihari community, especially the women, may not feel comfortable about sharing living spaces with people from another community. But these are preferences only and they agree that, in the worst conditions, all such biases and considerations will vanish and they will not mind going anywhere for survival and subsistence during disasters.

Some families from Opar Khamon and Khamon Birina, who can afford it, have taken rented houses in Dhokuakhona, Gogamukh Lakhimpur, Jonai, or Dhemaji for family members who have jobs there and students. Some family members shift temporarily to these houses so that their jobs and studies remain uninterrupted, while others stay back.

### Physical and structural adaptation strategies

When water-induced hazards like floods occur, the primary objective of adaptation for any community in any place is to ensure physical protection from the flood waters so that life goes on even when one is surrounded by water. Indigenously developed and locally- managed structural techniques are an important component of adaptation to floods. Communities living in our study areas have developed their own ways of adapting physically to floods that have withstood the test of time by evolving in response to changing environmental and social conditions.

**Houses** – Housing plays a major role in protecting communities from floods in the study sites. The Mishing community in Assam dwell on the flood plains, and they live in traditional stilt houses called 'chang ghar' (Figure 16), a type of house ideally suited to adapt to flood waters. A 'chang ghar' is usually a thatched house built on stilts made of wood and bamboo. The average height of the plinth is from six to eight feet above the ground, the height in general conforming to the highest flood level of the area adjudged from long-term observation, and experience of past floods. The base of the house (floor) made of bamboo and wood is adjustable and can be raised to cope with rising flood waters. The 'chang ghar' is an ingeniously designed, multipurpose house that makes it possible for the inmates to stay protected amidst flood waters and which allows enough light and air into the house. It has provisions for a kitchen, living room, and food store and also supports livestock (mainly pig) rearing and storage of essential household goods in the basement. The kitchen is located in the middle of the living room, making the living space comfortably warm

Figure 16: A 'chang ghar' (stilt house) of the Mishing community in Matmora – a classic example of adaptation to floods





**Figure 17:** A traditional Assamese house built on an elevated platform (left); the separate granary built on stilts (right) has provision for a living space during floods.

against the general cold ambience of riverine areas especially in the night. This house is a classic example of physical adaptation that has evolved through the experience of a riparian community. Under the influence of modern housing styles, the traditional 'chang ghar' has undergone changes in terms of building materials and style. Those who can afford to have used concrete pillars in place of bamboo or wooden stilts and corrugated iron sheets as roofing material in place of thatch to enhance durability and concrete staircases have also been added to the floor.

The non-Mishing communities in our project areas do not live in stilt houses. While most of the people live in 'kuccha' or mud houses, some live in traditional Assamese houses. Other houses have mixed structural

elements and designs demonstrating the economic status of the family or its concern for safety from flood waters. For example, some houses recently built have an earthen foundation walled with brick. In some mud houses the earthen foundation is strengthened with bamboo posts as a measure against soil erosion. To provide the much-needed elevation for protection from water, the foundations of the houses are raised three or four feet above the ground in general so that water does not enter the house in normal flooding conditions (Figure 17). The height of the plinth in different houses depends on the economic status of the family as well as the willingness of the household to invest in raising the plinth. Raising a homestead to match the rising river bed and flood level is a common way of coping with floods. Those who can meet the expense do so after every big flood. These houses are usually made with locally-available materials such as bamboo, cane, reed, wood, and thatch: the exceptions are bricks and concrete.

It is interesting to examine how cultural norms and traditions determine the way people build their houses and influence their physical adaptation to floods. The Mishing communities in Matmora live in their 'chang ghar' following their ancient tradition. The non-tribal people in Majgaon and in Matmora do not live or do not like to live in a 'chang ghar' because they think it is not their culture nor their habit to live in stilt houses. A ground-based mud house is the real Assamese traditional house. People do acknowledge the utility of living in a stilt house in a flood-prone area, however. For some people in Majgaon and Bahpora, both non-Mishing villages, it is also a matter of comfort and convenience besides culture. They do not like to live in stilt houses like the Mishing do, because they think it will not be comfortable and convenient. According to them cleanliness, hygiene, and good sanitation practices cannot be ensured in this style of living. Yet in the mindset of others, especially elderly people who are more conservative, the tribal-non tribal divide is strong and they consider it a social norm not to stay in a 'chang ghar'. For them it is virtually taboo to follow the Mishing way of living. It is seen as beneath their status to follow a tribal tradition. Although these are minority views, coming from the elders of the family, they do influence adaptive decision making in a family or community.

Some of the young people in Bahpora admit that if the situation becomes worse, there will come a time when they will be compelled to live in stilt houses permanently like the Mishing community does. Nevertheless, they will not like break the norms of their society and culture until it becomes absolutely necessary. One young couple in Bahpora expressed the hope that the new embankment under construction in Matmora will reduce the fury of floods in coming years so that it will not be necessary for them to think about living in stilt houses at all. Other households, who have no qualms about living in stilt houses, cannot do so because of the cost involved in making one. With raw materials, such as bamboo and timber, becoming scarce and with the community forests long gone, it will not be affordable for them to build one. They would rather invest money in raising the earthen or concrete foundations of their existing houses.

Interestingly, although these communities do not live in stilt houses, they are the same communities who build their granaries on stilts and to them social norms or other considerations that inhibit them from living in stilt houses do not come in the way of safeguarding the crops and seeds that are too valuable to be kept in normal houses. The granaries on stilts in Bahpora are bigger and better than those in Majgaon because of the comparatively better economic conditions of the Bahpora people. In Bahpora some people (both Brahmins and the Scheduled Castes) make the granaries large enough so that they can take shelter there during high floods (Figure 17). In Majgaon people raise the platforms three or four feet above the floor of the

house with adjustable heights. They use these to keep their valuables and essential commodities safe when flood waters submerge the floor of the house. People stay on these inner platforms or stilted granaries with their families and valuables and manage to cook there for weeks and months together during floods. People endure a lot of hardship also when they are confined to their stilted granaries or in-house raised platforms for a long time during floods. It seems living on in-house platforms is more inconvenient than the other alternatives. Small inner platforms which are more inconvenient are the only option for the majority of people (e.g., in Majgaon) because the more convenient large stilted granaries are expensive to construct. Another interesting practice seen in Matmora is that many people dismantle their houses on the eve of a major flood or when the house is certain to be washed away by the river. They take away all the important components of the house like roofing materials; wooden poles, pillars and trusses; and split bamboo mats from floors of the 'chang ghar' and keep those materials in safe places so that they can re-use them to construct another house in a new location.



Figure 18: Innovative local irrigation for 'boro' paddy by diversion of the flow in Chowkhamgaon: a model for the farmers of Majgaon

**Water-harvesting strategies and local irrigation** – Since these areas in both the study sites are perennially rainfed areas and usually have problems of excess water, traditional water harvesting or irrigation systems are not seen. Agriculture has depended mainly on the rains and the water retained on low-lying land after the flood waters recede, e.g., for 'bao' and 'boro' paddy. Natural water bodies created and enriched by the floods also served as temporary sources of localised irrigation. Since every household does not have a water source, collecting water for domestic purposes from other households is always a matter of effort, especially for the women. Some women walk for at least two kilometres to the Na-Nadi to wash clothes two to three times a week. Therefore, it is often seen that small water bodies retaining water from the last rainy season are used by people living nearby to wash clothes, bathe, and feed the cattle.

In Majgaon soil was dug out of the fields to construct a road through the village last year and the small holes left filled with water. People started using these water sources for all immediate needs, apart from drinking. In Matmora people dig out sand in some places to reach the original layer of moist soil so that they can grow gourds, pumpkins, and chillies. In Bahpora, people who are better off hire water pumps to irrigate small patches of land for 'boro' paddy. In Majgaon there were three cases of individuals using pot irrigation (using containers of tin) to grow vegetables in home gardens. In the changing situation the absence of an irrigation facility for winter crops has been a constraint. In Chowkhamgaon, to the east of Majgaon, a group of farmers are growing 'boro' paddy successfully by diverting part of the flow in the Singijaan, a small rivulet flowing to the Na-Nadi (Figure 18). This exemplary innovation has been supported by the agricultural officials of Dhemaji district. Some young villagers in Majgaon are planning to experiment with a similar idea in their village.

**Food storage systems** – The Mishing community has a well-defined traditional practice of storing food and seeds on a three-tiered bamboo platform with the shelves placed at various heights over the oven in the kitchen of the 'chang ghar' (Figure 19). The lowest shelf placed directly over the oven at a height of about four feet is called a 'parab'. Raw fish is dried as well as paddy in rainy season as objects on this shelf get direct heat from the oven. Utensils are also kept there. The shelf directly above is called the 'rabbang' and pitchers filled with 'apong' (the traditional wine of the Mishing) are kept here in winter to keep the wine warm and prevent it from becoming sour. In summer, however, the pitchers of 'apong' are placed on the floor of the 'chang ghar' to keep it cool. The uppermost shelf is called the 'kumbang' and this is where vegetables are kept. There is another storage place called a 'sansali' and this is a bamboo mat placed in the living room under the ceiling. People keep bags of rice on it so that the rice is not damaged by floods. Occasionally seeds of vegetables are kept there also. Food storage systems of the Mishing have changed with changing circumstances: for instance in some areas the 'sansali' is no longer used because no rice is grown.

Food is stored in case of emergencies and in the event of having to move to another location. Other communities have similar storage arrangements, but usually they use only one bamboo shelf. People in Majgaon store their crops (mainly paddy) and seeds in granaries placed on stilts and items like rice, salt, and potatoes on raised platforms inside the house for immediate use. IGSSS has built a storehouse on stilts to preserve seeds, but this has not been used properly because traditional methods



Figure 19: The three-tier food storage system in the 'chang ghar' of the Mishing community

of storage are still preferred. In Bahpora some people still use the 'tom' (a conical container made of bamboo), an old device for storing paddy seeds. Jute sacks and polythene bags are also used. Containers made of tin are used to store rice and vegetables are kept in baskets made of bamboo. Dry foods are kept in cloth bags. The Bihari community store flour and ground maize ('chattu') which is a major source of nutrition for them. Storing food is always the responsibility of the women.

#### Local flood control and/or erosion protection systems

– The examples given of community initiatives are actually examples of local efforts to control floods and erosion. In the case of small-scale erosion and breaches the community tries to control erosion by erecting branches of trees and triangular structures made of bamboo, bamboo screen, and sand bags on their own. These techniques are effective in arresting breaches on roads caused by the small inlet channels of the Brahmaputra (in Matmora) and on the embankment of Jiyadhhal (Majgaon).

#### Agricultural adaptation

'Boro' paddy cultivation in Bahpora village – After devastation of the crops and crop land by the 2008 floods, a group of eight households in Bahpora formed an informal farmers' cooperative society to cultivate 'boro' paddy for the first time. 'Boro' is a winter paddy sown usually in December and harvested (up to three times) by May. It is a viable alternative paddy for perennially flood-affected areas like Bahpora where mainstream

paddy like 'ahu' and 'sali' are difficult to grow because of the floods. The cooperative selected a plot of land covering seven bighas (approximately one hectare) with minimum sand deposits and water logged to the right level. The land belonged to five families who were members of the society. The group had eight core members, the members being the heads of their respective families, and about 60 general members out of which more than 20 were women. Three other members who had no share in the land helped to organise the members and manage the society. The paddy was sown in the third week of December 2008 and a water pump was hired from Dhokuakhona at the rate of Rs 800(ca \$US 17) per month for two months to irrigate the field when it became dry from January to April because of the lack of rainfall in the pre-monsoon and winter seasons in the area.

The group had learned about 'boro' paddy and its cultivation from agricultural officers in Dhokuakhona as well as from farmers in the nearby village of Bahpora No 2 who had already grown it. The group had no written rules, and its members contributed different amounts according to their capacities: they were to receive proportionate shares of the profit. They spent about Rs 22,000(ca \$US458) mainly to rent a water pump and buy chemical manure, pesticide, pipe for supplying water to the field, diesel and Mobil oil for the pump, and bamboo fencing. They did the entire farming themselves and men and women participated equally in the venture, although the women did the harvesting. The crop was harvested in the last week of April. Unfortunately, just before the first harvest, the crop was damaged by an early flood of moderate intensity (inundation being not more than a metre high) in the area in the last week of April 2009. As a result production was not up to expectations, incurring a loss of Rs 12,000(\$US250). They produced one quintal whereas had there not been a flood it would have been about three quintals. Nevertheless it was an important initiative in a situation in which agriculture has become almost impossible.

The group has about 10 women members who participate in all farming activities. Instead of becoming disheartened; the farmers have decided rather to carry on not only with 'boro' paddy but also with winter crops this year with the same

group. They think if the new embankment works well they will do well in their endeavours. Even if floods continue, they will try early varieties of 'boro' paddy so that they can harvest the crop well before the flood season. This is the second attempt at cooperative farming in their village 10 years after they had tried to grow mustard in a similar way. More families are joining this group and they expect to grow stronger this year. The group plans to register the society because this will make it eligible for government support.

**Mixed paddy cultivation in Majgaon** – Since 'sali' paddy invariably fails every year in Majgaon, people have begun mixed cultivation of the 'ahu' and 'bao' varieties of rice. Seeds of both 'ahu' and 'bao' are sown at the end of February. 'Ahu' can be harvested by the end of May and June, whereas 'bao' ripens in November and December. The logic behind mixed cultivation is that, even if the 'ahu' paddy is damaged by early floods, farmers will still be able harvest the 'bao' rice unless there is a catastrophic flood like that of 2007 when the 'bao' also failed. In a normal flood year, both varieties can be harvested. It is a useful method for smallholders because two varieties can be planted in one plot with almost the same amount of labour and investment required for one. More crops can be obtained from a single plot of land. If there is an early flood, say in April or May, the 'ahu' is damaged partially or fully depending on the nature of the flood. 'Bao' paddy has the property of thriving in water-logged conditions; in fact, it grows taller when submerged and it can resist currents. Majgaon farmers usually grow indigenous paddy varieties and they don't use chemical manure. Mixed paddy cultivation can be considered a novel practice that has been useful for the last 20 years in meeting at least a part of their food requirements.

**Settlement and agriculture on a river levee in Majgaon** – This is an example of pro-active coping by a few courageous families in Majgaon. Seven families from Majgaon have shifted from the main villages and settled down in a place called Lakhpathar on the opposite bank of the river Na-Nadi. Although detached from the main village of Majgaon, Lakhpathar is considered to be a part of it. It is located on higher ground than the rest of the village on the right bank of the river and so farming and other land-based activities are relatively less affected by floods than in Majgaon proper. The elders say that this area was deep marshland filled with thick grassy forests and wildlife before 1950. As a result of the earthquake and floods in 1950, these low-lying marshes rose up and filled up in the following years. The River Na-Nadi was further away by about one kilometre to the west. Fluvial action helped the area to evolve into a flat plain made of river-borne sediment and fertile soil. In the 1960s and 70s it was an isolated area where few people ventured. Apart from herdsmen who were the first to notice the gradual conversion of the pits and marches into flat land. Some of them had the foresight to realise that these lands in future could become good farm land with the added advantage that the right bank of the river was at a higher elevation from the rest of the area.

They started to clear the thick grassy forests and occupied the land in the middle of the 1970s. Others in Majgaon and its neighbouring villages followed them and, in the course of a decade, the entire area was taken over by four villages (Majgaon, Chowkhamgaon, Burhakuri, and Bahaktika). About 60% of the families in Majgaon now have land on both banks of the river. The topography of the area is such that the immediate banks of the river on the levee are higher than the level of the main village, including the vast areas of the present agricultural fields. Majgaon itself is mainly in a low-lying area like a bowl where the rain water from all sides collects and remains stagnant. Although the Majgaon people started farming there at the beginning of the 1980s, they did not live in the newly-occupied area permanently. They stayed there temporarily while clearing the area or planting or harvesting crops.

At present they can even grow 'sali' paddy (wet season paddy) here in normal flood years since the water level remains low except in very high floods. They also grow winter crops and vegetables such as mustard, lentils, cabbage, black gram, and cereals. The amount of land occupied by the villagers depended on the area they could clear. Thus those families who had more manpower could clear and occupy more land. There are a few households who have no land on the levee because they didn't have manpower at that time. There are others who compensated for the lack of manpower by engaging paid workers. In 1984 one individual decided to shift permanently to the river bank and live there to escape the regular flooding in the main village and also to take care of the crops. Others followed him. They named their new settlement Lakhpathar. This is an example of how communities try to cope with floods by migrating (on a very local scale) to a river levee and farming higher ground on river banks.

### Non-structural strategies

**Natural resources and natural resource management** – In the past both sites had good forests, orchards, and home gardens on private as well as community or government land. Later on, to cope with decreasing agricultural productivity they exploited the forests for fuelwood and sold forest produce commercially (e.g., bamboo, cane, and timber). This is how

the nearby Kukurhari forest near Majgaon was denuded of its resources by the late 1990s. Prolonged inundation of the village made home gardening and rearing of utility trees unviable in Majgaon. The Matmora villages, except for Bahpora, were denuded of vegetation when the few trees that existed dried or died. There is no irrigation and drinking water management is inequitable with the rich owning the sources (like tube wells and ring wells), and the sources provided by external agencies are inadequate.

For the poor, access to drinking water depends, to some extent, on the mercy of the source owners and good social relations among the villagers. The nearest public well, for some, is quite far from their house. Failing which, in rare cases, they collect water from a water body and render it potable by filtering (almost every household has a home-made filter equipped with sand and charcoal) and boiling it. In Matmora many of the tube wells were buried under deposits of sand during the 2007 and 2008 floods, rendering them unusable. Some people dug out the tube wells from six to eight feet down, repaired them, and now use them for water (Figure 20). In Matmora denudation of the forest and vegetation cover has exacerbated the problem of river bank erosion, creating a vicious cycle of forest degradation, collapse of ecosystem services and goods, and geomorphic hazards. People got drinking water from bore or ring wells and tube wells in the past. Cutting down of the remaining trees still takes place because of the desperation of some of the poorest families.

**Micro finance arrangements** – Villagers from the study sites are very familiar with micro credit and micro finance as they are core activities of self help groups (SHG), but this practice is confined to the women as all the SHGs are formed by women. It was after 2001 only that the concept of SHGs became known and popular among the villagers through government and NGO programmes. Women took the initiative of forming SHGs mainly because they were motivated by success stories from other places and buoyed by the will to improve the economic conditions of their families and the villagers in general. In Majgaon four groups are now functioning; and in Matmora there are eight SHGs in Bahpora village and three in Opar Khamon. There are none in Khamon Birina and Tinigharia. The SHGs in Bahpora have a common history of formation and present status. Most of these SHGs were introduced between 2001 and 2004 and they were started with a bank loan of Rs 10,000 (\$US 208) from local banks like the Subansiri Rural Bank or from grants provided by the District Rural Development Agency (DRDA), a government agency for rural development. To begin with activities included rearing livestock (e.g. goats and ducks), or cooperative farming on leased land ('sali' or 'bao' paddy) or rearing of muga silk trees (*Persea bombycina*). All these activities were highly vulnerable to floods, however, and came to a stop after the 2007 floods. The goats became sick from the submerged vegetation they consumed; did not respond to veterinary treatment; and died. The ducks met the same fate. Farming was jeopardised by inundation and sand casting. The muga silk tree (called 'som' in Assamese, scientific name *Persea bombycina*) died because of long exposure to water-logged conditions. There are no income-generating activities at present.

Most of the women are now not in a position to pay the membership fee after the devastating floods of 2007 and 2008. They cannot afford to have even the basic necessities of life. Not all of them are defunct, however. One group is still carrying out micro-finance operations and depositing membership contributions in the bank, whereas another one does have irregular transactions with the bank. The former consists of women from families who have permanent sources of income (jobs or business) although they are not involved in any of these activities. Thus the family economy is sustaining this SHG. For micro-credit, they take five per cent interest from members and 10% from outsiders who must be from the village.

Figure 20: Entombed water: people digging out tube wells buried under layers of sand and reusing the same as seen in Opar Khamon village, Matmora



The other groups have not been able to make bank deposits for the last two years.

Surprisingly, weaving, which is not directly affected by floods, does not feature in the activity profile of any of the SHGs in Bahpora. Weaving is a common skill among the village women and they produce much of their own clothing on hand-driven looms. The reason why they are reluctant to weave in SHGs is the lack of marketing skills. Learning from their own experience of what works and what does not in a flood-prone area and inspired by the good work of the weavers in the neighbouring Mishing community, they are now interested in taking up weaving activities once the SHGs are reactivated.

Three SHGs were established in Opar Khamon from 2003-2008. Two of them were registered with the state government and started rearing livestock (goats, pigs, and poultry) and making of *apong*, the traditional Mishing wine. As in Bahpora, here also all activities came to a stop after the 2007 floods. There was scarcity of fodder and the goats became diseased. Although pigs are an integral part of every Mishing household, rearing pigs commercially on a large scale became difficult because of scarcity of rice husk, the main fodder for pigs. The same was the case with poultry also. Making '*apong*' has continued at household level for the family and for sale; but as an SHG activity it could not be sustained on a large scale because of the collapse of rice cultivation, the consequent increased price of rice, and paucity of hay, all of which are required for making '*apong*'.

The third and most recent SHG was supported by a Member of Parliament from the Lakhimpur constituency who was recently re-elected from the ruling party in the last general elections in May 2009. This SHG has been provided with sewing machines, yarn, and hand looms for weaving. The leader of this group is an active political worker for the ruling party in Assam, and she was the president of the local panchayat from 2002-2007. She took an active role in sensitising the villagers, especially the women, about the importance of SHGs and she helped in their formation. The former two groups have become irregular in depositing their premiums in the bank. Their members are now working as labourers in road and embankment construction and the money earned is deposited. All the three groups are continuing with micro-credit at an interest rate of 10% for group members and 15 % for outsiders. Unlike the Bahpora groups, they have not taken loans from the bank. All three groups have helped needy people in the village by lending money for medical treatment, admission of students, and so forth.

**Conflict management arrangements** – The study villages do not have major conflicts. Minor issues related to land or distribution of relief materials sometimes arise but these are not significant. In general, the '*Namghar*' for the general caste groups and the '*Morang Ghar*' and the *Kebang* for the Mishings are the local institutions for settling conflicts amongst villagers. As seen now, these institutions are still prevalent but are less active than before. The '*Namghar*' is still a dominant social institution in Majgaon and Bahpora. In Matmora, among the Mishing community, the influence of the '*Kebang*' or the '*Morang Ghar*' has rapidly declined. It appears that the drastic impact of the floods has meant that people are too occupied with the problems of survival to worry about social concerns. Moreover, the general norms imposed by these institutions have lost their relevance in the dire straits in which the community finds itself.

**Social networks (family, neighbours, and clans)** – In both areas the social network is strong and social relations are good. People help each other in times of need. This is particularly true of the Mishing community in Matmora. Those having boats have an advantage in these areas, but only 55% have boats in Majgaon, 23% in Bahpora, and 44% in the three Mishing villages. People are liberal about sharing their boats with poor families and those having boats help others selflessly while rescuing and evacuating people. In both places the rich-poor divide is not sharp and those who are comparatively well off help others with food, money, and in many other ways.

It is interesting to see how people perceive being poor or rich in these areas. The official definition of below poverty line (BPL) families is often referred to as the basis by both officials and villagers for relief and rehabilitation. According to the Planning Commission of India, a household is said to be living below poverty line if the household's minimum income (expenditure) cannot satisfy the minimum consumption of food and /or energy equivalent of 2,400 kcal for a rural area (ASRB 2005). In reality, even among the BPL families, there are wide variations in respect to capacity and vulnerability. Most of the people in the Mishing community would like to call themselves poor because they have lost regular sources of income from agriculture or livestock rearing. It appears that for most of them, in all the communities and sites, being poor means not having a regular income. In simple words the poor families do not earn anything if they do not find work.

It was realised during focus group discussions with BPL families that being poor, to many of them, actually means not being able to afford two square meals a day or to manage to make or buy '*apong*', which is a daily habit in the community. The general indicators of poverty are: lack of two square meals, inability to send children to school, not being able to rebuild or repair the house, not owning a boat, and not being able to celebrate the cultural or religious festivals. There is a general agreement that families who have members with jobs or in business with regular incomes are not poor; i.e., they are rich in the local context and, hence, people who are doing relatively well.

In Majgaon some women from poor families find domestic work in other families but they are never treated as maid servants, but like fellow villagers. The Mishing community in Matmora has strong clan affiliations. Those families having well-built stilt houses give shelter and food to a number of other families, which are either homeless or have dilapidated houses that cannot withstand the current and flood waters. They get credit from each other at no or nominal interest in times

of need. In Opar Khamon, four families from nearby Janji and Madarguri, who have lost their land to the river, are being looked after by the villagers. On the embankment those settled permanently do not hesitate to share space amicably with others who shift to the embankment during floods. Many of the distressed families in Matmora find shelter and support from their relatives in other places. In the opinion of the people cohesive social relationships have remained more or less intact and this can be seen when disasters strike.

**Migration and remittances** – One significant development in the flood-affected areas has been the migration of youth to different parts of Assam and to India in search of jobs to support themselves and their families who are impoverished due to the impacts of flood, erosion, and land degradation. Because of poverty and unemployment at least eight young men from Majgaon aged from 20 to 30, out of about 33 in this age group, all male and unmarried, have migrated to Kerala and found employment in plywood and rubber factories there. The first young man migrated to Kerala in the year 2000 and then the others followed with help and support from him. They earn a modest income (Rs 5,000–Rs 8,000 per month- ca \$US104 to \$US166) and send back part of it to their families. Two girls, also unmarried, are working as trained weavers in Sualkuchi, the famous centre for traditional Assamese weaving in Kamrup (rural) District in western Assam and supporting their families back in the village. Migration for employment is usually temporary with the individuals spending some time in the village before returning to seasonal jobs. Table 7 gives an idea of how much the youths in Kerala send to their respective families. The same thing has happened in Matmora area with young men venturing out to other districts of Assam to work mainly as rickshaw and hand-cart pullers. A few of them have gone to Nagaland and Kerala. There is no news about others belonging to families who have left the villages over the years. Although the remittances have helped families to cope better with flood impacts, the migration of young people has also created a deficit of manpower for agricultural work. This has increased the workload on parents. The remittances are used mainly to repair houses, maintain livestock, and buy foodstuff.

Table 7: **Remittances to families in Majgaon from family members working in Kerala** (Source: Project survey)

Migrant person	Average monthly income of the h/h without remittance (Rs.)	Average monthly remittance (Rs.)
A	1500	1500-2000
B	1800	700-800
C	2000	700-800
D	1000	1000-1500
E	1500	2500-3000
F	2500	500-700
G	700	1000-1500
H	1500	600-700

**Diversification to low vulnerability livelihoods** – Since agriculture is the most damaged sector (and especially in the case of paddy, the main crop), the villagers, in an instinctive response to cope with the changed situation, have diversified into new income-earning opportunities through a varied range of endeavours that are less vulnerable, although some of these occupations would not have been taken up in earlier days. The main livelihoods in the past were limited to agriculture, livestock rearing (pigs, goats, and poultry), regular jobs (government and private), small businesses (grocery shops, milk sales, and handicrafts), rearing and selling 'muga' silk, and menial labour. New occupations include trading in fish (selling raw and dried fish), selling country liquor and traditional wine, daily wage labour (in construction, agriculture, and pulling rickshaws and handcarts), earning commission as middlemen (reselling rice and milk), weaving, carpentry, and handicrafts.

Although new livelihoods provide for alternative sources of income, all of them do not necessarily trade off the risk effectively. In fact some of these have vulnerabilities of different kinds. Finding employment by migrating to other places, trading in fish, weaving, and handicrafts can be considered as livelihoods with low vulnerability. Fishing activities flourish in floods both in the Brahmaputra River, inland fisheries, wetlands, and waterlogged areas. During high floods, the flood waters make it very difficult for fishermen to navigate the river. Sometimes the fish stock in the inland fisheries and wetlands are flushed out by large flood waves. Migration for jobs means adapting to a new environment and culture as well as hard work. It also creates shortage of manpower in the family. Making liquor is looked down upon in society (Majgaon) and the family (mainly women) has to live with a sense of guilt. Abundance of country liquor is also partly responsible for social degeneration and domestic violence. Traditional wine ('apong') is made with rice and other raw materials (Matmora) that are vulnerable to price fluctuations. Catching driftwood is fraught with danger. Weaving, carpentry, and handicrafts are more immune to flood impacts. Menial labour in local areas is uncertain as there are more workers than opportunities.

**Other local institutional arrangements** – In Majgaon and Bahpora the ‘Namghar’ is a strong local institution that fulfils people’s religious and spiritual needs and governs behavioural standards. It helps in conflict resolution and provides a platform for discussion and decision making on community issues. On some occasions, villagers in Majgaon have taken collective decisions regarding proper distribution of relief materials and location of facilities like ring wells, tube wells, and seed banks donated by government and non-government agencies. The ‘Namghar’ is a popular place where people spend time, exchange information, and learn about new ideas related to what others are doing and what they should do to improve the condition of their families and the village. The Mishing have a very definite structure and affinity focused on the clan. Apart from the ‘Kebang’ (Union of villagers) the ‘Morang Ghar’ (community hall) is a place where community problems are discussed and decisions are taken. In Matmora these institutions used to be good platforms for social networking, but when the society suffered all-pervading uncertainties, regular sessions ceased. The various ‘Morang Ghar’ have been destroyed by floods.

**Communication strategies** – Folk beliefs and proverbs about weather, rainfall, water, and floods have been transferred from one generation to the next through oral communication. Methods of communicating information and warning signals about floods have already been discussed.

## Enabling and constraining factors

### Enabling factors

There are several factors that have helped people to cope and adapt to the impacts of water stress and hazards or which have enhanced people’s capacity to practice and perpetuate traditional adaptation strategies with refinement in the changing circumstances both in the past and the present. There are also factors that have hindered people’s capacities and efforts to cope. The same factors can both enable and hinder coping mechanisms.

**Physical and mental attributes** – Physical and mental qualities play an important role in coping with any crisis situation. The communities living in the study sites have shown remarkable spirit and resilience to have survived in these difficult places for so long. Skills in swimming and managing boats and making and handling rafts are common skills (Figure 21). All people are not equally skilled, however. As a community the Mishing are more skilful than others in these attributes: men, women, and children are good swimmers and sailors. They are also skilful at traditional swimming styles that help them spend a long time under water or to rescue a person who is drowning. Similarly the majority of people in Majgaon, both men and women, have these skills. In Bahpora, a sizeable section of the community has no such skills. Women who have been married into the village from flood-free areas survive the floods by staying confined to their houses, sometimes standing on the raised platforms for weeks, and starting from the beginning again after the floods recede: this is a testimony to their mental toughness and agility. The more adventurous and desperate people in the Mishing community collect driftwood from the river bed using their unbelievable swimming skills. Women demonstrate more stamina and staunchness by enduring the physical discomfort and managing the family responsibilities during periods of confinement. Mental resoluteness and an immense capacity for endurance make it possible for them to build up their lives again from the ruins after each flood episode.

**Structural intervention** – Construction of embankments, spurs, and dykes and the use of concrete porcupines (Figure 22) are among the protective measures used against floods and erosion in these areas for many years. The presence of such structures, especially embankments, assures people of safety and encourages them to plan adaptive activities based on the protection ensured by these measures. Embankments have had a considerable influence on adaptive decision making in both the past and present. For example, after the small fisheries in Bahpora were destroyed by floods in 2007 and 2008, the people did not restore the water bodies, fearing floods would occur in future. They will be restored only if the new embankment which is under construction contains the floods. Similarly, the cooperative farmers

Figure 21: Engendered skills – young Mishing women transporting, navigating, and rescuing marooned people in Matmora during the 2008 floods





Figure 22: Away from us! Holding back the river with porcupine anti-erosion measures at the breached portion (eastern) of the Matmora embankment

structures are essential for flood control. Nevertheless, embankments can both enable and disable adaptation. They protect people from floods and, at the same time, render them dependent on an embankment's existence, influencing their plans for adaptation. In both areas studied, people found it difficult to cope with frequent breaches in the embankments that took place over the last ten years.

**Flood-plain dwelling** – All the ethnic communities in the two areas have lived on the river banks and in the vicinity of water bodies over the centuries, and this has led to the evolution of adaptive strategies in terms of housing types, cultivation practices, crop selection, water or river-based livelihoods (fishing and driftwood collection), and development of physical skills (rowing, raft and boat-making, and swimming) through collective learning and experience. Although the most obvious rationale for living on river banks is the availability of fertile lands, at least in the case of the Mishing there is a traditional bond of the community with the river. In fact, the root words of Mishing, 'Mi' and 'shing' mean 'man' and 'water' or 'river' respectively. Therefore the word Mishing means people who live by the side of water or a river (Bordoloi et al. 1987). Similarly, the word 'Koi' means 'water' and 'barta' means 'to exist', thus depicting the historical linkage of the Koibartta community with water-based livelihoods (mainly fishing).

The communities in both areas have a strong bond of attachment to their native places and this is an integral part of their ethnicity. Sentimental attachment to the soil is very strong for the older generation. They find it difficult to leave the village and migrate to other areas in spite of the problems they are facing. This strong sense of ethnocentricity prevailing in a great proportion of each community has, in a way, motivated them to cope better with floods and other water-induced stresses. The compulsion to stay in their native place has made it all the more important for them to adapt in more efficient ways to water-induced hazards. In extreme situations, however, immobility resulting from such sentiments could prove to be detrimental to survival.

The Mishing community has so far adapted well to the movements of the rivers by moving and migrating. Lack of land has made this practice redundant in the current socio-political context, however. A large section of the Mishing community in Matmora is now in favour of resettling elsewhere to get rid of the curse of floods, erosion, and sand casting. Relocation in other places is not feasible for all of them, however, even if they want to do so because of lack of suitable land or rehabilitation packages.

**Traditional knowledge base** – A long ethnic history of survival in the flood plains has equipped the Mishing community with a rich repertoire of traditional knowledge which has enabled them to live and cope with floods in many ways. The important elements of this indigenous wisdom include being able to interpret signs about the occurrence of rains and floods; practice of traditional medicine and healing systems; knowledge and skills in swimming and in making rafts and boats; house building; and pig rearing, wine making, fishing, and crop cultivation. Some of the traditional practices have been enriched with modern knowledge later to make them more robust and effective in coping with a riparian environment

Water and river-centric culture and flood-plain dwelling, coupled with their traditional knowledge has helped the communities to acquire agricultural knowledge that is useful in their kind of environment. The Mishing community has been adopting agricultural practices in tune with the flood cycles of the rivers in different parts of Assam (Barthakur 2000). Crop calendars prepared by the community during focus group discussions show that, in both places, the timings of activities

growing 'boro' paddy are observing the embankment before planning their future crops. In the past also agricultural practices and other livelihoods in Matmora, e.g., cultivation of 'Sali' paddy, rearing of 'muga' and mulberry silk, and poultry raising were developed based on the security provided by the embankment.

Whether people will invest in buying a boat or raising a house will depend on how well the embankment holds. Similarly, in Majgaon fish traders invest money based on the fact that the next big flood from the Jiyadhhal will be checked by the embankment. The old embankment is a reliable shelter for people affected by floods from nearby villages. That is why people from these areas believe that proper repair, maintenance, or reconstruction of the embankments and anti-erosion

related to cultivation have undergone gradual changes over the last decade in response to the impacts of floods. This is more evident in Majgaon than in Matmora, because there is hardly any agriculture in Matmora now, except in Bahpora. It is also a fact that their traditional agricultural knowledge needs to be strengthened by inputs from modern agricultural science and technology to enable them to cope with the changing impacts of floods.

**Intervention of NGOs** – Relief and rehabilitation programmes carried out by NGOs have helped people cope better both during and after floods in both study sites. IGSSS provided several facilities to the people of Majgaon such as tube wells, ring wells, seeds, high-rise seed banks, high-rise platform boats, and public address systems for flood warnings. Villagers now find it easier to take refuge in high-rise platforms with their livestock, use the community boats for rescue, moving location, shopping for essentials, and fetching drinking water during floods. They can now save the seeds outside their house, especially in high floods when granaries are at risk. Getting drinking water, especially in the dry season, has become easier because of the tube wells. Food items, plastic roofing materials, and medicines were also provided by the NGO during the floods in 2007 and 2008. Other welfare organisations also distribute food items, clothes, and medicine to flood victims. In Matmora, the Rural Volunteer Centre, the Red Cross Society, and the 'Takam Mishing Porin Kebang' (TMPK) provide relief materials such as plastic sheets for tents, hygiene kits (buckets, mugs, and water-purifying aids), and tube wells. In May 2009, the Peoples Action for Development (PAD), a voluntary organisation from Gogamukh, distributed boats in Bahpora and Khamon Birina, and these were used in the floods in June 2009 for rescue operations. Dependence on external aid, however, even if it is to a limited extent only, also limits innovative thinking about new ways of adapting and coping with floods. In both areas the study team tried to sensitise the people about reducing their reliance on external interventions and increasing their resilience by innovation, enterprise, and collective action.

**Government policy and programmes** – Under routine government disaster-relief operations, relief materials (mainly food) are distributed to those who are marooned by the floods: sometimes housing materials, such as corrugated sheets for roofing and cash, are also provided. Selected households in both study sites have received government help in recent years, but it was inadequate because of insufficiency of resources and lack of a proper and equitable distribution system. The communities complain that the list of BPL families usually targeted by government programmes does not include the growing number of poor families. Work on construction and repair of a road by the National Rural Employment Guarantee Act (NREGA) assisted the people in Majgaon with much-needed cash income in 2008. Villagers were provided with job cards and given an opportunity to work as labourers on the road. This road has facilitated communication between Majgaon and neighbouring villages, such as Burhakuri, and the Bordoloni market. It also serves as an area of high ground for shelter during floods. Most of the women in the village were involved in this project, and the amount they received, though nominal and irregular, helped them to survive, at least temporarily. The ongoing construction of the new embankment in Matmora is expected to provide much-needed respite from annual floods in coming years.

Lack of proper policies in relevant sectors is a major hindrance to reducing people's vulnerability enhancing their adaptation capacities. For example, the state is yet to put a water policy in place and the draft water policy does not address the impacts of climate change at all, nor does it address concerns for reducing vulnerability adequately. Critics say the policy once implemented may lead to increased vulnerability for rural people because it promotes water privatisation and natural water may also have a price tag in future. Government performance has been dismal in terms of providing proper rehabilitation and resettlement arrangements, and this makes people reluctant to shift to safer places because they have no confidence in government promises. Often rehabilitation measures are not sensitive to the culture or the environment, resulting in allocation of land in places that are not acceptable for displaced people because they would find it very difficult to adapt culturally or environmentally in those areas. Reluctance to leave temporary shelter on embankments or roads and having no alternative places to settle make the population even more vulnerable to the following year's floods, as seen in Matmora. Moreover, permanent settlements on the embankment have damaged its structure, making it more prone to the onslaught of erosion in future. There is no clear policy on construction and maintenance of embankments. There are no policies or suitable programmes either for health hazards, flood insurance or flood-plain zoning, restoration of degraded lands, innovative agriculture on degraded land, and alternative livelihoods for flood-affected people. What is surprising is that even after the destruction of thousands of hectares of fertile agricultural land over the last decade in Dhemaji and Lakhimpur districts, no effective programme has been introduced by the agricultural departments in these areas to train people in soil restoration and alternative agro-practices suitable for sandy lands.

**Changing nature of weather, climate, and floods** – Although the communities have lived and coped with floods for years using their traditional knowledge and skills, their coping practices are no longer as effective as before because of the highly

erratic nature of flooding, especially since the late 1990s, in terms of both frequency and intensity. According to the people, flooding is more frequent now with more than five flood waves being experienced every year. With an increase in the period of inundation, the rate of siltation has also magnified. In the case of Majgaon, the village becomes water logged or inundated by rain water alone, and heavy rainfall is becoming being more frequent. In Matmora sand casting rather than inundation makes people more vulnerable. Hundreds of acres of land in more than two dozen villages have been buried under sand deposits (fine to coarse particles with grain sizes of 0.002 -2 mm) up to a level of four to eight feet. Hardly any original soil layer is exposed. People have no definite idea of how to farm or what to do as an alternative livelihood. The scale and intensity of sand casting is so high that people are still trying to come to terms with the consequences. Winter crops ('rabi') and vegetables in Majgaon, e.g., potatoes, mustard, lentils, black gram, and assorted vegetables, are entirely dependent on the post-monsoon and winter rainfall in the post-flood season. In the 'rabi' season in 2008-2009 (October to February), mustard was not as productive as normal because there was not a single drop of rain in these areas in this season last year. The Matmora area has also suffered from frequent storms in the last five years in the pre-monsoon and the monsoon seasons. These storms have damaged the poorly built, makeshift houses, especially those on the embankment.

**Lack of irrigation practices or facilities** – Shortage of public irrigation facilities in Assam is an important issue that has constrained agro-productivity to a great extent. It is because of lack of irrigation that the Majgaon community cannot cultivate the 'boro' paddy that could have significantly improved their food security. Irrigation has become essential for the Matmora people now to experiment with various alternative crops and cropping methods that might be viable in sandy soil. Not having irrigation has greatly constrained their options for coping with the post-flood food crisis. If there were irrigation facilities or practices, more groups in Bahpora could have grown 'boro' paddy and winter vegetables. In the other villages of Matmora, however, water harvesting or irrigation is not viable in current conditions.

**Break-down in transport and communication** – Although boats and rafts help marooned people travel to different places to meet their needs, most people do not own boats. The breakdown of general transportation linkages like roads and motorised transport and communication facilities such as public telephone booths limit people's abilities to reach out to other places in urgent situations such as medical emergencies and going to work and school elsewhere; or even visiting friends and relatives to ask for or offer help. Donor agencies and government relief workers also suffer because of lack of transport and communication facilities during floods, and this is one of the reasons why many needy people in the interior do not get help in time. This makes people more vulnerable to the impacts of disasters. It is not possible to reach some villages in ordinary boats because of the strong currents, and only mechanised boats are useful. There are examples from Matmora of people surviving by climbing trees and staying on the roofs of houses for more than two days because rescue teams could not reach them.

**Poverty and lack of resources** – Poverty is one of the most important factors affecting people's traditional coping mechanisms in both areas. Being poor is a constraint to coping effectively with the impacts of disasters. In both areas, people were better off in the past (at least a decade back) than in the present. In Matmora many families that used to be well to do and self sufficient were reduced to paupers. Poverty is not only a limiting factor in their struggle for survival; it is also a mental agony for them, a condition that they cannot accept psychologically. It is undeniable that most of the activities the communities are undertaking to ensure their survival and a chance to thrive need financial resources. Not being able to pay for seeds or for the use of a tractor or build a home in fact seriously hampers their ability to cope. In Majgaon many families are experimenting with new crops and new methods of cropping they had never considered before. For example, people are growing peas, potatoes, and lentils in home gardens for family use. They cannot grow them on a large scale because they have no money to buy seeds that cost Rs 30-40 (\$US 0.62 to 0.83) per kg.

In 2008 only one household in Majgaon had a good crop of potatoes because most families could not afford improved seeds. They used seeds of an inferior quality and ended up with almost nothing. The normal winter rains failed last year and some 'rabi' crops were not very productive. Improved, drought-resistant varieties only survived. Villagers admit that, because of poverty, they struggle to earn two square meals a day and are too exhausted to try innovative coping mechanisms. In Matmora, students who were to appear for the High School Leaving Certificate (HSLC), the most important examination for a school-level student, in 2008, left for other towns to work as rickshaw and hand-cart pullers to help support their families. Schools report an increasing drop-out rate. Education and cultural activities have taken a back seat and all efforts are concentrated on earning one's daily bread. It is because of lack of family income that most SHGs in the study areas have ceased income-generating activities.

**Lack of general awareness and exposure** – The community in general is not aware of recent developments in alternative agriculture or other diversified livelihood options. Even in traditional sectors, like raising pigs and poultry and weaving,

their knowledge about improved practices and marketing channels is limited. In a situation in which the increasing impact of floods and the menace of sand casting have made agriculture less productive in Majgaon and almost non-existent in Matmora, specialised knowledge about and training on how to grow crops and vegetables in sandy and water-logged soils are become important elements in adaptation mechanisms. Innovations in agriculture, poultry, fishing, or weaving need to be internalised to improve traditional coping practices that have become inadequate. Lack of exposure about how other communities in the state and nation are faring in similar situations also limits the capacity to adapt to a changed situation.

People in general understand that floods can be prevented and erosion arrested by proper structural measures because they have witnessed the same in their areas. Nevertheless, many people are not clear about the physical, geological, climatic, and anthropogenic factors causing and/or exacerbating flood hazards. That is precisely why it took time for people in Matmora to appreciate the fact that denudation of the forest was partly responsible for erosion.

**Cultural mores and taboos** – Vulnerability and adaptation are mainly determined by cultural mores, taboos, and superstitions of indigenous communities. Culture too can play a positive and a limiting role in coping and adaptation in traditional societies. Important examples from our study sites are the perceptions and taboos pertaining to living in stilt houses (of non-Mishing communities), selling fish, or making and selling liquor for a living. These aspects have been described already in this report.

Even when it is acknowledged that cultural perceptions are sensitive issues, it can be safely concluded that people's resistance to living in stilt houses has made the non-Mishing community more vulnerable in the physical sense at least. Similarly taboos related to fishing have hindered their adaptation for a long time. Notwithstanding, the interdiction related to selling country liquor in public has developed in the greater interest of the community, keeping in mind the affect on health and the social degeneration that it could lead to in a traditional society. Such norms are deep rooted but not rigid. In fact changing situations have paved the way for gradual changes in people's mindsets regarding these proscriptions. In Majgaon such changes started to take place at the beginning of the eighties, whereas in Matmora things changed rapidly after 1998

**Risk trade-off** – A careful look at how communities have tried to adapt to the varied impacts of water hazards reveals that, in many cases, these are actually attempts to choose between two or more options with different degrees of vulnerability. This results sometimes in choosing a more vulnerable option. For example, the migrant youth of Majgaon are contributing to improvement of the household economy. At the same time, some of them are being called back by their parents because there is insufficient manpower for farming, and the latter is a greater need than jobs and remittances. At the government level, construction of embankments is an example of risk trade-off. It protects the population for some time but causes water logging on the country side and, when it fails, flash floods assume devastating proportions. Settlements on the embankment protect the people as long as the embankment lasts; but embankments wear out with settlement activities. In Majgaon eight families have shifted to the high banks of the River Na-Nadi because it is better for agriculture; but, in the process, they are slowly losing the social safety net of the parent village and the school in Majgaon is too far for the children, especially in rainy season when the farmlands on the way to school contain water up to four feet deep. They are now planning to send the mothers and children back to the village, so that the children can continue their education.

**Local governance and politics** – Breaching of embankments, events now taken for granted every rainy season, have become a symbol of bad governance, corruption, and the unholy nexus between the contractor, politicians, and government departments. People of Matmora allege that there is gross negligence on the part of the Water Resources' Department of Assam in terms of repairing the embankment in a technically sound manner earlier and reconstructing the eroded and breached portion of the embankment after 2007. After the 2007 floods the embankment was built from soil and sand only and, too, only a fraction of it was completed before the floods of 2008 brought it down again. The new embankment being built with geo-tube technology could not be completed before the flood season in 2009. As a result the incomplete piles of tubes were washed away by the floods in the fourth week of June, causing yet another major flood in Matmora. People and newspaper reports blame the connivance between local officials of the Water Resources' Department, politically powerful people, and contractors for the Matmora debacle over the last three years. Petty political interests and the lack of strong, organised protests from the communities are mainly responsible for the stark underdevelopment and improper implementation of development programmes in Matmora area. Lack of opportunities for local organisations and institutions to participate in the decision-making process and governance of embankments is an issue of concern.

## Conclusions and way forward

### Analysis of different adaptations (or maladaptations)

Analysis of major coping and adaptation strategies—Stilt houses ('chang ghar') of the Mishing community (a) protect the household from flood waters, and the multipurpose use of the house allows for rearing pigs and normal cooking and sanitation practices during floods; (b) the old style houses on bamboo and wooden pillars have adjustable floors to match the rising water level: in Matmora it will be costly to raise the height of the plinth and floor of those houses dwarfed by four to six feet of sand; (c) modifications by using concrete make the posts and pillars (usually the part of the house most exposed to water) more durable and resistant to flood currents, however, houses modified with concrete pillars and staircases have lost the flexibility to adjust to water levels; and (d) although the stilt houses have endured for centuries, in places like Matmora their efficacy has decreased because of sand casting which deprives the house of some of the height over ground level. Living in stilt houses as an adaptation strategy will remain sustainable if the problems of sand casting are managed successfully or if the elevation of the house is raised proportionately. In the context of future climate change impacts and a worsening flood scenario, it will be difficult for very poor families to maintain stilt houses.

### Houses with raised foundations (non-Mishing community)

- (a) This house type protects people in normal floods, but is far less effective than the stilt houses in dealing with severe floods. The in-house raised platforms on which the family stays when the house is submerged are inconvenient and uncomfortable, especially for women.
- (b) The height of the foundation can be raised periodically with earth filling or by using brick and concrete, which is too costly for poor families; however the in-house platforms can be raised as required.
- (c) The provision for an in-house raised platform is culturally acceptable whereas the stilt houses are not, which makes it a feasible option.
- (d) It is sustainable in the sense that villagers have lived in these raised homesteads for many years. With more frequent flooding, changes in the village morphology, and chances of higher flood levels, however, the foundation might need to be raised periodically also. Hence these houses may remain effective in future only for those who can invest in repairing and elevating them.

### Alternative livelihoods

These include selling fish including dried fish, selling liquor, carpentry, daily wage labour, and labour migration.

- (a) These alternative options helped people to tide over and meet their immediate needs for cash and food after mainstream agriculture failed in consecutive years, and people became homeless and temporarily displaced.
- (b) All the options are flexible, people can change the way they are doing things now if needed in future or adopt other occupations. People have already shown a great deal of resilience in choosing and adapting to new livelihoods.
- (c) People have resorted to these activities out of compulsion and in the absence of other options: not much creativity but rather desperation is the reason for breaking social norms. (d). All other options will remain sustainable except that of daily wage labour which is uncertain because it depends on suitable opportunities being available locally.

### Food storage

- (a) The food storage methods used currently by all the communities (described earlier) ensure that essential food items are not damaged by flood water.
- (b) With increasing inundation periods more food needs to be stored, and the community cannot afford to do this.
- (c) Food-storage techniques are both innovative and creative because they are tuned to the local micro environment and flood levels. People know what will last long and what will not, they know how to survive and maintain nutrition with minimum amounts of food. The selection of food for storing and carrying away in case they need to move includes rice, 'apong', dried fish, and vegetables in that order of importance.
- (d) The traditional food-storage techniques of the Mishing will work as long as the stilt houses are effective. There is not enough opportunity to maintain these practices when people are in temporary settlements like those on the embankments.

## Agriculture

- (a) The 'bao' paddy that is grown most successfully is water resistant and grows in water-logged and marshy areas; and some varieties can withstand strong currents. The practice of mixing 'bao' and 'ahu' cultivation ensures that at least one crop survives in the case of early or high floods. Cultivation of 'boro' paddy is a suitable alternative for these areas and more people are expected to plant it to ensure food security in Bahpora.
- (b) The winter ('rabi') crops or autumn rice follow a modified cropping calendar to escape from the main flood waves. The changed crop calendars are well adjusted to the current, normal flood cycle and provide an element of flexibility to the practices.
- (c) Mixed paddy, a new crop calendar, 'boro' paddy in naturally water-logged areas, and the most recent pit culture in the sandy soil of Matmora (Figure 23) are examples of innovation and novelty.
- (d) All these agricultural practices are suitable and viable in these areas. The water requirements for 'boro' paddy can be met either by using water bodies in the locality or by using water pumps through SHG or cooperative farmer groups. Provision of irrigation facilities by the Government would be very useful.

## Shelter and settlement on embankments (maladaptation)

- (a) Embankments are preferred for immediate shelter during floods and some people who have lost their homes stay back for a long time, and even permanently, on the embankment. Being much higher than the flood plains, people on the embankment are protected physically, but the possibility of erosion and breaches make them vulnerable also. If the embankment breaches in the midst of a flood, the people on it become isolated and damage and loss of life can be greater than if they had taken shelter in other places.
- (b) This option is flexible in Matmora to date because people like to accommodate each other even if the embankment is overcrowded. The situation may change in future with increasing damage to the embankment due to human pressure. The changing nature of floods and erosion may cause the embankment to breach more frequently, rendering it an unsafe option.
- (c) No creativity or innovation is associated with this option; it is rather a compulsion when no other high ground is available nearby.
- (d) The sustainability of this strategy depends on the physical state of the embankment. As soon as the condition of the embankment deteriorates it will no longer be a suitable safe place.

## Shifting of the village to safer places (for the Matmora area)

- (a) It used to be a common practice for the Mishing people of Matmora to leave their old homes and settle in new areas when their old villages were engulfed by the river or became too vulnerable to erosion. Moving the whole village or a certain number of families to safer places worked well as an adaptation strategy in the past because there was no dearth of land where new villages and colonies could be established. But the respite achieved by shifting was only temporary, because the advancing river would very soon consume the new localities and they would shift to yet another place as happened in Matmora, Janji, Arkep, and Bali. At present there is not enough vacant land in which large numbers of people can settle. So, as a strategy, it has become less viable.
- (b) This option is losing the flexibility it used to have in the past in the sense that it is not easy for people to choose a place and go and settle there because of paucity of fertile land by the river.
- (c) It developed as an adaptation mechanism as a natural recourse to the need to meet the changes in a dynamic riverine environment. It had no element of innovation or creativity.
- (d) In the present circumstances it will not remain a sustainable activity for long unless suitable places are provided by the Government for rehabilitation and resettlement.

Figure 23: Learning to live with sand – vegetables like pumpkins and gourds are grown by planting the seeds in deep pits in Opar Khamon, Matmora



## Possible adaptation options

Possible options for adaptation are summarised in Table 8.

Table 8: **Assessing adaptation options in the context of climate variability and change**

Possible Local Adaptation Options	Who benefits from this option?	What kind of activities are necessary?	How much investment required?	Potential adverse consequences?	Etc.
Facilitate strengthening of houses on stilts for the Mishing community	Entire Mishing community including those residing on the embankment	Provide easy housing loans for constructing, repairing and raising of stilt houses	US\$ 150,000	Unwillingness to repay loans on the part of the community	
Promote safe housing for non-Mishing communities	Entire non-Mishing community	Promote housing awareness, facilitate repairing and raising of homesteads with easy subsidised financing/loans for non-Mishing communities in Majgaon and Bahpora	US\$ 200,000	Unwillingness to repay loans on the part of the community	
Small-scale water harvesting	Small holder farmers for agricultural use, general households for domestic purposes and for livestock	Using already existing natural depressions in both sites including abandoned channels of rivers, small pond like structures created by earth cutting for the road in Majgaon, digging out new ponds in at both sites	US\$ 20,000	Creation of water logged area, germination of mosquitoes, downstream users?	
Training and education on innovative agriculture suited for flood and sand-affected areas.	Whole community especially farmers	General awareness and hands on agricultural training by agricultural experts, researchers, entrepreneurs, successful farmers from other places, training on new farming techniques on degraded land, water-resistant varieties of paddy and other crops and marketing strategies	US\$ 30,000	Lack of support for seeds, irrigation, and crop insurance	
Provide seeds		Make quality seeds of various crops and vegetables available to the farmers free of cost at least for five consecutive years	US\$ 60,000	Indigenous varieties may lose preference to high-yielding varieties	
Education on alternative diversified livelihood options	Youth, women, other interested individuals	Awareness on other options not known to the community that could be feasible in their environment and conditions also about how to optimise gains from the existing options	US\$ 25,000	Expectation will be created in the community about further financial support for adopting the same	
Promote fishing as a livelihood	Families involved in fishing in both sites	Provide financial incentives for buying boats and fishing gear to families, form community cooperatives, and facilitate easy lease of fish bearing areas, create small fisheries	US\$ 120,000	May not be welcomed by some in the community initially, but persistence will pay	

Training skill enhancement in weaving and marketing woven products	Women mainly, also young entrepreneurs, traders, merchants	Hands on training by experts on how to do it more efficiently on larger commercial scale, new design; promotion of traditional tribal textiles of the Mishing community, other common weaving products by other groups; creating network of producers, marketers, and sellers	US\$ 25,000	The Mishing traditional weaving is gorgeous, colourful, and attractive and other groups may feel less benefitted
Creating a network of volunteers for dissemination of early warning and local specific forecast products	All communities of target villages and nearby areas	Educating volunteers equipped with mobile phones about information gathering about flood forecasting and early warning, incorporate individuals from upstream foothills to the target villages along the river stretch, include government personnel into the network, producing forecast statements in local languages incorporating inputs from national and international meteorological agencies	US\$ 40,000	Fear of rumour mongering or false information being propagated and panic in the community
Introduce mobile (on wheels) as well as floating (on boat) dispensary with doctors and nurses, basic medicines and treatment for water borne diseases and child birth	Community as a whole especially women and children	Visit villages every day during and after floods and on urgent calls, refer more serious cases for advanced treatment	US\$ 50,000	Unnecessary or unsolicited urgent calls, community ignoring traditional medicine for urgent application
Introduce fleet of large and small boats for rescue and communication under community ownership at least two small and two large boats per village	Community as a whole, especially old people, children and women	Make boats, set up institutional arrangement for community ownership and use, ensure access by the poor and needy	US\$ 20,000	Over dependence on community boats to communicate and commute, less emphasis on their own efforts
Construct separate high rise platforms in Matmora villages (at least two) for humans and cattle and one platform for humans in Majgaon	Whole community, livestock	Get structures constructed using paid community labour, set up norms for use	US\$ 20,000	People may like to over use or use for a long time even after the situation becomes normal, injuring infrastructure
Initiate and strengthen structural measures	Whole community	Repair the embankments on the Brahmaputra properly (Matmora) and Jiadhal (near Majgaon); build an embankment on the River Na-Nadi near Majgaon; Construct a sluice gate near Majgaon to flush out additional water-logging in low lying areas	No idea about how to estimate such costs, it is primarily the responsibility of the state government	Over dependence on structures may stunt growth of adaptation and coping mechanism

## Existing gaps and further knowledge needs

- (i) At present, knowledge about future climate change in the Brahmaputra basin and consequent impacts on the Brahmaputra flood plains is limited. Proper research should be carried out as a priority by ICIMOD in order to establish a knowledge base derived from General Circulation Models (GCM) and regional models as well as empirical research and statistical analysis. Detailed study and documentation need to be taken up in order to map the impacts of climate change and climate variability (both observed and expected) on the spatial scales of the whole Brahmaputra basin, the eastern Himalayan region, Northeast Indian region, the Brahmaputra valley, and Assam—downscaling to the district levels of Dhemaji and Lakhimpur.
- (ii) There is no comprehensive socioeconomic and cultural database specific to these villages. Reliable data should be generated for the districts, development blocks, panchayats, and the villages. Some data and information have been collected during the literature review for this study, but this needs to be augmented, organised, and updated.
- (iii) Little policy research is carried out in the disaster risk reduction (DRR) sector in Assam. As a result no information has been available about different policies or programmes relevant to DRR and climate change at district level in these areas or for the target villages. An attempt has been made by ICIMOD in this study to gather information about various government policies and programmes as well as those of development agencies and local NGOs related to DRR and adaptation strategies in collaboration with the National Institute of Disaster Management (NIDM), New Delhi. Related issues such as impacts (both positive and negative) of policies and lack of policies and programmes are being studied with respect to the target villages. When the results of this policy analysis study are completed they are expected to reflect the ground realities of the districts as a whole.

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## Acronyms and abbreviations

ASRB	Assam State Road Board
BPL	below the poverty line
CWC	Central Water Commission
DES	Department of Economics and Statistics
DRDA	District Rural Development Agency
DRR	disaster risk reduction
GCM	General Circulation Model
GLOF	glacial lake outburst flood
ICIMOD	International Centre for Integrated Mountain Development
IGSSS	Indo Global Social Service Society
IMD	India Meteorological Department
IPCC	Inter-Governmental Panel for Climate Change
LDOF	landslide dam outburst flood
NEFA	North East Frontier Agency
NGO	non-government organisation
NIDM	National Institute of Disaster Management
NREGA	National Rural Employment Guarantee Act
PAD	People's Action for Development
PRA	participatory rural appraisal
RCC	reinforced concrete

R&R	relief and rehabilitation
RRA	rapid rural appraisal
SC	scheduled caste
SHG	self help group
TMPK	Takam Mishing Porin Kebang

## Local terms

**Ali Ai Ligang:** The most important colourful Spring Festival of the Mishing community which is held every year on the first Wednesday of the month of 'Ginmur Polo', i.e., the Assamese month of Fagun (approximately from mid February to mid March in the English calendar). The community observes this festival to appease mother earth and their forefathers and mark the sowing of the new seeds. 'Ali' means root or seed; 'Ai' or 'yai' means fruit, and 'Ligang' means sowing. Thus Ali-Ai-Ligang refers to the ceremonial sowing of paddy which starts on a Wednesday

**Aniruddha Deva:** Aniruddha Deva was the spiritual leader of the Mayamaria community or the Mattaks who propounded another school of the Vaishnavite religion after Srimanta Sankardeva.

**Apong** is traditional rice beer, a delicacy for the Mishing community.

**Bhur** refers to a rectangular raft made of banana tree stumps which is ubiquitous in all flood prone areas in Assam. It provides an immediate means of transport on water during floods.

**Bolia Pani:** 'Bolia' means mad and 'pani' means water: Bolia pani is also used to indicate a situation when rivers carry a heavy discharge of water and flood the banks suddenly as if the river has become mad.

**Bortop:** A Bortop is a cannon which was used in the latter part of Ahom rule.

**Chang Ghar:** Chang means a platform and ghar mean a house. A chang ghar is a typical Mishing dwelling built on stilts of bamboo or wood (now-a-days with RCC pillars)

**Chapori:** Another name in Assamese for the char.

**Char:** Char refers to mid-river islands that are usually of temporary or seasonal nature in existence, e.g., those in the river Brahmaputra in Assam and Bangladesh.

**Chariali:** An Assamese word meaning a junction of four roads heading in different directions or a crossing of four roads from different directions.

**Dabaru Puja:** A religious ritual of the Mishing community

**Donyi-Polo:** The Mishing consider themselves to be descendants of the sun and the moon gods. They regard Polo (moon) as their father while Donyi (sun) is their mother. They are always worshipped at any ceremony, before business, or in necessity or need.

**Jaluwoi** refers to a person skilled in catching fish by using a net.

**Mahaldar:** (Usually a lease owner or a contractor in the context of fishing) A person who hires a fishery, or a water body or a river, on lease from the state or district authorities and in return enjoys the right to fish and sell the catch for. He can sublease part of the fishery to other contractors.

**Mayamoria:** A small community of people also known as the Mattaks confined mainly to eastern Assam. They organised a rebellion during the Ahom rule protesting against the religious hegemony of the Ahom kings.

**Namghar:** The Namghar is a traditional community prayer house or hall and an important socioreligious institution of Assamese society: a contribution of the Neo-Vaishnavite religion propounded by Saint Sankardeva in the 15th and 16th century.

**Pahar Bhanga Pani:** Pahar means hills, bhanga means to break, and pani means water. It means water that gushes out of the hills as if breaking the hills apart, often referring to the deluge of a flash flood caused by cloudbursts or heavy rains or landslide dam outburst floods in the hills of Arunachal Pradesh (Himalayas)

**Panchayat:** The Panchayat is the village-level constitutional agency in India for local governance and its members are elected by the people of rural areas.

**Srimanta Sankar Deva (1449-1568):** A great saint-scholar, playwright, socioreligious reformer, Srimanta Sankar Deva is a colossal figure in the cultural and religious history of Assam. He provided a thread of unity to Assam straddling two major kingdoms (Ahom and Koch kingdoms). He is the person who founded the bedrock of Assamese culture and literature building on past literary activities. His biggest contribution was the new religion he had propounded that gave shape to a set of new values and social synthesis. The religion he preached called 'Mahapuruxiya Dharma' was part of the Bhakti movement then flourishing in India. It is practised by a large population, and Sattras (monasteries) that he and his followers established continue to flourish and sustain his legacy of the Neo-Vaiṣṇavite Movement. His literary and artistic contributions are living traditions in Assam today.

**Srimanta Sankar Dev Sangha:** Srimanta Sankardev Sangha, the largest sociocultural and religious organisation in the North-east was set up in Nagaon district of Assam in 1930 with the aim to perpetuate the 'Ek Saran Nam Dharma', the egalitarian spirit of the new Vaishnavite religion propounded by Srimanta Sankardeva. It runs schools promoting spiritual education, dance forms, music, and literature created by Sankaradeva.

**Uram Festival:** A religious festival of the Mishing community

Other local terms and local seed varieties are explained in the text.

**Annex**

Annex: **Details of research methods**Table A1: **Step by step and chronological approach to the research**

Month	Week	Activity
June	Week 1	First communication regarding the project from ICIMOD
June	Week 2	Participation in the inception workshop at ICIMOD and conceptualisation of the field campaign
June	Week 3	Reporting to the project implementing agency (Aaranyak) by team leader about organisation of the project and the ToR
July	Week 1-2	Formation of field team with Team leader, one RA and two Project Assistants, visit of team leader to some probable field sites and interaction with probable local partners
July	Week 3-4	Orientation of field team
July	Week 4	Official endorsement of the Letter of Agreement (LoA) and ToR by ICIMOD and Aaranyak
August	Week 1-4	Visit to different probable project sites with research associates; RRA, site identification
August-September	Whole two months	Stock taking of literature
August	Week 1-4	Building local network of partner organisations and facilitators
September-February	All weeks	Actual field work in two sites; viz., participatory research- phase-I
January	Week 4	Presentation of preliminary results by team leader at the National Institute of Disaster Management (NIDM), New Delhi
February	Week 1	Presentation of project results in the Delhi Sustainable Development Summit (DSDS)-2009
February	Week 2	Interaction of field team with visiting experts from ICIMOD; joint field work
February	Week 3-4	Analysis of field data and writing of first draft report, submission of report to ICIMOD
March	Week 1-2	Participation in report back workshop at Dhulikhel
March	Week 3-4	Further literature review
April-June	All weeks	Field work - Phase-II
April	Week 4	Tour of field sites with policy expert consultant and NIDM policy team
June	Week 1-2	Field work with participation of ICIMOD expert and film team
June	Week 4	Survey of flood situation by local field team
June- July	June week 4 to July week 2	Writing the second draft of the report
July	Week 4	Presentation of progress and summary of results in Aaranyak research seminar

Number of field visits: 10 times (for 2 sites) in the two phases; Field days: At least 100 days for both sites covered by different field team members

Table A2: Details of PRA exercises

PRA method	Number of events			Number of participants			Ethnic representation		Gender representation
	Majgaon	Matmora	Total	Majgaon	Matmora	Total	Majgaon	Matmora	
Transect walk	7	12	19	36	62	98	Ahom-23 Chutiya-13	Mishing-32; SC-20;Brahmin-4;Bihari-6	Women(33), Men(65)
Focus group	16	22	38	132	156	288	Ahom-78, Chutiya-54	Mishing-74; SC-56; Brahmin-12; Bihari-14	Women(92), Men(64)
Community meeting	4	4	8	97	128	225	Ahom-55 Chutiya-42	Mishing-67; SC-47; Brahmin-6; Bihari-8	Women(130), Man(95)
Key informant interview	8	12	20	8	12	20	Ahom-5 Chutiya-3	Mishing-6; SC-4; Brahmin-1; Bihari-1	Women(8), Men(12)
Semi-structured interview (household survey with semi-structured questionnaire) in phase-I	17*	37*	54*	17**	37**	46**	Ahom-11 Chutiya-6	Mishing-20; SC-13; Brahmin-2; Bihari-2	Woman(17), Men(30)
Resource mapping	16	27	43	86	140	226	Ahom-27 Chutiya-16	Mishing-33; SC-36; Brahmin-6; Bihari-11	Women(32), Men(24)
Historical timeline & trend analysis	1	1	2	25	15	37	Ahom-13 Chutiya-12	Mishing 15	Women(16), Men(21)
Informal discussion/chat	15	20	35	Not recorded	NR	NR	NR	NR	NR

\*Number of households visited; \*\*Number of respondents on behalf of the households

Table A3: Monthly distribution of different types of PRA exercises conducted during the study period

Year	2008	2008	2008	2008	2009	2009	2009	2009	2009	2009	Total
Month	September	October	November	December	January	February	March	April	May	June	
PRA type											
Transect Walk	MMM TT	M TT	M T		M T			TT TTT		M T	7M 12T
Focused Group	MM TT	MM TTT	M TT	M T	MM TTT	MM TT		MM TT	MM TTT	MM TTTT	16M 22T
Community Meeting	M T	M T				M T		M T			4M 4T
Key Informant Interview	MM TTT	M T	M T	T	M TTT	M T		M T	M T		8M 12T
Semi-structured Interview (Household survey with semi-structured questionnaire)		MMMM TTTTTTT	MMMMMM TTTTTTTT	MMMMMM TTTTTTTT	MMM TTTTTT	TTTTT					17M 37T
Resource mapping	MM TT	MM TTT	M TT	TT	MM TTT	MM TTTT		MM TTT	MMM TTTTT	MM TTT	16M 27T
Historical Timeline & Trend Analysis										M T	1M 1T
Informal Discussion/Chat	MMMM TTTT	MM TTT	MM TT	M TT	MM TTTT	MM TTT		M T	M T		15M 20T
Total no of exercises in a month											
Majgaon	14	13	11	7	11	8		7	7	6	84
Matmora	14	21	16	15	21	16		10	13	9	135
Total	28	34	27	22	32	24		17	20	15	221

'M' refers to an exercise carried out in Majgaon while 'T' refers to one in Matmora



## Acknowledgements

This report is one case study out of five studies of local responses to climate related water stress and floods. The case studies were carried out between June 2008 and September 2009 as part of the two projects 'Too much water, too little water – adaptation strategies to climate-induced water stress and hazards in the greater Himalayan region', funded by the Swedish International Development Cooperation Agency (Sida), and 'Himalayan climate change impact and adaptation assessment' (HICIA), funded by the Norwegian Ministry of Foreign Affairs. This financial support from Sweden and Norway, which enabled important field work leading to findings on climate change and adaptation based on evidence, is gratefully acknowledged.

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## Publication details

Published by International Centre for Integrated Mountain Development  
GPO Box 3226, Kathmandu, Nepal

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This publication is available in electronic form at [www.books.icimod.org](http://www.books.icimod.org).

**Citation:** Das, P; Chutiya, D; Hazarika, N (2009) Adjusting to floods on the Brahmaputra plains, Assam, India. Kathmandu: ICIMOD

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The International Centre for Integrated Mountain Development, ICIMOD, is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush-Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalisation and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.





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